2601 and 2602 System SourceMeter® Specifications

SPECIFICATION CONDITIONS

This document contains specifications and supplemental information for the 2601 & 2602. Specifications are the standards against which the 2601 & 2602 are tested. Upon leaving the factory the 2601 & 2602 meet these specifications. Supplemental and typical values are non-warranted, apply at 23°C and are provided soley as useful information.

The source and measurement accuracies are specified at the SourceMeter CHANNEL A (2601 & 2602) or SourceMeter CHANNEL B (2602) terminals under the following conditions:

1. 23°C + 5°C <70% relative humidity.
2. After 2 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 = 1 year.

SOURCE SPECIFICATIONS

Voltage Programming Accuracy[1]

Range	Programming Resolution	Accuracy (1 Year) 23°C ±5°C ±(% rdg. + volts)	Noise (peak-peak) 0.1Hz-10Hz
100.000mV	1µV	0.02% + 250µV	20µV
1.00000V	10µV	0.02% + 400µV	50µV
6.00000V	10µV	0.02% + 1.8mV	100µV
40.0000V	100µV	0.02% + 12mV	500µV

TEMPERATURE COEFFICIENT (0°-18°C & 28°-50°C): ±(0.15 x accuracy specification)/°C.

MAXIMUM OUTPUT POWER AND SOURCE/SINK LIMITS[2]: 40.4W per channel maximum. ±40.4V @ ±1.0A, ± 6.06V @ ±3.0A, four quadrant source or sink operation.

VOLTAGE REGULATION: Line: 0.01% of range. **Load:** 0.01% of range + 100µV.

NOISE 10Hz-20MHz (peak-peak): 25mV typical into a resistive load.

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: <10mV typical (Iout <= 100mA).

Current Programming Accuracy

Range	Programming Resolution	Accuracy (1 Year) 23°C ±5°C ±(% rdg. + amps)	Noise (peak-peak) 0.1Hz-10Hz
100.000nA	1pA	0.06 + 100pA	5pA
1.00000µA	10pA	0.03% + 600pA	15pA
10.0000µA	100pA	0.03% + 2nA	50pA
100.000µA	1nA	0.03% + 30nA	2nA
1.00000mA	10nA	0.03% + 200nA	5nA
10.0000mA	100nA	0.03% + 3µA	200nA
100.000mA	1µA	0.03% + 20µA	500nA
1.00000A	10µA	0.05% + 900µA	50µA
3.00000A[2]	10µA	0.06% + 1.5mA	150µA

TEMPERATURE COEFFICIENT (0°-18°C & 28°-50°C): ±(0.15 x accuracy specification)/°C.

MAXIMUM OUTPUT POWER AND SOURCE/SINK LIMITS[2]: 40.4W per channel maximum. ±1.01A @ ±40.0V, ±3.03A @ ±6.0V, four quadrant source or sink operation.

CURRENT REGULATION: Line: 0.01% of range. **Load:** 0.01% of range + 100pA.

VOLTAGE LIMIT/COMPLIANCE[4]: 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.
   100mV, 1V Ranges: <50µs typical.
   6V Range: <100µs typical.
   40V Range: <150µs 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.
   3A–10mA Ranges: <80µs typical (current less than 2.5A, Rload greater than 1.5Ω).
   1mA Ranges: <100µs typical.
   100µA Range: <150µs typical.
   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:
   40V Range: Max. output voltage = 42V — total voltage drop across source leads (Maximum 1Ω per source lead).
   6V Range: Max. output voltage = 8V — total voltage drop across source leads.

OVER TEMPERATURE PROTECTION: Internally sensed temperature overload puts unit in standby mode.

VOLTAGE SOURCE RANGE CHANGE OVERSHOOT: Overshoot into a 100kΩ load, 20MHz BW, 300mV typical.

CURRENT SOURCE RANGE CHANGE OVERSHOOT: <5% + 300mV/Rload of larger range typical. (See CURRENT SOURCE OUTPUT SETTLING TIME for additional test conditions.)

NOTES

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 (quadrant 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.
4. For sink mode operation (quadrant II and IV), add 10% of compliance range and ±0.02% of limit setting to corresponding voltage source specification. For 100mV range add an additional 60mV of uncertainty.

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METER SPECIFICATIONS

VOLTAGE MEASUREMENT ACCURACY[1]

Range	Display Resolution[3]	Input Resistance	Accuracy (1 Year) 23°C ±5°C ±(% rdg. + volts)
100.000mV	1µV	>10GΩ	0.015% + 150µV
1.00000V	10µV	>10GΩ	0.015% + 200µV
6.00000V	10µV	>10GΩ	0.015% + 1mV
40.0000V	100µV	>10GΩ	0.015% + 8mV

TEMPERATURE COEFFICIENT (0°–18°C & 28°–50°C): ±(0.15 x accuracy specification)/°C.

CURRENT MEASUREMENT ACCURACY

Range	Display Resolution[3]	Voltage Burden[2]	Accuracy (1 Year) 23°C ±5°C ±(% rdg. + amps)
100.000nA	1pA	<1mV	0.05% + 100pA
1.00000µA	10pA	<1mV	0.025% + 300pA
10.0000µA	100pA	<1mV	0.025% + 600pA
100.000µA	1nA	<1mV	0.02% + 12nA
1.00000mA	10nA	<1mV	0.02% + 60nA
10.0000mA	100nA	<1mV	0.02% + 1.2µA
100.000mA	1µA	<1mV	0.02% + 6µA
1.00000A	10µA	<1mV	0.03% + 700µA
3.00000A	10µA	<1mV	0.05% + 1mA

TEMPERATURE COEFFICIENT (0°–18°C & 28°–50°C): ±(0.15 x accuracy specification)/°C.

ADDITIONAL METER SPECIFICATIONS

LOAD IMPEDANCE: Stable into 10,000pF typical.

COMMON MODE VOLTAGE: 250VDC.

COMMON MODE ISOLATION: >1GΩ, <4500pF.

OVERRANGE: 101% of source range, 102% of measure range.

MAXIMUM SENSE LEAD RESISTANCE: 1kΩ for rated accuracy.

SENSE INPUT IMPEDANCE: >10GΩ.

NOTES

1. Add 50µV to source accuracy specifications per volt of HI lead drop.
2. Four-wire remote sense only.
3. Applies when in single channel display mode.

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.
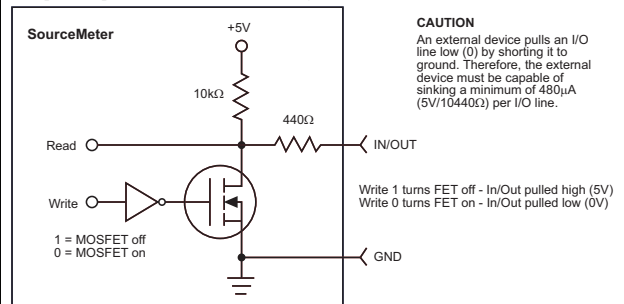Cable Type: Category 5e or higher LAN crossover cable.
Length: 3 meters maximum between each TSP enabled instrument.

DIGITAL I/O INTERFACE:
Connector: 25-pin female D
Input/Output Pins: 14 I/O bits. See figure below.

Output Enable Pin: Active high input. When the output enable input has been activated, each SourceMeter output will be disabled when Output Enable is <1.5V.

5V Power Supply Pin: Limited to 600mA, solid state fuse protected.

POWER SUPPLY: 100V to 240VAC, 50–60Hz (manual setting), 240VA max.

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

WARRANTY: 1 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 x 213mm wide x 460mm deep (3 1/2 in x 8 3/8 in x 17 1/2 in). Bench Configuration (with handle & feet): 104mm high x 238mm wide x 460mm deep (4 1/8 in x 9 3/8 in x 17 1/2 in).

WEIGHT: 2601: 4.75kg (10.40 lbs). 2602: 5.50kg (12.00 lbs).

ENVIRONMENT: For indoor use only.
Altitude: Maximum 2000 meters above sea level.
Operating: 0°–50°C, 70%R.H. up to 35°C. Derate 3% R.H./°C, 35°–50°C.
Storage: −25°C to 65°C.

ACCESSORIES SUPPLIED:
Cables & Connectors: SourceMeter DUT interface connector kit for each SourceMeter channel. Kit includes one hooded screw terminal connector that mates with the SourceMeter measurement terminals. TSP-Link cable, power cable.
Printed Documentation: User's Manual
Electronic Media: CD-ROMs containing
- User's and Reference manual .PDF files
- Test Script Builder script development software
- IVI/VISA drivers for VB, VC/C++, LabVIEW, and LabWindows/CVI

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SPEED SPECIFICATIONS[1]

MAXIMUM SWEEP OPERATION RATES (operations per second) FOR 60Hz (50Hz):

A/D CONVERTER SPEED	TRIGGER ORIGIN	MEASURE TO MEMORY	MEASURE TO GPIB	SOURCE MEASURE TO MEMORY	SOURCE MEASURE TO GPIB	SOURCE MEASURE PASS/FAIL TO MEMORY	SOURCE MEASURE PASS/FAIL TO GPIB
0.001 NPLC	Internal	10000 (10000)	8000 (8000)	5500 (5500)	3600 (3600)	4900 (4900)	3100 (3100)
0.001 NPLC	Digital I/O	2700 (2650)	2100 (2100)	2300 (2300)	1900 (1875)	2200 (2150)	1800 (1775)
0.01 NPLC	Internal	4000 (3500)	3600 (3200)	2750 (2700)	2300 (2100)	2800 (2500)	2100 1975)
0.01 NPLC	Digital I/O	1900 (1775)	1600 (1500)	1700 (1600)	1450 (1400)	1600 (1500)	1400 (1325)
0.1 NPLC	Internal	565 (475)	555 (470)	540 (450)	510 (440)	535 (455)	505 (430)
0.1 NPLC	Digital I/O	490 (420)	470 (405)	470 (410)	450 (390)	470 (400)	450 (390)
1.0 NPLC	Internal	59 (49)	59 (49)	58 (49)	58 (48)	58 (49)	58 (48)
1.0 NPLC	Digital I/O	58 (48)	58 (48)	58 (48)	57 (48)	57 (48)	57 (48)

Maximum SINGLE MEASUREMENT RATES (operations per second) FOR 60Hz (50Hz):

A/D CONVERTER SPEED	TRIGGER ORIGIN	MEASURE TO GPIB	SOURCE MEASURE TO GPIB	SOURCE MEASURE PASS/FAIL TO GPIB
0.001 NPLC	Internal	1100 (1000)	880 (880)	840 (840)
0.01 NPLC	Internal	950 (900)	780 (760)	730 (710)
0.1 NPLC	Internal	390 (345)	355 (310)	340 (305)
1.0 NPLC	Internal	57 (48)	56 (47)	56 (47)

MAXIMUM MEASUREMENT RANGE CHANGE RATE: >4500/second typical.

MAXIMUM SOURCE RANGE CHANGE RATE: >1000/second typical.

MAXIMUM SOURCE FUNCTION CHANGE RATE: >500/second typical.

EXTERNAL TRIGGER INPUT: The Digital I/O interface signals can be configured to behave as trigger inputs.
Input Latency (time from trigger input to start of measurement or source change): <150μs, typical.
Input Jitter: <100μs, typical.

COMMAND PROCESSING TIME: Maximum time required for the output to begin to change following the receipt of the smux.source.levelv or smux.source.leveli command. <1ms typical.

NOTES

1. See the Speed Specifications Test Conditions Appendix in the Series 2600 Reference Manual for more information regarding test conditions.

Specifications subject to change without notice.

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SUPPLEMENTAL INFORMATION

FRONT PANEL INTERFACE: 2-line Vacuum Florescent Display (VFD) with keypad and rotary knob.

Display:
- Show error messages and user defined messages.
- Display source and limit settings.
- Show current and voltage measurements.
- View measurements stored in non-volatile reading buffers.

Keypad Operations:
- Change host interface settings.
- Save and restore instrument setups.
- Load and run factory, and user defined, test scripts (i.e. sequences) that prompt for input and send results to the display.
- Store measurements into non-volatile reading buffers.

PROGRAMMING: Embedded Test Script Processor (TSP) accessible from any host interface. Responds to individual instrument control commands. Responds to high-speed test scripts comprised of instrument control commands and Test Script Language (TSL) statements (e.g. branching, looping, math, etc…). Able to execute high-speed test scripts stored in memory without host intervention.

Minimum Memory Available: 3 Mbytes (approximately 50,000 lines of TSL code).

Test Script Builder: Integrated Development Environment for building, running, and managing TSP scripts. Includes an Instrument Console for communicating with any TSP enabled instrument in an interactive manner. Requires:
- VISA (NI-VISA included on CD).
- Microsoft .NET Framework (included on CD).
- Keithley I/O Layer (included on CD).
- Pentium III 800MHz or faster personal computer.
- Microsoft Windows 98, NT, 2000, or XP.

Drivers: IVI/VISA drivers for VB, VC/C++, LabVIEW, TestPoint, and LabWindows/CVI.

READING BUFFERS: Non-volatile storage area(s) reserved for measurement data. Reading buffers are arrays of measurement elements. Each element can hold the following items:
- Measurement
- Measurement status
- Timestamp
- Source setting (at the time the measurement was taken)
- Range information

Two reading buffers are reserved for each SourceMeter channel. Reading buffers can be filled using the front panel STORE key and retrieved using the RECALL key or host interface.

Buffer Size, with timestamp and source setting: >50,000 samples.

Buffer Size, without timestamp and source setting: >100,000 samples.

Battery Backup: Lithium-ion battery backup. 30 days of non-volatile storage @ 23°C, and >4 hours of charge time. 3 year battery life @ 23°C. 1.5 year battery life @ 50°C.

FACTORY TSP SCRIPTS: See www.keithley.com for Keithley-supported application-specific scripts.

SYSTEM EXPANSION: The TSP-Link expansion interface allows TSP enabled instruments to trigger and communicate with each other. See figure below:
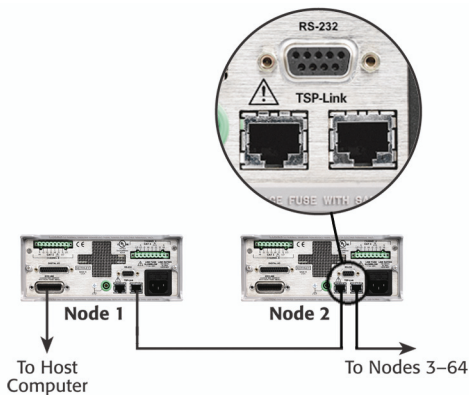
- Each SourceMeter has two TSP-Link connectors to facilitate chaining instruments together.
  - Once SourceMeters are interconnected via TSP-Link, a computer can access all of the resources of each SourceMeter via the host interface of any SourceMeter.
  - A maximum of 64 TSP-Link nodes can be interconnected. Each SourceMeter consumes one TSP-Link node.

TIMER: Free running 47 bit counter with 1MHz clock input. Reset each time instrument powers up. Rolls over every 4 years.

Timestamp: TIMER value automatically saved when each measurement is triggered.

Resolution: 1μs.

Accuracy: 50ppm.