Series 2600 System SourceMeter instruments offer electronic component and semiconductor device manufacturers a scalable, high throughput, highly cost-effective solution for precision DC, pulse, and low frequency AC source-measure testing. Building on the tightly integrated source-measure technology originally developed for Keithley’s popular Series 2400 SourceMeter line, Series 2600 instruments provide from two to four times the test speed of competitive products in I-V functional test applications. They also offer higher source-measure channel density and a significantly lower cost of ownership than competing products. The analog-to-digital converters provide simultaneous I and V measurements in less than 100µs (10,000 rdgs/s) and source-measure sweep speeds of less than 200µs per point (5,500 points/s). This high speed source-measure capability, plus advanced automation features and time-saving software tools make Series 2600 SourceMeter instruments an ideal solution for I-V testing of a wide range of devices.

**System scalability without a mainframe**

Series 2600 instruments incorporate an innovative technology that makes it possible to create multi-channel I-V test systems economically, without sacrificing test throughput. TSP-Link is a high speed system expansion interface, which test system builders can use to connect multiple SourceMeter channels into a system that can be programmed and controlled as a single instrument. TSP-Link makes it easy to scale the system’s channel count to match the application.
System SourceMeter®
Multi-Channel I-V Test Solutions

Series 2600 instruments in a master/slave configuration. Once connected, all the Series 2600 instruments in a system can be programmed and operated under the control of the master unit, just as if they were housed in the same chassis. By eliminating the need for a chassis/mainframe, the TSP-Link provides virtually unlimited flexibility to scale a test system’s channel count up or down as the application requires, while ensuring seamless integration.

New capabilities for increasing test speed and lowering test cost

The Test Script Processor (TSP)

Any Series 2600-based system can run high speed, embedded test scripts on the master unit’s Test Script Processor (TSP), the other major new technology on which the Series 2600 is based. The test sequence is processed and run on the embedded computer in the instrument, rather than from an external PC controller, so delays due to GPIB traffic congestion are eliminated. TSP test scripts allow throughput gains of up to 10× over equivalent PC-based programs controlling the same instruments via GPIB. TSP test scripts can be loaded and run from the front panel or over the system’s GPIB interface. A single TSP test script, running on the master unit, can control all the SourceMeter channels in the system and acquire data from any Series 2600 instrument connected to the TSP-Link, which supports connections for up to 64 Series 2600 instruments.

TSP for advanced automation

A Series 2600-based system can stand alone as a complete measurement and automation solution for semiconductor device or component testing, with the master unit controlling sourcing, measuring, pass/fail decisions, test sequence flow control, binning, and the component handler or prober. In contrast with existing embedded test sequencers for instrumentation, the TSP test scripts offer far greater programming flexibility, including support for:

• Instrument command queuing
• Modular subroutines with passable parameters
• Pass/fail and limit testing
• A wide range of math operations
• Flexible branching and looping capability
• Flexible external triggering
• Intelligent digital I/O read and write capability
• RS-232 communication

Factory and custom TSP test scripts

The Test Script Processor is programmed with a simple BASIC-style programming language that runs in real time on the instrument. Keithley provides built-in test scripts for:

• Sweeping
• Pulsing
• Waveform generation
• Common component tests like binary search, VF, VTH, LIV (light intensity/current/voltage)

A number of test scripts are included in the instrument, while others can be downloaded at no charge from www.keithley.com. These pre-written factory test scripts can be used as provided or easily customized for a given application, so production users can get their systems up and running faster than ever before.

Users can also create custom test scripts in several different ways, including a programming tool called Test Script Builder. Custom scripts can be downloaded from the PC to the master SourceMeter unit and saved in non-volatile memory. All four models provide 16 megabytes of non-volatile memory for storing up to 50,000 lines of TSP code and more than 100,000 readings.

1-888-KEITHLEY (U.S. only)
www.keithley.com
Series 2600
System SourceMeter®
Multi-Channel I-V Test Solutions

Third-generation SMU design ensures faster test times
The Series 2600’s new SMU design enhances test speed in several ways. For example, while earlier designs used a parallel current ranging topology, the Series 2600 uses a series ranging topology (patent pending), which provides faster and smoother range changes and outputs that settle more quickly. It also allows the current output limit to be programmed independently of the measurement current range for fast charging of capacitive loads and more intuitive operation during bench use.

Each Series 2600 SourceMeter channel offers a highly flexible, four-quadrant source coupled with precision voltage and current meters/limiters. Each channel can be configured as a:
- Precision power supply (up to 200V and 3A DC/10A pulsed output with 1pA readback resolution)
- True current source
- DMM (DCV, DCl, ohms, power, with 5½-digit resolution)
- Power V or I pulse generator (Pulse width: 200µs and longer—source and measure)
- Power V or I waveform generator (20-point sine wave up to 400Hz in a TSP test script)
- Electronic load (with sink mode capability)

High speed and precision A/Ds with simultaneous source-readback
All Series 2600 instruments provide four-quadrant operation and can be connected in series or in parallel to extend their dynamic range. In the first and third quadrants, they operate as a source, delivering power to a load. In the second and fourth quadrants, they operate as a sink, dissipating power internally. They measure voltage and current simultaneously with up to 5½-digit resolution, and they display voltage, current, resistance, or power readings.

Two analog-to-digital converters per channel (one for I, one for V) can run simultaneously, providing precise source-readback without sacrificing test throughput. These A/D converters offer the flexibility of programmable integration rates, allowing the user to optimize for either high speed (>10,000 rdgs/s at 0.001 NPLC setting) or for high resolution (up to 24 bits at 10 NPLC setting) to make high accuracy measurements.

Digital I/O Interface
A back panel port on every Series 2600 instrument provides 14 bits of universal digital I/O to link the instrument to a variety of popular handlers for sorting and binning components after testing. These I/O lines are also backward-compatible with Keithley’s earlier Trigger Link instrument triggering technology. These lines simplify integrating Series 2600 instruments into systems that employ other external instrumentation, including Series 2400 SourceMeter instruments, Series 7000 switch mainframes, and Series 2700 Integra data acquisition/multimeter systems.

Built-in Contact Check Function
The Contact Check function makes it simple to verify good connections quickly and easily before an automated test sequence begins. This eliminates measurement errors and false product failures associated with contact fatigue, breakage, contamination, loose or broken connection, relay failures, etc.
Series 2600 Multi-Channel I-V Test Solutions

Graphical instrument setup. LabTracer 2.0 supports up to eight Series 2600 SourceMeter channels. Model 2400 and Model 2410 SourceMeter instruments are also supported for extended voltage capability. Drop-down menus in LabTracer 2.0’s instrument setup window allow configuring any channel of a SourceMeter instrument for fixed point or sweeping operation. Once the instrument is configured, a single key press is all it takes to execute a test.

Once a test is complete, data is displayed in the spreadsheet panel and graphing panel. Measurement data can be manipulated in the spreadsheet by applying a formula to the results. For more detailed analysis, data can also be exported to Microsoft® Excel with a simple cut and paste.

Spanning I-V test applications from R&D to functional test
The Series 2600 SourceMeter Instruments provide simple-to-use yet powerful solutions for R&D testing. At the same time, they offer the speed and reliability needed for volume production testing.

High power and simplicity for R&D applications
In R&D and device characterization environments, Series 2600 instruments offer high testing versatility for both interactive and automated testing. The free downloadable LabTracer 2.0 software allows users to configure and control up to eight Series 2600 or 2400 SourceMeter channels quickly and easily for curve tracing or device characterization. It provides a simple graphical user interface for setup, control, data acquisition, and graphing of DUT data from SourceMeter instruments. When used together, LabTracer and SourceMeter instruments offer lab users a powerful, easy-to-use, and economical alternative to chassis-based solutions.
Series 2600
System SourceMeter®
Multi-Channel I-V Test Solutions

Dramatic throughput improvements for production test
Series 2600 instruments help component manufacturers improve their test throughput dramatically, as well as provide test solutions that can handle today’s devices, which often have higher pin counts and more analog circuitry than earlier designs. In the past, manufacturers have been forced by the lack of optimized test solutions for multi-channel source-measure applications to choose between bulky, expensive mainframe-based systems, slow instrument-based systems employing PC control, or fast instrument-based systems that require complex development. The Series 2600 offers:

- The highest density available in any SMU-based system to address growing pin counts.
- The industry’s fastest throughput, which helps reduce the cost of test. The speed of the onboard processor and TSP test scripts, combined with the tight triggering synchronization offered by the TSP-Link bus, makes high speed parallel testing practical.
- A lower capital investment. By eliminating the need for a mainframe/chaﬁs, they allow test engineers to conﬁgure a readily scalable system at a signiﬁcantly lower cost per channel than other solutions.

Test Script Builder software
Test Script Builder is a free software tool that is provided with all Series 2600 SourceMeter instruments to help users create, modify, debug, and store TSP test scripts. It provides a project/file manager window to store and organize test scripts, a text-sensitive program editor (like Visual Basic) to create and modify test TSP code, and an immediate instrument control window to send GPIB commands and receive data from the instrument. The immediate window allows viewing the output of a given test script and simplifies debugging.

TYPICAL APPLICATIONS
- I-V functional test and characterization of a wide range of devices, including:
  - Discrete and passive components
  - Two-leaded – Resistors, disk drive heads, metal oxide varistors (MOVs), diodes, zener diodes, sensors, capacitors, thermistors
  - Three-leaded – Small signal bipolar junction transistors (BJTs), ﬁeld-effect transistors (FETs), and more
  - Parallel test – Two- and three-leaded component arrays
  - Simple ICs – Optos, drivers, switches, sensors
  - Integrated devices – Small Scale Integrated (SSI) and Large Scale Integrated (LSI).
    - Analog ICs
    - Radio frequency integrated circuits (RFICs)
    - Application speciﬁc integrated circuits (ASICs)
    - System on a chip (SOC) devices
  - Optoelectronic devices such as light-emitting diodes (LEDs), laser diodes, high brightness LEDs (HBLEDs), vertical cavity surface-emitting lasers (VCSELs), displays
  - R&D and device characterization of these types of devices

Store and organize test scripts in the file manager window.
Create and modify test TSP code in the context sensitive editor window.
The immediate window displays test script output and assists in debugging.

1.888.KEITHLEY (U.S. only)
www.kehle.com
**SPECIFICATION CONDITIONS**

This document contains specifications and supplemental information for the Models 2601 and 2602. Specifications are the standards against which the Models 2601 and 2602 are tested. Upon leaving the factory the 2601 and 2602 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 (2601 and 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).
5. Remote sense operation or properly zeroed local operation.
6. Calibration period = 1 year.

**SOURCE AND MEASURE**

**Multi-Channel I-V Test Solutions**

**VOLTAGE SPECIFICATIONS**

**VOLTAGE SPECIFICATIONS**

**VOLTAGE SOURCE SPECIFICATIONS**

**VOLTAGE PROGRAMMING ACCURACY**

<table>
<thead>
<tr>
<th>RANGE</th>
<th>PROGRAMMING RESOLUTION</th>
<th>ACCURACY (1 Year)</th>
<th>TYPICAL NOISE (peak-peak)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100.000 mV</td>
<td>5 μV</td>
<td>0.02% + 250 μV</td>
<td>20 μV</td>
</tr>
<tr>
<td>1.00000 V</td>
<td>50 μV</td>
<td>0.02% + 400 μV</td>
<td>50 μV</td>
</tr>
<tr>
<td>6.00000 V</td>
<td>500 μV</td>
<td>0.02% + 1.8 mV</td>
<td>100 μV</td>
</tr>
<tr>
<td>40.00000 V</td>
<td>5000 μV</td>
<td>0.02% + 12 mV</td>
<td>500 μV</td>
</tr>
</tbody>
</table>

**TEMPERATURE COEFFICIENT (0°–18°C & 28°–50°C): ±0.15 μV per °C ± accuracy specification (°C) .

**MAXIMUM OUTPUT POWER AND SOURCE/SINK LIMITS**

1. ±0.1 A, ±0.06 V @ ±30mA, 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**

**CURRENT PROGRAMMING ACCURACY**

<table>
<thead>
<tr>
<th>RANGE</th>
<th>PROGRAMMING RESOLUTION</th>
<th>ACCURACY (1 Year)</th>
<th>TYPICAL NOISE (peak-peak)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100.000 nA</td>
<td>1 pA</td>
<td>0.06% + 100 pA</td>
<td>5 pA</td>
</tr>
<tr>
<td>1.00000 µA</td>
<td>10 pA</td>
<td>0.03% + 600 pA</td>
<td>25 pA</td>
</tr>
<tr>
<td>10.0000 µA</td>
<td>100 pA</td>
<td>0.03% + 2 nA</td>
<td>50 pA</td>
</tr>
<tr>
<td>100.000 µA</td>
<td>1 nA</td>
<td>0.03% + 30 nA</td>
<td>5 nA</td>
</tr>
<tr>
<td>1.00000 mA</td>
<td>10 nA</td>
<td>0.03% + 200 nA</td>
<td>5 nA</td>
</tr>
<tr>
<td>10.0000 mA</td>
<td>100 nA</td>
<td>0.03% + 3 nA</td>
<td>200 nA</td>
</tr>
<tr>
<td>100.000 mA</td>
<td>1 µA</td>
<td>0.03% + 20 µA</td>
<td>500 nA</td>
</tr>
<tr>
<td>1.00000 A</td>
<td>10 µA</td>
<td>0.05% + 900 µA</td>
<td>60 µA</td>
</tr>
<tr>
<td>10.0000 A</td>
<td>100 µA</td>
<td>0.06% + 1.5 mA</td>
<td>150 µA</td>
</tr>
</tbody>
</table>

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

**MAXIMUM OUTPUT POWER AND SOURCE/SINK LIMITS**

1. ±0.1 A, ±0.06 V at ±30mA, four quadrant source or sink operation.

**CURRENT REGULATION:** Line: ±0.01% of range; Load: ±0.01% of range + 100µA.

**VOLTAGE LIMIT/COMPLIANCE**

**CURRENT LIMIT/COMPLIANCE**

**ADDITIONAL SOURCE SPECIFICATIONS**

**TRANSIENT RESPONSE TIME:** <700µs 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, when changing from 10% to 90% of range, after source level command is processed on a fixed range.

100mV, 1V Ranges: <50µs typical.

6V Range: <100µs typical.

**CURRENT SOURCE OUTPUT SETTLING TIME:** Time required to reach 0.1% of final value, when changing from 10% to 90% of range, after source level command is processed on a fixed range.

Values below for Iout · Rload = 2V unless noted.

3A–10mA Ranges: <30µs typical (current less than 2.5A, Rload >1.5Ω).

1mA Range: <100µs typical.

100µA Range: <500µs typical.

1µA Range: <500µs typical.

1mA Range: <2.5ms typical.

100mA Range: <25ms typical.

**DC FLOATING VOLTAGE:** Output can be floated up to ±250VDC from chassis ground.

**REMOTE SOURCE OPERATING RANGE:**

1. Maximum voltage between HI and SENSE HI = 3V.

2. 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 = 6V – 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, 600mV typical.

**CURRENT SOURCE RANGE CHANGE OVERSHOOT:** ±5% + 300mV/Load 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 50°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.

4. 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 100mA range add an additional 60mV of uncertainty.

5. Add 15mA when measuring on the 1A range.
2601
2602
System SourceMeter®
Multi-Channel I-V Test Solutions

METER SPECIFICATIONS

VOLTAGE MEASUREMENT ACCURACY

<table>
<thead>
<tr>
<th>RANGE</th>
<th>DISPLAY RESOLUTION</th>
<th>INPUT RESISTANCE</th>
<th>ACCURACY (1 Year) 23°C ±25°C (%) rdg. + (volts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100.000 mV</td>
<td>1 µV</td>
<td>&gt;10 GΩ</td>
<td>±100 µV, ±0.015% + 150 µV</td>
</tr>
<tr>
<td>1.00000 V</td>
<td>10 µV</td>
<td>&gt;10 GΩ</td>
<td>±100 µV, ±0.015% + 200 µV</td>
</tr>
<tr>
<td>6.00000 V</td>
<td>10 µV</td>
<td>&gt;10 GΩ</td>
<td>±100 µV, ±0.015% + 1 µV</td>
</tr>
<tr>
<td>40.0000 V</td>
<td>100 µV</td>
<td>&gt;10 GΩ</td>
<td>±100 µV, ±0.015% + 8 mV</td>
</tr>
</tbody>
</table>

TEMPERATURE COEFFICIENT (0°C–18°C & 28°C–50°C): ±0.15% of accuracy specificationº/C.

CURRENT MEASUREMENT ACCURACY

<table>
<thead>
<tr>
<th>RANGE</th>
<th>DISPLAY RESOLUTION</th>
<th>VOLTAGE BURDEN</th>
<th>ACCURACY (1 Year) 23°C ±25°C (%) rdg. + (amps)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100.000 nA</td>
<td>1 pA</td>
<td>&lt;1 mV</td>
<td>±100 pA, ±0.025% + 100 pA</td>
</tr>
<tr>
<td>1.00000 µA</td>
<td>10 pA</td>
<td>&lt;1 mV</td>
<td>±100 pA, ±0.025% + 300 pA</td>
</tr>
<tr>
<td>10.0000 µA</td>
<td>100 pA</td>
<td>&lt;1 mV</td>
<td>±100 pA, ±0.025% + 1.5 nA</td>
</tr>
<tr>
<td>100.000 µA</td>
<td>1 nA</td>
<td>&lt;1 mV</td>
<td>±100 pA, ±0.025% + 25 nA</td>
</tr>
<tr>
<td>1.00000 mA</td>
<td>10 nA</td>
<td>&lt;1 mV</td>
<td>±100 pA, ±0.025% + 2.5 µA</td>
</tr>
<tr>
<td>10.0000 mA</td>
<td>100 nA</td>
<td>&lt;1 mV</td>
<td>±100 pA, ±0.025% + 20 µA</td>
</tr>
<tr>
<td>100.000 mA</td>
<td>1 mA</td>
<td>&lt;1 mV</td>
<td>±100 pA, ±0.025% + 200 µA</td>
</tr>
<tr>
<td>1.00000 A</td>
<td>10 mA</td>
<td>&lt;1 mV</td>
<td>±100 pA, ±0.025% + 1.5 mA</td>
</tr>
<tr>
<td>10.0000 A</td>
<td>100 mA</td>
<td>&lt;1 mV</td>
<td>±100 pA, ±0.025% + 15 mA</td>
</tr>
</tbody>
</table>

TEMPERATURE COEFFICIENT (0°C–18°C & 28°C–50°C): ±0.15% of accuracy specificationº/C.

CONTACT CHECK

<table>
<thead>
<tr>
<th>SPEED</th>
<th>MAXIMUM MEASUREMENT TIME TO MEMORY FOR 60Hz (50Hz)º</th>
<th>ACCURACY (1 Year) 23°C ±25°C (%) rdg. + (ohms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FAST</td>
<td>1 (2) ms</td>
<td>±100 µh, ±0.0015% + 100 µh</td>
</tr>
<tr>
<td>MEDIUM</td>
<td>4 (9) ms</td>
<td>±100 µh, ±0.0015% + 100 µh</td>
</tr>
<tr>
<td>SLOW</td>
<td>36 (42) ms</td>
<td>±100 µh, ±0.0015% + 100 µh</td>
</tr>
</tbody>
</table>

ADDITIONAL METER SPECIFICATIONS

LOAD IMPEDANCE: Stable into 10,000pF typical.
COMMON MODE VOLTAGE: 250VDC.
COMMON MODE ISOLATION: >1 GΩ, <500pF.
OVERRANGE: 101% of source range, 102% of measure range.
MAXIMUM SENSE LEAD RESISTANCE: 1Ω for rated accuracy.
SENSE INPUT IMPEDANCE: >10 GΩ.

NOTES
1. Add 50µV to source accuracy specifications per volt of HI lead drop.
2. Fourwire remote sense only.
3. Applies when in single channel display mode.
4. Includes measurement of SENSE HI to HI and SENSE LO to LO contact resistances.

1.888.KEITHLEY (U.S. only)
www.keithley.com

HOST INTERFACES: Computer control interfaces.
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 TSPLink 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 open drain I/O bits.
Absolute Maximum Input Voltage: ±25V
Absolute Minimum Input Voltage: ±0.25V
Maximum Logic Low Input Voltage: 0.7V ±850µA max.
Minimum Logic High Input Voltage: 2.1V ±570µA.
Maximum Source Current (flowing out of Digital I/O bit): ±900µA.
Maximum Sink Current (flowing into Digital I/O pin): ±5mA.
5V Power Supply Pin: Limited to 600mA, solid state fuse protected.

SOURCExMEASURE
DIGITAL11
RS-232:

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.
DIMENSIONS: 89mm high × 238mm wide × 460mm deep (3.5 in × 9 in × 17.5 in).
Bench Configuration (with handle & feet): 104mm high × 238mm wide × 460mm deep (4.1 in × 9 in × 17.5 in).
WEIGHT: 2601: 7.5kg (16 lbs). 2602: 12.1 kg (26.5 lbs).
ENVIRONMENT: For indoor use only.
Altitude: Maximum 2000 meters above sea level.
Operating: 0°C–50°C. 70% R.H. up to 35°C. Derate 3% R.H./°C, 35°C–50°C.
Storage: −25°C to 65°C.

A GREATER MEASURE OF CONFIDENCE

Keithley Instruments, Inc.
28350 Corporate Center Drive
Cleveland, OH 44135-3455
Phone: 866.KEITHLEY (866.534.8359) or 216.431.1211
Fax: 216.431.6390
www.keithley.com

Software 
Written by
Keithley Instruments, Inc.
Read by
Keithley Instruments, Inc.

Limited warranty, not liable for defects resulting from misuse, modification, accident, or normal wear and tear. No responsibility assumed for errors in this manual or for any consequential or incidental loss or damage. No responsibility assumed for any errors or omissions in this document. No part of this publication may be reproduced or transmitted in any form or by any means without written permission.

Series 2600 specifications

KEITHLEY® is a registered trademark of Keithley Instruments, Inc.
**SPECIFICATION CONDITIONS**

This document contains specifications and supplemental information for the Models 2611 and 2012. Specifications are the standards against which the Models 2611 and 2012 are tested. Upon leaving the factory the 2611 and 2012 meet these specifications. Supplemental and typical values are non-standard, apply at 23°C, and are provided solely as useful information.

The source and measurement accuracies are specified at the SourceMeter CHANNEL A (2611 and 2012) or SourceMeter CHANNEL B (2612) terminals under the following conditions:

1. 23°C ± 5°C, <70% relative humidity.
2. After 2 hour warm-up.
3. Speed normal (1 NPLC).
5. Remote sense operation or properly zeroed local sense operation.
6. Calibration period = 1 year.

**SOURCE SPECIFICATIONS**

<table>
<thead>
<tr>
<th>RANGE</th>
<th>PROGRAMMING RESOLUTION</th>
<th>ACCURACY (1 Year)</th>
<th>NOISE (peak-peak)</th>
</tr>
</thead>
<tbody>
<tr>
<td>200.000 mV</td>
<td>5 µV</td>
<td>±(0.02% + 375 µV)</td>
<td>20 µV</td>
</tr>
<tr>
<td>2.00000 V</td>
<td>50 µV</td>
<td>±(0.02% + 600 µV)</td>
<td>50 µV</td>
</tr>
<tr>
<td>20.0000 V</td>
<td>500 µV</td>
<td>±(0.02% + 5 mV)</td>
<td>300 µV</td>
</tr>
<tr>
<td>200.000 V</td>
<td>5 mV</td>
<td>±(0.02% + 50 mV)</td>
<td>2 mV</td>
</tr>
</tbody>
</table>

**VOLTAGE PROGRAMMING ACCURACY**

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

Maximum output power and source/sink limits: ±30.603W per channel maximum.

Voltage programming resolution: typical, 20V range, 1A limit.

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

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

Guard offset voltage: <±1µV (current ±10mA).

**CURRENT PROGRAMMING ACCURACY**

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

Maximum output power and source/sink limits: ±30.603W per channel maximum.

Current regulation: Line: ±0.01% of range (±rdg. + amps).

Voltage limit/compliance: Bipolar voltage limit (compliance) set with a single value. Minimum value is 10V. 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**

**TRANSPORT 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: <5µs typical.
20V Range: <10µs typical.
200V Range: <70µs 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 load = 2V unless noted.

1.5–1A Ranges: <120µs typical (Load >62Ω).
10µA Range: <500µs typical.

**MAXIMUM OUTPUT POWER:** 30.603W per channel maximum. (See CURRENT SOURCE OUTPUT SETTLING TIME for additional test conditions.)

**PULSE SPECIFICATIONS**

<table>
<thead>
<tr>
<th>REGION</th>
<th>MAXIMUM CURRENT LIMIT</th>
<th>MAXIMUM PULSE WIDTH</th>
<th>MAXIMUM DUTY CYCLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>100 mA @ 200 V</td>
<td>DC: no limit</td>
<td>100%</td>
</tr>
<tr>
<td>2</td>
<td>1.5 A @ 20 V</td>
<td>DC: no limit</td>
<td>100%</td>
</tr>
<tr>
<td>3</td>
<td>1 A @ 180 V</td>
<td>8.5 ms</td>
<td>1%</td>
</tr>
<tr>
<td>4</td>
<td>10 A @ 5 V</td>
<td>1 ms</td>
<td>2.2%</td>
</tr>
</tbody>
</table>

**MINIMUM PROGRAMMABLE PULSE WIDTH**: 20µs. Note: Minimum pulse width for settled source at a given I/V output and load can be longer than 20µs. See note 11 for typical settling times.

**Pulse width programming resolution**: 1µs.

**Pulse width programming accuracy**: ±25µs.

**Typical pulse width jitter**: 50µs.
2611
2612

System SourceMeter®
Multi-Channel I-V Test Solutions

SOURCE SPECIFICATIONS (continued)

PULSE SPECIFICATIONS (continued)

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 (quadrants II and IV), add 12% of limit range and ±0.02% of limit setting to corresponding current limit accuracy specifications. For 0.1A range add an additional 40mA of uncertainty.
4. 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 200µA range add an additional 120mV of uncertainty.
5. 10A range accessible only in pulse mode.
6. Accuracy specifications do not include connector leakage. Derate accuracy by Vout/2E11 per °C when operating between 18°–28°C. Derate accuracy by Vout/2E11 + (0.15 x Vout/2E11) per °C when operating <18°C and >28°C.
7. 150mV under pulse conditions with compliance set to 1A.
8. Times measured from the start of pulse to the start of off-time; see figure below.
9. 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.
10. Voltage source operation with 1.5A current limit.
11. Typical performance for minimum settled pulse widths:

<table>
<thead>
<tr>
<th>Source Value</th>
<th>Load</th>
<th>Source Settling (% of range)</th>
<th>Min. Pulse Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 V</td>
<td>0.5 Ω</td>
<td>1%</td>
<td>500 µs</td>
</tr>
<tr>
<td>20 V</td>
<td>20 Ω</td>
<td>0.2%</td>
<td>200 µs</td>
</tr>
<tr>
<td>180 V</td>
<td>180 Ω</td>
<td>0.2%</td>
<td>5 µs</td>
</tr>
<tr>
<td>200V (1.5A limit)</td>
<td>200 Ω</td>
<td>0.2%</td>
<td>15 ms</td>
</tr>
<tr>
<td>100 mA</td>
<td>200 Ω</td>
<td>1%</td>
<td>200 µs</td>
</tr>
<tr>
<td>1 A</td>
<td>10 Ω</td>
<td>0.2%</td>
<td>500 µs</td>
</tr>
<tr>
<td>1 A</td>
<td>10 Ω</td>
<td>0.2%</td>
<td>500 µs</td>
</tr>
<tr>
<td>10 A</td>
<td>0.5 Ω</td>
<td>0.5%</td>
<td>300 µs</td>
</tr>
</tbody>
</table>

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.

SOURCE AND MEASURE

2612 System SourceMeter
Multi-Channel I-V Test Solutions

METER SPECIFICATIONS

VOLTAGE MEASUREMENT ACCURACY 1, 7

<table>
<thead>
<tr>
<th>Range</th>
<th>Display Resolution²</th>
<th>Input Resistance</th>
<th>Accuracy (1 Year) 23°C ±5°C ±(% rdg. + volts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>200,000 mV</td>
<td>1 µV</td>
<td>&gt;10 GΩ</td>
<td>0.015% + 225 µV</td>
</tr>
<tr>
<td>2,000,000 V</td>
<td>10 µV</td>
<td>&gt;10 GΩ</td>
<td>0.02% + 350 µV</td>
</tr>
<tr>
<td>20,000 V</td>
<td>100 µV</td>
<td>&gt;10 GΩ</td>
<td>0.015% + 5 mV</td>
</tr>
<tr>
<td>200 V</td>
<td>1 mV</td>
<td>&gt;10 GΩ</td>
<td>0.015% + 50 mV</td>
</tr>
</tbody>
</table>

CURRENT MEASUREMENT ACCURACY 6, 7

<table>
<thead>
<tr>
<th>Range</th>
<th>Display Resolution²</th>
<th>Voltage Burden²</th>
<th>Accuracy (1 Year) 23°C ±5°C ±(% rdg. + amps)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100,000 nA</td>
<td>1 pA</td>
<td>&lt;1 mV</td>
<td>0.05% + 100 pA</td>
</tr>
<tr>
<td>1,000,000 µA</td>
<td>10 pA</td>
<td>&lt;1 mV</td>
<td>0.025% + 500 pA</td>
</tr>
<tr>
<td>10,000 µA</td>
<td>100 pA</td>
<td>&lt;1 mV</td>
<td>0.025% + 1.5 mA</td>
</tr>
<tr>
<td>100,000 µA</td>
<td>1 nA</td>
<td>&lt;1 mV</td>
<td>0.02% + 25 nA</td>
</tr>
<tr>
<td>1,000,000 A</td>
<td>10 µA</td>
<td>&lt;1 mV</td>
<td>0.05% + 1.5 mA</td>
</tr>
<tr>
<td>1,500,000 A</td>
<td>10 µA</td>
<td>&lt;1 mV</td>
<td>0.05% + 3.5 mA</td>
</tr>
<tr>
<td>10,000 A</td>
<td>100 µA</td>
<td>&lt;1 mV</td>
<td>0.4% + 25 mA</td>
</tr>
</tbody>
</table>

CONTACT CHECK³

<table>
<thead>
<tr>
<th>Speed</th>
<th>Maximum Measurement Time to Memory for 60Hz (50Hz)⁴</th>
<th>Accuracy (1 Year) 23°C ±5°C ±(% rdg. + ohms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FAST</td>
<td>1 (1.2 ms)</td>
<td>5% + 1</td>
</tr>
<tr>
<td>MEDIUM</td>
<td>4 (5 ms)</td>
<td>5% + 1</td>
</tr>
<tr>
<td>SLOW</td>
<td>36 (42 ms)</td>
<td>5% + 0.3</td>
</tr>
</tbody>
</table>

ADDITIONAL METER SPECIFICATIONS

LOAD IMPEDANCE: Stable into 10,000Ω typical.
COMMON MODE VOLTAGE: 250VDC.
COMMON MODE ISOLATION: >10GΩ, <500pF.
OVER RANGE: 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.
4. Includes measurement of Sense HI to HI and Sense LO to LO contact resistances.
5. 10A range accessible only in pulse mode.
6. Derate accuracy by Vout/2E11 per °C when operating between 18°–28°C. Derate accuracy by Vout/2E11 + (0.15 x Vout/2E11) per °C when operating <18°C and >28°C.
7. Derate accuracy specifications for NPLC setting <1 by increasing error term. Add appropriate % of range term using accuracy specification)/°C.
## GENERAL

**HOST INTERFACES:** Computer control interfaces.
- 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 2601/02 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, +850µA max.
- **Minimum Logic High Input Voltage:** 2.1V, +570µA.
- **Maximum Source Current (flowing out of Digital I/O bit):** +960µA.
- **Maximum Sink Current @ Maximum Logic Low Voltage (0.7V):** –5.0mA.
- **5V Power Supply Pin:** Limited to 600mA, solid state fuse protected.
- **Safety Interlock Pin:** Active high input. >3.4V @ 24mA (absolute maximum of 0V) must be externally applied to this pin to insure 200V operation. This signal is pulled down to chassis ground with a 10kΩ 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 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 × 213mm wide × 460mm deep (31⁄2 in × 83⁄8 in × 171⁄2 in). Bench Configuration (with handle & feet): 104mm high × 238mm wide × 460mm deep (41⁄8 in × 93⁄8 in × 171⁄2 in).

**WEIGHT:**
- 2611: 4.75kg (10.4 lbs).
- 2612: 5.50kg (12.0 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.
### SPEED SPECIFICATIONS 1

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

<table>
<thead>
<tr>
<th>A/D CONVERTER SPEED</th>
<th>TRIGGER ORIGIN</th>
<th>MEASURE TO MEMORY</th>
<th>MEASURE TO GPIB</th>
<th>SOURCE MEASURE TO MEMORY</th>
<th>SOURCE MEASURE TO GPIB</th>
<th>SOURCE MEASURE PASS/FAIL TO MEMORY</th>
<th>SOURCE MEASURE PASS/FAIL TO GPIB</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.001 NPLC</td>
<td>Internal</td>
<td>40000 (10000)</td>
<td>8000 (8000)</td>
<td>5500 (5500)</td>
<td>5600 (3600)</td>
<td>4900 (4900)</td>
<td>3100 (3100)</td>
</tr>
<tr>
<td>0.001 NPLC</td>
<td>Digital I/O</td>
<td>2700 (2650)</td>
<td>2100 (2100)</td>
<td>2300 (2300)</td>
<td>1900 (1875)</td>
<td>2200 (2150)</td>
<td>1800 (1775)</td>
</tr>
<tr>
<td>0.01 NPLC</td>
<td>Internal</td>
<td>6600 (5500)</td>
<td>5600 (3200)</td>
<td>2750 (2700)</td>
<td>2300 (2100)</td>
<td>2800 (2500)</td>
<td>2100 (1975)</td>
</tr>
<tr>
<td>0.01 NPLC</td>
<td>Digital I/O</td>
<td>1900 (1775)</td>
<td>1600 (1500)</td>
<td>1700 (1600)</td>
<td>1450 (1400)</td>
<td>1600 (1500)</td>
<td>1400 (1325)</td>
</tr>
<tr>
<td>0.1 NPLC</td>
<td>Internal</td>
<td>565 (475)</td>
<td>555 (470)</td>
<td>540 (450)</td>
<td>510 (440)</td>
<td>535 (455)</td>
<td>505 (430)</td>
</tr>
<tr>
<td>0.1 NPLC</td>
<td>Digital I/O</td>
<td>490 (420)</td>
<td>470 (405)</td>
<td>470 (410)</td>
<td>450 (390)</td>
<td>470 (400)</td>
<td>450 (390)</td>
</tr>
<tr>
<td>1.0 NPLC</td>
<td>Internal</td>
<td>59 (49)</td>
<td>59 (49)</td>
<td>58 (49)</td>
<td>58 (48)</td>
<td>58 (49)</td>
<td>58 (48)</td>
</tr>
<tr>
<td>1.0 NPLC</td>
<td>Digital I/O</td>
<td>58 (48)</td>
<td>58 (48)</td>
<td>58 (48)</td>
<td>57 (48)</td>
<td>57 (48)</td>
<td>57 (48)</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>A/D CONVERTER SPEED</th>
<th>TRIGGER ORIGIN</th>
<th>MEASURE TO MEMORY</th>
<th>MEASURE TO GPIB</th>
<th>SOURCE MEASURE TO MEMORY</th>
<th>SOURCE MEASURE TO GPIB</th>
<th>SOURCE MEASURE PASS/FAIL TO MEMORY</th>
<th>SOURCE MEASURE PASS/FAIL TO GPIB</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.001 NPLC</td>
<td>Internal</td>
<td>1110 (1000)</td>
<td>880 (880)</td>
<td>840 (840)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.01 NPLC</td>
<td>Internal</td>
<td>950 (890)</td>
<td>780 (760)</td>
<td>750 (710)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.1 NPLC</td>
<td>Internal</td>
<td>390 (345)</td>
<td>355 (320)</td>
<td>340 (305)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.0 NPLC</td>
<td>Internal</td>
<td>57 (48)</td>
<td>56 (47)</td>
<td>56 (47)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

Specifications are subject to change without notice. Rev B
Series 2600

System SourceMeter®
Multi-Channel I-V Test Solutions

SUPPLEMENTAL INFORMATION

FRONT PANEL INTERFACE: 2-line vacuum fluorescent 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
• Range information
• Measurement status
• Timestamp
• Source setting (at the time the measurement was taken)
• 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 @ 25°C and >1 hours of charge time. 5 year battery life @ 25°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 SourceMeter instruments 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 16 bit counter with 1MHz clock input. Reset each time instrument powers up. Rolls over every 4 years.

TSP-Link: 47 bit counter with 1MHz clock input. Reset each time instrument powers up. Rolls over every 4 years.

Resolution: 1µs.

Accuracy: ±50ppm.

Specifications are subject to change without notice.
All Keithley trademarks and trade names are the property of Keithley Instruments, Inc.
All other trademarks and trade names are the property of their respective companies.

KEITHLEY INSTRUMENTS, INC. 28775 AURORA ROAD  CLEVELAND, OHIO 44139-1891 1-888-KEITHLEY www.keithley.com

© Copyright 2006 Keithley Instruments, Inc.
Printed in the U.S.A. No. 2594 0606