Series 2600B

- Tightly integrated, 4-quadrant voltage/current source and measure instruments offer best in class performance with 6½-digit resolution
- Family of models offer industry’s widest dynamic range: 10A pulse to 0.1fA and 200V to 100nV
- Built-in, Java-based test software enables true plug & play I/V characterization and test through any browser.
- TSP (Test Script Processing) technology embeds complete test programs inside the instrument for best-in-class system-level throughput
- TSP-Link expansion technology for multi-channel parallel test without a mainframe
- Software emulation for Keithley’s Model 2400
- USB 2.0, LXI-C, GPIB, RS-232, and digital I/O interfaces
- Free software drivers and development/debug tools
- Optional ACS-Basic semiconductor component characterization software

System SourceMeter® SMU Instruments

The Series 2600B System SourceMeter SMU Instruments are the industry’s leading current/voltage source and measure solutions, and are built from Keithley’s third generation SMU technology. The Series 2600B offers single- and dual-channel models that combine the capabilities of a precision power supply, true current source, 6½-digit DMM, arbitrary waveform generator, pulse generator, and electronic load – all into one tightly integrated instrument. The result is a powerful solution that significantly boosts productivity in applications ranging from bench-top I-V characterization through highly automated production test. For bench-top use, Series 2600B SMU instruments feature built-in, Java-based software that enables plug & play I-V testing through any browser, on any computer, from anywhere in the world. For automated system applications, the Series 2600B’s Test Script Processor (TSP®) runs complete test programs from inside the instrument for industry-best throughput. In larger, multi-channel applications, Keithley’s TSP-Link® Technology works together with TSP Technology to enable high-speed, SMU-per-pin parallel testing. Because Series 2600B SourceMeter SMU Instruments have fully isolated channels that do not require a mainframe, they can be easily reconfigured and re-deployed as your test applications evolve.

Java-based Plug & Play I-V Test Software

The Series 2600B are the only SMU instruments to feature built-in, Java-based test software that enables true plug & play I-V characterization through any browser, on any computer, from anywhere in the world. This unique capability boosts productivity across a wide range of applications such as R&D, education, QA/FA, and more. Simply connect the 2600B to the internet via the supplied LAN cable, open a browser, type in the 2600B’s I.P. address, and begin testing. Resulting data can be downloaded to a spreadsheet such as Excel for further analysis and formatting, or for inclusion in other documents or presentations.
### Ordering Information

2601B Single-channel System SourceMeter SMU Instrument (3A DC, 10A Pulse)
2602B Dual-channel System SourceMeter SMU Instrument (3A DC, 10A Pulse)
2604B Dual-channel System SourceMeter SMU Instrument (5A DC, 10A Pulse, Benchtop Version)
2611B Single-channel System SourceMeter SMU Instrument (200V, 10A Pulse)
2612B Dual-channel System SourceMeter SMU Instrument (200V, 10A Pulse)
2614B Dual-channel System SourceMeter SMU Instrument (200V, 10A Pulse, Benchtop Version)
2634B Dual-channel System SourceMeter SMU Instrument (1fA, 10A Pulse, Benchtop Version)
2635B Single-channel System SourceMeter SMU Instrument (0.1fA, 10A Pulse)
2636B Dual-channel System SourceMeter SMU Instrument (0.1fA, 10A Pulse)

### Accessories Supplied

- Operators and Programming Manuals
- 2600-ALG-2: Low Noise Triax Cable with Alligator Clips, 2m (6.6 ft.) (two supplied with 2634B and 2636B, one with 2635B)
- 2600-Kit: Screw Terminal Connector Kit (2601B/2602B/2611B/2612B/2614B)
- 2600-B-800A: Series 2400 Emulation Script for Series 2600B (supplied on USB memory stick)
- 7709-308A: Digital I/O Connector
- CA-180-3A: TSP-Link/Ethernet Cable (two per unit)
- TSP Express Software Tool (embedded)
- Test Script Builder Software (supplied on CD)
- LabVIEW Driver (supplied on CD)
- ACS Basic Edition Software (optional)

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### Unmatched Throughput for Automated Test with TSP Technology

For test applications that demand the highest levels of automation and throughput, the Model 2600B’s TSP technology delivers industry-best performance. TSP technology goes far beyond traditional test command sequencers... it fully embeds then executes complete test programs from within the SMU instrument itself. This virtually eliminates all the time-consuming bus communications to and from the PC controller, and thus dramatically improves overall test times.

---

### SMU-Per-Pin Parallel Testing with TSP-Link Technology

TSP-Link is a channel expansion bus that enables multiple Series 2600B’s to be inter-connected and function as a single, tightly-synchronized, multi-channel system. The 2600B’s TSP-Link Technology works together with its TSP technology to enable high-speed, SMU-per-pin parallel testing. Unlike other high-speed solutions such as large ATE systems, the 2600B achieves parallel test performance without the cost or burden of a mainframe. The TSP-Link based system also enables superior flexibility, allowing for quick and easy system re-configuration as test requirements change.

---

### Model 2400 Software Emulation

The Series 2600B is compatible with test code developed for Keithley’s Model 2400 SourceMeter SMU instrument. This enables an easier upgrade from Model 2400-based test systems to Series 2600B, and can improve test speeds by as much as 80%. In addition, it provides a migration path from SCPI programming to Keithley’s TSP technology, which when implemented can improve test times even more. For complete support of legacy test systems, the Model 2400’s Source-Memory-List test sequencer is also fully supported in this mode.

---

### Third-generation SMU Instrument Design Ensures Faster Test Times

Based on the proven architecture of earlier Series 2600 instruments, the Series 2600B’s SMU instrument design enhances test speed in several ways. For example, while earlier designs used a parallel current ranging topology, the Series 2600B uses a patented series ranging topology, which provides faster and smoother range changes and outputs that settle more quickly.
The Series 2600B SMU instrument design supports two modes of operation for use with a variety of loads. In normal mode, the SMU instrument provides high bandwidth performance for maximum throughput. In high capacitance (high-C) mode, the SMU instrument uses a slower bandwidth to provide robust performance with higher capacitive loads.

**Simplify Semiconductor Component Test, Verification, and Analysis**

The optional ACS Basic Edition software maximizes the productivity of customers who perform packaged part characterization during development, quality verification, or failure analysis. Key features include:

- Rich set of easy-to-access test libraries
- Script editor for fast customization of existing tests
- Data tool for comparing results quickly
- Formulator tool that analyzes captured curves and provides a wide range of math functions

For more information about the ACS Basic Edition software, please refer to the ACS Basic Edition data sheet.

**Powerful Software Tools**

In addition to the embedded Java-based plug & play software and optional ACS Basic Edition software, the free Test Script Builder software tool is provided to help users create, modify, debug, and store TSP test scripts. Table 1 describes key features of Series 2600B software tools.

**Three New Dual-Channel Bench-Top Models of Series 2600B Offer Industry-Best Value and Performance**

For applications that do not require leading-edge system-level automation capabilities, Keithley has expanded the Series 2600B to include 3 new value-priced “bench-top” models – the 2604B, 2614B, and 2634B. These models offer similar performance to Models 2602B, 2612B, and 2636B, respectively, however do not include TSP-LINK, Contact Check, and Digital I/O capabilities.

**Complete Automated System Solutions**

Keithley’s S500 Integrated Test Systems are highly configurable, instrument-based systems for semiconductor characterization at the device, wafer, or cassette level. Built on our proven Series 2600B System SourceMeter SMU instruments, our S500 Integrated Test Systems provide innovative measurement features and system flexibility, scalable to your needs. The unique measurement capability, combined with the powerful and flexible Automated Characterization Suite (ACS) software, provides a comprehensive range of applications and features not offered on other comparable systems on the market.

**Table 1. Series 2600B software tools**

<table>
<thead>
<tr>
<th>Feature/Functionality</th>
<th>ACS Basic Edition</th>
<th>Java-based Plug &amp; Play</th>
<th>Test Script Builder (TSB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Semiconductor characterization software for component test, verification, and analysis</td>
<td>Quick Start Java-based Plug &amp; Play Tool for fast and easy I-V testing, primarily for bench and lab users</td>
<td>Custom script writing tool for TSP instruments</td>
</tr>
<tr>
<td>Supported hardware</td>
<td>Series 2400, Series 2600B, 4200-SCS</td>
<td>Series 2600B</td>
<td>Series 2600B, Series 3700</td>
</tr>
<tr>
<td>Supported buses</td>
<td>GPIB, LAN/LXI</td>
<td>LAN/LXI</td>
<td>GPIB, RS-232, LAN/LXI, USB</td>
</tr>
<tr>
<td>Functionality</td>
<td>Intuitive, wizard-based GUI. Rich set of test libraries, curve trace capability</td>
<td>Linear/Log Sweeps, Pulsing, Custom sweeps, Single point source-measures. Note: Uses new 2600B’s new APIs for precision timing and channel synchronization</td>
<td>Custom scripts with total flexibility, full featured debugger</td>
</tr>
<tr>
<td>Data management</td>
<td>Formulator tool with wide range of math functions</td>
<td>.csv export</td>
<td>User defined</td>
</tr>
<tr>
<td>Installation</td>
<td>Optional purchase</td>
<td>Not necessary. Embedded in the instrument.</td>
<td>Free Download or CD Install on PC.</td>
</tr>
</tbody>
</table>

When you need to acquire data on a packaged part quickly, the wizard-based user interface of ACS Basic Edition makes it easy to find and run the test you want, like this common FET curve trace test.

The flexible software architecture of ACS Basic Edition allows configuring systems with a wide range of controllers and test fixtures, as well as the exact number of SourceMeter SMU instruments the application requires.
TYPICAL APPLICATIONS
I-V functional test and characterization of a wide range of devices, including:

- Discrete and passive components
  - Two-leaded – Sensors, 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
- Simple ICs – Optos, drivers, switches, sensors, converters, regulators
- 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
- Wafer level reliability
  - NBTI, TDDB, HCI, electromigration
- Solar Cells
- Batteries
- And more...

In the first and third quadrants, Series 2600B SMU instruments operate as a source, delivering power to a load. In the second and fourth quadrants, they operate as a sink, dissipating power internally.
### Series 2600B

**System SourceMeter® SMU Instruments**

**SPECIFICATION CONDITIONS**

This document contains specifications and supplemental information for the Models 2601B, 2602B, and 2604B System SourceMeter® SMU instruments. Specifications are the standards against which the Models 2601B, 2602B, and 2604B are tested. Upon leaving the factory, the 2601B, 2602B, and 2604B meet these specifications. Supplemental and typical values are non-warranted, apply at 23°C, and are provided solely as useful information.

Accuracy specifications are applicable for both normal and high capacitance modes.

The source and measurement accuracies are specified at the SourceMeter CHANNEL A (2601B, 2602B, and 2604B) or SourceMeter CHANNEL B (2602B and 2604B) terminals under the following conditions:

1. 23°C ± 5°C
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 operation
6. Calibration period = 1 year

**SOURCE SPECIFICATIONS**

**VOLTAGE SOURCE SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Voltage Programming Accuracy</th>
<th>Accuracy (1 Year) 23°C ± 5°C ±(% rdg. + volts)</th>
<th>Typical Noise (peak-peak) 0.1Hz–10Hz</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Range</strong></td>
<td><strong>Programming Resolution</strong></td>
<td><strong>Typical Noise</strong></td>
</tr>
<tr>
<td>100 mV</td>
<td>5 µV</td>
<td>±0.02% + 250 µV ±20 µV</td>
</tr>
<tr>
<td>1 V</td>
<td>50 µV</td>
<td>±0.02% + 400 µV ±50 µV</td>
</tr>
<tr>
<td>6 V</td>
<td>50 µV</td>
<td>±0.02% + 1.8 mV ±100 µV</td>
</tr>
<tr>
<td>40 V</td>
<td>500 µV</td>
<td>±0.02% + 12 mV ±500 µV</td>
</tr>
</tbody>
</table>

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

**MAXIMUM OUTPUT POWER AND SOURCE/SINK LIMITS:** 1. 40W per channel maximum. ±40.4V @ ±1.0A, ±6.06V @ ±3.0A, four quadrant source or sink operation.

**VOLTAGE REGULATION:** Line: ±0.01% of range = ±10ppm. Load: ±0.01% of range + 100µA/V.

**NOISE 10Hz–20MHz:** <20mV peak-peak (typical), <3mV RMS (typical), 6V range.

**CURRENT LIMIT/COMPLIANCE:** Bipolar current limit (compliance) set with single value.

**MINIMUM ACCURACY SPECIFICATIONS:**

**GUARD OFFSET VOLTAGE:** <1mV typical. Current <10mA.

**CURRENT SOURCE SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Current Programming Accuracy</th>
<th>Accuracy (1 Year) 23°C ± 5°C ±(% rdg. + amps)</th>
<th>Typical Noise (peak-peak) 0.1Hz–10Hz</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Range</strong></td>
<td><strong>Programming Resolution</strong></td>
<td><strong>Typical Noise</strong></td>
</tr>
<tr>
<td>100 nA</td>
<td>2 pA</td>
<td>±0.06% + 100 pA ±5 pA</td>
</tr>
<tr>
<td>1 µA</td>
<td>20 pA</td>
<td>±0.03% + 800 pA ±25 pA</td>
</tr>
<tr>
<td>10 µA</td>
<td>200 pA</td>
<td>±0.03% + 5 nA ±60 nA</td>
</tr>
<tr>
<td>100 µA</td>
<td>2 nA</td>
<td>±0.03% + 60 nA ±6 nA</td>
</tr>
<tr>
<td>1 mA</td>
<td>20 nA</td>
<td>±0.03% + 300 nA ±60 nA</td>
</tr>
<tr>
<td>10 mA</td>
<td>200 nA</td>
<td>±0.03% + 6 µA ±200 nA</td>
</tr>
<tr>
<td>100 mA</td>
<td>2 µA</td>
<td>±0.03% + 30 µA ±600 nA</td>
</tr>
<tr>
<td>1 A</td>
<td>20 µA</td>
<td>±0.05% + 1.8 mA ±70 µA</td>
</tr>
<tr>
<td>3 A</td>
<td>20 µA</td>
<td>±0.06% + 4 mA ±150 µA</td>
</tr>
<tr>
<td>10 A</td>
<td>200 µA</td>
<td>0.5% + 40 mA (typical)</td>
</tr>
</tbody>
</table>

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

**MAXIMUM OUTPUT POWER AND SOURCE/SINK LIMITS:** 1. 40W 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 + 100µA.

**VOLTAGE LIMIT/COMPLIANCE:** Bipolar voltage limit (compliance) set with single value.

**MINIMUM VALUE is 10mV. Accuracy is the 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 within 0.1% for a 10% to 90% step change in load.

**VOLTAGE SOURCE OUTPUT SETTLING TIME:** Time required to reach within 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 within 0.1% of final value after source level command is processed on a fixed range. Values below for Iout × Rload = 1V unless noted.

**3A Range:** <80µs typical (current less than 2.5A, Rload >262Ω).

**1A–10mA Ranges:** <80µs typical (Rload >62Ω).

**1mA Range:** <100µs typical.

**100µA Range:** <150µs typical.

**1µA Range:** <2.5ms typical.

**100nA Range:** <25ms typical.

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

**REMOTE SENSE OPERATING RANGE:**

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 (maximum 1Ω per source lead).

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

**VOLTAGE SOURCE RANGE CHANGE OVERSHOOT:** <300mV + 0.1% of larger range (typical).

**Overshoot into an 100kΩ load, 20MHz BW.**

**CURRENT SOURCE RANGE CHANGE OVERSHOOT:** <5% of larger range + 300mVRMS典型 (with source settling set to SETTLE_SMOOTH_100NA). 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. High Capacitance Mode accuracy is applicable at 23°C ±5°C only.
3. Full power source operation regardless of load to 30°C ambient. Above 30°C and/or power sink operation, refer to “Operating Boundaries” in the Series 2600B Reference Manual for additional power derating information.
4. For sink mode operation (quadrants II and IV), add 0.06% of limit range to the corresponding current limit accuracy specifications. Specifications apply with sink mode operation enabled.
5. Full power source operation regardless of load to 50°C ambient. Above 50°C and/or power sink operation, refer to “Operating Boundaries” in the Series 2600B Reference Manual for additional power derating information.
6. 30A range accessible only in pulse mode.
7. High Capacitance Mode accuracy is applicable at 23°C ±5°C only.
8. Full power source operation regardless of load to 50°C ambient. Above 50°C and/or power sink operation, refer to “Operating Boundaries” in the Series 2600B Reference Manual for additional power derating information.
9. 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 30A range add an additional 60mV of uncertainty.
10. Add 150µs when measuring on the 1A range.
11. Add 90µV to source accuracy specifications per volt of HI lead drop.

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**www.keithley.com**

A Greater Measure of Confidence

A Tektronix Company
SOURCE SPECIFICATIONS (continued)

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>1 A @ 40 V</td>
<td>DC, no limit</td>
<td>100%</td>
</tr>
<tr>
<td>2</td>
<td>2.5 A @ 6 V</td>
<td>DC, no limit</td>
<td>100%</td>
</tr>
<tr>
<td>3</td>
<td>5 A @ 35 V</td>
<td>4 ms</td>
<td>4%</td>
</tr>
<tr>
<td>4</td>
<td>10 A @ 20 V</td>
<td>1.8 ms</td>
<td>1%</td>
</tr>
</tbody>
</table>

MINIMUM PROGRAMMABLE PULSE WIDTH 16, 17: 100µs. NOTE: Minimum pulse width for settled source at a given 1/V output and load can be longer than 100µs.

PULSE WIDTH PROGRAMMING RESOLUTION: 1µs.

PULSE WIDTH PROGRAMMING ACCURACY 15: ±5µs.

PULSE WIDTH JITTER: 2µs (typical).

QUADRANT DIAGRAM:

NOTES

12. Times measured from the start of pulse to the start off-time; see figure below.

13. Thermally limited in sink mode (quadrants II and IV) and ambient temperatures above 30°C. See power equations in the reference manual for more information.


15. Times measured from the start of pulse to the start off-time; see figure below.

VOLTAGE MEASUREMENT ACCURACY 16, 17

<table>
<thead>
<tr>
<th>Range</th>
<th>Default Display Resolution 16</th>
<th>Input Resistance</th>
<th>Accuracy (1 Year) 23°C ±5°C ±(% rdg. + volts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 mV</td>
<td>100 mV</td>
<td>&gt;10 GΩ</td>
<td>0.015% + 150 µV</td>
</tr>
<tr>
<td>1 V</td>
<td>1 µV</td>
<td>&gt;10 GΩ</td>
<td>0.015% + 200 µV</td>
</tr>
<tr>
<td>6 V</td>
<td>10 µV</td>
<td>&gt;10 GΩ</td>
<td>0.015% + 1 mV</td>
</tr>
<tr>
<td>40 V</td>
<td>100 µV</td>
<td>&gt;10 GΩ</td>
<td>0.015% + 8 mV</td>
</tr>
</tbody>
</table>

TEMPERATURE COEFFICIENT (0°–18°C and 28°–50°C) 16, ±0.15 × accuracy specification/°C. Applicable for normal mode only. Not applicable for high capacitance mode.

CURRENT MEASUREMENT ACCURACY 17

<table>
<thead>
<tr>
<th>Range</th>
<th>Default Display Resolution 18</th>
<th>Voltage Burden 19</th>
<th>Accuracy (1 Year) 23°C ±5°C ±(% rdg. + amps)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 nA</td>
<td>100 nA</td>
<td>&lt;1 mV</td>
<td>0.05% + 100 pA</td>
</tr>
<tr>
<td>1 µA</td>
<td>1 µA</td>
<td>&lt;1 mV</td>
<td>0.02% + 500 pA</td>
</tr>
<tr>
<td>10 µA</td>
<td>10 µA</td>
<td>&lt;1 mV</td>
<td>0.02% + 1.5 nA</td>
</tr>
<tr>
<td>1 mA</td>
<td>1 mA</td>
<td>&lt;1 mV</td>
<td>0.02% + 200 nA</td>
</tr>
<tr>
<td>10 mA</td>
<td>10 mA</td>
<td>&lt;1 mV</td>
<td>0.02% + 2.5 µA</td>
</tr>
<tr>
<td>100 mA</td>
<td>100 mA</td>
<td>&lt;1 mV</td>
<td>0.02% + 20 µA</td>
</tr>
<tr>
<td>1 A</td>
<td>1 A</td>
<td>&lt;1 mV</td>
<td>0.05% + 1.5 mA</td>
</tr>
<tr>
<td>5 A</td>
<td>5 A</td>
<td>&lt;1 mV</td>
<td>0.05% + 3.5 mA</td>
</tr>
<tr>
<td>10 A</td>
<td>10 A</td>
<td>&lt;1 mV</td>
<td>0.4% + 25 µA (typical)</td>
</tr>
</tbody>
</table>

CURRENT MEASURE SETTLING TIME (Time for measurement to settle after a Vref change): Time required to reach within 0.1% of final value after source level command is processed on a fixed range. Values for Vref = 1V unless noted. Current Range: 1mA. Settling Time: <100µs (typical).

ADDITIONAL METER SPECIFICATIONS

MAXIMUM LOAD IMPEDANCE:

Normal Mode: 10mF (typical). High Capacitance Mode: 50µF (typical).

COMMON MODE VOLTAGE: 250VDC.

COMMON MODE ISOLATION: >1GΩ; <450pF.

OVER RANGE: 101% of source range, 102% of measure range.

MAXIMUM SENSE LEAD RESISTANCE: 1kΩ for rated accuracy.

SENSE INPUT IMPEDANCE: >10GΩ.

NOTES

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

17. De-rate accuracy specifications for NPLC setting < 1 by increasing error term.

18. Applicable when in single channel display mode.

19. High Capacitance Mode accuracy is applicable for 23°C ±5°C only.

20. Applies when in single channel display mode.

21. Four-wire remote sense only with current meter mode selected. Voltage measure set to 100mV or 1V range only.

22. 10A range accessible only in pulse mode.

23. Compliance equal to 300mA.

24. High Capacitance Mode accuracy is applicable for 23°C ±5°C only.

25. Includes measurement of SENSE HI to HI and SENSE LO to LO contact resistances.
**Series 2600B specifications**

### 2601B, 2602B, 2604B

**System SourceMeter® SMU Instruments**

**HIGH CAPACITANCE MODE** 26, 27, 28

**VOLTAGE SOURCE OUTPUT SETTLING TIME**: Time required to reach 0.1% of final value after source level command is processed on a fixed range. Current limit = 1A.

<table>
<thead>
<tr>
<th>Voltage Source Range</th>
<th>Settling Time with C&lt;sub&gt;load&lt;/sub&gt; = 4.7µF</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 mV</td>
<td>200 µs (typical)</td>
</tr>
<tr>
<td>1 V</td>
<td>200 µs (typical)</td>
</tr>
<tr>
<td>6 V</td>
<td>200 µs (typical)</td>
</tr>
<tr>
<td>40 V</td>
<td>7 ms (typical)</td>
</tr>
</tbody>
</table>

**CURRENT MEASURE SETTLING TIME**: Time required to reach 0.1% of final value after voltage source is stabilized on a fixed range. Values below for V<sub>out</sub> = 1V unless noted.

<table>
<thead>
<tr>
<th>Current Measure Range</th>
<th>Settling Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 A – 1 A</td>
<td>&lt;120 µs (typical) (R&lt;sub&gt;load&lt;/sub&gt; &gt; 2Ω)</td>
</tr>
<tr>
<td>100 mA – 10 mA</td>
<td>&lt;100 µs (typical)</td>
</tr>
<tr>
<td>1 µA</td>
<td>&lt; 3 ms (typical)</td>
</tr>
<tr>
<td>100 µA</td>
<td>&lt; 3 ms (typical)</td>
</tr>
<tr>
<td>10 µA</td>
<td>&lt; 230 ms (typical)</td>
</tr>
<tr>
<td>1 µA</td>
<td>&lt; 230 ms (typical)</td>
</tr>
</tbody>
</table>

**CAPACITOR LEAKAGE PERFORMANCE USING HIGH-C SCRIPTS**: See reference manual for details.

- 1 µA: 230 ms (typical)
- 10 µA: < 230 ms (typical)
- 100 µA: 3 ms (typical)
- 100 mA – 10 mA: <100 µs (typical)
- 6 V: 200 µs (typical)
- 40 V: 7 ms (typical)
- 1 V: 200 µs (typical)
- 100 mV: 200 µs (typical)

**MODE CHANGE DELAY**:

- 100µA Current Range and Above:
  - Delay into High Capacity Mode: 10ms.
  - Delay out of High Capacity Mode: 10ms.
- 1µA and 10µA Current Ranges:
  - Delay into High Capacity Mode: 250ms.
  - Delay out of High Capacity Mode: 10ms.

**VOLTAGE SOURCE OUTPUT RANGE OVERSHOOT**:

- 1 µA and 10 µA Current Ranges:
  - Overshoot into a 100kΩ load, 20MHz BW.
- 100 µA Current Range and Above:
  - Overshoot into a 100kΩ load, 20MHz BW.

**NOTES**

- 26. High Capacitance Mode specifications are for DC measurements only.
- 27. 100mA range is not available in High Capacitance Mode.

**GENERAL**


**USB CONTROL**: USB 2.0 device, TMC488 protocol.

- **RS-232**: Baud rates from 300bps to 115200bps.
- **ETHERNET**: RJ-45 connector, LXI Class C, 10/100BT, no auto MDIX.

**EXPANSION INTERFACE**: The TSP-Link expansion interface allows TSP enabled instruments to trigger and communicate with each other. (Not available on Model 2604B.)

**DIGITAL I/O INTERFACE**: (Not available on Model 2604B)

- **+5V Pins** (on DIGITAL I/O connector)
- **Digital I/O Pin** (on DIGITAL I/O connector)
- **GND Pin** (on DIGITAL I/O connector)

**Connector**: 25-pin female D.

**Input/Output Pins**: 14 open drain I/O bits.

**DIGITAL I/O INTERFACE**

- **Solid State Fuse**: 5.1kΩ; 100mA, 20MHz BW.
- **+5VDC**: +960µA.
- **Read by firmware**: 5V Power Supply Pins: Limited to 250mA total for all three pins, solid state fuse protected.
- **Write by firmware**: Absolute Maximum Sink Current (flowing into Digital I/O pin): –11mA (not including Model 2604B).
- **USB Power Supply Pins**: Limited to 250mA total for all three pins, solid state fuse protected.
- **Output Enable**: Active high input pulled down internally to ground with a 10kΩ resistor; when the output enable input function has been activated, each SourceMeter channel will not turn on unless the output enable pin is driven to >2.1V (nominal current = 2.1V/10kΩ = 210µA).

**NOTE**

**USB FILE SYSTEM**: USB 2.0 Host: Mass storage class device.

**POWER SUPPLY**: 100V to 250VAC, 50–60Hz (auto sensing), 240VA max.

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


**DIMENSIONS**: 89mm high × 238mm wide × 460mm deep (3½ in × 9½ in × 17½ in). Bench Configuration (with handle and feet): 106mm high × 250mm wide × 460mm deep (4¼ in × 9¾ in × 17½ in).

**WEIGHT**: 2601B: 4.75kg (10.4 lbs). 2602B, 2604B: 5.50kg (12.0 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°–50°C.
- **Storage**: –25°C to 65°C.
2611B, 2612B, 2614B
System SourceMeter® SMU Instruments

SPECIFICATION CONDITIONS
This document contains specifications and supplemental information for the Models 2611B, 2612B, and 2614B System SourceMeter® SMU instruments. Specifications are the standards against which the Models 2611B, 2612B, and 2614B are tested. Upon leaving the factory the 2611B, 2612B, and 2614B meet these specifications. Supplemental and typical values are non-warranted, apply at 23°C, and are provided solely as useful information.

Accuracy specifications are applicable for both normal and high capacitance modes. The source and measurement accuracies are specified at the SourceMeter CHANNEL A (2611B, 2612B, and 2614B) or SourceMeter CHANNEL B (2612B, 2614B) 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

VOLTAGE SOURCE SPECIFICATIONS

<table>
<thead>
<tr>
<th>VOLTAGE PROGRAMMING ACCURACY</th>
<th>Range</th>
<th>Programming Resolution</th>
<th>Accuracy (1 Year) 23°C ±5°C</th>
<th>Typical Noise (Peak-Peak) 0.1Hz–10Hz</th>
</tr>
</thead>
<tbody>
<tr>
<td>200 mV</td>
<td>5 µV</td>
<td>0.02% + 375 µV</td>
<td>20 µV</td>
<td></td>
</tr>
<tr>
<td>2 V</td>
<td>500 µV</td>
<td>0.02% + 5 mV</td>
<td>500 µV</td>
<td></td>
</tr>
<tr>
<td>200 V</td>
<td>500 µV</td>
<td>0.02% + 5 mV</td>
<td>500 µV</td>
<td></td>
</tr>
</tbody>
</table>

TEMPERATURE COEFFICIENT (0°C–18°C and 28°C–50°C): ±(0.15 × accuracy specification)/°C. Applicable for normal mode only. Not applicable for high capacitance mode.

NOTES
1. Add 50µV to source accuracy specifications per volt of HI lead drop.
2. High Capacitance Mode accuracy is applicable at 25°C ±5°C only.
3. Full power source operation regardless of load to 50°C ambient. Above 30°C and/or power sink operation, refer to “Operating Boundaries” in the Series 2600B Reference Manual for additional power derating information.
4. For sink mode operation quadrants II and IV, add 0.06% of limit range to the corresponding current limit accuracy specifications. Specifications apply with sink mode operation enabled.
5. Accuracy specifications do not include connector leakage. Derate accuracy by Vc×2E11 per °C when operating between 18°C–28°C. Derate accuracy by Vc×2E11 + (0.15×Vc×2E11) per °C when operating <18°C and >28°C.
6. Full power source operation regardless of load to 50°C ambient. Above 50°C and/or power sink operation, refer to “Operating Boundaries” in the Series 2600B Reference Manual for additional power derating information.
7. 10A range accessible only in pulse mode.
8. High Capacitance Mode accuracy is applicable at 25°C ±5°C only.
9. Full power source operation regardless of load to 50°C ambient. Above 50°C and/or power sink operation, refer to “Operating Boundaries” in the Series 2600B Reference Manual for additional power derating information.
10. For sink mode operation quadrants II and IV, add 0.10% of compliance range and ±10% of limit setting to corresponding voltage source accuracy specifications. For 200mV range add an additional 120mV of uncertainty.
11. Add 50µV to source accuracy specifications per volt of HI lead drop.

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>2 A @ 180 V</td>
<td>8.5 ms</td>
<td>1%</td>
</tr>
<tr>
<td>4</td>
<td>1 A @ 200 V</td>
<td>2.2 ms</td>
<td>1%</td>
</tr>
<tr>
<td>5</td>
<td>10 A @ 5 V</td>
<td>1 ms</td>
<td>2.2%</td>
</tr>
</tbody>
</table>

MINIMUM PROGRAMMABLE PULSE WIDTH: 10 µs. NOTE: Minimum pulse width for settled source at a given UV output and load can be longer than 100µs.

PULSE WIDTH PROGRAMMING RESOLUTION: 1µs.

PULSE WIDTH PROGRAMMING ACCURACY: ±2.5µs.

PULSE WIDTH JITTER: 4µs (typical).

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2611B, 2612B, 2614B

System SourceMeter® SMU Instruments

SOURCE SPECIFICATIONS (continued)

PULSE SPECIFICATIONS (continued)

QUADRANT DIAGRAM:

NOTES

12. Times measured from the start of pulse to the start off-time; see figure below.

Source Level

Bias Level

Start ton

Start toff

Bias Level

Source Level

Start ton

Start toff

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

16. Times measured from the start of pulse to the start off-time; see figure below.

CONTACT CHECK 27 (not available on Model 2614B)

ADDITIONAL METER SPECIFICATIONS

MAXIMUM LOAD IMPEDANCE:

Normal Mode: 10mΩ (typical)  
High Capacitance Mode: 50µF (typical).

COMMON MODE VOLTAGE: 250VDC.

COMMON MODE ISOLATION: >1GΩ, <450pF.

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

MAXIMUM SENSE LEAD RESISTANCE: 1kΩ for rated accuracy.

SENSE INPUT IMPEDANCE: >10GΩ.

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**METER SPECIFICATIONS (continued)**

**NOTES**
- Ad. 10µA source accuracy specifications per volt of HT lead drop.
- 11. Deviate accuracy specifications for NPLC setting <1 by increasing error term. Add appropriate % of range term using table below.
- 12. Accuracy specifications do not include connector leakage. De-rate accuracy by \( V_{out}/2E11 \) per °C when operating between 18°–28°C.
- 13. Compliance equal to 100mA. Refer to chassis ground with a 10kΩ resistor. This signal is pulled down to chassis ground with a 10kΩ resistor.
- 14. Requires remote sense only and with current meter mode selected. Voltage measure set to 200mV or 2V range only.
- 15. 10mA range only available in pulse mode.
- 16. Compliance equal to 100mA. Refer to chassis ground with a 10kΩ resistor.
- 17. Includes measurement of SENSE HI to HI and SENSE LO to LO contact resistances.
- 18. Accuracy specifications do not include connector leakage. De-rate accuracy by \( V_{out}/2E11 \) per °C when operating between 18°–28°C.
- 19. Applies when in single channel display mode.
- 20. High Capacitance Mode accuracy is applicable at 25°C ±5°C only.
- 21. Accuracy specifications do not include connector leakage. De-rate accuracy by \( V_{out}/2E11 \) per °C when operating between 18°–28°C.
- 22. Applies when in single channel display mode.
- 23. Four-wire remote sense only and with current meter mode selected. Voltage measure set to 200mV or 2V range only.
- 24. Accuracy specifications do not include connector leakage. De-rate accuracy by \( V_{out}/2E11 \) per °C when operating between 18°–28°C.
- 25. Compliance equal to 100mA. Refer to chassis ground with a 10kΩ resistor.
- 26. High Capacitance Mode accuracy is applicable at 25°C ±5°C only.
- 27. Includes measurement of SENSE HI to HI and SENSE LO to LO contact resistances.
- 28. High Capacitance Mode specifications are for DC measurements only.
- 29. 100mA range is not available in High Capacitance Mode.
- 30. High Capacitance Mode specifications do not include connector leakage. De-rate accuracy by \( V_{out}/2E11 \) per °C when operating between 18°–28°C.

**HIGH CAPACITANCE MODE**

**VOLTAGE SOURCE OUTPUT SETTLING TIME:** Time required to reach within 0.1% of final value after source level command is processed on a fixed range. Current limit = 1A.

<table>
<thead>
<tr>
<th>Voltage Source Range</th>
<th>Setting Time with ( C_{load} = 4.7\mu F )</th>
</tr>
</thead>
<tbody>
<tr>
<td>200 mV</td>
<td>600 µs (typical)</td>
</tr>
<tr>
<td>2 V</td>
<td>600 µs (typical)</td>
</tr>
<tr>
<td>20 V</td>
<td>1.5 ms (typical)</td>
</tr>
<tr>
<td>200 V</td>
<td>20 ms (typical)</td>
</tr>
</tbody>
</table>

**CURRENT MEASURE SETTLING TIME:** Time required to reach within 0.1% of final value after voltage source is stabilized on a fixed range. Values below for \( V_{out} = 2V \) unless noted.

<table>
<thead>
<tr>
<th>Current Measure Range</th>
<th>Setting Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 A – 1 A</td>
<td>&lt;120 µs (typical) (( R_{in} &gt; 5\Omega ))</td>
</tr>
<tr>
<td>100 mA – 10 mA</td>
<td>&lt;100 µs (typical)</td>
</tr>
<tr>
<td>1 mA</td>
<td>&lt;5 ms (typical)</td>
</tr>
<tr>
<td>100 µA</td>
<td>&lt;5 ms (typical)</td>
</tr>
<tr>
<td>10 µA</td>
<td>&lt;250 ms (typical)</td>
</tr>
<tr>
<td>1 µA</td>
<td>&lt;250 ms (typical)</td>
</tr>
</tbody>
</table>

**CAPACITOR LEAKAGE PERFORMANCE USING HIGH-C SCRIPTS**

Test: 5V step and measure. 200ms (typical) @ 50nA.

**MODE CHANGE DELAYS:**

- **100µA Current Range and Above:** Delay into High Capacitance Mode: 10ms.
- **1µA and 10µA Current Ranges:** Delay into High Capacitance Mode: 20ms.

**VOLT METER INPUT IMPEDANCE:** 30GΩ in parallel with 3300pF.

**NOISE:** 100Hz–20MHz (20V Range): <30mV p-p (typical).

**VOLTAGE SOURCE RANGE CHANGE OVERSHELL (for 20V range and below):** <400mV ± 0.1% of larger range (typical). Overshoot into a 200Ω load, 20MHz BW.

**NOTES**
- 28. High Capacitance Mode specifications are for DC measurements only.
- 29. 100mA range is not available in High Capacitance Mode.
- 30. High Capacitance Mode utilizes locked ranges. Auto Range is disabled.
**2634B, 2635B, 2636B**

**SYSTEM SOURCEMETER® SMU INSTRUMENTS**

**SPECIFICATION CONDITIONS**

This document contains specifications and supplemental information for the Models 2634B, 2635B, and 2636B System SourceMeter® SMU instruments. Specifications are the standards against which the Models 2634B, 2635B, and 2636B are tested. Upon leaving the factory the 2634B, 2635B, and 2636B meet these specifications. Supplemental and typical values are non-warranted, apply at 23°C, and are provided solely as useful information.

Accuracy specifications are applicable for both normal and high capacitance modes.

The source and measurement accuracies are specified at the SourceMeter CHANNEL A (2634B, 2635B, and 2636B) or SourceMeter CHANNEL B (2634B, 2636B) terminals under the following conditions:

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

**SOURCE SPECIFICATIONS**

**VOLTAGE SOURCE SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Range</th>
<th>Programming Resolution</th>
<th>Accuracy (1 Year) 23°C ± 5°C</th>
<th>Typical Noise (peak-peak) 0.1Hz–10Hz</th>
</tr>
</thead>
<tbody>
<tr>
<td>200 mV</td>
<td>5 µV</td>
<td>0.02% ± 375 µV</td>
<td>20 µV</td>
</tr>
<tr>
<td>2 V</td>
<td>50 µV</td>
<td>0.02% ± 600 µV</td>
<td>50 µV</td>
</tr>
<tr>
<td>20 V</td>
<td>500 µV</td>
<td>0.02% ± 5 mV</td>
<td>2 mV</td>
</tr>
<tr>
<td>200 V</td>
<td>5 mV</td>
<td>&lt;±0.1% of range + 100 µV</td>
<td>2 mV</td>
</tr>
</tbody>
</table>

**VOLTAGE LIMIT/COMPLIANCE 9:**

- Bipolar voltage limit (compliance) set with a single value.
- ±20.2V @ ±1.5A, ±202V @ ±100mA, four quadrant source or sink operation.

**NOISE 10Hz–20MHz:**

<table>
<thead>
<tr>
<th>Region</th>
<th>Maximum Noise</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 Hz–20 MHz</td>
<td>&lt;20 mV pk-pk (typical), &lt;3 mV rms (typical)</td>
</tr>
</tbody>
</table>

**OVERSHOOT:**

- 10mA – 10mA <80 µs (typical)
- 1mA – 100 µA <100 µs (typical)
- 1 µA – 10 µA <200 µs (typical)
- 10 µA – 100 µA <1 ms (typical)
- 100 µA – 1 mA <5 ms (typical)
- 1 mA – 10 mA <25 ms (typical)
- 10 mA – 100 mA <100 ms (typical)
- 100 mA – 1 A <150 ms (typical)
- 1 A – 10 A <300 ms (typical)
- 10 A – 100 A <1000 ms (typical)

**PERIODIC CALIBRATION:**

- Internal periodic calibration of the test instrument is performed at least once a year.
- Calibration is performed by a calibrated source.
- The source and measurement accuracies are specified at the SourceMeter CHANNEL A (2634B, 2635B, and 2636B) or SourceMeter CHANNEL B (2634B, 2636B) terminals under the following conditions:

**ADDITIONAL SOURCE SPECIFICATIONS**

**TRANSIENT RESPONSE TIME:**

- <70µs for the output to recover to within 0.1% for a 10% to 90% step change in load.

**VOLTAGE SOURCE OUTPUT SETTLING TIME:**

- Time required to reach within 0.1% of final value after source level command is processed on a fixed range.

**Range**

- 200 mV: <50 µs (typical)
- 2 V: <50 µs (typical)
- 20 V: <110 µs (typical)
- 200 V: <700 µs (typical)

**CURRENT SOURCE OUTPUT SETTLING TIME:**

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

**Current Range**

- 1.5 A – 1 A: <120 µs (typical)
- 1 mA: <100 µs (typical)
- 100 µA: <150 µs (typical)
- 1 µA: <500 µs (typical)
- 100 nA: <2 ms (typical)
- 10 nA: <20 ms (typical)
- 1 nA: <150 ms (typical)

**DC FLOATING VOLTAGE:**

- Output can be floated up to ±250VDC.

**REMOTE SENSOR OPERATING RANGE:**

- Maximum voltage between HI and SENSE HI = 3V.
- Maximum voltage between LO and SENSE LO = 3V.

**VOLTAGE OUTPUT HEADROOM:**

- 200V Range: Max. output voltage = 202V – total voltage drop across source leads (maximum 10% per channel maximum).
- 20V Range: Max. output voltage = 25.3V – total voltage drop across source leads (maximum 10% per channel maximum).

**OVER TEMPERATURE PROTECTION:**

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

**VOLTAGE SOURCE RANGE CHANGE OVERSHOOT:**

- <300mV + 0.1% of larger range (typical).

**CURRENT SOURCE RANGE CHANGE OVERSHOOT:**

- <5% of larger range + 500mV + Rload (typical – With source settling set to SETTLE_SMOOTH_100NA). 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>1</td>
<td>1.5 A @ 20 V</td>
<td>DC, no limit</td>
<td>100%</td>
</tr>
<tr>
<td>2</td>
<td>1 A @ 100 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:**

- 10 µs

**PULSE WIDTH PROGRAMMING RESOLUTION:**

- 1µs

**PULSE WIDTH PROGRAMMING ACCURACY:**

- ±5µs

**PULSE WIDTH JITTER:**

- 50µs (typical)

**QUADRANT DIAGRAM:**

- [Diagram showing DC, Pulse, and other waveform patterns]

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**SOURCE SPECIFICATIONS (continued)**

**NOTES**
1. Add 50µV to source accuracy specifications per volt of HI lead drop.
2. High Capacitance Mode accuracy is applicable at 25°C ±5°C only.
3. Full power source operation regardless of load to 30°C ambient. Above 30°C and/or power sink operation, refer to "Operating Boundaries" in the Series 2600B Reference Manual for additional power derating information.
4. For sink mode operation (quadrants II and IV), add 0.06% of limit range to the corresponding current limit accuracy specifications. Specifications apply with sink mode operation enabled.
5. Full power source operation regardless of load to 30°C ambient. Above 30°C and/or power sink operation, refer to "Operating Boundaries" in the Series 2600B Reference Manual for additional power derating information.
6. 10% range accessible only in pulse mode.
7. High Capacitance Mode accuracy is applicable at 25°C ±5°C only.
8. Full power source operation regardless of load to 30°C ambient. Above 30°C and/or power sink operation, refer to "Operating Boundaries" in the Series 2600B Reference Manual for additional power derating information.
9. 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.
10. Add 50µV to source accuracy specifications per volt of HI lead drop.
11. Times measured from the start of pulse to the start off-time; see figure below.
12. Thermally limited in sink mode (quadrants II and IV) and ambient temperatures above 30°C, see power equations in the Reference Manual for more information.
13. Voltage source operation with 1.5 A current limit.
14. 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>20 V</td>
<td>200 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 ms</td>
</tr>
<tr>
<td>200 V (1.5 A Limit)</td>
<td>200 Ω</td>
<td>0.2%</td>
<td>1.5 ms</td>
</tr>
<tr>
<td>100 mA</td>
<td>100 Ω</td>
<td>1%</td>
<td>200 µs</td>
</tr>
<tr>
<td>1 A</td>
<td>100 Ω</td>
<td>0.2%</td>
<td>5 ms</td>
</tr>
<tr>
<td>10 A</td>
<td>10 Ω</td>
<td>0.5%</td>
<td>300 µs</td>
</tr>
</tbody>
</table>

15. Times measured from the start of pulse to the start off-time; see figure below.

**METER SPECIFICATIONS**

**VOLTAGE MEASUREMENT ACCURACY**

<table>
<thead>
<tr>
<th>Range</th>
<th>Default Display Resolution</th>
<th>Input Resistance</th>
<th>Accuracy (1 Year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>200 mV</td>
<td>100 mV</td>
<td>&gt;10^9 Ω</td>
<td>0.015% + 225 µV</td>
</tr>
<tr>
<td>2 V</td>
<td>1 µV</td>
<td>&gt;10^10 Ω</td>
<td>0.02% + 350 µV</td>
</tr>
<tr>
<td>20 V</td>
<td>10 µV</td>
<td>&gt;10^10 Ω</td>
<td>0.015% + 5 mV</td>
</tr>
<tr>
<td>200 V</td>
<td>100 µV</td>
<td>&gt;10^10 Ω</td>
<td>0.015% + 50 mV</td>
</tr>
</tbody>
</table>

**TEMPERATURE COEFFICIENT (0°–18°C and 28°–50°C)**: ±0.15 × accuracy specification°C. Applicable for normal mode only. Not applicable for high capacitance mode.

**CURRENT MEASUREMENT ACCURACY**

<table>
<thead>
<tr>
<th>Range</th>
<th>Default Display Resolution</th>
<th>Voltage Burden</th>
<th>Accuracy (1 Year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>*+100 pA</td>
<td>0.1 A</td>
<td>&lt;1 mV</td>
<td>0.15% + 120 nA</td>
</tr>
<tr>
<td>1 nA</td>
<td>1 A</td>
<td>&lt;1 mV</td>
<td>0.15% + 240 nA</td>
</tr>
<tr>
<td>10 µA</td>
<td>10 µA</td>
<td>&lt;1 mV</td>
<td>0.15% + 3 nA</td>
</tr>
<tr>
<td>1 µA</td>
<td>100 µA</td>
<td>&lt;1 mV</td>
<td>0.06% + 40 nA</td>
</tr>
<tr>
<td>10 µA</td>
<td>100 µA</td>
<td>&lt;1 mV</td>
<td>0.2% + 25 nA</td>
</tr>
<tr>
<td>100 µA</td>
<td>1000 µA</td>
<td>&lt;1 mV</td>
<td>0.2% + 25 µA</td>
</tr>
<tr>
<td>1 A</td>
<td>100 A</td>
<td>&lt;1 mV</td>
<td>0.02% + 20 µA</td>
</tr>
<tr>
<td>1.5 A</td>
<td>1.5 A</td>
<td>&lt;1 mV</td>
<td>0.03% + 1.5 µA</td>
</tr>
<tr>
<td>10 A</td>
<td>10 A</td>
<td>&lt;1 mV</td>
<td>0.4% + 25 mA</td>
</tr>
</tbody>
</table>

* 100 pA range not available on Model 2634B.

**CURRENT MEASURE SETTLING TIME** (Time for measurement to settle after a Vstep)²: Time required to reach within 0.1% of final value after source level command is processed on a fixed range. Values for Vstep = 2V unless noted. Current Range: 1mA. Settling Time: <100µs (typical).

**CONTACT CHECK**² (Not available on Model 2634B)

<table>
<thead>
<tr>
<th>Speed</th>
<th>Maximum Measurement Time to Memory For 60Hz (50Hz)</th>
<th>Accuracy (1 Year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FAST</td>
<td>1 (1.2) ms</td>
<td>5% + ohms</td>
</tr>
<tr>
<td>MEDIUM</td>
<td>4 (5) ms</td>
<td>5% + ohms</td>
</tr>
<tr>
<td>SLOW</td>
<td>56 (42) ms</td>
<td>5% + 0.5 Ω</td>
</tr>
</tbody>
</table>

**ADDITIONAL METER SPECIFICATIONS**

- **MAXIMUM LOAD IMPEDANCE**: Normal Mode: 10Ω (typical). High Capacitance Mode: 50µF (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.
METER SPECIFICATIONS (continued)

NOTES
16. Add 90µV to source accuracy specifications per volt of HI lead drop.
17. DC-acc accuracy specifications for NPLC setting <1 by increasing error term. Add appropriate % of range term using table below.

<table>
<thead>
<tr>
<th>NPLC Setting</th>
<th>200mV Range</th>
<th>2V–200V Range</th>
<th>100mA Range</th>
<th>1µA–100mA Range</th>
<th>1A–1.5A Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>0.01</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>0.001</td>
<td>0.8%</td>
<td>0.6%</td>
<td>1%</td>
<td>0.5%</td>
<td>1.1%</td>
</tr>
</tbody>
</table>

18. Applies when in single channel display mode.
19. High Capacitance Mode accuracy is applicable at 25°C ±5°C only.
20. Applies when in single channel display mode.
21. Four-wire remote sense only and with current meter mode selected. Voltage measure set to 200mV or 2V range only.
22. 10-NPLC, 11-Point Median Filter, <200V range, measurements made within 1 hour after zeroing. 23°C ± 1°C
23. Under default specification conditions: ±(0.15% + 750fA).
24. Under default specification conditions: ±(0.15% + 1µA).
25. 10A range accessible only in pulse mode.
26. Delay factor set to 1. Compliance equal to 100mA.
27. High Capacitance Mode accuracy is applicable at 25°C ±5°C only.
28. Includes measurement of SENSE HI to HI and SENSE LO to LO contact resistances.
29. 100nA range and below are not available in high capacitance mode.
30. 1µA and 10µA Current Ranges:

VOLTAGE SOURCE OUTPUT SETTLING TIME: Time required to reach within 0.1% of final value after source level command is processed on a fixed range. Current limit = 1A.

CURRENT MEASURE SETTLING TIME: Time required to reach within 0.1% of final value after voltage source is stabilized on a fixed range. Values below for $V_{max} = 2V$ unless noted.

CURRENT MEASURE Range | Settling Time
1.5 A – 1 A | <120 µs (typical) ($R_{load} > 6Ω$)
100 mA – 10 mA | <300 µs (typical)
1 mA | <3 ms (typical)
100 µA | <3 ms (typical)
10 µA | <250 ms (typical)
1 µA | <200 ms (typical)

CAPACITOR LEAKAGE PERFORMANCE USING HIGH-C SCRIPTS 32:

Test: 5V step and measure. 200ms (typical) @ 50mA.

CONNECTOR SPECIFICATIONS:

Connector: 25-pin female D.
Input/Output Pins: 14 open drain I/O bits.
Absolute Maximum Input Voltage: 5.25V.
Absolute Maximum Input Current: 25mA.
Maximum Logic Low Input Voltage: 0.7V, +850µA max.
Minimum Logic High Input Voltage: 2.4V, +570µA.
Maximum Source Current (flowing into Digital I/O bit): +960µA.
Maximum Sink Current (flowing into Digital I/O bit): –50mA.
Maximum Absolute Sink Current (flowing into Digital I/O pin): –11mA.

Digital I/O Interface: (Not available on Model 2614B)

USB CONTROL (REAR):
USB 2.0 device, TMC488 protocol.
USB CONTROL (REAR): USB 2.0 device, TMC488 protocol.
RS-232: Baud rates from 300bps to 115200bps. Programmable number of data bits, parity type, and flow control (RTS/CTS hardware or none).
ETHERNET: RJ-45 connector, LXI Class C, 10-100BT, no auto MDIX.
EXPANSION INTERFACE: The TSP-Link expansion interface allows TSP-enabled instruments to trigger and communicate with each other. (Not available on Model 2614B.)

Cable Type: Category 5e or higher LAN crossover cable.
Length: 3 meters maximum between each TSP enabled instrument.
LXI COMPLIANCE: LXI Class C. I. 4

DIGITAL I/O INTERFACE: (Not available on Model 2614B)

USB FILE SYSTEM (FRONT): USB 2.0 Host: Mass storage class device.
POWER SUPPLY: 100V to 250VAC, 50–60Hz (auto sensing), 240VA max.
COOLING: Forced air. Side intake and rear exhaust. One side must be unobstructed when rack mounted.
DIMENSIONS: 89mm high x 213mm wide x 460mm deep (3% in × 8% in × 17½ in). Bench Configuration (with handle and feet): 104mm high × 258mm wide × 460mm deep (4½ in × 9% in × 17½ in).
WEIGHT: 2635B: 4.75kg (10.4 lbs). 2634B, 2636B: 5.5kg (12 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°–50°C.
Storage: −25°C to 65°C.

Series 2600B Specifications

2634B, 2635B, 2636B

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A Greater Measure of Confidence
### Series 2600B

**System SourceMeter® SMU Instruments**

Applicable to Models 2601B, 2602B, 2604B, 2611B, 2612B, 2614B, 2634B, 2635B, and 2636B.

### MEASUREMENT SPEED SPECIFICATIONS 1, 2, 3

#### 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 Using User Scripts</th>
<th>Measure To GPIB Using User Scripts</th>
<th>Source Measure To Memory Using User Scripts</th>
<th>Source Measure To GPIB Using User Scripts</th>
<th>Source Measure To Memory Using Sweep API</th>
<th>Source Measure To GPIB Using Sweep API</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.001 NPLC</td>
<td>Internal</td>
<td>20000 (20000)</td>
<td>10500 (10500)</td>
<td>7000 (7000)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.001 NPLC</td>
<td>Digital I/O</td>
<td>8100 (8100)</td>
<td>7100 (7100)</td>
<td>5500 (5500)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.01 NPLC</td>
<td>Internal</td>
<td>5000 (4000)</td>
<td>4000 (3500)</td>
<td>3400 (3000)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.01 NPLC</td>
<td>Digital I/O</td>
<td>5600 (5200)</td>
<td>5400 (5000)</td>
<td>3600 (3000)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.1 NPLC</td>
<td>Internal</td>
<td>580 (490)</td>
<td>560 (475)</td>
<td>550 (465)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.1 NPLC</td>
<td>Digital I/O</td>
<td>560 (470)</td>
<td>540 (460)</td>
<td>510 (450)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.0 NPLC</td>
<td>Internal</td>
<td>59 (49)</td>
<td>59 (49)</td>
<td>59 (49)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.0 NPLC</td>
<td>Digital I/O</td>
<td>58 (48)</td>
<td>58 (49)</td>
<td>59 (49)</td>
<td></td>
<td></td>
<td></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 GPIB</th>
<th>Source Measure To GPIB</th>
<th>Source Measure Pass/Fail To GPIB</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.001 NPLC</td>
<td>Internal</td>
<td>1900 (1800)</td>
<td>1400 (1400)</td>
<td>1400 (1400)</td>
</tr>
<tr>
<td>0.01 NPLC</td>
<td>Internal</td>
<td>1400 (1400)</td>
<td>1200 (1100)</td>
<td>1100 (1100)</td>
</tr>
<tr>
<td>0.1 NPLC</td>
<td>Internal</td>
<td>450 (390)</td>
<td>425 (370)</td>
<td>425 (375)</td>
</tr>
<tr>
<td>1.0 NPLC</td>
<td>Internal</td>
<td>58 (48)</td>
<td>57 (48)</td>
<td>57 (48)</td>
</tr>
</tbody>
</table>

**NOTES**


2. Exclude current measurement ranges less than 1mA.

3. 2635B/2636B with default measurement delays and filters disabled.

---

**TRIGGERING AND SYNCHRONIZATION SPECIFICATIONS 1**

- **TRIGGERING:**
  - Trigger in to trigger out: 0.5µs, typical.
  - Trigger in to source change: ≤ 10 µs, typical.
  - Trigger Timer accuracy: ± 2µs, typical.
  - Source change < 450µs, typical.

- **SYNCHRONIZATION:**
  - Single-node synchronized source change: ≤ 0.5µs, typical.
  - Multi-node synchronized source change: ≤ 0.5µs, typical.

**NOTES**

1. TSP-Link not available on Models 2604B, 2614B, and 2634B.

2. Fixed source range, with no polarity change.
Series 2600B

System SourceMeter® SMU Instruments

Applicable to Models 2601B, 2602B, 2604B, 2611B, 2612B, 2614B, 2634B, 2635B, and 2636B.

SUPPLEMENTAL INFORMATION

FRONT PANEL INTERFACE: Two-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 dedicated 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 dedicated 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: 16MB (approximately 250,000 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
Software Interface: TSP Express (embedded), Direct GPIB/VISA, READ/WRITE for VB, VC/C++, LabVIEW, LabWindows/CVI, etc.
READING BUFFERS: Dedicated 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.
Accuracy: ±100ppm.

ACCESSORIES AVAILABLE

CABLES AND CONNECTORS
2600-BAN Banana Test Leads/Adapter Cable. For a single 2601B/2602B/2604B/2611B/2612B/2614B SMU instrument channel
2600-KIT Extra screw terminal connector, strain relief, and cover for a single SourceMeter channel (one supplied with 2601B/2601B, two with 2602B/2604B/2612B/2614B)
2600-FLX TRIAX Phoenix-to-Triax Adapter for 2 wire sensing
2600-FLX TRIAX Phoenix-to-Triax Adapter for 4 wire sensing
7078-TRX-GL 3-Slot, Low Noise Triax Cable, 0.5m–6.1m. For use with 2600-TRIAX Adapter
7078-TRX-GND 3-Slot male triax to BNC adapter (guard removed)
7709-30BA Digital I/O Connector (model specific)
8606 High Performance Modular Probe Kit. For use with 2600B-BAN
GPIB INTERFACES AND CABLES
7007-1 Double Shielded GPIB Cable, 1m (3.3 ft)
7007-2 Double Shielded GPIB Cable, 2m (6.6 ft)
KPCI-488LPA IEEE-488 Interface/Controller for the PCI Bus

DIGITAL I/O, TRIGGER LINK, AND TSP-LINK
2600-1LNK Digital I/O to TSP-Link Adapter, 1m
CA-126-1A Digital I/O and Trigger Cable, 1m
CA-180-3A CAT5 Crossover Cable for TSP-Link and direct Ethernet connection (two supplied)
RACK MOUNT KITS
4299-1 Single Rack Mount Kit with front and rear support
4299-2 Dual Rack Mount Kit with front and rear support
4299-5 IU Vent Panel
TEST FIXTURES
8101-4IV DC, Pulse IV and C Component Test Fixture
8101-4TRX 4 Pin Transistor Fixture
LB8028 Component Test Fixture – Optimized for device testing at up to 200V/1A
SOFTWARE
ACS-BASIC Component Characterization Software
SWITCHING
Series 3700A DMM Switch Systems
707B Semiconductor Switching Matrix Mainframe

SERVICES AVAILABLE FOR ALL SERIES 2600B MODELS

EXTENDED WARRANTIES
26xxB-1Y-WS 1 Year Factory Warranty extended to 2 years
26xxB-3Y-WS 1 Year Factory Warranty extended to 3 years
26xxB-5Y-WS 1 Year Factory Warranty extended to 5 years

CALIBRATION CONTRACTS
C/26xxB-5Y-STD 3 Calibrations within 3 years
C/26xxB-5Y-STD 5 Calibrations within 5 years
C/26xxB-3Y-DATA 3 Calibrations within 3 years and includes calibration data before and after adjustment
C/26xxB-5Y-DATA 5 Calibrations within 5 years and includes calibration data before and after adjustment
C/26xxB-3Y-CALIB 3 ISO-17025 accredited calibrations within 3 years
C/26xxB-5Y-CALIB 5 ISO-17025 accredited calibrations within 5 years

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