Application Overview: Simplified I/V Characterization of LEDs

What is a SMU?

Source measure units (SMUs) are an all-in-one solution for current voltage (I/V) characterization with the combined functionality of a precision power supply, high precision DMM, and electronic load. Keithley pioneered the development of individual, compact, bench-top SMU instruments and is the leading supplier of these instruments today.

Testing a LED

Visible light emitting diodes (LEDs) have a gained a reputation for high efficiency and long lifetimes, which has led to their use in a growing list of applications such as automotive displays and exterior lights, backlighting for televisions and video monitors, street lights, outdoor signs, and interior lighting. Therefore, their accurate and cost-effective testing is critical. Keithley is the industry leader in developing and supporting solutions for electrical testing of LEDs. The figures below illustrate SMUs in different configurations in use for I/V characterization of an LED.

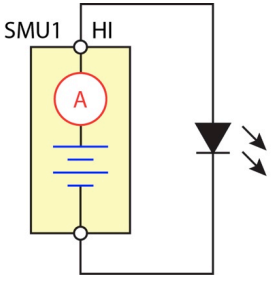

***Figure 1a**: Circuit diagram showing a SMU (Source V, Measure I configuration) in use for I/V characterization of an LED.*

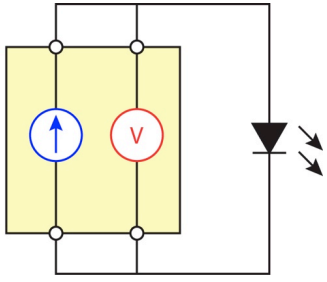

***Figure 1b:** Circuit diagram showing a SMU (Source I, Measure V configuration) in use for I/V **characterization** of an LED.*

Common Measurements Made in I/V Characterization of LEDs

- Forward Voltage Test (V_f) - The forward voltage test is performed by sourcing a known current and measuring the resulting voltage drop across the diode. The results of this test are typically used by manufacturers for binning purposes as the forward voltage is directly related to the chromaticity of the LED.
- Reverse Breakdown Voltage (V_R) - Applying a negative bias current to the LED will allow the measurement of reverse breakdown voltage. This test is performed by sourcing a low-level reverse bias current for a specified time, then measuring the voltage drop across the LED.
- Leakage Current (I_L) - The leakage current test measures the low-level current that leaks across the LED when a reverse voltage less than the breakdown is applied. It is a common practice for leakage measurements and isolation measurements to make sure a certain threshold is not exceeded in production.

These measurements can be seen in the I/V curve of a typical LED shown below in ***Figure 2.***

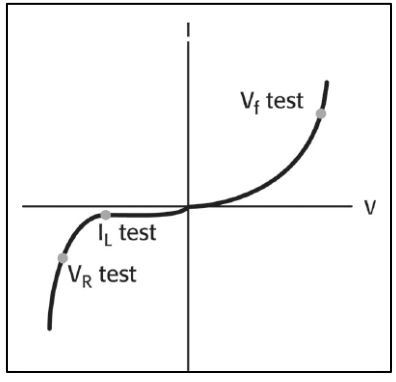

***Figure 2:** I/V curve of a typical LED.*

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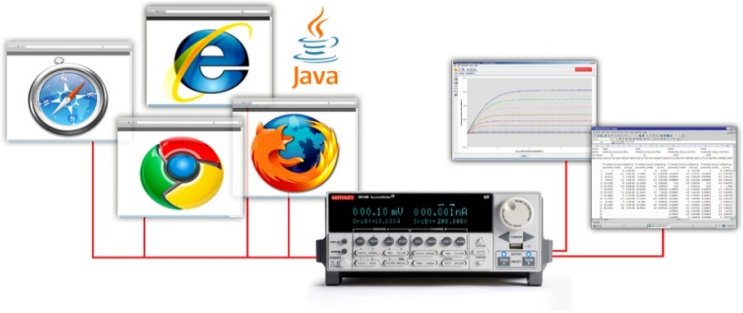
What are Series 2600B SourceMeter® SMU Instruments?

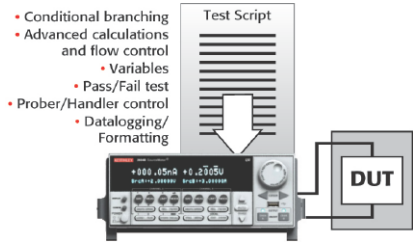
The Series 2600B are the industry's leading current/voltage source and measure solutions, and are built from Keithley's 3rd generation SMU technology. The Series 2600B offers single- and dual-channel models that significantly boost productivity in applications ranging from bench-top I/V characterization through highly-automated production test.

Browser-based Testing



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. Simply connect the Series 2600B instrument to the Internet via the supplied LAN cable, open a browser, type in the Series 2600B instrument's I.P. address, and begin testing. Resulting data can then be exported to a spreadsheet, such as Excel, for further analysis and formatting, or for inclusion in other documents & presentations.

Automated Testing without Control of a PC



For test applications that demand the highest levels of automation and throughput, the Series 2600B'stest script processor (TSP®) technology delivers industry-best performance by fully embedding and then executing 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.

Key Specifications of the Series 2600B SourceMeter SMU Instruments

Features	2601B / 2611B Single Channel	2602B / 2612B Dual Channel	2604B / 2614B Dual Channel Bench-Top	2634B /2635B / 2636B Low Current Single Channel (2635B) Dual Channel (2634B, 2636B)
# of Channels	1 (optional expansion to 32 via TSP-Link)	2 (optional expansion to 64 via TSP-Link.)	2	1 – 2 (optional expansion to 32 or 64 via TSP-Link. Not available for 2634B)
Current Max / Min	10A pulse /100fA	10A pulse /100fA	10A pulse / 100 fA	10A pulse / 0.1fA for 2635B 10A pulse / 0.1fA for 2636B 10A pulse/ 1fA for 2634B
Voltage Max / Min	40V/100nV for 2601B 200V/100nV for 2611B	40V /100nV for 2602B 200V /100nV for 2612B	40V/100nV for 2604B 200V/100nV for 2614B	200V / 100nV
Power	30 – 40W	30 – 40W per channel	30 – 40W per channel	30W per channel
Max readings / sec	20,000	20,000	20,000	20,000
Computer Interface	GPIB, LAN (LXI), USB 2.0, RS-232	GPIB, LAN (LXI), USB 2.0, RS-232	GPIB, LAN (LXI), USB 2.0, RS-232	GPIB, LAN (LXI), USB 2.0, RS-232
Connectors / Cabling	Screw terminal; adaptors available for banana or triax	Screw terminal; adaptors available for banana or triax	Screw terminal; adaptors available for banana or triax	Triax
System-level automation	Digital I/O, TSP-Link, Contact Check	Digital I/O, TSP-Link, Contact Check	Not available	Digital I/O, TSP-Link, Contact Check (not available on 2634B)
Test times for a typical diode test	19 ms vs. 65ms taken by closest competitive SMU= **Over 200% faster test times using a Series 2600B**			

For additional information, please refer to Keithley's website at **www.keithley.com** for:

- Detailed Series 2600B specifications
- Application notes
- White papers

For other information, please contact your local applications engineer.

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