Application Overview: Simplified I/V Characterization of Transistors

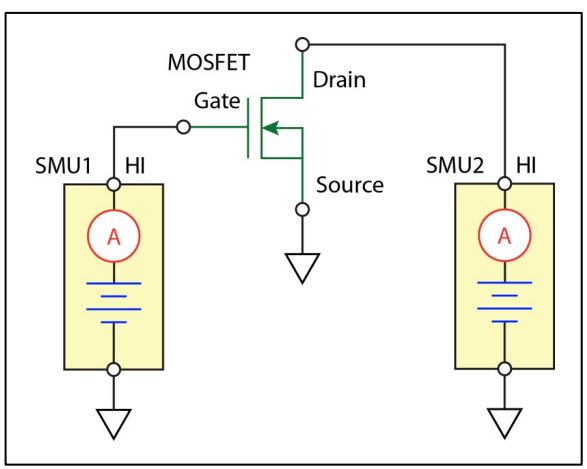
What is a SMU?

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 Transistor

Semiconductor devices (e.g., transistors) are the foundation of electronic products. Most devices need to be electrically characterized in various settings of the research and development process: research labs, fabs, universities, device manufacturers, etc. Keithley is the industry leader in I/V characterization of transistors. Using Keithley SourceMeter® SMU instruments for semiconductor characterization is ideal because of their ability to both source and measure, especially low currents. Testing devices that have more than two terminals usually requires more than one SMU. However, a two-channel SMU can perform most characterizations on a single field effect transistor (FET). **Figure 1** below shows two SMUs in use for I/V characterization of a MOSFET.

Figure 1: *Circuit diagram showing a two-channel SMU in use for I/V characterization of a MOSFET.*



Common Measurements Made in I/V Characterization of Transistors

- Drain Voltage (V_D) - The voltage appearing at the drain terminal of a field-effect transistor is called the drain voltage.
- Drain Current (I_D) - The current taken from the voltage source by the drain terminal is called the drain current. Drain current can yield a lot of insight on the device's operation and efficiency.
- Other common measurements include:

  Gate Voltage (V_G) • Gate Current (I_G) • Threshold Voltage (V_{TH})

Figure 2 shows a MOSFET drain family of curves generated by using a dual-channel Keithley SourceMeter SMU instrument.

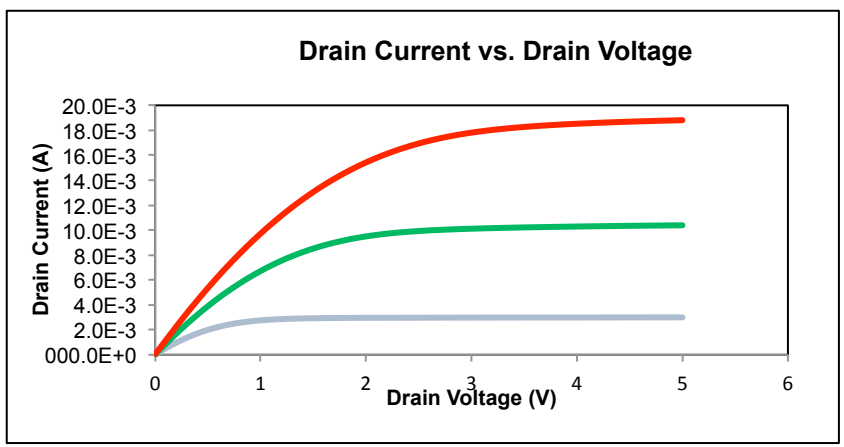


Figure 2: *I/V curve of a MOSFET.*

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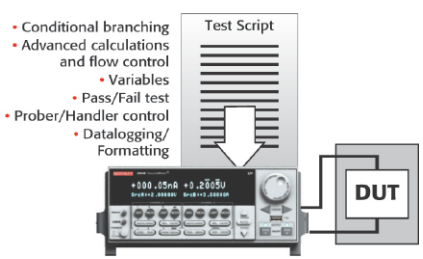
What are Series 2600B SourceMeter SMU Instruments?

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's test 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)

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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