APPLICATION NOTE

Using a Source Measure Unit as a Device Power Supply for Semiconductor Testing

Key Words: SMU, Source Measure Unit, DPS, Device Power Supply, Semiconductor Testing, Accuracy, Settling Time, Measurement Speed, Four-Quadrant Operation

Product Family: Model 52400 series SMU (Source Measure Unit)

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SCOPE

This document is going to explain why Source Measure Unit (SMU) is an ideal Device Power Supply (DPS) for semiconductors testing.

SMUs are optimized for both speed and precision, repeatability, and they offer faster rise time and much lower measurement uncertainty than typical power supplies. Due to the combination of source and measurement into a single unit, many advantages are found during semiconductor testing. The high level of integration and remarkable flexibility make the SMUs ideal and economical for semiconductor testing.

DEVICE POWER SUPPLY

Semiconductor testing requires supplying a voltage or current to Device under Test (DUT) and making a voltage or current measurement, it's so called Device Power Supply.

Figure-1 Semiconductor Testing

Several things need to be considered when using a Device power supply for the semiconductor testing. The first is the resolution and accuracy of the power supply. Another factor that should be taken into account is settling time. (The settling time is the length of time for a power supply's output to settle to its final value.) This is an important issue while performing semiconductor testing.

SOURCE MEASURE UNIT

An SMU integrates the capabilities of a precision power supply (PPS) with those of a high-performance digital multimeter (DMM) in a single instrument (Refer to Figure-2). SMUs can simultaneously source or sink voltage while measuring current, or source or sink current while measuring voltage.

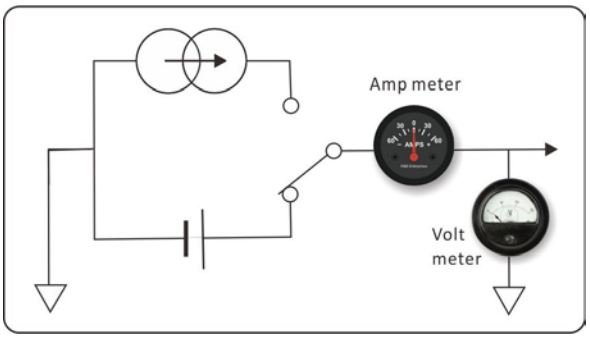

Figure-2 Basic SMU Schematic

The real benefit of an SMU in semiconductor testing is its ability to source and measure signals simultaneously, rather than using separate instruments to handle each function. The simultaneous operation of SMU also provides faster test time and simplified connections.

An SMU performs a wide variety of DC and low-frequency AC measurements without changing connections or using additional equipment.

PRECISION & MEASUREMENT SPEED

SMUs are optimized for both speed and precision, and they offer faster rise time and much lower measurement uncertainty than typical power supplies. The source voltage and source current take settling time about a few uS (micro seconds, Refer to Figure-3) with accuracy of uV (micro volts) or uA (micro amps) or even better. This is much faster and more accurate than a typical DC power supply.

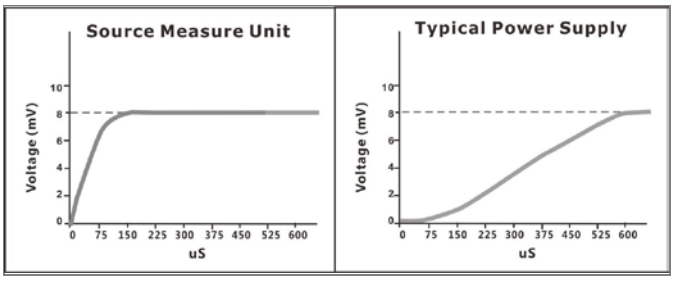

Figure-3 Measurement Speed (Settling Time)

CONTROLLABLE BANDWIDTH

To increase test speeds, shorter settling time and faster rise/fall time (or slew rate) are required. This can be achieved by increasing the control bandwidth of a DPS design. However, with different cable impedance or DUT characterization, high control bandwidth will sometimes cause oscillation. Therefore, to optimize-test speed and stability, adjustable bandwidths are required when the SMU acts as a DPS. Figure-4 shows the condition of a voltage waveform under different control bandwidths.

TEST SEQUENCER

The sourcing conditions of DPS may vary depending on the test functions. Also, the measurements should be taken simultaneously in the desired test mode. With the high speed nature of Semiconductor testing, latency caused by PC communication is not acceptable! Therefore, a Test Sequence is required to predefine the measurement sequences when the SMU acts as a DPS.

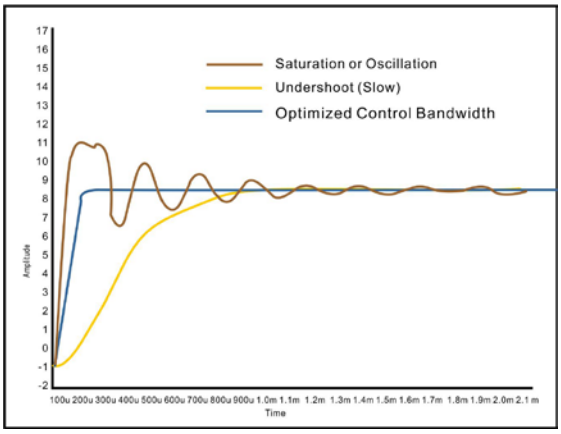

Figure-4 SMU Output Waveform under Different Control conditions

PROTECTING the DUT

A Semiconductor is a very sensitive device. Undesired voltage or current overshoot may damage a valuable DUT. Conventional slow voltage and current clamp protection using software feedback cannot provide a real protection for high speed semiconductor devices. So, a SMU with a fast responding clamp circuit ~~is~~ would be a critically important measurement tool.

BATTERY SIMULATION

Semiconductor devices would sometimes be powered by a battery. For those devices that would draw bursts of current, the internal impedance of the battery may generate a voltage dip that causes the device to work abnormally. This phenomenon is hard to simulate by conventional SMUs or DPSs. To meet modern semiconductor test requirements, a qualified SMU which intended to be used as DPS will provide the needed battery internal impedance simulator function.

Chroma 52400 Series SMUs

Chroma 52400 SMU series features high precision, settling time in microseconds with accuracy of nano-Volts and nano-Amps, 16 Control Bandwidth Selection to avoid oscillation and for shorter settling time, hardware sequencer for precise output profile control, fast respond clamp circuit to protect DUT, and unique programmable resistance to simulate battery. These features make Chroma 52400 SMU an ideal measurement tool for semiconductor testing.

In addition, the 52400 series SMU complements excellent accuracy and repeatability with fast measurement speed. It can operate as a four quadrant voltage/current source, an electrical load, a voltage/current meter, a pulse generator and an arbitrary waveform generator.

Model 52400 series SMU

For more detailed information about Chroma 52400 series SMU & other Chroma solutions, please visit Chroma's website at: www.chromaus.com.

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