

SMU1023 Source-Measure-Unit

The mb-Technologies Source-Measure-Unit SMU1023 is designed for testing integrated semiconductor devices at high speed and high accuracy. This instrument combines a bipolar voltage source for voltages from 1 mV to ± 200 V (4 ranges), a bipolar current source for currents from 1 pA to ± 400 mA (10 ranges), a voltage meter, an ampere meter and a capacitance meter. When used as voltage source, a current compliance can be defined, likewise, when used as a current source, a voltage compliance can be used.

The Source-Measure-Unit is usually part of a larger test system with multiple units and other instruments like multiplexers. Up to 250 units can be connected to the controlling personal computer using a high-speed bus system. A dedicated calibration bus is used for calibrating the instruments with reference equipment or checking each other.

In order to achieve accurate measurements the Source-Measure-Unit has separate Force and Sense connections (Kelvin guarding) which eliminate any voltage drop across cables and connectors when measuring higher currents. The cables and connectors are actively guarded and shielded (tri-axial connections) to avoid leakage and noise when measuring lower currents. This also speeds up measurements as the cable capacitance is virtually eliminated by the active guard. Each unit has a ground sense input which needs to be connected to a central ground hub together with the other instruments involved.

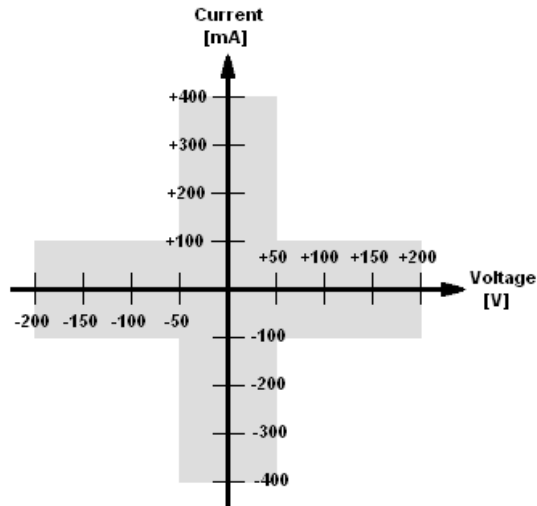
Each Source-Measure-Unit has a microcontroller build into. In addition to basic measurement operations like averaging and auto-ranging it allows approx. 40000 test operations and 10000 results to be executed and stored independently of the main computer.

Features:

- Full power four quadrant operation
- Separate Force/Sense connections
- All signal paths guarded and shielded
- Common ground sense connection
- Large internal program and data memory
- Internal voltage and current auto-range
- Internal averaging and filtering
- Local trigger bus to communicate with other instruments
- Noise and oscillation suppression
- Calibration bus, calibration data stored on-board
- High speed communication via optically isolated RS485 interface
- Safety interlock

Power:

Output Voltage	Output Current	Maximum Output Power
≤ 50 V	± 400 mA	20 W
> 50 V	± 100 mA	20 W



Voltage Ranges

Voltage Range	Force Resolution	Measure Resolution	Accuracy
200 V	10 mV	1 mV	0.05% (value) + 0.05% (range)
20 V	1 mV	100 μ V	0.05% (value) + 0.05% (range)
2 V	100 μ V	10 μ V	0.05% (value) + 0.05% (range)
200 mV	10 μ V	1 μ V	0.20% (value) + 0.20% (range)

Current Ranges

Current Range	Force Resolution	Measure Resolution	Accuracy
1 A	50 μ A	5 μ A	0.10% (value) + 0.10% (range)
100 mA	5 μ A	500 nA	0.05% (value) + 0.05% (range)
10 mA	500 nA	50 nA	0.05% (value) + 0.05% (range)
1 mA	50 nA	5 nA	0.05% (value) + 0.05% (range)
100 μ A	5 nA	500 pA	0.05% (value) + 0.05% (range)
10 μ A	500 pA	50 pA	0.05% (value) + 0.05% (range)
1 μ A	50 pA	5 pA	0.05% (value) + 0.05% (range)
100 nA	5 pA	500 fA	0.10% (value) + 0.10% (range)
10 nA	500 fA	50 fA	0.20% (value) + 0.20% (range)
1 nA	50 fA	5 fA	0.50% (value) + 0.50% (range)

Specification Conditions:

- Accuracy is defined as percentage of set value or reading + offset
- 23°C ± 5°C, RH < 60%. Unspecified for operation at other temperatures or relative humidity.
- At least 30 minutes warm-up after power-on.
- Integration "long", accuracy specifications double for integration "normal", 5 times for "fast".
- Kelvin-connections and guarding plus shielding of cables.
- Calibration interval is 1 year.

Supplemental Information:

Compliance Accuracy

Compliance accuracy is 2x the source specification.

Settling and Measurement Time

Settling time is typical 1 ms for current ranges $\geq 1 \mu\text{A}$. This also includes voltage and current measurement.

Overshoot

Overshoot is typical within specification limits.

Noise

Voltage force noise is typical $< 0.01\%$ of range max. 2 mV. Current force noise is typical $< 0.1\%$ of range. Measurement noise is typical $<$ specification accuracy.

Noise and oscillation suppression

The unit supports adjustable slew rate and filtering to avoid noise and oscillation effects when measuring devices with high gain or other effects which otherwise may causes unstable measurements.

Remote Sensing

For remote sensing the maximum acceptable voltage drop over the cable resistor in series with the Force connection is 4 V, i.e. the parasitic resistance must by not higher than 10 Ohms for 400 mA output current.

Safety Interlock

Open safety interlock connections will limit the output voltage to $\pm 40 \text{ V}$ in any case.

Self Protection

The unit is protected against shorts to any voltage within $\pm 210 \text{ V}$ for infinite periods of time however connecting the outputs to any device delivering voltages outside these values will immediately destroy the unit and void warranty.

Power Requirements

230 VAC 50/60 Hz 30 W

Dimensions

71 mm x 128 mm x 235 mm (W x H x D)