

# SMU1012 Source-Measure-Unit

The mb-Technologies Source-Measure-Unit SMU1012 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  $\pm 300$  V (4 ranges), a bipolar current source for currents from 1 pA to  $\pm 150$  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 255 units can be connected to the controlling personal computer using a high-speed bus system.

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.

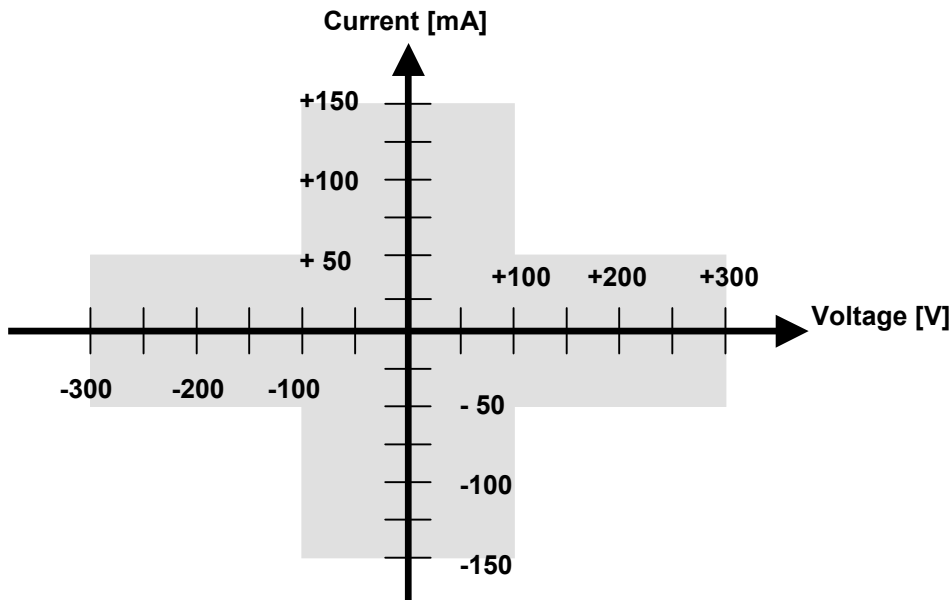
Each Source-Measure-Unit has a microcontroller build into. In addition to basic measurement operations like averaging and auto-ranging it allows approx. 20000 test operations to be executed at full speed and approx. 10000 results stored independently of the main computer.

## 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
- 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
$\leq 100$ V	$\pm 150$ mA	15 W
$> 100$ V	$\pm 50$ mA	15 W



## Voltage Ranges

Voltage Range	Force Resolution	Measure Resolution	Accuracy
300 V	15 mV	1.5 mV	0.02% (value) + 0.02% (range)
20 V	1 mV	100 $\mu$ V	0.02% (value) + 0.02% (range)
2 V	100 $\mu$ V	10 $\mu$ V	0.05% (value) + 0.05% (range)
200 mV	10 $\mu$ V	1 $\mu$ V	0.20% (value) + 0.20% (range)

## Current Ranges

Current Range	Force Resolution	Measure Resolution	Accuracy
1 A	50 $\mu$ A	5 $\mu$ A	0.10% (value) + 0.10% (range)
100 mA	5 $\mu$ 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 $\mu$ A	5 nA	500 pA	0.05% (value) + 0.05% (range)
10 $\mu$ A	500 pA	50 pA	0.05% (value) + 0.05% (range)
1 $\mu$ 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".
- Kevin-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 5 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. 5 mV. Current force noise is typical < 0.1% of range. Measurement noise is typical < specification accuracy.

**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 be 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  $\pm 310 \text{ V}$  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 10 W,  $\pm 320 \text{ VDC}$  150 mA,  $\pm 80 \text{ VDC}$  600 mA, + 5 VDC 500 mA

**Dimensions**

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