Primary Standards Laboratory
DC Electrical Project

Fact Sheet

The Primary Standards Laboratory (PSL) maintains a wide variety of primary DC standards to assure accurate and traceable measurements for its customers. Capabilities include voltage, current, resistance, and ratio devices.

The primary DC standards are directly traceable to the Systeme International through the National Institute of Standards and Technology (NIST), other National Metrology Institutes, fundamental physical constants, or to self-calibration/ratio techniques. The primary standards include laboratory and portable Josephson Array Voltage Standards, a set of Thomas 1-ohm resistors, high-voltage dividers, Hamon transfer standards, and various ratio devices (current comparators, potentiometers, ratio sets, and cryogenic current comparator). These standards support a variety of measurement systems, including a teraohmmeter, automated resistance calibration system, shunt calibration system, and intermediate- and high-voltage (HV) calibration systems.

HV Facility

Capabilities

Below is a representative sample of the project's best k=2 expanded uncertainties. The PSL is accredited under Lab Code 105002-0 by the NIST/National Voluntary Laboratory Accreditation Program (NVLAP). For full details, see **http://ts.nist.gov/standards/scopes/1050020.pdf**

Voltage

Capability	Uncertainty (k=2)
J-Volt (10V)	.017 µV/V
J-Volt (1.0 to 1.018V)	0.14 µV/V
0 V to 10V	(0.5 µV/V + 0.2µV)
10 V to 300V	1.4 µV/V
300 V to 1200 V	4.0 µV/V
1.0 kV to 100 kV	106 µV/V
100 kV to 200 kV	140 µV/V

Resistance

Capability	Uncertainty (k=2)
Thomas 1Ω Resistor	0.038 µΩ/Ω

Standard Resistors

Capability	Uncertainty (k=2)
0.0001Ω to 0.1Ω	5 to 0.21 µΩ/Ω
1.0Ω to 10kΩ	0.038 to 0.089 µΩ/Ω
100kΩ to 1GΩ	0.25 to 5 µΩ/Ω
10 GΩ to 1PΩ	470 to 6700 µΩ/Ω

Shunts

Capability	Uncertainty (k=2)
0.1 A to 2500 A	5.0 µΩ/Ω

Ratio Devices

1:1 to 1:100,000 $\pm 0.5\times10^{-7}$

Major Resources

- DC voltage measurements start with the Josephson Array Voltage Standard that can generate voltages between zero and 10 volts and calibrate Zener voltage standards with an accuracy of better than ± 0.02 µV/V at 10 volts.

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- Ratio devices are self-calibrating, but require stable auxiliary equipment for the calibration process. Standard resistors and various ratio sets, including double-ratio, direct-reading, and universal ratio sets are used to determine ratio.

- The Zener standards are used in the intermediate voltage system where voltages to 1200 volts are obtained using an automated intermediate voltage system. Precision high-voltage resistors calibrated by NIST are used in a special HV calibration facility with controlled temperature and humidity to extend the range to 200,000V.

High Resistance Lab

- The standard of resistance is maintained using a group of Thomas 1 Ω resistors that are calibrated periodically by NIST. The uncertainty assigned to these resistors by NIST is ± 0.020μΩ/Ω. Transfer of the ohm to higher and lower resistance values is obtained using resistance ratio devices. Typical uncertainties for resistors are listed above. See **http://ts.nist.gov/standards/scopes/1050020.pdf**

Primary Resistance Standards

- An automated teraohmmeter is used to extend the resistance measurements to 1PΩ (10^{15}Ω).

- A high-current facility is used to calibrate shunts to 2500A using an automated current comparator and a standard resistor. A new, pneumatically actuated, reversing switch improves and simplifies calibrations.

- Ratio devices are self-calibrating, but require stable auxiliary equipment for the calibration process. Standard resistors and various ratio sets, including double-ratio, direct-reading, and universal ratio sets, are used to determine ratio.

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