Excellence in Resistance

100-Series High Resistance Standards
Instruction Manual

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1. General

Ohm-Labs' 100-Series High Resistance Standards are designed as transportable or laboratory references for maintaining the ohm at levels between one megohm and ten teraohms. Based on recent advances in measurement and construction, each standard is individually manufactured from selected, custom manufactured resistance elements which have been processed for long term stability. Internal guarding and electrical isolation of terminals reduce errors caused by leakage currents. Hermetically sealed, these standards are highly immune from changes in barometric pressure and relative humidity. All models are supplied with a traceable report of calibration at two voltages. These standards are recommended for use at an ambient temperature near 23 °C. A thermistor in close proximity to the internal resistance element is provided for monitoring purposes. This thermistor is electrically isolated from both the case and the internal element.

The 100-Series High Resistance Standards are offered in decade values. Non-decade values are available by special order.

2. Specifications

Model Number	Nominal Resistance	Tolerance in ppm	Internal Guard	Temperature Coefficient	Voltage Coefficient	12 month Stability	Recom. Voltage	Max. Voltage
106	1 Meg	5	1 Meg	1 ppm / °C	0.1 ppm / V	<5 ppm	10	100
107	10 Meg	10	10 M	3	0.1	10	20	300
108	100 Meg	20	100 M	10	0.1	20	50	1000
109	1 Gig	35	1 G	15	0.1	25	100	1000
110	10 Gig	50	10 G	20	0.1	50	100	1000
100-Series Ultra-High Resistance Standards								
111	100 Gig	200	100 G	25	0.2	100	200	3000
112	1 Tera	500	1 T	50	1	200	500	3000
113	10 Tera	1000	10 T	300	10	500	500	3000

Option: Type N connector, specify –N in model number

Notes:
- Tolerance is accuracy at time of manufacture, stated within the absolute accuracy listed.
- Temperature coefficient is at 23 °C +/-5 °C.
- Voltage coefficient is at recommended voltage –50 % / +100 %.
- Internal thermistor = 10,000 ohms (nominal) at 25 °C

Physical:
- 106-110: 178 x 75 x 100 mm / 7" x 3" x 4"; 1.5 kG / 3 #
- 111-113: 228 x 125 x 125 mm / 9" x 5" x 5"; 2.5 kG / 5 #

Accessories and options available:
- Type N coaxial connectors, add –N to model number
- External guard terminal (omit internal guard resistor)
- BPO female to BNC adaptor (specify EL4302 for BNC male or EL4303 for BNC female)
- 1 m cables: BPO to BNC male (specify EL4305), thermistor (2 mm plug) to spade lug cable (EL4111), thermistor to 4 mm banana plug cable (EL4112)
- Protective caps for BPO connectors (EL4320)
- Transit container (for four standards)

3. Use

On receipt, inspect the standard for physical damage. If damaged, please immediately contact the carrier. We will assist with any damage claims and/or necessary repair.

Review the Report of Calibration accompanying the standard. The reported value is at 23 °C. Allow 24 hours for the standard to acclimatize at ambient temperature (23 °C nominal). To monitor the internal temperature of the standard, connect a thermistor thermometer to the 2 mm banana jack in the lid of the resistor. If using an ohmmeter, refer to a thermistor table showing temperature versus resistance for a 10 K (at 25 °C) thermistor.

These standards must be used in a guarded measurement system to realize their stated accuracy. An internal resistor connects the coaxial shields to provide a return path for the guard circuit current. This resistor is nominally equal to the value of the standard.

Connections are made with silver plated BPO (British Post Office) type coaxial connectors. Protective caps should be left in place when the standard is not in use. Optional type N connectors may also be ordered. Use shielded, low noise cables. The low (voltage) shield should be connected to ground (or to the low point corresponding to the junction of the standard). The high (voltage) shield should be driven at measurement voltage. For safety, a triaxial cable may be used, with the outer-most shield at ground potential.

Connect the resistor case ground binding post to an earth ground to reduce measurement noise. Connect the measurement low (voltage) to the left connector (closest to ground terminal); connect the measurement high (voltage) to the right terminal. Although either terminal may be high, to best match the factory calibration conditions, the left terminal (closest to ground terminal) should be low, and the right terminal high.

Due to coaxial cable capacitance and triboelectric currents in high resistance measurement systems, rapid voltage reversals may cause errors proportional with resistance; these errors increase with increasing resistance (decreasing measurement currents). Improved measurements, particularly above 10 G, will be obtained by allowing the standard to ‘soak’ at voltage for a period of time (120 seconds or more) before measuring.

After connecting the standard to the measuring system, apply positive voltage. Allow 2 to 5 minutes stabilization (discard these measurements); take a series of measurements and average this forward voltage reading. Apply negative voltage. Allow 2 to 5 minutes stabilization (discard these measurements); take a series of measurements and average this reverse reading. Finally, average the forward and reverse readings.

High resistance measurements are susceptible to interference from electrical signal noise; to reduce noise, measurement in a low traffic area, or at times of reduced activity, is recommended.

For best measurement accuracy, do not exceed the maximum voltage rating of the standard.

Caution: Application of voltage in excess of the rated maximum may damage or destroy these standards.

4. Temperature and Voltage Coefficients of Resistance

Each high resistance standard's report of calibration includes its measured value at 23 °C (nominal) at two voltages.

The difference between these two values, divided by the voltage difference between the two measurements, gives the standard's voltage coefficient (in microvolts / volt). Barring damage, the voltage coefficient of resistance will not change significantly over the life of the standard and does not need to be re-determined.

The alpha (α) temperature coefficient of resistance is the change in resistance with temperature at 23 °C; the beta (β) coefficient is the curvature of this change. Within a temperature range around ambient (18 ° - 30 °C), the resistance of a standard may be accurately expressed as:

$$R_t = R_{23}[1+\alpha(t-23)+\beta(t-23)^2]$$

Where:

R_t	=	Resistance at temperature 't'
R_{23}	=	Resistance at 23 °C
t	=	Temperature of resistor

5. Maintenance and Repair

No maintenance is required. The fluoropolymer mounts around the BPO plugs must be kept free from oil and other contaminants. These mounts may be occasionally cleaned with ethanol. To slow tarnishing of the silver plated BPO plugs, keep the protective caps in place when not in use. The plugs may be cleaned with a silver polishing cloth. Repairs must be performed by the manufacturer.

6. Calibration

Periodically recertify the resistance of the standard at its recommended temperature and voltage. The calibration cycle will depend on the user's needs. We recommend annual calibration. Please return the standard to the manufacturer (or to another qualified laboratory) for calibration.

7. Storage and Shipment

Never use expanding foam fill around resistance standards; the heat generated can permanently shift their resistance. Do not expose the standard to temperatures above 40 °C. Protect from shock and extreme vibration. Handle as you would any other precision instrument. Shipment during cooler months is recommended.

8. Warrantee

These standards are warranted for five years from the date of shipment. Please see our Terms & Conditions for additional information.

9. Application Notes

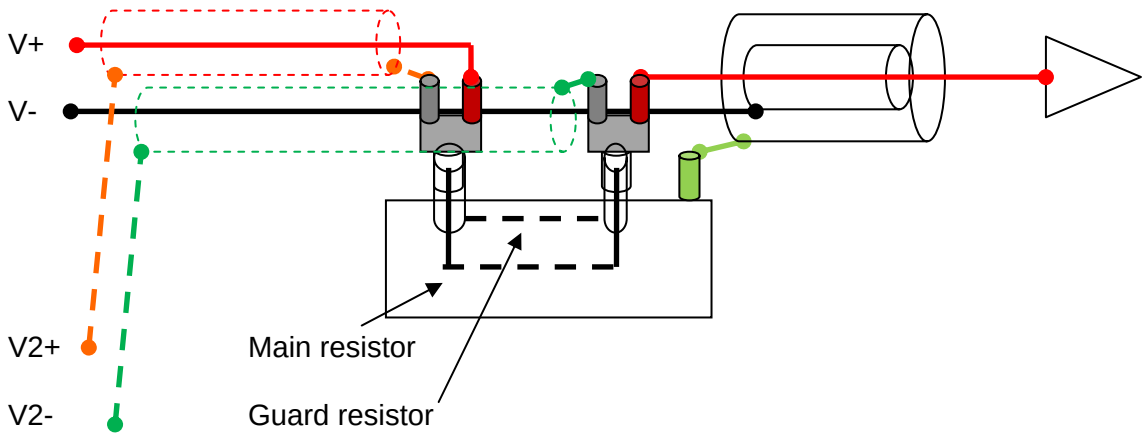
9.1. Electrometer Calibration

To use Ohm-Labs guarded high resistance standards for calibrating electrometers, apply a known voltage and calculate the current using Ohm's Law: I = E/R

Using coax to dual banana plug adaptors, connect voltage calibrator high output to center pin of one resistor terminal; connect center pin of second resistor terminal to electrometer input. Connect voltage calibrator low output to electrometer low (return). Connect electrometer ground to resistor ground.

To reduce noise, use short cable lengths.

Application of 1 volt through 1 GΩ will produce 1 μA; 2 V through 1 TΩ will be 2 pA, etc.



To reduce leakage, connect a second voltage source to the resistor guard high and low as shown in the dotted lines.