



200-Series Resistance Standards Instruction Manual



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1) General

Ohm-Labs' 200-Series Resistance Standards are designed as primary laboratory references for maintaining the ohm at levels from one ohm to ten megohms. Based on the most recent research in materials and processing, each standard is individually wound and carefully processed for low temperature coefficients of resistance and long term stability. 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, including temperature coefficient data. The 200-series standards are optimized for near zero temperature coefficients at 20, 23 or 25 °C, depending on customer application.

The 200-Series are offered in decade values, –T values for thermometry, and –Q values for use with a Quantum Hall System. Special values are available upon request.

Two types are manufactured. Up to 1000 ohms, connection is via binding posts; these should be used as 4-wire resistors. Above 1000 ohms, binding posts and a pair of coaxial BPO connectors are provided for use as 2-wire, 4-wire or guarded standards.

Models up to 1000 ohms can be supplied with a thermometer well. Above 1000 ohms, the standards include a 10 K thermistor for internal temperature monitoring.

2) Specifications

Model	Nominal	Tolerance	Current	Coefficients	Stability / year
200	1 Ohm	<2	100 mA	Temperature: $\alpha < 0.1 \text{ ppm} / ^\circ\text{C}$ $\beta < 0.01 \text{ ppm} / ^\circ\text{C}$ Voltage $< 0.1 \text{ ppm} / \text{V}$ Pressure $< 0.1 \text{ ppm} / \text{kPa}$	<0.1 ppm
201	10	<2	30		<0.2
201-T	25	<2	25		<0.2
202	100	<2	10		<0.2
203	1000	<3	3		<0.2
203-Q	6400	<5	1.25		<0.3
204	10 K	<2	1		<0.2
204-Q	12.9 K	<10	1		<0.3
205	100 K	<5	0.3		<0.3
206	1 Meg	<5	0.1		<0.5
207	10 Meg	<10	0.03		<1

Notes:

Tolerance is accuracy at time of manufacture

Temperature coefficient is at nominal 20, 23 or 25 +/-5 °C.

Physical:

127 mm dia. x 165 mm high (5" x 6.5"); 4.5 kg (10 #)

Environmental Limits (Storage):

0-40 °C, 0-95 %RH, protect from shock or excessive vibration

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 measured value is reported at either 20.0, 23.0 or 25.0 °C (+/- 0.02 °C), depending on the customer requirement.

Up to 1000 ohms, these standards must be used as four-terminal resistors to realize their stated accuracy. Make current and potential connections via the binding posts on the top of the standard. The lid is engraved to identify these terminals.

Binding post connections may be made with bare or silver plated solid copper wire, gold plated copper spade lugs or gold plated 4 mm banana plugs. Wire may be passed through the hole in the binding post or wrapped around the post. Do not over tighten the binding posts; a snug finger tight torque is adequate. The rotating barrels on the binding posts will reduce wire deformation.

Above 1000 ohms, they may be used as 4-terminal, 2-terminal, or guarded standards. In these models, the BPO center pins connect to the resistance standard. The BPO shields connect to an internal guard which is nominally equal to the value of the standard. The guard circuit is isolated from the resistor case.

If using a guarded measurement system, use BPO socket connectors. Ohm-Labs can provide BPO to BNC adapters or cables. Connect the measurement low guard to ground. Connect the measurement high guard to a voltage approximately equal to the measurement voltage.

Thermistor connections are made with 2 mm banana plugs.

Allow a minimum of 24 hours for the standard to acclimatize at its operating temperature.

For best measurement accuracy, do not exceed the current ratings of the standard. Although application of up to three times the rated current will not damage these standards, self-heating will change the resistance from the reported value.

Caution: Application of current in excess of three times the rated value may permanently shift the resistance of these standards.

The 200-series have not exhibited measurable barometric effects at the one ohm level. Due to their similar construction, other resistance values are expected to have similar immunity from barometric pressure changes.

Long term drift is estimated to be $<0.2 \mu\Omega/\Omega/\text{year}$. Settling during the first few years may occur.

4) Measured Value and Temperature Coefficients of Resistance

Each standard's Report of Calibration includes its measured value at 20, 23 or 25 °C and its alpha and beta temperature coefficients of resistance at this temperature. Barring damage, the temperature coefficients of resistance will not change over the life of the standard.

The alpha (α) coefficient is the change in resistance with temperature at its reference temperature; 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:

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

Where:

R_t	=	Resistance at temperature 't'
R_{ref}	=	Resistance at 20, 23 or 25 °C
t	=	Temperature of resistor
t_{ref}	=	20, 23 or 25 °C

Each resistor is supplied with a table of resistance from 18 to 30 °C. As a visual aid, this data is also presented in a graph.

5) Maintenance and Repair

No maintenance is required. Repairs must be performed by the manufacturer.

6) Calibration

Periodically recertify the resistance of the standard at its recommended temperature. The calibration cycle will depend on the user's needs. To develop drift history on the resistor, a useful cycle is every three months for the first year, every six months for the second and third years, and annually thereafter. As the resistor settles into its long term behavior, the calibration cycle may be extended to two, three or five years. Ohm-Labs can provide ISO17025 accredited re-calibration.

The calibration method is comparison against a reference standard using a resistance comparator bridge.

7) Storage and Shipment

Do not expose the standard to temperatures above 40 °C. Protect from shock and extreme vibration. Handle as you would any other precision instrument. Never use expanding foam to package the resistor, as the heat generated may permanently shift the value. Shipment during cooler months is recommended. The 200-series are designed to withstand commercial shipment by ground or air without degradation of performance or significant shift in resistance value.

8) Warrantee

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