Interchangeable Rox™

RX-102A features

- Standard curve interchangeable
- Good radiation resistance
- Useful down to 50 mK
- Low magnetic field-induced errors

RX-202A features

- Standard curve interchangeable
- Good radiation resistance
- Monotonic from 50 mK to 300 K
- 4× improvement in magnetic field-induced errors over other ruthenium oxides

RX-103A features

- Standard curve interchangeable
- Good radiation resistance
- Best choice for interchangeability from 1.4 K to 40 K
- Low magnetic field-induced errors

Ruthenium oxide temperature sensors are thick-film resistors used in applications involving magnetic fields. These composite sensors consist of bismuth ruthenate, ruthenium oxides, binders, and other compounds that allow them to obtain the necessary temperature and resistance characteristics. Each interchangeable Lake Shore Rox™ model adheres to a single resistance versus temperature curve.

RX-102A

The RX-102A (1000 Ω at room temperature) is useful down to 50 mK and has better interchangeability than the RX-202A as well as low magnetic field-induced errors below 1 K.

RX-202A

The RX-202A (2000 Ω at room temperature) has a 4× improvement in magnetic field-induced errors over other commercially available ruthenium oxide temperature sensors with similar resistances and sensitivities. Most ruthenium oxide sensors have a maximum useful temperature limit well below room temperature, where the sensitivity changes from negative to positive. The RX-202A however, is designed to have a monotonic response from 0.05 K up to 300 K.

RX-103A

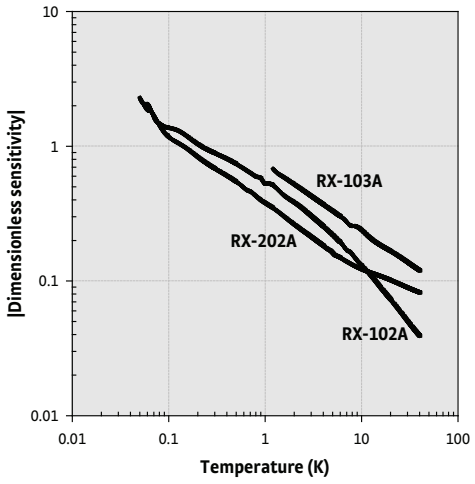
The RX-103A (10,000 Ω at room temperature) has a unique resistance and temperature response curve combined with low magnetic field-induced errors, and is the best choice for interchangeability from 1.4 K to 40 K.

Packaging options

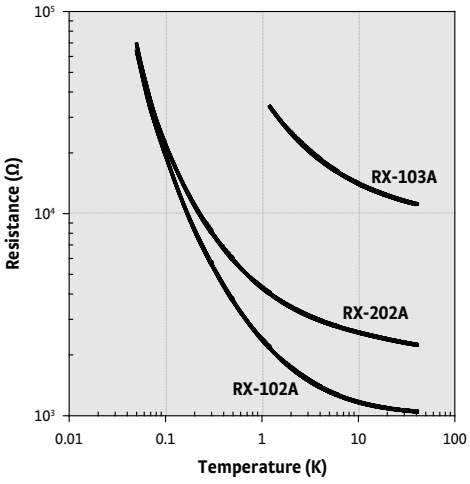
AA, BR

RX-AA

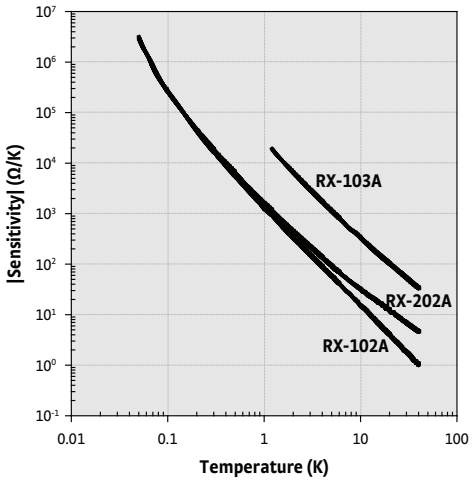
Typical interchangeable Rox™ resistance



Typical interchangeable Rox™ sensitivity



Typical interchangeable Rox™ dimensionless sensitivity



Specifications

Standard curve[1] 102 and 202: 0.05 K to 40 K; 103: 1.4 K to 40 K

Recommended excitation[2] RX-102 and RX-202: 20 µV (0.05 K to 0.1 K); 63 µV (0.1 K to 1.2 K); 10 mV or less for T > 1 K. RX-103: 10 mV or less for T > 1 K

Dissipation at recommended excitation 102 and 202: 7.5×10^{-8} W at 4.2 K; 103: 3.2×10^{-9} W at 1.4 K, 5.5×10^{-9} W at 4.2 K, 9.6×10^{-9} W at 77 K

Thermal response time 0.5 s at 4.2 K, 2.5 s at 77 K

Use in radiation Recommended—see Appendix B

Use in magnetic field[3] Recommended—see Appendix B

Reproducibility[4] ±15 mK

Soldering standard J-STD-001 Class 2

[1] 102B does not follow a standard curve

[2] Recommended excitation for T < 1 K based on Lake Shore calibration procedures using an AC resistance bridge—for more information refer to Appendix D and Appendix E

[3] 102B not recommended for use in magnetic fields

[4] Short-term reproducibility data is obtained by subjecting sensor to repeated thermal shocks from 305 K to 4.2 K

Range of use

	Minimum limit	Maximum limit
RX-102A-AA	0.05 K	40 K
RX-202A-AA	0.05 K	40 K
RX-103A-AA	1.4 K	40 K

Long-term stability

	RX-102A-AA	RX-202A-AA	RX-103A-AA
4.2 K	±30 mK	±50 mK	±15 mK

Calibrated accuracy[5]

	RX-102A-AA	RX-202A-AA	RX-103A-AA
20 mK	—	—	—
50 mK	—	—	—
1.4 K	±16 mK	±16 mK	±16 mK
4.2 K	±16 mK	±16 mK	±17 mK
10 K	±18 mK	±18 mK	±22 mK

[5] $[(\text{Calibration uncertainty})^2 + (\text{reproducibility})^2]^{0.5}$ for more information see Appendices B, D, and E

Accuracy: interchangeability

	RX-102A-AA-M matched	RX-102A-AA unmatched	RX-202A-AA-M matched	RX-202A-AA unmatched	RX-103A-AA-M matched	RX-103A-AA unmatched
0.05 K	±5 mK	±10 mK	±10 mK	±15 mK	—	—
0.3 K	±15 mK	±20 mK	±20 mK	±25 mK	—	—
0.5 K	±20 mK	±25 mK	±25 mK	±30 mK	—	—
1.4 K	±25 mK	±50 mK	±50 mK	±100 mK	±50 mK	±150 mK
4.2 K	±75 mK	±125 mK	±150 mK	±250 mK	±100 mK	±400 mK
20 K	±500 mK	±1.25 K	±1 K	±2.5 K	±700 mK	±2 K
40 K	±1.5 K	±4 K	±2 K	±5 K	±1.5 K	±4 K

Temperature response data table (typical)—See Appendix G for expanded response table

	102A			202A			103A		
	R (Ω)	dR/dT (Ω/K)	(T/R)·(dR/dT)	R (Ω)	dR/dT (Ω/K)	(T/R)·(dR/dT)	R (Ω)	dR/dT (Ω/K)	(T/R)·(dR/dT)
0.05 K	63765	-2888654	-2.27	69191	-3186379	-2.3	—	—	—
0.1 K	19400	-266199	-1.37	21927	-256913	-1.17	—	—	—
0.3 K	5615	-16647	-0.89	8079	-18420	-0.68	—	—	—
1.4 K	2005	-667	-0.47	3820	-879	-0.32	30745	-13571	-0.62
4.2 K	1370	-80.4	-0.25	2929	-124	-0.18	18149	-1559	-0.36
10 K	1167	-15.2	-0.13	2582	-31.6	-0.12	14083	-337	-0.24
20 K	1089	-3.96	-0.07	2389	-12.1	-0.1	12289	-102	-0.17
40 K	1049	-1.03	-0.04	2243	-4.6	-0.08	11137	-33	-0.12
40 K	1049	-1.06	-0.04	2244	-4.58	-0.08	11150	-21.7	-0.08

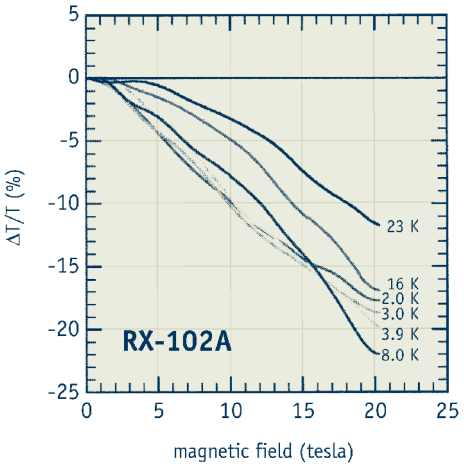
Typical magnetic field-dependent temperature errors ΔT/T (%) at B (magnetic induction)

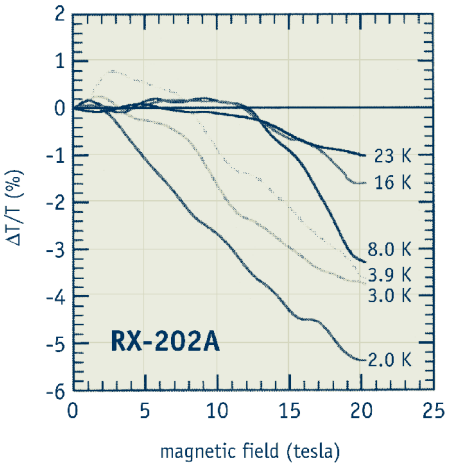
Rox™ 102A				
	2.5 T	8 T	14 T	19 T
2 K	-1.4	-7.9	-13	-17
3 K	-1.5	-7	-14	-18
4 K	-0.56	-6.7	-14	-18
8 K	-1.3	-6.1	-13	-21
16 K	-0.40	-3.4	-9.6	-16
23 K	-0.31	-2.2	-6.2	-11

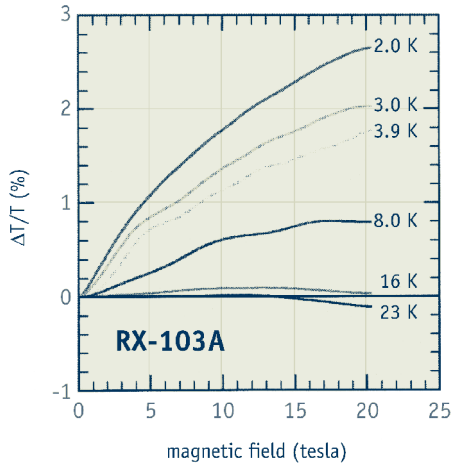
Rox™ 202A				
	2.5 T	8 T	14 T	19 T
2 K	-0.13	-2.2	-3.9	-5.2
3 K	0.18	-0.68	-2.7	-3.7
4 K	0.77	0.046	-1.8	-3.2
8 K	-0.023	0.16	-0.65	-3.0
16 K	0.03	0.16	-0.48	-1.5
23 K	-0.05	-0.08	-0.39	-0.92

Rox™ 103A				
	2.5 T	8 T	14 T	19 T
2 K	0.58	1.5	2.2	2.6
3 K	0.44	1.1	1.7	2.0
4 K	0.27	0.95	1.4	1.7
8 K	0.11	0.49	0.71	0.80
16 K	0.018	0.076	0.089	0.040
23 K	0.0051	0.0058	-0.0060	-0.095

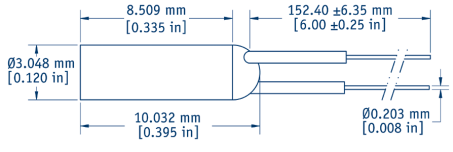
Magnetic field dependance data for sample interchangeable Rox™





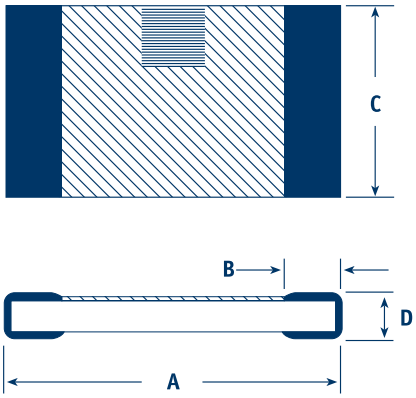


RX-AA



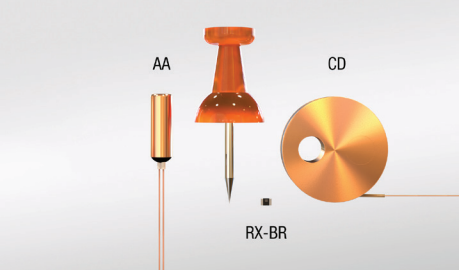
General tolerance of ±0.127 mm [±0.005 in] unless otherwise noted

Bare chip (see table on 50)



Packaging options

For more information on sensor packages and mounting adapters, see page 20.



See the appendices for a detailed description of:
Installation
Uncalibrated sensors
SoftCal™
Calibrated sensors
CalCurve™
Sensor packages

To add length to sensor leads see page 25.

Packaging

The Rox™ 202A, 102A, and 103A sensors are available in the Lake Shore standard copper AA canister. Two are available as bare chips for applications requiring a smaller sensor or a faster thermal response time. The RX-102A-BR is a bare chip version of RX-102A. This bare chip features wrap-around noble metal contacts that can be soldered to using standard lead/tin solder. The RX-103A-BR is a bare chip version of the RX-103A. This bare chip has wrap-around pretinned contacts that can be soldered to using standard lead/tin solder. The pretinned contacts increase the sensor thickness from 0.25 mm to 0.41 mm. Leads are not attached to these models, so they are not available as matched or calibrated.

See the Physical Specifications for details and individual dimensions.

Physical specifications

	Mass	Lead type	Internal atmosphere
RX-102A-AA	3.3 g	Two 6 in 32 AWG copper leads with heavy build Formvar® attached with epoxy strain relief at sensor–user should branch to 4 (no polarity)	Air
RX-202A-AA	3.28 g		
RX-103A-AA	3.36 g		

Bare chip	A (chip length)	B (pad width)	C (chip width)	D (thickness)
RX-102A-BR	1.45 mm (0.057 in)	0.30 mm (0.012 in)	1.27 mm (0.050 in)	0.65 mm (0.022 in)
RX-103A-BR	1.40 mm (0.070 in)	0.21 mm (0.010 in)	1.23 mm (0.060 in)	0.41 mm (0.016 in)

Ordering information

Rox™ RTD	Calibration range suffix codes Numeric figure is the low end of the calibration Letters represent the high end: B=40 K, M = matched *(calibration of matched sensors is available—consult Lake Shore)*			
Part number	Uncal	0.05B	0.3B	1.4B
RX-202A-AA, CD	■	■	■	■
RX-202A-AA-M	■			
RX-102A-AA, CD	■	■	■	■
RX-102A-AA-M	■			
RX-102A-BR	■			
RX-103A-AA, CD	■			■
RX-103A-AA-M	■			
RX-103A-BR	■			

Accessories available for sensors

8000-CD	Calibration report on CD-ROM
8000-USB	Calibration report on USB
COC-SEN	Certificate of conformance

USD VISA MasterCard AMERICAN EXPRESS PayPal

Accessories suggested for installation—see Accessories section for full descriptions

Stycast® epoxy
Apiezon® grease
90% Pb, 10% Sn solder
Indium solder
VGE-7031 varnish
Phosphor bronze wire
Manganin wire