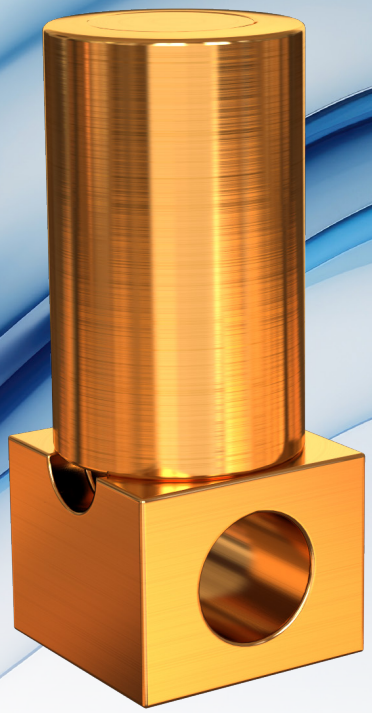
Lake Shore CRYOTRONICS
a DwyerOmega brand

Ultra-low Temperature Rox™

Cryogenic Temperature Sensor



Product Features

Temperature range: 5 mK to 40 K
Resistance range: 1 kΩ to 20 kΩ
Calibration curve: Required
Accuracy: ±1.2 mK at 5 mK
Short-term stability: ±15 mK at 4.2 K
Magnetic fields: Not recommended
Radiation: Not recommended
Packages: RS
Temperature controller: 372

Product Overview

ULT Rox sensors are designed to achieve ultra-low temperatures down to 5 mK. These sensors are calibrated down to 5 mK and up to 40 K. The package is optimized for thermalization and minimizes optical radiation absorption, thereby reducing heat load and temperature rise from line-of-sight radiation emitted by higher-temperature objects such as a cold plate or surrounding shields. The package is also designed to minimize environmental noise, which is critical for 5 mK measurements. This sensor pairs with the 372 temperature controller to monitor and control temperature below 50 mK.

Calibration accuracies

ULT Rox™ sensors go through an intensive cryogenic calibration process. Each sensor comes with a downloadable calibration curve and traceability to NIST standards. Figure 1 demonstrates an example of roll-over behavior of a calibrated ULT Rox. Calibration ensures a roll-over point beyond the calibration limit, ensuring readings down to 5 mK. It is critical to follow the installation instructions to replicate the calibration environment and wait for the sensor to fully cool down to meet accuracies at 5 mK.

5 mK[1]	±1.2 mK
7 mK[1]	±0.8 mK
10 mK[1]	±1 mK
20 mK[1]	±2 mK
50 mK[1]	±4 mK
1.4 K[2]	±16 mK
4.2 K[2]	±16 mK
10 K[2]	±30 mK

[1] Calibration done utilizing a noise thermometer
[2] [(Calibration uncertainty)^2 + (reproducibility)^2]$^{0.5}$

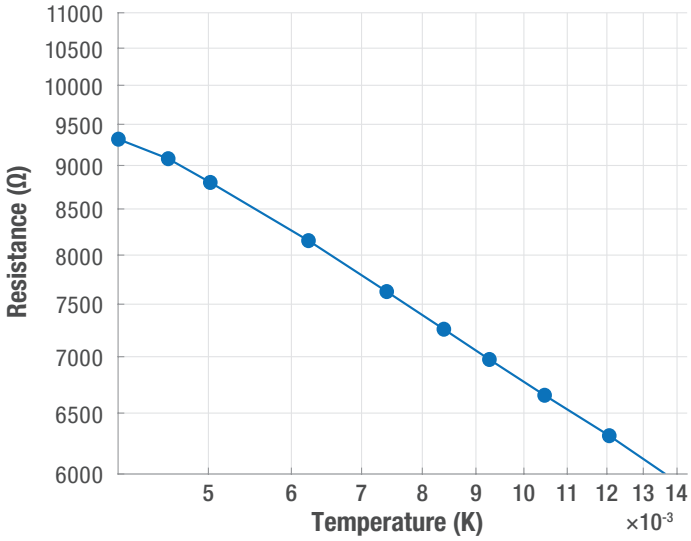


Figure 1
Example roll-off curve of one ULT Rox sensor

Temperature sensitivity

At 5 mK, ULT Rox devices typically exhibit a sensitivity of approximately 300,000 ohms/K, indicating a high responsiveness to temperature changes. Additionally, the resistance at 5 mK is around 10 kΩ. This high sensitivity means that even small temperature fluctuations result in significant changes in resistance, making the device highly effective for precise measurements in ultra-low temperature environments.

Typical sensitivity Ω/K

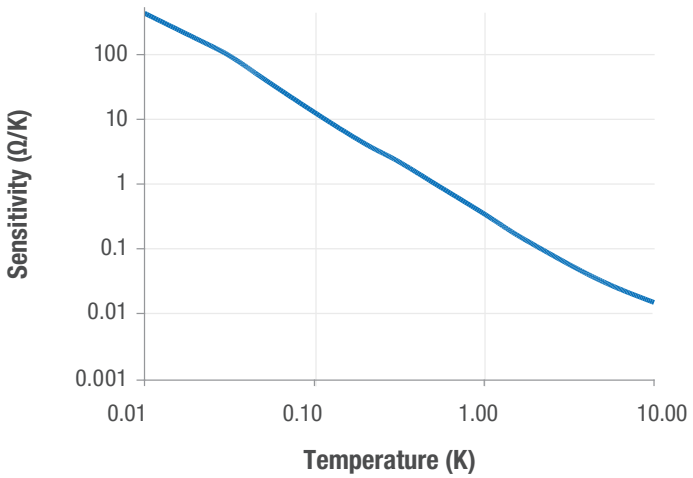


Figure 2
Typical sensitivity over temperature for ULT Rox sensors, showing increases responsiveness at lower temperatures

Typical resistance Ω

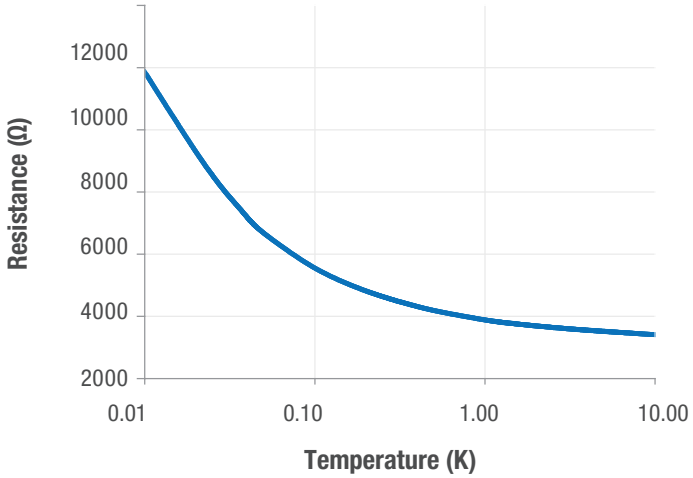


Figure 3
Typical resistance curve of a ULT Rox™ sensor varies from 10,000 Ω to 2,000 Ω over its operational temperature range

Performance specifications

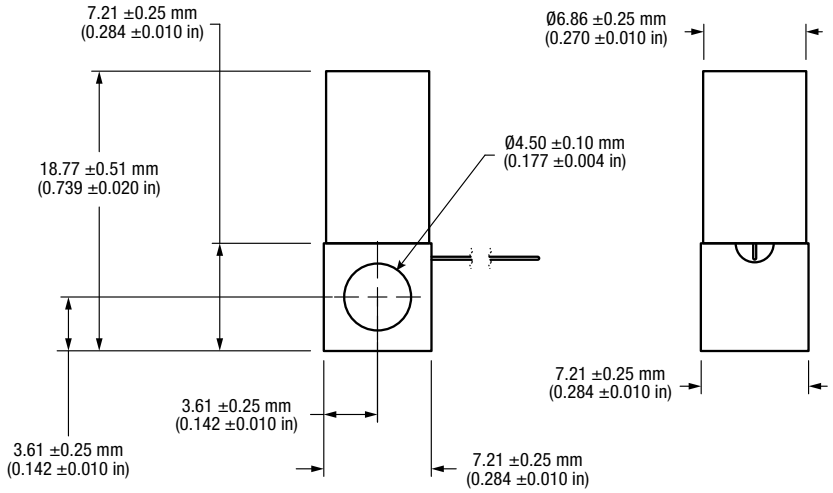
Temperature range (RX-102B-RS-0.01B)	5 mK to 40 K
Resistance range	10 kΩ to 20 kΩ
Recommened excitation[3]	20 µV at 0.05 K to 0.1 K 63 µV at 0.1 K to 1 K 10 mV or less for temp >1 K
Short-term stability[4]	±15 mK at 4.2 K
Long-term stability	±30 mK/year at 4.2 K
Thermal response time	0.5 s at 4.2 K
Maximum power before damage	10^{-5} W, 0.1 mA or 1 V (whichever is lowest)
Dissipation at rated excitation (typical)	7.5^{-8} W at 4.2 K

[3] Recommended excitation for T < 1 K based on Lake Shore calibration procedures using a 372 AC resistance bridge temperature controller.
[4] Short-term reproducibility data is obtained by subjecting sensor to repeated thermal shocks from 305 K to 4.2 K.

Physical specifications

Lead wire	Two-lead, no polarity
Package options	RS
Mass	5.36 g
Mounting	M3 or #6 brass screw (included) Minimum washer OD of 7 mm (included) N-Grease (not included)
Wire	36 AWG copper, insulated with heavy build polyimide to an overall diameter of 0.152 mm (0.006 in), 40 cm (16 in) long. Lead ends tinned with 63/37 SnPb solder
Soldering standard	J-STD-001 Class 2

RX-102B-RS



Ordering information

ULT Rox™ sensor

Package—RS	
Part	RX-102B-RS-0.01B
Calibration	5 mK to 40 K

Lead extensions

ULT Rox™ come standard with approximately 406 mm (16 in) lead wires. Extensions can be added to your device to extend lead length, with a variety of wire types available to suit your application. Below are the most common configurations. Refer to the Lead Extensions datasheet for the complete list.

-QT	Quad-Twist™, 36 AWG, 2 m
-QL	Quad-Lead™, 32 AWG, 2 m

Included mounting hardware

Each filtered ULT Rox™ sensor ships with metric brass screws. Brass screws are optimal for thermal conductivity and replicates the calibration environment for accurate measurements. Proper mounting is critical to meet specifications, see installation instructions.

- M3 brass fastener, 12 mm length
- M4 brass fastener, 14 mm length
- M3 washer
- M4 washer
- Apiezon N grease is required for installation (not included)

Temperature controller

A 372 temperature controller is required to take readings below 50 mK. Add a 3726 scanner card to increase the number of channels from 2 to 17 and provide a fully guarded signal path.

372N	AC resistance bridge temperature controller
372S	AC resistance bridge temperature controller with 3726 scanner

Contact us:

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