



Cryogenic Control Systems, Inc.

R500

Ruthenium Oxide Temperature Sensor

General Description

The R500 Ruthenium Oxide temperature sensor is a Thick-Film resistance temperature sensor that is designed primarily for ultra-low temperature operation. They feature high interchangeability by conforming to a standard calibration curve. Additionally, they are useful in high magnetic fields.

Applications

- Dilution refrigerators
- Helium 3 refrigerators. High sensitivity / low resistance at 200mK
- Low temperature super-conducting magnet systems.

Features

- **Temperature range:** <50mK to 40K. Monotonic to 273K.
- **High Sensitivity.**
- **Ultra-low Temperature use:** High sensitivity and relatively low resistance below 1K.
- **Interchangeability:** Conforms to a standard curve without special calibrations.
- **Magnetic Field Dependence:** Extremely low. Useful in magnetic fields to 16T with a small but predictable temperature shift.
- **Extremely stable:** Minimum long-term drift.
- **Very low susceptibility to ionizing radiation.**

Specifications

Useful Temperature Range: 50mK to 40K.

Standard Curve: Cryo-con R-500.

Temperature Coefficient: Negative

Leads: 36AWG Phosphor-Bronze. Four-lead color-coded cryogenic ribbon cable, 24", Other lengths available by special order.

Lead Resistance: 10Ω/m

Recommended Excitation

Constant-Voltage AC excitation only.
 Above 1.5K: 10mV.
 1.0K to 200mK: 1.0mV to 100μV
 200mK to 100mK: 100μV to 20μV
 100mK to 50mK: 20μV to 10μV

Maximum Storage Temperature: 400K

Maximum excitation current: 3.0mA

Thermal Response Time: 0.5S at 4.2K

Use in Radiation: Recommended for use in ionizing radiation environments.

Magnetic Field Dependence: See graph below.

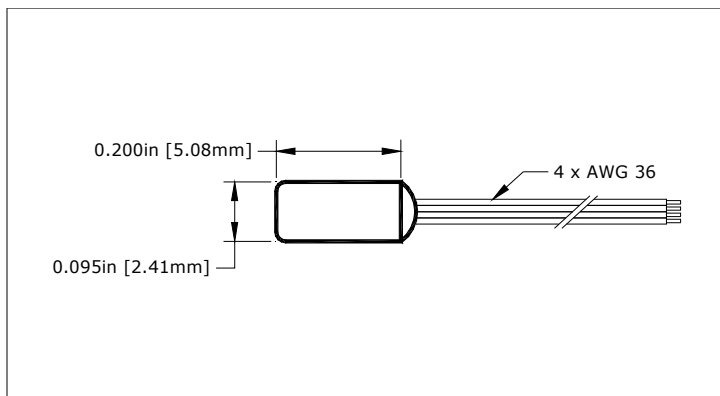
Connection:

All connections should be 4-wire in order to eliminate errors due to lead resistance.

Leads are coated with Butyl and may be separated by dipping them in Isopropyl Alcohol.

Lead insulation is heavy Formvar® which is difficult to strip. Techniques include use of a mechanical stripper or scraping with a razor blade.

Cable Color Code	
V+	Clear
V-	Green
I+	Black
I-	Red



R500 Canister Package

Construction: Gold-plated cylindrical OHFC copper canister, Stycast® epoxy filler. There is no internal atmosphere. Epoxy limits the maximum storage temperature to 400K.

Leads: Four, 36 AWG, Phosphor-Bronze, color coded. Formvar® insulation.

Mass: 0.4g.

Installation: Use a 0.101" diameter drill. Place a small amount of Apiezon® N grease in the hole before inserting the sensor. Ensure that the leads are thermally anchored.

Accuracy / Calibration

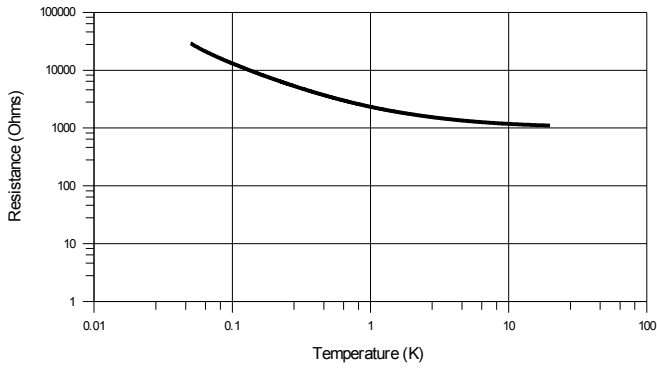
	50mK	1.5K	4.2K	20.0K
Group A	±10mK	±60mK	±100mK	±1.00K
Uncalibrated	±10mK	±100mK	±200mK	±1.00K

Ordering Information

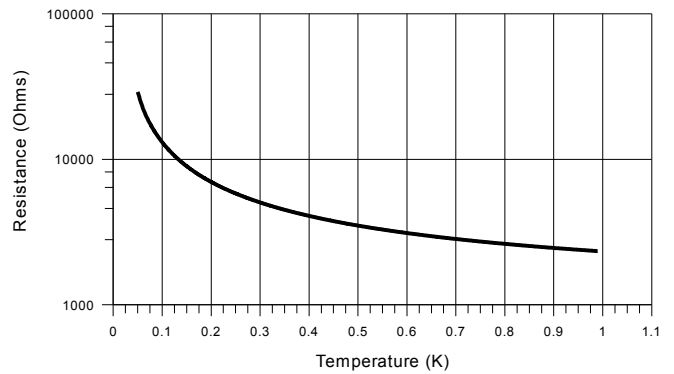
Ruthenium-Oxide Temperature Sensor in Canister Package	
R500-A	Tolerance band A.
R500	Uncalibrated.

Typical Performance Characteristics

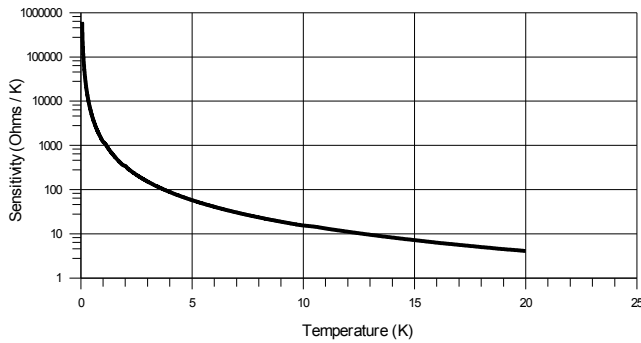
Temperature Response



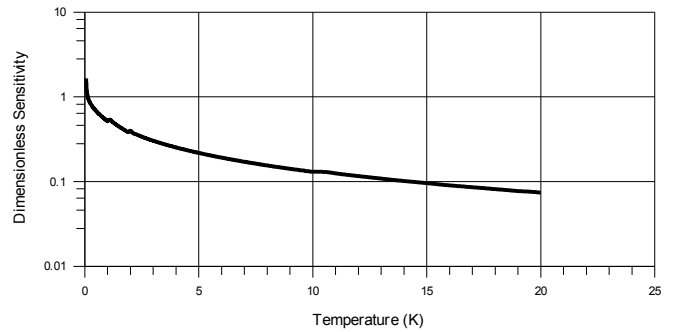
Temperature Response Below 1.0K



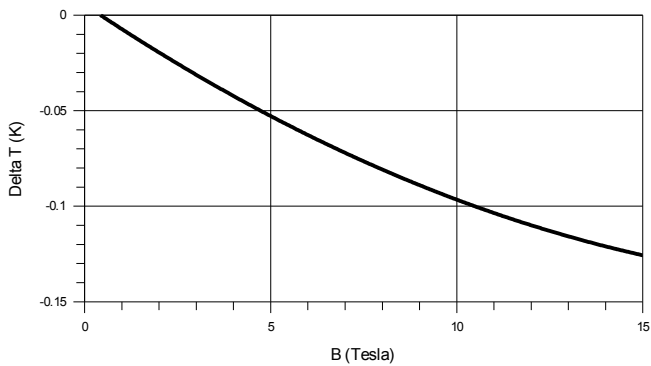
Sensitivity (Ohms/K)



Dimensionless Sensitivity (T/R)(dR/dT)



**Temperature Dependence in Magnetic Fields
T = 50mK to 4.2K**



Typical Temperature Response

T(K)	R(Ω)	S(Ω/K)
20	1100	4.08
5.00	1325	58
1.00	2327	1203
0.500	3503	4760
0.200	6996	30943
0.100	13115	145658
0.050	29072	628083



Cryogenic Control Systems,
Inc.
PO Box 7012
Rancho Santa Fe, CA 92067

Tel: (858) 756-3900
Fax: (858) 759-3515
e-mail: sales@cryocon.com
Web: www.cryocon.com

Specifications subject to change without notice.
© Cryogenic Control Systems, Inc. 2011, R500b