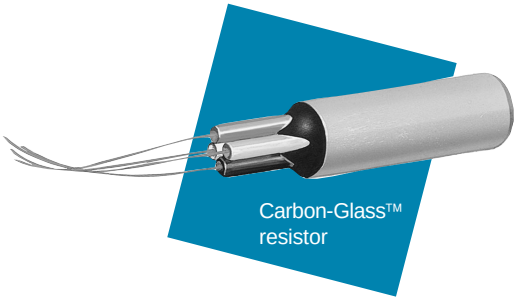
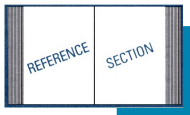
CGR Carbon-Glass™ RTDs*

- For use in magnetic fields to 19 tesla or higher
- Good repeatability in the range from 1.4 K to 100 K
- Monotonic in R vs. T and dR/dT vs. T
- High sensitivity at liquid helium temperature provides submillikelvin control at 4.2 K and below
- Usable sensitivity over the broad range 1.0 K to 325 K
- Good resistance to ionizing radiation

CGRs have the longest history of use of any sensor suitable for high magnetic field, wide range temperature sensing. The CGR Carbon-Glass™ resistance temperature sensor is a highly reproducible sensor that can be used from 1.0 K to 100 K and above in magnetic fields up to 20 tesla or higher. Because of the sensor's extremely high sensitivity at liquid helium temperatures, it is very useful for sub-millikelvin control below 10 K. Carbon-Glass™ sensors are monotonic in resistance temperature characteristic between 1.0 K and 325 K, but their reduced sensitivity (≈0.01 Ω/K) above 100 K confines their usage near room temperature to low accuracy temperature indication. Accurate corrections can be made for magnetoresistive errors in temperature readings.





See the Reference Section for a detailed description of

Self-heating
Installation
Uncalibrated sensors
Calibrated sensors
CalCurve™
Sensor packages

Typical Magnetic Field-Dependent Temperature Errors ΔT/T (%) at B (magnetic induction)

Package Parallel to Field

T(K)	B (tesla) 2.5	8	14	19
4.2	-0.5	-2.3	-4.9	-6.6
10	-0.2	-1.1	-2.6	-3.8
25	0.02	0.22	0.54	0.79
45	0.07	0.48	1.3	2.2
88	0.05	0.45	1.3	2.30
306	<0.01	0.22	0.62	1.1

Long axis of thermometer is parallel to the applied field.

Negative ΔR/R when T> 60 K.

Correctable to <2% temperature error.

ΔT/T errors negative below 20 K.

L.G. Rubin, B.L. Brandt and H.H. Sample, Some Practical Solutions to Measurement Problems Encountered at Low Temperatures and High Magnetic Fields, Advances in Cryogenic Engineering, Vol. 31, Plenum Press, New York (1986), p. 1221.

For information on Packages for Sensor Installation, see pages 1-40 to 1-42.

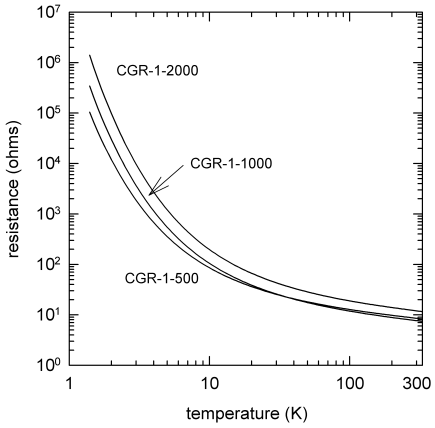
Adding lead length to sensors - see page 1-43.

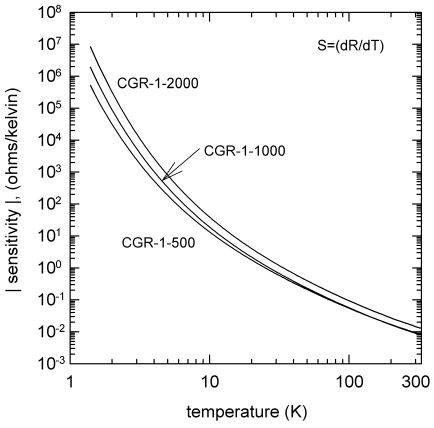
Model	Typical resistance at 4.2 K	Suggested useful range*
CGR-1-500	250-750 Ω	1.0 K to 77 K
CGR-1-1000	750-1500 Ω	1.4 K to 100 K
CGR-1-2000	1500-3000 Ω	2.5 K to 325 K

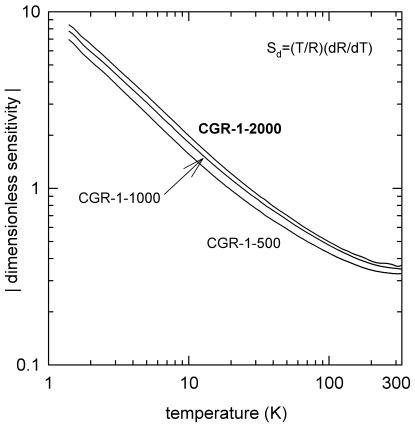
* All Carbon-Glass™ resistors can be used up to 325 K with reduced sensitivity.

* U.S. Patent #3,760,325 exclusively assigned to Lake Shore Cryotronics, Inc.

Typical Resistance and Sensitivity values for Carbon-Glass™ RTDs. See page A-52 for tabular data.







Specifications

	CGR Carbon-Glass™
Temperature	
Useful range	
Minimum	1.0 K
Maximum	325 K
Maximum storage temperature	305 K
Standard curve	Not applicable
Resistance (typical)	See plots on previous page
Sensitivity (typical)	See plots on previous page
Dimensionless sensitivity (typical)	See plots on previous page
Accuracy (interchangeability)	Not applicable
Accuracy (calibrated)	±5 mK at T < 10 K; ±20 mK at 20 K; ±55 mK at 50 K
Stability	
Short-term	±0.75 mK at 4.2 K
Long-term (per year)	-5 mK at 4.2 K -30 mK at 15 K -100 mK at 77 K -600 mK at 300 K Long term stability is expected to be -0.2% of temperature or -0.1 K per year, whichever is greater.
Thermal response time	1 second at 4.2 K; 1.5 seconds at 77 K in liquid
Recommended recalibration schedule	Annual
Excitation	
Recommended	10 mV (1.4 K to 325 K)(1)
Maximum power before damage	10^{-4} W, 10 mA or 1 V, whichever is less
Dissipation at rated excitation	Typical 10^{-7} W at 4.2 K (model dependent)
Units range (ohms)	Typical 10 Ω at room temperature; to 1 MΩ at 1.2 K (model dependent)
Lead wire configuration	Four leads (color coded)
Physical Specifications	
Materials in the sensor/construction	The CGR temperature sensing element, fabricated from a carbon-impregnated glass matrix, is mounted strain-free in a cylindrical gold plated copper can.
Size in millimeters	3 mm diameter x 8.5 mm long cylinder
Mass	330 milligrams
Leads	
Size	0.20 mm diameter x 15 cm long
Number	Four (4), color coded
Material	32 AWG phosphor-bronze wire
Insulation	Heavy build Polyimide
Internal atmosphere	Helium 4 (^{4}He) is standard
Environmental	
Radiation effects	Recommended for use in ionizing radiation.
Magnetic fields	Useful over the full temperature range and up to 30 tesla.
ESD sensitivity	Not applicable
Noise sensitivity	Not applicable

(1) See Reference Section for self-heating information.

USD | American Express | VISA | MasterCard

Ordering Information

Uncalibrated sensor

Specify the Model number in the left column only, for example CGR-1-500.

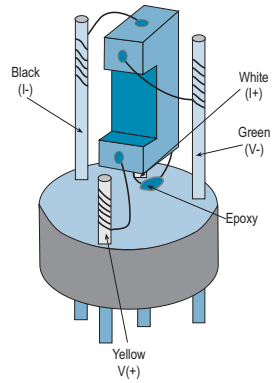
Calibrated sensor

Add Calibration Range Suffix Code to the end of the Model number, for example CGR-1-500-1.4L.

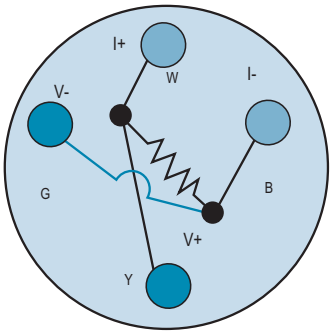
Carbon-Glass™ RTD
Calibration Range Suffix Codes
Numeric figure is the low end of the calibration.
Letters represent the high end: B = 40 K; D = 100 K; L = 325 K.

Model number	1.4B	1.4D	1.4L	4B	4D	4L
CGR-1-500	✓	✓	✓	✓	✓	✓
CGR-1-500-CD	✓	✓	✓	✓	✓	✓
CGR-1-1000	✓	✓	✓	✓	✓	✓
CGR-1-1000-CD	✓	✓	✓	✓	✓	✓
CGR-1-2000	✓	✓	✓	✓	✓	✓
CGR-1-2000-CD	✓	✓	✓	✓	✓	✓

Other packaging available through special order. Consult Lake Shore.



CGR-1 series construction detail

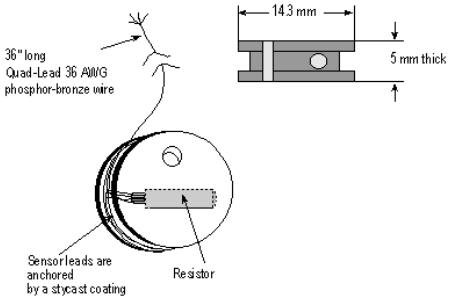


Looking at the wiring end with leads toward user

	Key	Lead Color
W	I+	White
G	V-	Green
Y	V+	Yellow
B	I-	Black

Sensor lead identification for CGR-1 RTDs

CD Package



Material of bobbin: Copper bobbin
Size of bobbin: 14.4 mm x 5 mm thick
Leads: 36", 36 AWG color coded Quad-Lead™ wire
Lead material: Phosphor bronze alloy

Accessories suggested for installation (see Section 3):

- Stycast® Epoxy
- Apiezon® Grease
- IMI-7031 Varnish
- Indium Solder
- 90% Pb, 10% Sn Solder
- Phosphor-Bronze Wire
- Manganin Wire
- CryoCable™