

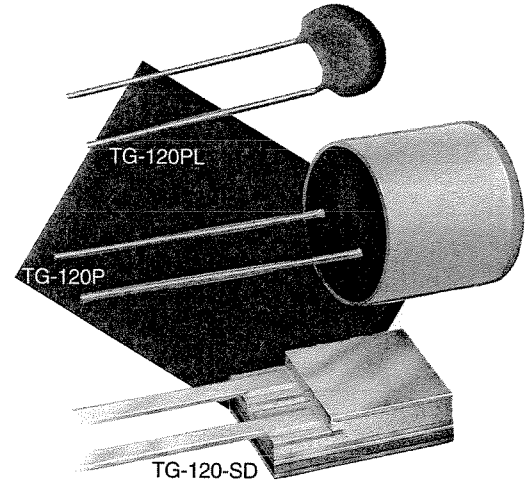
Series TG-120 Gallium-Aluminum-Arsenide Diodes*

GaAlAs Diodes

- Voltage-temperature characteristics are monotonic over the useful temperature range from 1.4 K to 500 K.
- Excellent sensitivity (dV/dT) at temperatures below 50 K, making it an ideal replacement for older design GaAs diode temperature sensors
- Relatively low magnetic field dependence, $\Delta T/T < 4\%$ for $B < 5$ T and $T > 4.2$ K

The TG-120 gallium-aluminum-arsenide (GaAlAs) diode temperature sensors are particularly well suited for low to moderate magnetic field applications at low temperatures. The GaAlAs sensing element exhibits high sensitivity (dV/dT) at low temperatures. Voltage-temperature characteristics are monotonic over the sensor's useful range from 1.4 K to 500 K (see plots below).

Gallium aluminum arsenide diodes are direct band-gap, single junction devices that produce small output variances in the presence of magnetic fields. Consequently, their low magnetic field dependence makes them ideally suited for applications in moderate magnetic fields up to five tesla.



* Patent # 4,643,589, "Thermometry Employing Gallium Aluminum Arsenide Diode Sensor" Lake Shore Cryotronics, Inc.

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

Package Perpendicular to Field

T(K)	B (tesla)				
	1	2	3	4	5
4.2	2.9	3.8	3.7	2.8	1
30	0.2	0.2	0.3	0.3	0.2
78	<0.1	<0.1	0.17	0.16	0.1
300	-0.1	-0.1	-0.1	-0.1	-0.1

When junction is parallel to B, induced errors are typically less than, or on the order of, those shown.

REFERENCE SECTION

See the Reference Section for a detailed description of

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

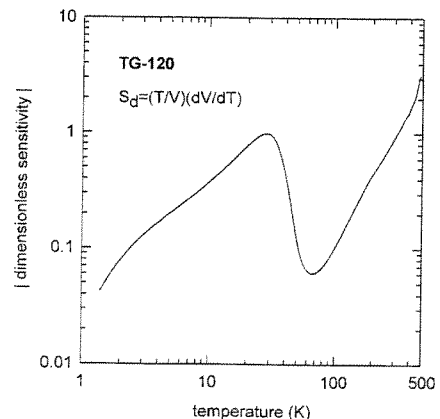
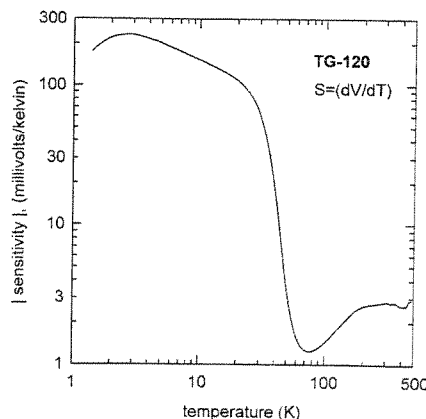
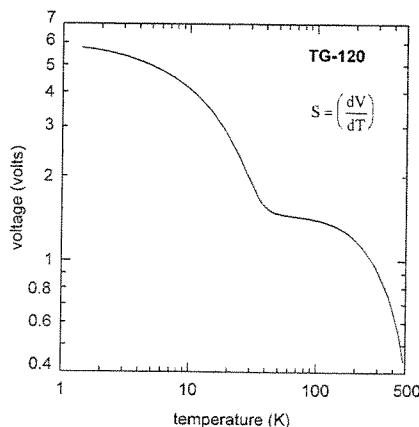
Accessories suggested for installation (see Section 3):

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

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

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

Typical Voltage and Sensitivity values for GaAlAs Diodes. See page A-52 for tabular data.



Specifications

	TG-120P	TG-120PL	TG-120-SD
Temperature			
Useful range			
Minimum	1.4 K	1.4 K	1.4 K
Maximum	325 K	325 K	500 K ⁽¹⁾
Maximum storage temperature	305 K	305 K	305 K
Standard curve	Not available	Not available	Not available
Voltage (typical)	5.200 V at 4.2 K; 1.420 V at 77 K; 0.900 V at 305 K (all models)		
Sensitivity (typical)	-180 mV/K at 4.2 K; -1.4 mV/K at 100 K; -2.8 mV/K at 300 K (all models)		
Dimensionless sensitivity (typical)	See Reference Section	See Reference Section	See Reference Section
Repeatability	Repeatability to better than ± 50 mK is required over four thermal cycles. Repeatability is typically better than ± 10 mK (all models).		
Accuracy (interchangeability)	None	None	None
Accuracy (SoftCal™)	Not applicable	Not applicable	Not applicable
Accuracy (calibrated)	± 50 mK	± 50 mK	± 50 mK
Stability			
Short-term	± 10 mK at 4.2 K	± 10 mK at 4.2 K	± 10 mK at 4.2 K
Long-term (per year)	± 15 mK at 4.2 K ± 50 mK at 77 K ± 50 mK at 330 K	± 15 mK at 4.2 K ± 50 mK at 77 K ± 50 mK at 330 K	± 15 mK at 4.2 K ± 50 mK at 77 K ± 50 mK at 330 K
Thermal response time (typical)	100 ms at 4.2 K; 250 ms at 77 K; 3 seconds at 305 K		< 10 ms at 4.2 K
Recommended recalibration schedule	Annual	Annual	Annual
Excitation			
Recommended	10 μ A $\pm 0.05\%$	10 μ A $\pm 0.05\%$	10 μ A $\pm 0.05\%$
Maximum reverse voltage (diode)	2 volts	2 volts	2 volts
Maximum forward current (diode)	500 μ A	500 μ A	500 μ A
Maximum power before damage	2 mW	2 mW	2 mW
Dissipation at rated excitation	50 μ W max. at 4.2 K; 14 μ W at 77 K; 10 μ W at 300 K (typical all models)		
Units range (volts or ohms)	0 to 6 volts	0 to 6 volts	0 to 6 volts
Lead wire configuration (polarity)	Short lead positive, long lead negative.	Short lead positive, long lead negative.	Positive lead on right with package lid up and leads towards user.
Physical Specifications			
Materials in the sensor/construction	BeO ceramic header set into a gold-plated copper cylinder.	Constructed with platinum, Stycast® epoxy, alumina.	Sapphire base with alumina body and lid. Molybdenum, manganese metallization on base and lid top with nickel and gold plating.
Size	2.8 mm long x 3 mm diameter	1.6 mm long x 1.1 mm max. thickness	1 mm x 1.9 mm x 3.2 mm long
Mass	79 milligrams	20 milligrams	38 milligrams
Leads			
Size			
Cathode	0.15 mm diameter x 25 mm long	0.25 mm x 0.05 mm x 19 mm long	0.25 mm x 0.05 mm x 19 mm long
Anode	0.15 mm diameter x 19 mm long	0.25 mm x 0.05 mm x 16 mm long	0.25 mm x 0.05 mm x 19 mm long
Number	Two (2)	Two (2)	Two (2)
Material	Phosphor-bronze, insulated	Platinum	Platinum, welded to pkg.
Insulation	Heavy build Polyimide	None	None
Internal atmosphere	Air	Solid epoxy	Hermetically sealed in vacuum
Environmental			
Radiation effects	See Reference Section	See Reference Section	See Reference Section
Magnetic fields	Recommended for use up to 5 tesla (all models)		
ESD sensitivity	Insensitive (Bipolar device)	Insensitive	Insensitive
Noise sensitivity	Can be significant ⁽²⁾	Can be significant ⁽²⁾	Can be significant ⁽²⁾

(1) The TG-120-SD has not been tested at 500 K to determine long term stability.

(2) See the application note titled "Measurement system induced errors in diode thermometry," *Rev. Sci. Instrum.* 57 (4), April 1986. Lake Shore order number 1420.

Ordering Information

Model number	Calibration Range Suffix Codes									
	1.4B	1.4D	1.4L	1.4H	4B	4D	4L	4H	70L	70H
TG-120P	✓	✓	✓		✓	✓	✓			✓
TG-120PL*	✓	✓	✓		✓	✓	✓			✓
TG-120-SD	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
TG-120-CO	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
TG-120-CU	✓	✓	✓		✓	✓	✓			✓

Other packages available through special order. Please consult Lake Shore.

See page 1-41 for additional adaptors. * Below 10 K, calibration is valid in a vacuum only.

When ordered with Lake Shore temperature controllers, these diodes should be ordered as calibrated sensors in order to read temperature.

Uncalibrated sensor
Specify the Model number in the left column only,
for example TG-120P.

Calibrated sensor
Add Calibration Range Suffix Code to the end of
the Model number, for example TG-120P-1.4L.

Accessories available for sensors
ECRIT Expanded interpolation table
SCR Special calibration report
8000 Calibration report on floppy disk
COC-SEN Certificate of conformance

