Series TG-120 Gallium-Aluminum-Arsenide 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, ΔT/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.

<table>
<thead>
<tr>
<th>Package Perpendicular to Field B (tesla)</th>
<th>T(K)</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4.2</td>
<td>2.9</td>
<td>3.8</td>
<td>3.7</td>
<td>3.8</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>0.2</td>
<td>0.2</td>
<td>0.3</td>
<td>0.3</td>
<td>0.2</td>
</tr>
<tr>
<td></td>
<td>78</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td>0.17</td>
<td>0.16</td>
<td>0.1</td>
</tr>
<tr>
<td></td>
<td>300</td>
<td>-0.1</td>
<td>-0.1</td>
<td>-0.1</td>
<td>-0.1</td>
<td>-0.1</td>
</tr>
</tbody>
</table>

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

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

<table>
<thead>
<tr>
<th></th>
<th>TG-120P</th>
<th>TG-120PL</th>
<th>TG-120 SD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Temperature</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Useful range</td>
<td>1.4 K</td>
<td>1.4 K</td>
<td>1.4 K</td>
</tr>
<tr>
<td>Minimum</td>
<td>1.4 K</td>
<td>1.4 K</td>
<td>1.4 K</td>
</tr>
<tr>
<td>Maximum</td>
<td>325 K</td>
<td>325 K</td>
<td>500 K</td>
</tr>
<tr>
<td>Maximum storage temperature</td>
<td>305 K</td>
<td>305 K</td>
<td>305 K</td>
</tr>
<tr>
<td>Standard curve</td>
<td>Not available</td>
<td>Not available</td>
<td>Not available</td>
</tr>
<tr>
<td>Voltage (typical)</td>
<td>5,200 V at 4.2 K; 1,420 V at 77 K; 0.900 V at 305 K (all models)</td>
<td>5,200 V at 4.2 K; 1,420 V at 77 K; 0.900 V at 305 K (all models)</td>
<td>Not available</td>
</tr>
<tr>
<td>Sensitivity (typical)</td>
<td>-180 mV/K at 4.2 K; -1.4 mV/K at 100 K; 2.8 mV/K at 300 K (all models)</td>
<td>Not available</td>
<td></td>
</tr>
<tr>
<td>Dimensionless sensitivity (typical)</td>
<td>See Reference Section</td>
<td>See Reference Section</td>
<td>See Reference Section</td>
</tr>
<tr>
<td>Repeatability</td>
<td>Repeatability to better than ±50 mK is required over four thermal cycles. Repeatability is typically better than ±10 mK (all models).</td>
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</tr>
<tr>
<td>Accuracy (interchangeability)</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Accuracy (SoftCal)</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Accuracy (calibrated)</td>
<td>± 50 mK</td>
<td>± 50 mK</td>
<td>± 50 mK</td>
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<tr>
<td>Stability</td>
<td></td>
<td></td>
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<tr>
<td>Short-term</td>
<td>± 10 mK at 4.2 K</td>
<td>± 10 mK at 4.2 K</td>
<td>± 10 mK at 4.2 K</td>
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<tr>
<td>Long-term (per year)</td>
<td>± 15 mK at 4.2 K</td>
<td>± 15 mK at 4.2 K</td>
<td>± 15 mK at 4.2 K</td>
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<tr>
<td></td>
<td>± 50 mK at 77 K</td>
<td>± 50 mK at 77 K</td>
<td>± 50 mK at 77 K</td>
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<tr>
<td></td>
<td>± 50 mK at 330 K</td>
<td>± 50 mK at 330 K</td>
<td>± 50 mK at 330 K</td>
</tr>
<tr>
<td>Thermal response time (typical)</td>
<td>100 ms at 4.2 K; 250 ms at 77 K; 3 seconds at 305 K</td>
<td>&lt; 10 ms at 4.2 K</td>
<td></td>
</tr>
<tr>
<td>Recommended recalibration schedule</td>
<td>Annual</td>
<td>Annual</td>
<td>Annual</td>
</tr>
</tbody>
</table>

### Excitation

- **Recommended:**
  - 10 μA ± 0.05%  
- 19 μA ± 0.05%  
- 19 μA ± 0.05%
- Maximum reverse voltage (diode):
  - 2 volts
- Maximum forward current (diode):
  - 50μA
- Maximum power before damage:
  - 2 mW
- Dissipation at rated excitation:
  - 50 μW max. at 4.2 K; 14 μW at 77 K; 10 μW at 300 K (typical all models)
- Units range (volts or ohms):
  - 0 to 6 volts
- Lead wire configuration (polarity):
  - Short lead positive, long lead negative.

### Physical Specifications

- **Materials in the sensor/construction:**
  - BeO ceramic header set into a gold-plated copper cylinder.
  - Constructed with platinum, Styreca® epoxy, alumina.
  - Sapphire base with alumina body and lid, Molybdenum, manganese metalization 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
    - Anode: 0.15 mm diameter x 19 mm long
  - **Number:**
    - Two (2)
  - **Material:**
    - Phosphor-bronze, insulated
    - Platinum
    - Platinum, welded to pigt.
  - **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 (Snapout device)
  - Insensitive
  - Insensitive
- **Noise sensitivity:**
  - Can be significant
  - Can be significant
  - Can be significant

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

## Ordering Information

### GaAlAs Diode

<table>
<thead>
<tr>
<th>Model number</th>
<th>1.4B</th>
<th>1.4D</th>
<th>1.4L</th>
<th>1.4H</th>
<th>4B</th>
<th>4D</th>
<th>4L</th>
<th>4H</th>
<th>70L</th>
<th>70H</th>
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<td>TG-120PL</td>
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<td>TG-120-SD</td>
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<td>TG-120-CO</td>
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<td>TG-120-CU</td>
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</table>

*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:**
- **ECRT**: Expanded intercalation table
- **SCR**: Special calibration report
- **8000**: Calibration report on floppy disk
- **COC-SEN**: Certificate of conformance

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