240 Series
Cryogenic Temperature Sensor Input Modules

240 Series modules are the ideal companion to Cernox®
Integrates seamlessly with industry-leading Lake Shore Cernox® RTDs, platinum RTDs, and silicon diodes, providing a flexible platform for reporting temperature measurements over a PLC network. PROFIBUS certified, allowing this module to be integrated into a wide range of PLC networks.

Temperature values are communicated directly with the PLC master device, removing the need for additional analog conversion equipment or complex PLC programming to generate temperature values. Measurement circuitry based on Lake Shore’s industry-leading benchtop instruments, allowing for longer cable runs between sensor and module; ideal for applications where sensors must be located in hazardous environments.

Model 240-2P
For smaller installations and high-speed measurements
- Updates readings as fast as 1 ms
- Dedicated readings on front screen
- Highest level of equipment redundancy

Model 240-8P
For installations with many sensors
- Most cost-effective solution in large installations
- More sensors for each fieldbus address

Simplifying large-scale cryogenic temperature measurement
Lake Shore benchtop cryogenic instruments are trusted throughout the world for precision temperature measurement—and now that same measurement performance can be achieved in widely distributed high-energy physics applications like particle accelerators, fusion reactors, and other large industrial sites.

Normal mode with EMF-cancellation and signal filtering for the best measurement possible, or high-speed mode for the fastest notification of a temperature change.

A high-quality OLED display on the front of the unit provides helpful status and measurement data; this is in addition to being able to access this information via the PLC network or the local USB connection.

Convenient pluggable connectors enable individual sensors to be disconnected for maintenance without losing readings from other sensors on the same module.

Easy DIN rail mounting with integrated rear connections allowing power and fieldbus communications to be shared between modules.
Native fieldbus integration

The 240 Series modules connect with PROFIBUS-DP compatible networks, giving PLCs direct access to temperature values. This eliminates the need for additional I/O modules and complex conversion algorithms within the PLC to generate values when working with cryogenic temperature sensors.

The ability to communicate temperature directly with a PLC has many advantages:

- Commercially supported solution with proven results
- No additional I/O modules required to energize or read the temperature sensor
- The process of converting from measured voltage or resistance to temperature units does not need to be programmed into the PLC’s control logic.

Internally converting to temperature units represents the greatest reduction in time, cost, and risk when building a control system that includes cryogenic temperature management. Creating code that generates temperature values reliably can take days and the ability to maintain that code then becomes a liability if the attached sensor ever needs to be changed.

Lake Shore 240 Series modules are the only low-risk option available for cryogenic temperature control in a PLC network.

Direct instrument connection via USB makes configuration and maintenance easy and can be used for permanent temperature monitoring in systems not compatible with PROFIBUS-DP.

Temperature Sensors
4-lead connections, RTDs or diodes
**Built-in temperature conversion**

The process of converting from sensor units (ohms for RTDs and volts for diodes) to temperature values is extremely important and can be quite challenging. Many of the best cryogenic sensors (such as Cernox®) have unique calibration curves that change from device to device. Even sensors with common curves can become more accurate through the process of creating a unique calibration curve for those sensors.

Lake Shore’s 240 Series modules take the time and risk out of performing these conversions, in a way that guarantees sensor calibration accuracy is not degraded. The product software features native support for the electronic calibration files provided with each Lake Shore calibrated temperature sensor and includes many of the standard temperature conversion curves for other common interchangeable sensors.

This allows 240 Series modules to communicate temperature values automatically after just a few minutes of initial setup.

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**Intuitive module configuration**

The Lake Shore MeasureLINK™ software allows a streamlined configuration experience for all 240 Series input modules. Connecting directly to the module through the USB port provides immediate access for MeasureLINK and allows complete configuration of the module in just a few minutes.

MeasureLINK™ provides access to:

- Module configuration (communications settings and module maintenance)
- Input configuration (sensor calibration curve loading and other measurement settings)
- Live measurement readings for all module inputs simultaneously

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**240 Series temperature conversion flowchart**

1. Provides optimum current source to achieve reliable measurements without inducing self-heating offsets
2. Measures resulting voltage, automatically adjusting the measurement technique based on module configuration
3. Converts to digitized sensor units appropriate for the connected sensor (Ω/V)
4. Automatically converts to a digital temperature measurement using the calibration curve configured for the connected sensor
5. Allows access to these temperature measurements through a PROFIBUS or USB communications connection

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**Convenient OLED display**

The built-in OLED display in every 240 Series input module allows immediate verification that a module is operating correctly by displaying temperature conversion values or error states if something is not operating as intended.

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**User-friendly sensor wiring**

Pluggable terminal blocks provide an easy way to pre-terminate sensor wire to the included connectors before plugging them into the input module. Sensor maintenance or replacement is also made easier using these connectors, particularly if the remaining sensors on the module must remain live while another sensor is replaced.
Extended sensor wire lengths

An unfortunate characteristic of many high-energy physics facilities is the level of radiation generated by the machine during operation. Lake Shore Cernox® sensors are designed to tolerate this radiation, however, electronic devices require protection from this radiation. Lake Shore’s 240 Series modules facilitate this requirement by allowing extremely long sensor cabling to be employed between the sensor and input module. See the application note at www.lakeshore.com for additional information on this topic.

Simplifying cryogenic sensor excitation

Cryogenic temperature monitoring requires a constant balance between supplying enough power to make good measurements and keeping the power low enough to minimize sensor self-heating errors. Lake Shore’s 240 Series optimize measurement accuracy and resolution by automatically adjusting excitation level based on the temperature and connected sensor.

Thermal EMF offsets are also eliminated using current reversal techniques, canceling out these unwanted measurement errors that would be present in any other equipment not specifically designed for cryogenic measurements.

**Normal mode**

Best option for most installations. Provides the most accurate and precise measurements and is available on all 240 Series models.

- Current reversal available to remove thermal EMF offsets
- Modified measurement window to ignore signal rise when using long cable runs
- Fixed 100 ms update rate for the Model 240-2P or 400 ms for the Model 240-8P

**High-speed mode (240-2P only)**

Measurement option for times when low latency measurements are required. This feature is best used with sensors with extremely fast thermal response times.

- Update rates from 1 to 100 ms; configurable to match the network update rate
- Constant measurement with no interruptions caused by current reversal of input switching
- Current reversal not available in this mode, so thermal EMF offsets should be anticipated and managed
### Specifications

#### Input specifications (normal mode, reversing)

<table>
<thead>
<tr>
<th>Sensor temperature coefficient</th>
<th>Input range</th>
<th>Excitation current</th>
<th>Display resolution</th>
<th>Measurement resolution</th>
<th>Electronic accuracy (at 25 °C)</th>
<th>Measurement temperature coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diode</td>
<td>0 V to 7.5 V</td>
<td>0 Ω ± 0.05%</td>
<td>100 μΩ</td>
<td>20 μΩ</td>
<td>±320 μΩ ±0.01% of rdg</td>
<td>(20 μΩ + 0.0015% of rdg)/°C</td>
</tr>
<tr>
<td>PTC RTD 1 mA</td>
<td>0 Ω to 1 kΩ</td>
<td>1 mA</td>
<td>10 mΩ</td>
<td>20 mΩ</td>
<td>±0.04 Ω ±0.02% of rdg</td>
<td>(1 mΩ + 0.0015% of rdg)/°C</td>
</tr>
<tr>
<td>PTC RTD 10 mV</td>
<td>0 Ω to 10 kΩ</td>
<td>1 mA</td>
<td>0.1 mΩ</td>
<td>0.1 mΩ + 0.002% of rdg</td>
<td>±0.002 Ω ±0.06% of rdg</td>
<td>(1 mΩ + 0.0015% of rdg)/°C</td>
</tr>
<tr>
<td>NTC RTD 10 mV</td>
<td>0 Ω to 100 kΩ</td>
<td>100 µA</td>
<td>1 mΩ</td>
<td>1 mΩ + 0.002% of rdg</td>
<td>±0.01 Ω ±0.04% of rdg</td>
<td>(0.1 Ω + 0.0015% of rdg)/°C</td>
</tr>
<tr>
<td>Diode</td>
<td>0 Ω to 3 kΩ</td>
<td>10 mΩ</td>
<td>0.1 mΩ</td>
<td>0.1 mΩ + 0.002% of rdg</td>
<td>±0.002 Ω ±0.06% of rdg</td>
<td>(1 mΩ + 0.0015% of rdg)/°C</td>
</tr>
<tr>
<td>PTC RTD 1 mA</td>
<td>0 Ω to 30 kΩ</td>
<td>300 µA</td>
<td>0.1 mΩ</td>
<td>0.1 mΩ + 0.002% of rdg</td>
<td>±0.002 Ω ±0.06% of rdg</td>
<td>(1 mΩ + 0.0015% of rdg)/°C</td>
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<td>PTC RTD 10 mV</td>
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</tr>
<tr>
<td>NTC RTD 10 mV</td>
<td>0 Ω to 30 kΩ</td>
<td>300 nA</td>
<td>1 mΩ</td>
<td>3 mΩ + 0.002% of rdg</td>
<td>±0.01 Ω ±0.04% of rdg</td>
<td>(1 mΩ + 0.0015% of rdg)/°C</td>
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<tr>
<td>Diode</td>
<td>0 Ω to 100 kΩ</td>
<td>100 nA</td>
<td>1 Ω</td>
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<td>±0.01 Ω ±0.04% of rdg</td>
<td>(1 mΩ + 0.0015% of rdg)/°C</td>
</tr>
</tbody>
</table>

1. Current reversal used only for resistive ranges
2. Rated temperature coefficient from 15 °C to 35 °C, reduced accuracy from -20 °C to 50 °C

#### Sensor input configuration

<table>
<thead>
<tr>
<th>RTD</th>
<th>Diode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement type</td>
<td>4-lead differential</td>
</tr>
<tr>
<td>Excitation</td>
<td>Constant current with current reversal</td>
</tr>
<tr>
<td>Supported sensors</td>
<td>Cernox®, platinum, germanium, carbon-glass, rhodium-iron, and Rox®</td>
</tr>
<tr>
<td>Standard curves supplied</td>
<td>LSCI PT-100, IEC PT-100, IEC PT-1000</td>
</tr>
<tr>
<td>Input connector</td>
<td>5-pin terminal plug</td>
</tr>
</tbody>
</table>

#### Thermometry

Number of inputs: 2 (Model 240-2P), 8 (Model 240-8P)
Isolation: Sensor inputs isolated from other circuits but not each other
Input accuracy: Sensor dependent, refer to Input Specifications table
Measurement resolution: Sensor dependent, refer to Input Specifications table

#### Measurement speed

<table>
<thead>
<tr>
<th>Normal mode</th>
<th>240-2P</th>
<th>240-8P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Update rate</td>
<td>10 rdg/s</td>
<td>2.5 rdg/s</td>
</tr>
<tr>
<td>Filter</td>
<td>100 ms</td>
<td>100 ms</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>High speed mode</th>
<th>240-2P</th>
<th>240-8P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Update rate</td>
<td>10 to 1000 rdg/s</td>
<td>N/A</td>
</tr>
<tr>
<td>Filter</td>
<td>10 to 1000 ms</td>
<td>N/A</td>
</tr>
</tbody>
</table>

1. Update rate is halved when input is on the 100 kΩ range with current reversal enabled
2. All inputs are tied to the update rate (filter = 1000/update rate)

### Digital I/O – USB

Function: Emulates a standard RS-232 serial port
- Baud rate: 115,200, 8 data bits, 1 stop bit, no parity, no handshaking
- Connector: USB micro-B
- Reading rate: Matches update rate of the instrument

### Management

Module configuration: Module configured over USB interface
Configuration software: MeasureLINK™ (free download, supported on Windows 7, 8, and 10)
Firmware update: Firmware updated over USB port

### Display

Display: 128 × 32 pixel OLED
Display units: K, °C, °F, V, Ω
Display update rate: 2 rdg/s

<table>
<thead>
<tr>
<th>240-2P</th>
<th>240-8P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Displayed readings</td>
<td>2</td>
</tr>
<tr>
<td>Readings cycling</td>
<td>Fixed (no cycling)</td>
</tr>
</tbody>
</table>

#### Conversion Rates

Temperature display resolution: 0.0001 °F from 0 °F to 9.9999 °F, 0.01 °F from 10 °F to 99.999 °F, 0.1 °F above 1000 °F
Sensor units display resolution: Sensor dependent, to 5 digits
LED annunciators: Module status and communication status

### Power supply

Connection: Screw terminal
- Voltage requirement: 24 VDC, ±10%
- Current requirement: 100 mA per connected module
- Power distribution: Maximum 20 units connected through the DIN rail backplane connector
(power supply must be available to source required current)
Internal protection: Over-voltage, under-voltage, and reverse polarity protection

### Physical

- Case material: Polyamide
- Mounting: 35 mm DIN rail (EN 50022)
- Water ingress: IP20: not protected against harmful ingress of water
- Case inflammability: Class V0 according to UL 94
- Sensor connector wire size: 16 to 28 AWG
- Power connector wire size: 12 to 24 AWG
- Size: 22.5 mm W × 115 mm H × 100 mm L (240-2P), 90 mm W × 115 mm H × 100 mm L (240-8P)
- Weight: 120 g (240-2P), 300 g (240-8P)

### Environmental

Compliance: RoHS, CE
- Operating temperature: 15 °C to 35 °C at rated accuracy, -20 °C to 50 °C at reduced accuracy
- Storage temperature: -40 °C to 85 °C
- Relative humidity: 0% to 70% at rated accuracy, reduced accuracy up to 95%, non-condensing
Getting to know the 240 Series

A convenient self-contained kit provides most of the components required to evaluate these modules in your systems. Everything you need to connect a set of 240 Series input modules to your PLC system and start taking readings, without the requirement to have a functioning cryogenic system to take readings from. The evaluation kit contains:

- A 240-2P and 240-8P input module
- Universal power supply
- DIN rail
- Dummy sensors
- Software and documentation
- Other miscellaneous accessories

Available to keep or to demo on a short term basis. Contact your Lake Shore representative to secure your evaluation kit today.

Ordering information

<table>
<thead>
<tr>
<th>Part number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>240-2P</td>
<td>2-input cryogenic temperature sensor input module</td>
</tr>
<tr>
<td>240-8P</td>
<td>8-input cryogenic temperature sensor input module</td>
</tr>
</tbody>
</table>

**Accessories/options**

| 240-ACC-KIT | 240 Series accessory kit. Contains items needed for configuration of one or more 240 modules. Includes: 240 Series manual, 240 Series quick start guide, USB cable, flash drive containing product data and software, 240 Series screwdriver, 2 spare power, 4 spare sensor, and 2 spare backplane connectors. |

All specifications are subject to change without notice.
240 Series Cryogenic Temperature Sensor Input Modules

Best in-class measurement and instrument quality

Based on the same measurement circuitry that has made Lake Shore temperature instruments the industry leader in the field of fundamental research, the 240 Series modules take the guesswork out of cryogenic temperature measurement. Assembled and calibrated in the USA at the Lake Shore Cryotronics manufacturing facility, these modules are built to be the most reliable and accurate PLC-focused instruments for cryogenic temperature monitoring.