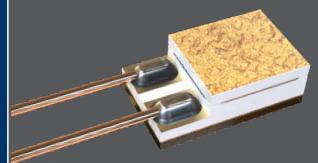
240 Series

Cryogenic Temperature Sensor Input Modules



240 Series modules are the ideal companion to Cernox®



Lake Shore CRYOTRONICS

a **DwyerOmega** brand



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.

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

Native support for Profibus-DP, Modbus RTU, and Lake Shore ASCII communication, allowing this module to be integrated into a wide range of PLC networks and control systems

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

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.

In addition to PROFIBUS-DP, modules with version 2.4 firmware or later have additional communications support for Modbus RTU and ASCII Serial protocols, further expanding communications compatibilities to a wider range of RS-485 PLCs and SBCs.

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.

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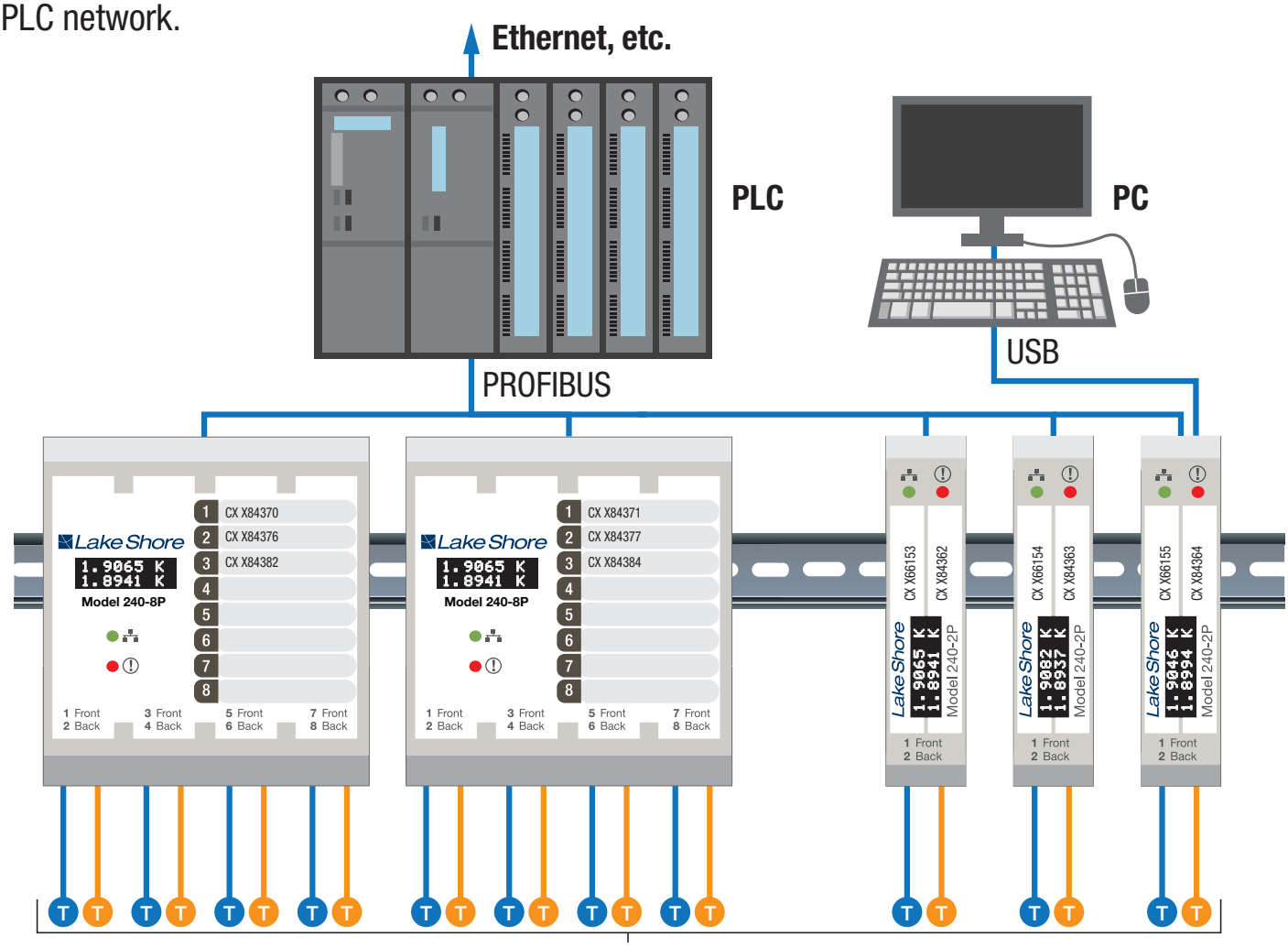


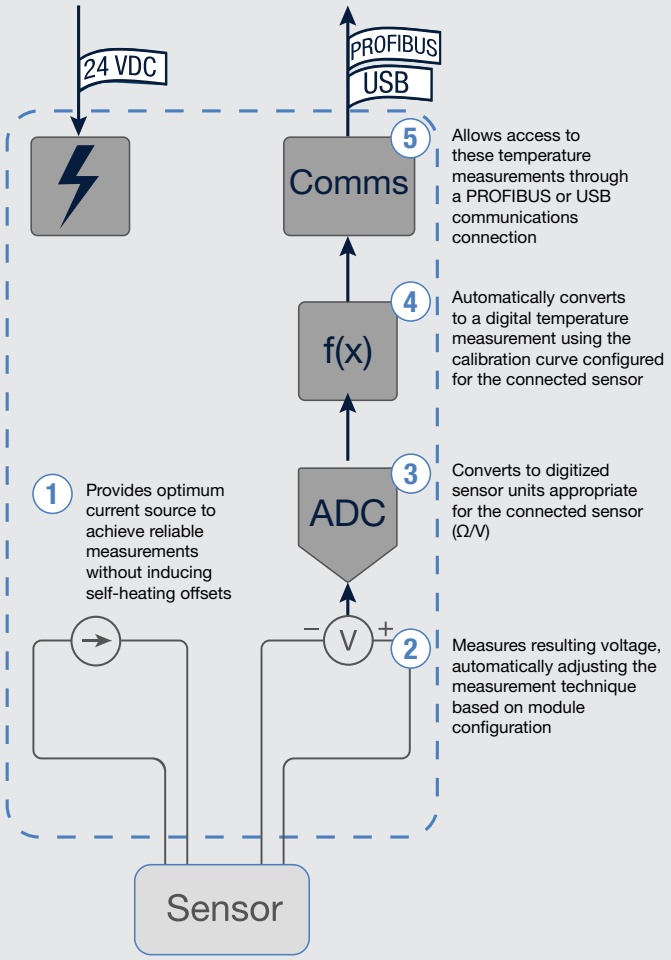
Built-in temperature conversion

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.

240 Series temperature conversion flowchart

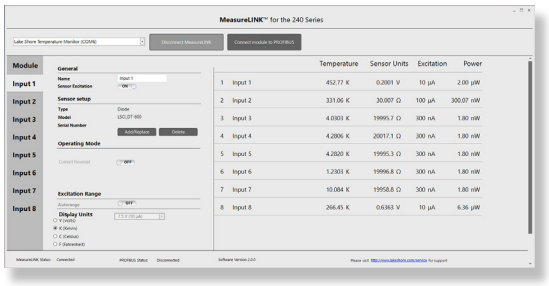


Intuitive module configuration

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.

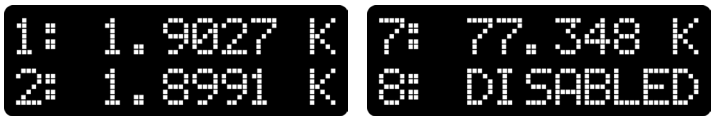
MeasureLINK™ provides access to:

- 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



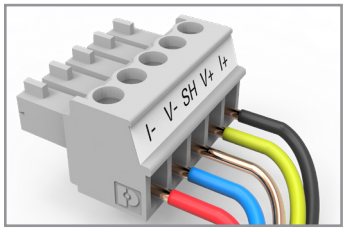
Convenient OLED display

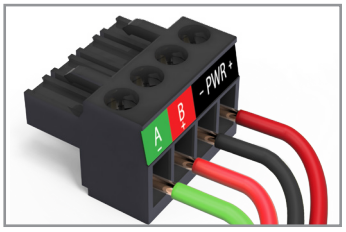
The built-in OLED display in every 240 Series input module allows immediate verification that a module is operating correctly by displaying temperature conversion values or error states if something is not operating as intended.



User-friendly sensor wiring

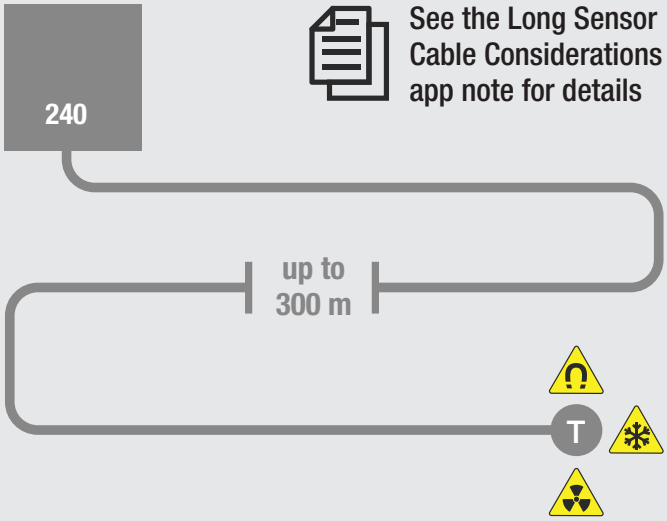
Pluggable terminal blocks provide an easy way to pre-terminate sensor wire to the included connectors before plugging them into the input module. Sensor maintenance or replacement is also made easier using these connectors, particularly if the remaining sensors on the module must remain live while another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



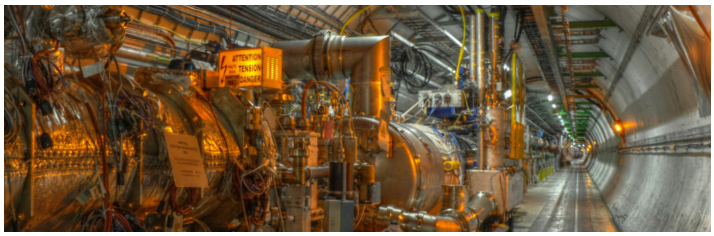


Extended sensor wire lengths

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

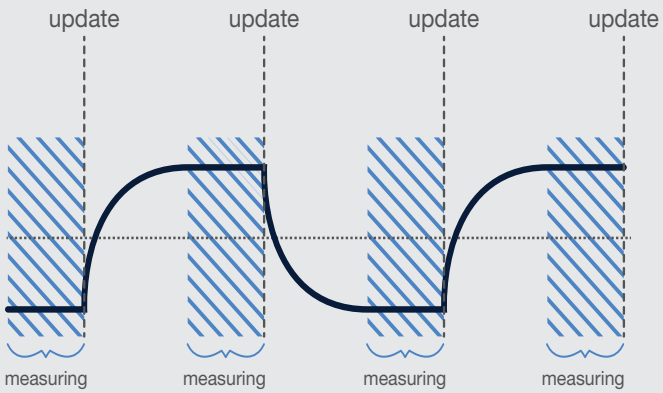
Best option for most installations. Provides the most accurate and precise measurements and is available on all 240 Series models.

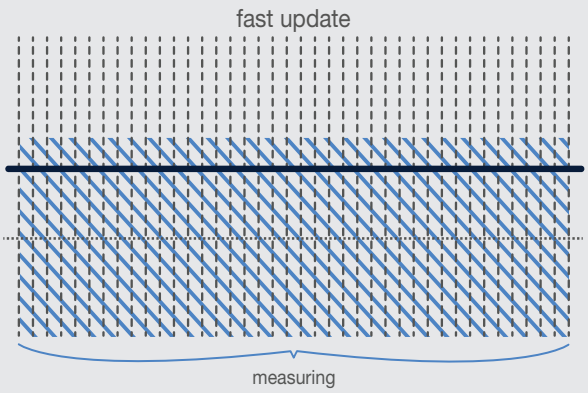
- Current reversal available to remove thermal EMF offsets
- Modified measurement window to ignore signal rise when using long cable runs
- Fixed 100 ms update rate for the Model 240-2P or 400 ms for the Model 240-8P

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

Standard inputs (normal mode, reversing[1])

	Sensor temperature coefficient	Input range	Excitation current	Display resolution	Measurement resolution	Electronic accuracy (at 25 °C)	Measurement temperature coefficient
Diode	Negative	0 V to 7.5 V	10 µA ±0.05%	100 µV	20 µV	±320 µV ±0.01% of rdg	(20 µV + 0.0015% of rdg)/°C[1]
PTC RTD 1 mA	Positive	0 Ω to 1 kΩ	1 mA	10 mΩ	20 mΩ	±0.04 Ω ±0.02% of rdg	(1 mΩ + 0.0015% of rdg)/°C[1]
NTC RTD 10 mV	Negative	0 Ω to 10 Ω	1 mA	0.1 mΩ	0.1 mΩ + 0.002% of rdg	±0.002 Ω ±0.06% of rdg	(0.1 mΩ + 0.0015% of rdg)/°C[1]
		0 Ω to 30 Ω	300 µA	0.1 mΩ	0.3 mΩ + 0.002% of rdg	±0.002 Ω ±0.06% of rdg	(0.1 mΩ + 0.0015% of rdg)/°C[1]
		0 Ω to 100 Ω	100 µA	1 mΩ	1 mΩ + 0.002% of rdg	±0.01 Ω ±0.04% of rdg	(0.1 mΩ + 0.0015% of rdg)/°C[1]
		0 Ω to 300 Ω	30 µA	1 mΩ	3 mΩ + 0.002% of rdg	±0.01 Ω ±0.04% of rdg	(0.3 mΩ + 0.0015% of rdg)/°C[1]
		0 Ω to 1 kΩ	10 µA	10 mΩ	10 mΩ + 0.002% of rdg	±0.01 Ω ±0.04% of rdg	(1 mΩ + 0.0015% of rdg)/°C[1]
		0 Ω to 3 kΩ	3 µA	10 mΩ	30 mΩ + 0.002% of rdg	±0.01 Ω ±0.04% of rdg	(3 mΩ + 0.0015% of rdg)/°C[1]
		0 Ω to 10 kΩ	1 µA	100 mΩ	100 mΩ + 0.002% of rdg	±1.0 Ω ±0.04% of rdg	(10 mΩ + 0.0015% of rdg)/°C[1]
		0 Ω to 30 kΩ	300 nA	100 mΩ	300 mΩ + 0.002% of rdg	±2.0 Ω ±0.04% of rdg	(30 mΩ + 0.0015% of rdg)/°C[1]
		0 Ω to 100 kΩ	100 nA	1 Ω	1 Ω + 0.002% of rdg	±10.0 Ω ±0.04% of rdg	(100 mΩ + 0.0015% of rdg)/°C[1]

[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

	RTD	Diode
Measurement type	4-lead differential	4-lead differential
Excitation	Constant current with current reversal	10 µA constant current
Supported sensors	Cernox®, platinum, germanium, carbon-glass, rhodium-iron, and Rox™	Silicon, GaAlAs
Standard curves supplied	LSCI PT-100, IEC PT-100, IEC PT-1000	LSCI DT-670, LSCI DT-470
Input connector	5-pin terminal plug	5-pin terminal plug

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

	240-2P	240-8P
Normal mode		
Update rate	10 rdg/s[1]	2.5 rdg/s[1,2]
Filter	100 ms	100 ms
High speed mode		
Update rate	10 to 1000 rdg/s	N/A
Filter	1 to 100 ms[3]	N/A

[1] Update rate is halved when input is on the 100 kΩ range with current reversal enabled

[2] All inputs enabled

[3] Filter settings are tied to the update rate (filter = 1000/update rate)

Temperature conversion: Lake Shore calibration curves (linear interpolation)
User curves: Each input has storage for one 200-point curve
Reporting units: K, °C, °F, V, Ω

Digital I/O – RS-485

Protocol: Profibus DP-V0, Modbus RTU, LS ASCII Syntax
Baud rates: 9.6 k, 19.2 k, 45.45 k, 93.75 k, 187.5 k, 500 k, 1.5 M, 3 M, 6 M, 12 M (auto baud-rate detect)
Identification number: 0x0F84
Reading data format: Single precision float (32-bit)
Reading rate: Matches update rate of the instrument

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

	240-2P	240-8P
Displayed readings	2	2
Readings cycling	Fixed (no cycling)	3 second hold per pair

Temperature display resolution: 0.0001° from 0° to 9.9999°, 0.001° from 10° to 99.999°,
0.01° from 100° to 999.99°, 0.1° above 1000°
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 able 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

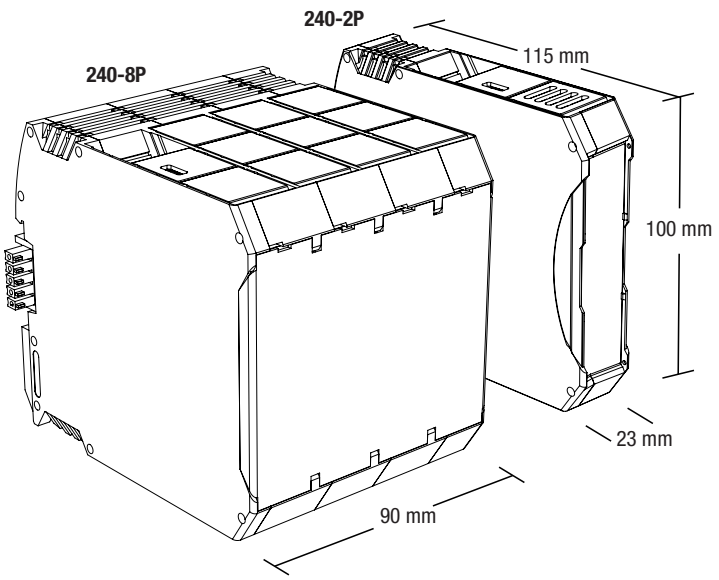
Getting to know the 240 Series

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

Part number	Description
240-2P	2-input cryogenic temperature sensor input module
240-8P	8-input cryogenic temperature sensor input module

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

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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.



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