

# Cryogenic Temperature Monitor

## Model 12C



The Model 12C is a two-channel cryogenic temperature monitor that is designed to support general purpose laboratory and cryogenic applications.

### Highlights:

- Two multipurpose input channels support Diode, Platinum RTD and most cryogenic NTC temperature sensors.
- Operation from **500mK** to over **1,200K** with an appropriate sensor.
- Two 10-Ampere dry-contact relay outputs.
- Flexible input power: Power over Ethernet or 7.5-48V AC/DC.
- Continuous **data logging** into internal Non-Volatile memory.
- Built-in web server. Temperature monitoring and instrument configuration can be performed using any web browser.
- E-mail on selected alarm conditions.
- Remote interfaces include **Ethernet** and **RS-232**. **USB 2.0** and **IEEE-488.2 (GPIB)** are optional. **LabView™** drivers available for all interfaces.
- Remote command language is IEEE-488.2 SCPI compliant, ensuring your system software will not become obsolete.

### Applications:

#### General Purpose Laboratory:

- Supports virtually every cryogenic temperature sensor.
- Ethernet connectivity for ease of remote control.
- Temperature activated relays and alarms. E-mail on alarms.
- Instrument status and control via a standard web browser.

#### Distributed Instrumentation:

- Ethernet facilitates separation of instruments over great distances so the instrument can be moved closer to the temperature sensors.
- Many instruments can be connected to a single LAN.
- Power over Ethernet simplifies power distribution

#### Superconducting Magnets:

- Robust support for the NTC temperature sensors that are commonly used in magnet systems.
- Internal data logging to NV memory records time stamped data and survives power failure

#### Data Acquisition / Computer Control:

- Ethernet interface
- Remote command language is SCPI compliant.
- LabView™ drivers.

#### Cryogen-Free Systems:

- Two input channels
- Two high current relay outputs



## Sensor Inputs

The Model 12C has two identical and independent input channels, each capable of supporting the same wide range of sensor types. Inputs are not scanned or multiplexed.

**Silicon diode** sensors are supported over their full temperature range by using 10µA constant-current DC excitation.

**Negative-Temperature-Coefficient (NTC) resistors** are often used as low temperature thermometers. Examples include **Ruthenium-oxide**, **Carbon-Glass**, **Cernox™**, **Carbon-Ceramic**, **Germanium** and several others. The Model 14C/12C provides robust support for these sensors by using constant-voltage AC excitation. In the warm region where the sensor has low resistance and low sensitivity, constant-voltage will apply a high excitation current to improve measurement accuracy. At low temperature where the sensor has high sensitivity and high resistance, measurement errors are dominated by sensor self-heating. Constant-voltage excitation reduces this error by reducing power dissipated in the sensor as temperature decreases.

Low temperature systems can also be negatively affected by coarse steps in excitation current. The Model 14C/12C prevents this by using a step-less, continuously variable excitation source.

**Positive Temperature Coefficient (PTC) resistor** sensors including **Platinum**, **CLTS** and **Rhodium-Iron** RTDs use constant-current, AC excitation.

Platinum RTD sensors use a built-in DIN standard calibration curve that has been extended to 14K for cryogenic use. Lower temperature use is possible with custom calibrations.

The Model 14C/12C includes built-in **sensor calibration curves** that support most industry standard temperature sensors. Additionally, eight **user calibration curves** are available for custom or calibrated sensors. Each user curve may have up to 200 entries.

For all sensor types, conversion of a sensor reading into temperature is performed by using a **Cubic Spline** interpolation algorithm. In addition to providing higher accuracy than conventional linear interpolation, the spline function eliminates discontinuities during temperature ramps or sweeps by ensuring that the first and second derivatives are continuous.

Model 12C Supported Sensors		
	Temperature Range	Example Sensors
<b>Silicon Diode</b>	1.4 - 500K	Cryo-con S900 SI-440, 430, 410 Lakeshore DT-670, 470
<b>Platinum RTD</b>	14 - 1200K	Cryo-con CP-100 Cryo-con GP-100 Cryo-con XP-100 Cryo-con XP-1K
<b>Rhodium-Iron</b>	1.4 - 800K	Oxford PHZ 0002
<b>Germanium Thermistor</b>	500mK - 400K	AdSem, Inc.
<b>CLTS</b>	4 - 300K	Vishay CLTS-2B
<b>Silicon Thermistor</b>	1.0 - 720K	AdSem, Inc.
<b>Cernox™</b>	500mK - 325K	Lakeshore, all types
<b>Carbon-Ceramic</b>	500mK - 300K	Temati
<b>Ruthenium Oxide</b>	500mK - 270K	SI RO-600
<b>Thermistor</b>	193 - 523K	Measurement Specialties

**Input Channel Statistics:** The Model 14C/12C continuously tracks temperature history independently on each input channel and provides a statistical summary that indicates the channel's minimum, maximum, average and standard deviation. Also shown are the slope and the offset of the best-fit straight line of temperature history data.

Input Specifications			
	Diode sensors	PTC resistor sensors	NTC resistor sensors
<b>Input Configuration</b>	Constant-Current DC	Constant-Current AC	Constant-Voltage AC
<b>Input Range</b>	0.1V - 2.00V 0.3V - 6.0V	1.0mA: 0.1 - 750Ω 100µA: 1.0 - 7.5KΩ	Minimum: 5Ω Maximum: 100KΩ
<b>Accuracy:</b> % Rdg ± % Range	0.004% ± 80µV	0.01% ± 0.0005%	14 to 30KΩ: 0.05% ± 0.05% 4 to 100KΩ: 0.15% ± 0.15%
<b>Resolution:</b> % Range	10µV	0.0003%	0.0003%
<b>Excitation</b>	10µA DC	1.0mA, 100µA	10mV 1.25mA to 100nA

## Easy to use

The monitor's front panel consists of a large, bright TFT-LCD display, a 4-key keypad, an audio alarm and three status LEDs.

Several display formats may be selected. Both temperature readings may be displayed simultaneously or two channels with input names and temperature shown in a large easy to read font. Additional screens include temperature readings along with relay and alarm status information.

A single key press takes the screen to a menu tree where most features and functions of the instrument can be configured.

## Input Power

The monitor is shipped with a 12VDC@1A external power supply but may be powered by any source providing 7.5 to 24 Volts AC or DC.

The IEEE 802.3af Power over Ethernet (PoE) specification is also supported, allowing the Model 14C/12C to be powered by it's local area network connection. Since PoE provides both instrument power and data over a single cable, remote data acquisition and high channel count systems can be simplified.

<b>A: Sample Holder</b> <b>123.456K</b>
<b>B: Rad. Shield</b> <b>234.567K</b>

## Data logging

Data Logging is performed by continuously recording temperature and status to an internal circular memory buffer. Data is time stamped so that the actual time of an event can be determined. Non-volatile memory is used so that data will survive a power failure. The monitors will log up to 800 samples. Each sample includes readings for all input channels.

## Alarms and Relays

Two 10A dry-contact relay outputs can be asserted based on temperature setpoints from user selected input channels. These relays are large enough to switch most cryogenic valves.

Visual, remote and audible alarms are supported. Each may be programmed to assert or clear based on temperature setpoints.

Alarms may be latched. These are asserted on an alarm condition and will remain asserted until cleared by the user.

## Firmware updates

Full instrument firmware updates may be installed by using the Ethernet connection. Updates are free of charge and generally include enhancements and new features.

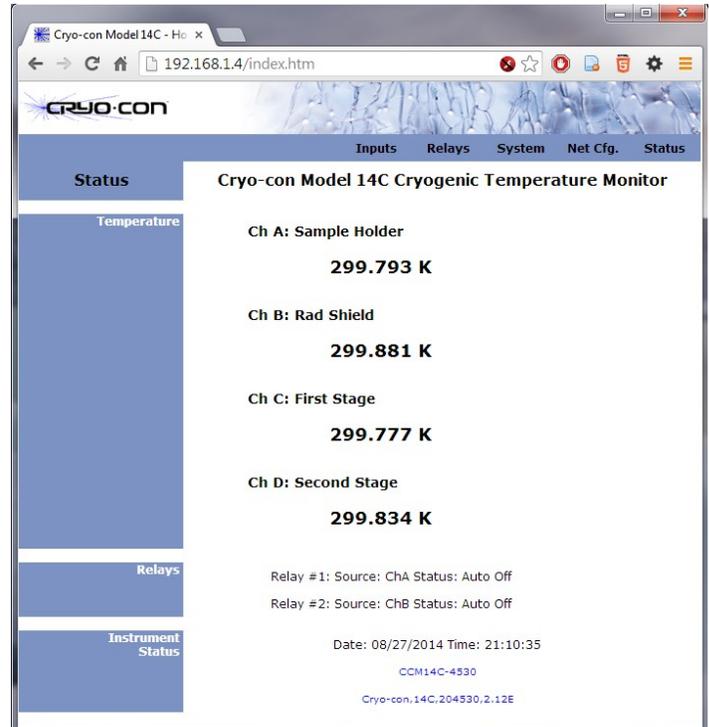
## Remote Control

Standard Remote Interfaces include Ethernet and RS-232. An **IEEE-488.2 GPIB** interface is optional and may be field installed at any time.

The **TCP** and **UDP** data port servers bring fast Ethernet connectivity to data acquisition software including LabView™.

Using the **SMTP** protocol, the monitor will send e-mail based on selected alarm conditions.

Using the Ethernet **HTTP** protocol, the monitor's **embedded web server** allows the instrument to be viewed and configured from any web browser.



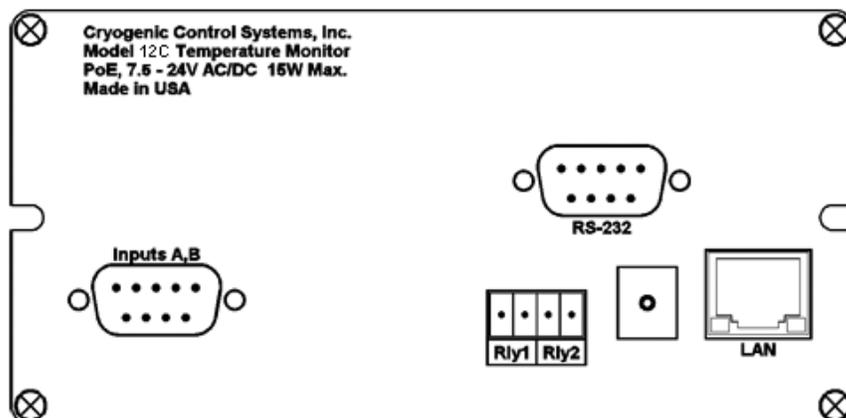
Remote interfaces implement an IEEE-488.2 SCPI compliant remote command language that is easy to learn and easy to read. This language is identical across all Cryo-con products to ensure that your investment in system software is always protected.

## Ordering Information

Part Number	Description
<b>Model 12C</b>	Two-channel monitor.
<b>3012-020</b>	Panel Mount hardware kit.
<b>05-0007</b>	International version of the external 12V power supply including multi-blade kit.
<b>4001-003</b>	Single Power over Ethernet Power injector.
<b>4001-002</b>	IEEE-488.2 (GPIB) Option, field installable.
<b>4001-001</b>	USB 2.0 Option. Serial Port Emulation. Field installable.

## Rear panel connections

- **Input Connectors:** DB-9 recepticals provide 4-wire measurement for two sensors each.
- **LAN:** Standard RJ-45 Ethernet connector. Power over Ethernet connection, GPIB Option.
- **Power input:** 7.5 to 24V AC/DC.
- **RS-232:** DB9 plug. Also used for USB option connection.
- **Relays:** 4-pin detachable terminal block.



## Specifications

### Input Channels

The Model 12C has two input channels. Both are identical and independent, each capable of supporting a wide range of sensor types.

**Sensor Connection:** 4-wire differential. DB9 Connectors.

**Thermocouple Connection:** External option. Field installable.

**Sensor Types:** See Supported Sensor Table.

**Sensor Selection:** Front Panel or remote interface.

**Input Configurations:** See input specifications table.

**Excitation Modes:** Constant-Current or Constant-Voltage.

**AC Excitation Frequency:** 1.625Hz bipolar square wave.

**Voltage Excitation:** 10mV. Minimum excitation current is 100nA, maximum is 1.25mA.

**Sample Rate:** 7.5Hz per channel, all modes.

**Digital Resolution:** 24 bits.

**Measurement Accuracy:** See input specifications table.

**Measurement Drift:** 30ppm/°C.

**Isolation:** Input channels are not isolated.

**Measurement Filter:** 0.5, 1, 2, 4, 8, 16, 32 and 64 Seconds.

**Calibration Curves:** Built-in curves for industry standard sensors plus eight user curves with up to 200 entries each. Interpolation is performed using a Cubic Spline.

### User Interface

**Display Type:** Graphics TFT LCD, 4mm and 8mm character height.

**Number of Inputs Displayed:** Up to two.

**Keypad:** Sealed Silicon Rubber.

**Temperature Display:** Six significant digits, autoranged.

**Display Update Rate:** 0.5 Seconds.

**Display Units:** K, C, F or native sensor units.

**Display Resolution:** Up to seven significant digits.

### Data Logging

Time stamped temperature data can be logged into an internal 800 entry circular buffer. Buffer memory is non-volatile and will retain valid data during loss of power. Both input channel temperatures are recorded.

### Status Outputs

**Audible and Visual Alarms:** Independent audible, remote and visual alarms. Alarms can be latched.

**Relays:** Two dry-contact relays. N.O. contacts available. Contact ratings: 10A@125VAC or 5A@30VDC.

### Remote Interfaces

Maximum reading rate for all interfaces is >40 rdg/s.

**Ethernet:** Connects to any Ethernet Local Area Network.

Electrically isolated. **TCP** and **UDP** servers provide remote control by using an ASCII command language. **HTTP** provides built-in web server. **SMTP** sends e-mail.

**RS-232:** Standard null modem. Data rates are 9600, 19,200, 38,400 and 57,200 Baud. Connector is a DB-9 plug.

**IEEE-488.2 (GPIB):** External Option, field installable.

**USB 2.0:** External option, field installable. Serial port emulation.

**Programming Language:** IEEE-488.2 SCPI compatible.

**LabVIEW™** drivers available for all interfaces.

### General

**Ambient Temperature:** 25°C ± 5°C for specified accuracy.

**Mechanical:** 5.6"W x 2.9"H x 8.8"D.

**Weight:** 3.5 Lbs.

**Power Requirement:** IEEE-802.3af Power over Ethernet (requires powered hub or injector) or 5 - 24V AC/DC. (External power supply included) 10VA.

**AC Power Switch:** Front panel.

**Conformity:** European CE certified.

**Calibration:** NIST traceable.

## Contact Information

Cryogenic Control Systems, Inc.

PO Box 7012

Rancho Santa Fe, CA 92067

Tel: (858) 756-3900 Fax: (858) 759-3515

E-mail: [sales@cryocon.com](mailto:sales@cryocon.com) Web: [www.cryocon.com](http://www.cryocon.com)

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