E1000
Dual Temperature Controller

Users Manual

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Revision History

Document Number 97-00041-002

Date	Revision	Description of Change
March 2010	1.0.0	New Document
April 2010	1.0.1	Added statement to clarify mode change sequence

E1000 Dual Channel Cryogenic Temperature Monitor

Overview

- Continuous visual update of two temperature sensors (channels) using backlit LCD display
- Drives two temperature diodes, intended for cryogenic temperature measurement
- Diode temperature curve selection from four pre-defined curves
- Supports one user-defined, programmable diode curve
- Six programmable setpoint relays (three per sensor/channel)
- Two 0 – 10 V analog outputs for temperature monitoring (one per sensor/channel)
- Provides an RS-232 serial port for a PLC or PC digital interface
- Independent control of two outputs

Description

The E1000 Dual Channel Temperature Monitor drives two diode temperature sensors, and provides a visual display of the temperature on a backlit LCD module. The intended applications of the E1000 include controlling two separate cryopumps or cryocoolers simultaneously, by using one diode (channel) for each coldhead. The E1000 also has the unique capability to control the temperature of a water pump to a user specified temperature from90 to 130K. While in the Water pump mode, the coldhead power will be stopped when the water pump reaches the selected off temperature and resume pumping when the upper temperature is reached. The high resolution measurement sensors provide noise rejection to deliver precise, accurate temperature readings. The diode curves are user selectable from four (4) pre-defined curves providing support for common diodes. In addition, a user-programmable curve is available for non-supported diodes. Temperature conversion is provided by a 10µA constant current source using a spline interpolation (piecewise polynomial).

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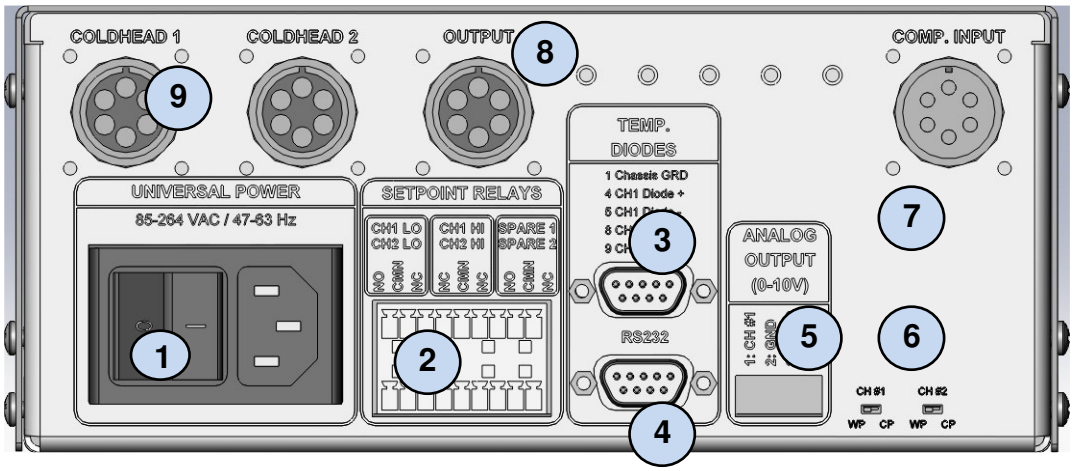
E1000 Installation



1 – IEC Power Entry. Universal Power input accepts 110 or 220 VAC at 50 or 60 Hz

2 – Setpoint Relays. Dry contacts are provided to trigger external equipment, or to provide status to control electronics, such as a PLC. Three relays are provided for each temperature channel. The top row connector is controlled by Channel #1 sensor, and the bottom is controlled by Channel #2. See the setpoint table for a detailed pin-out.

3 – D-sub 9 Female: Temperature Sensors. Connect temperature sensor according to the following pin out:

Pin 1: Shield (GND)
Pin 2: No Connect (NC)
Pin 3: NC
Pin 4: Diode Sensor #1 Positive
Pin 5: Diode Sensor #1 Negative
Pin 6 – 7: NC
Pin 8: Diode Sensor #2 Positive
Pin 9: Diode Sensor #2 Negative

4 – D-sub 9 Male: RS-232 Serial Port. Provides serial interface to a remote serial device. The serial port is intended to be used with a standard "straight through" serial cable (not NULL Modem).

Pin 1: No Connect (NC)
Pin 2: RS-232 Transmit Out
Pin 3: RS-232 Receive In
Pin 4: NC
Pin 5: GND
Pin 6 – 9: NC

5 – Analog Outputs. Analog outputs are provided for recorder logging, or as status to a PLC. The outputs provide 0 – 10 V for each channel.

Pin 1: Channel #1 Voltage Output
Pin 2: GND
Pin 3: Channel #2 Voltage Output
Pin 4: GND

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E1000 Rear Panel cont.

6 – Mode Selection. 2 miniature slide switches allow the user to select either Coldhead or Waterpump mode. In the coldhead mode, the channel will provide power to the output at all times and will operate the relays according to the user set temperatures. In the Cryopump mode, power will be supplied at all times to the coldhead, unless, the manual mode is selected. To change the Mode of the E1000, the power switch must be turned off and back on after changing the positioni of the switch.

7 – Compressor Power in. Input drive power from the compressor. Requires special drive cable.

8 – Compressor Power Out. Power out to drive and additional E1000. The power is fused at 3 amps.

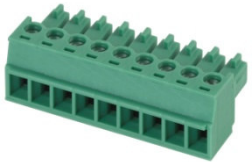
9 – Coldhead out - Output power to the coldhead or water pump. Uses standard cryopump drive cable.

Setpoint Relay Pin-out

The table below describes the relay configuration. For each channel, 3 separate dry contacts are provided. Each dry contact has three connections: Normally Open, Normally Closed, and Common.

Pin-out (Left to Right)	Top Row	Bottom Row	Relay Position
Pin 1	Channel 1 Low Relay	Channel 2 Low Relay	Normally Open
Pin 2			Common
Pin 3			Normally Closed
Pin 4	Channel 1 High Relay	Channel 2 High Relay	Normally Open
Pin 5			Common
Pin 6			Normally Closed
Pin 7	Channel 1 Spare Relay	Channel 2 Spare Relay	Normally Open
Pin 8			Common
Pin 9			Normally Closed

The dual row connector provided on the E1000 requires two male connectors for mating. The recommended mating connector is Phoenix Contact Part Number 1803646. Note that if only one channel is utilized, only one Phoenix Contact connector is needed.



Single Row Mating Connector (1803646)

Analog Outputs (0 – 10 V)

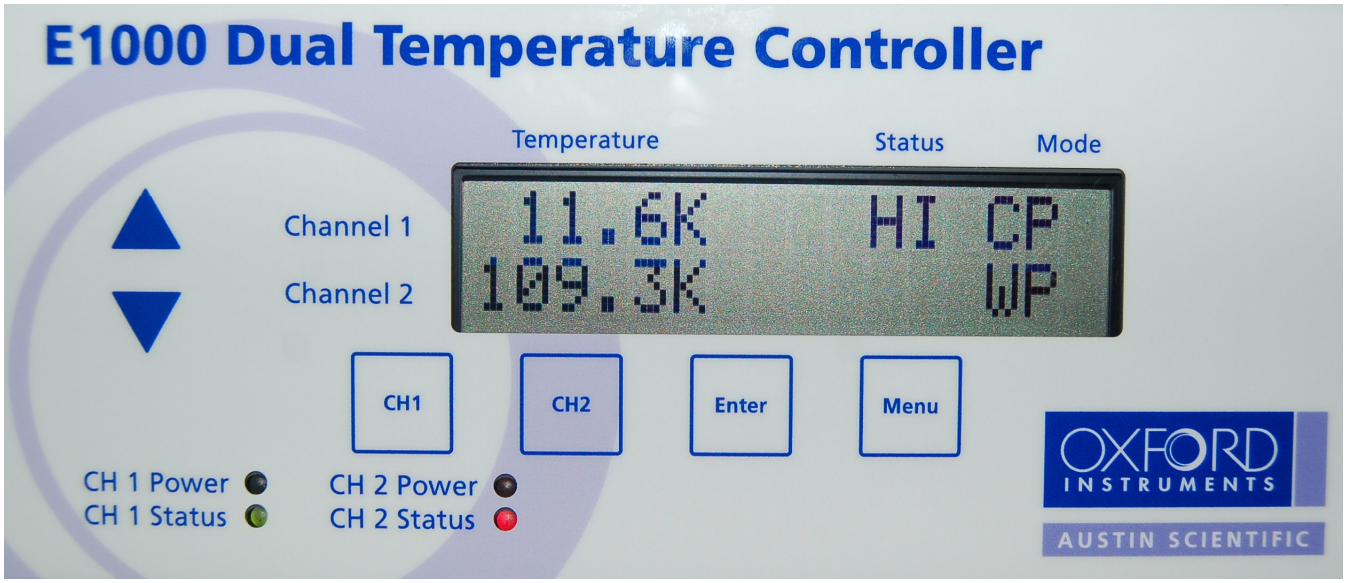
The E1000 provides an analog output for each channel. A terminal block style plug is required to connect to the analog outputs. The recommended mating connector is Phoenix Contact Part Number 1803594. The outputs can provide a maximum output current of 60 mA each. To convert the output voltage to temperature, use the following formula:

Temperature (Kelvin) = 35 * Analog Output Voltage (in Volts)

This formula provides a maximum range of 0 – 350.0 K. The pinout (also shown on the back panel of the unit) is as follows:

Analog Output Pinout (Pin#1 left-most)	
1	Channel #1 Analog Output
2	Ground
3	Channel #2 Analog Output
4	Ground

E1000 Front Panel



E1000 User Interface

The E1000 provides a continuous display of the temperature measurements. The display interface also provides diode curve selection, and setpoint configuration.

Manual/Auto Configuration

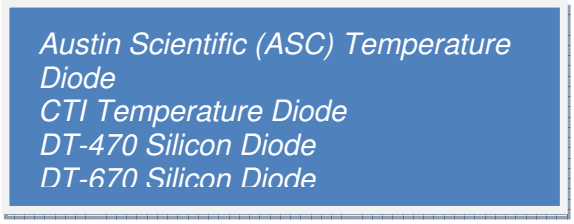
The user can manually control the operation of the coldhead by selecting the CH1 or CH2 switch from the front panel. Pushing the cold head switch causes the respective cold head to switch off. It the switch is pushed again the cold head is switched on. The manual mode will override the water pump control mode. To place the E1000 back into auto mode, use the menu function. Pressing the **menu** button will take the operator to the Manual/Auto selection on the first press of the button. Pressing the **UP** or **DOWN** keys to change the mode.

Diode Curve Selection

The user can select the diode curve which corresponds to the temperature diode sensor connected to the E1000. To select a diode curve:

1. Press the **MENU** button.
2. Scroll through the standard diode options by pressing the **UP** and **DOWN** buttons.
3. When the appropriate diode curve has been selected, press **MENU**.

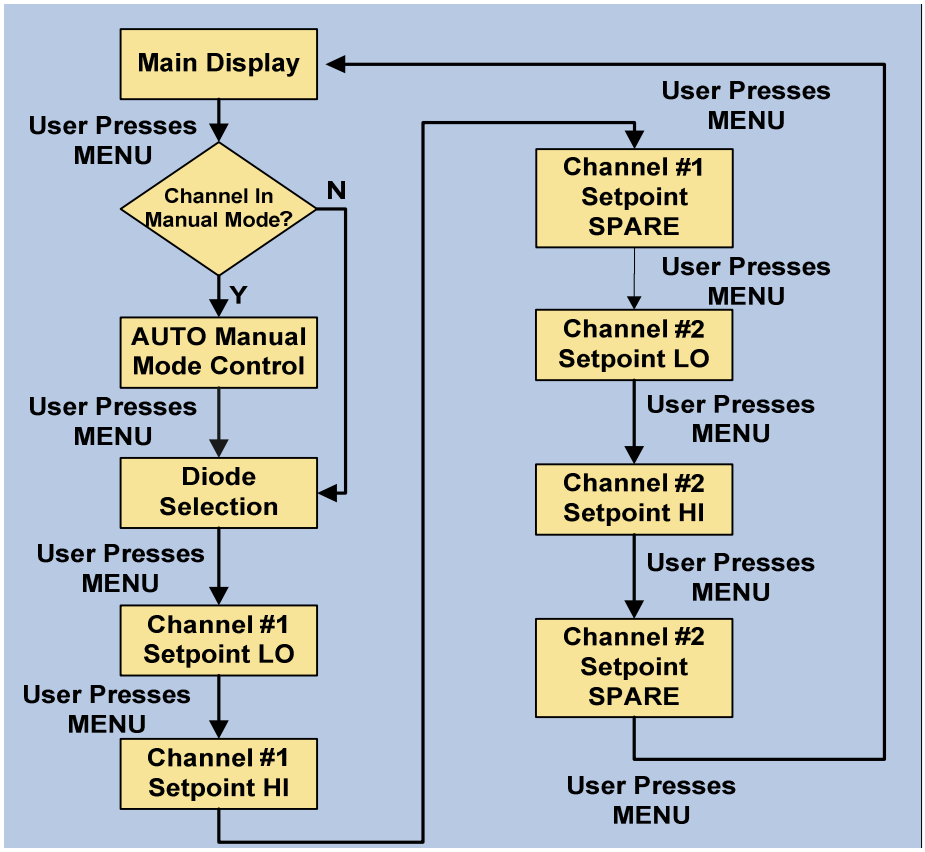
E1000 supports the following standard temperature sensor diodes:



Setpoint Configuration

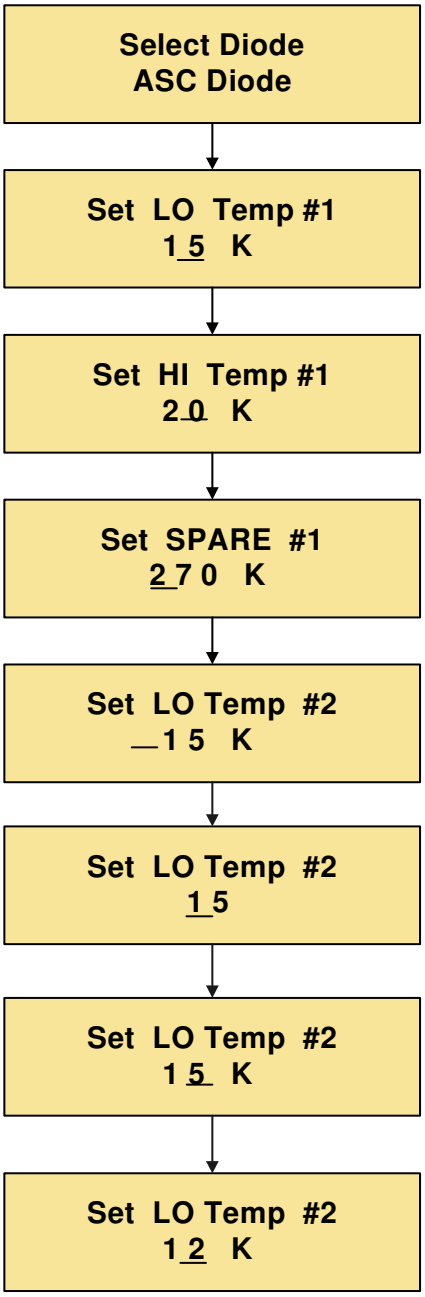
The user can individually configure each setpoint relay to a unique temperature. Each channel has 3 setpoints associated with its temperature measurement – LOW, HIGH, and SPARE. A flow chart is shown to aid in navigating the menus. In addition, an example is shown at the end of the section. If no buttons are pressed for roughly 10 seconds, the display times out and returns to the main menu. NOTE: the changes *are stored* and take effect if the menu times out. To configure a setpoint:

1. Press the **MENU** button twice. The first relay is "**Channel #1 LO**". When the temperature is *below* this value, the relay is in the "Active" position. The temperature value is modified by pressing **UP** or **DOWN** for each digit. Once the digit has been set, press **ENTER** to move to the next digit.
2. Press the **MENU** button to configure "**Channel #1 HI**". When the temperature is *above* this value, the relay is in the "Active" position.
3. Press the **MENU** button to configure "**Channel #1 SPARE**". When the temperature is *above* this value, the relay is in the "Active" position.
4. Continue to press the **MENU** button to cycle through the Channel #2 setpoints.



Example

The example shown below will configure Channel #2 Low Setpoint Relay to 12 K. Begin by pressing **MENU** to navigate to the "Select Diode" display shown below.



*Press **MENU** button to move to the "Channel #1 SPARE Temperature Setpoint.*

*The first menu is the diode selection menu. Press **MENU** button to move to the "Channel #1 Low Temperature Setpoint.*

*Press **MENU** button to move to the "Channel #1 High Temperature Setpoint.*

*Press **MENU** button to move to the "Channel #2 Low Temperature Setpoint. Note that the cursor is on the HUNDREDS digit. Press **ENTER** to move to the TENS digit.*

*Press **MENU** button to move to the "Channel #2 Low Temperature Setpoint.*

*The cursor is now on the TENS digit, so press **ENTER** again to move to the ONES digit.*

*Once the cursor is on the ONES digit, use the **UP** / **DOWN** keys to increment the value under the desired value of 12K is reached.*

*After the value has been set, either press **MENU** until the Main Display is reached, or let the display timeout after 10 seconds.*

Serial Port Interface

The E1000 provides a DB9 Male connector for serial port communications. A "straight through" serial cable, as shown in the diagram below, is necessary for interfacing to the serial port. Only pins 2, 3, and 5 are required.

Serial Port Cable

Pin Assignment		
DB9 Female (to E1000)		DB9 (to Controller)
1	----------	1
2	----------	2
3	----------	3
4	----------	4
5	----------	5
6	----------	6
7	----------	7
8	----------	8
9	----------	9

Serial Port Protocol

All commands start with '$', and end with \r\n. The serial port should be configured as shown in the following table.

Serial Port Settings	
Baud Rate	19,200
Data Bits	8
Parity	NONE
Stop Bits	1
Flow Control	None

Serial Port Commands

The following serial port commands are provided:

GetRev

Returns: Revision $x.x

	Example
SEND	$GetRev\r\n
RECEIVE	$Revision 1.0\r\n

GetTemp(channel) - Returns the current temperature in K for the selected channel.

Channel: 1 or 2

Returns:$xxx.x or "OOR" if out of range.

Example (Get Channel 2 Temp)	
SEND	$GetTemp 2\r\n
RECEIVE	$21.6\r\n

GetSetp (channel,relay)

Channel: 0 or 1 (0-> Channel 1, 1-> Channel 2)

Relay: 0, 1, or 2. 0->LO, 1->HI, 2->SPARE

Returns: $xxx (integer)

Example (Get Channel 2 SPARE setpoint)	
SEND	$GetSetp 1,2\r\n
RECEIVE	$280\r\n

SetSetp(channel,relay,temp)

Channel: 0 or 1 (0-> Channel 1, 1-> Channel 2)

Relay: 0, 1, or 2. 0->LO, 1->HI, 2->SPARE

Temp: xxx (integer, no decimal point)

Returns: $xxx\r\n (returns the new value stored)

Example (Set Channel 1 LOW setpoint to 12K)	
SEND	$SetSetp 0,0,12\r\n
RECEIVE	$12\r\n

GetVolt(channel) - Returns the voltage in Volts for the selected channel.
Channel: 1 or 2
Returns: $x.xxxx

Example (Get Channel 2 Voltage)	
SEND	$GetVolt 2\r\n
RECEIVE	$1.2345\r\n

SetColdhead (Coldhead, on /off) Turns the coldhead on and off
Channel: 0 or 1
Returns: $0 or $1 (0/1 for OFF/ON)

Example (Turn Channel 1 on Manual)	
SEND	$SetColdhead 0,1\r\n
RECEIVE	$0 or $1\r\n

GetColdhead x (where x is the Coldhead number, and it returns 0/1 for OFF/ON)
Channel: 0 or 1
Returns: $0 or $1 (0/1 for OFF/ON)

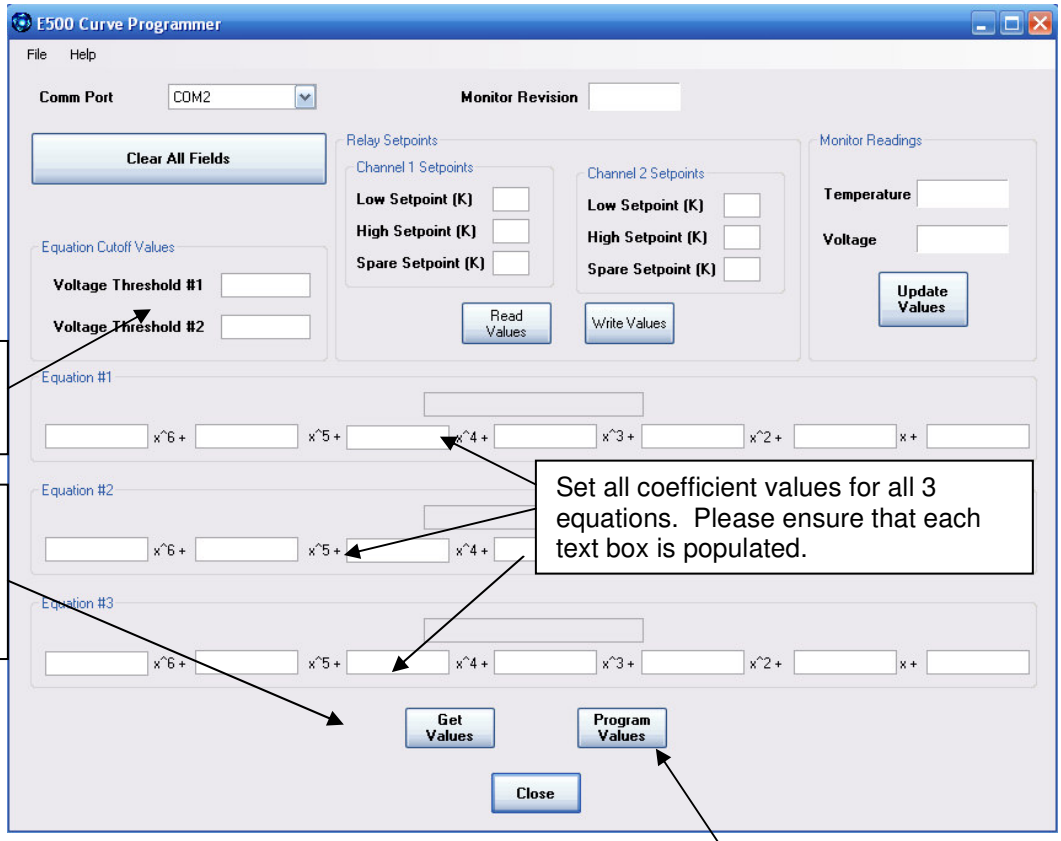
Example (Get The status of the coldead)	
SEND	$GetColdhead 0,1\r\n
RECEIVE	$0 or $1\r\n

GetMode 0 (Channel, Mode) – Returns the mode of the selected channel, Coldhead or water pump
Channel: 0 or 1
Returns: $0 or $1 (0 = Waterpump ,1 = Cryopump)

Example (Get the mode of the output)	
SEND	$Getmode 0 \r\n
RECEIVE	$0 or $1\r\n

E1000 Curve Programmer

To enter data for a user defined diode curve, the **E1000 Curve Programmer** can be used. This utility allows the user to enter the polynomial coefficients that control the voltage to temperature conversion.
In order to determine appropriate values, several "Voltage vs. Temperature" data points should be viewed in graph form. The graph can be broken up piece-wise into a maximum of 3 equations. For each of the equations, a trend line should be developed using a program such as Microsoft Excel or Matlab. Up to a 6th order polynomial can be used for each equation to provide maximum flexibility.
Once the values have been chosen, the fields shown below should be populated.



Set the 2 voltages values that determine the boundaries of the 3 equations.

Begin by pressing "Get Values" at the bottom of the screen. This will ensure that communications are established. If successful, the "Monitor Revision" will be available.

Set all coefficient values for all 3 equations. Please ensure that each text box is populated.

An advanced feature is also provided to allow the user to write the coefficients and setpoints to a file from the E1000 Temperature Monitor. Select "File -> Write Values to File…" and browse to a file location. This will create a user editable text file with the coefficients and setpoints. Updates can be made to the file to change values, and then downloaded back to the E1000 Monitor by selecting "File -> Program Values From File…".

Once all fields are populated, press "Program Values" to permanently program the new coefficients to the CUSTOM curve.

Technical Specifications

The technical specifications for the E1000 Dual Channel Cryogenic Temperature Monitor are listed in the table below.

E1000 Specifications

Features	Display 2 Temperatures	
	Four Selectable Diode Curves	
Power	110/220 VAC Input @ 50/60 Hz (Universal Input)	
Connectors	IEC Power Input	
	DB9F (Diode Driver)	
	DB9M (Serial Connector)	
Dry Contact Rating	Carry AC Current	10 A @ 250 VAC
	Carry DC Current	5 A @30 VDC
	Max Switching Voltage	400 VAC 300 VDC
	Max Switching Current	NO: 10 A NC: 8 A
	Max Switching Power	NO: 2,500 VA NC: 2,000 VA 150 W
Analog Output	0 – 10 V 60mA max	
Dimensions	8.46" (W) x 8.61(L) x 3.63" (H)	

Order Information

Use the following Table to determine the P/N and optional accessories when placing order with Austin Scientific.

E1000 Dual Channel Cryogenic Temperature Monitor	93-00040-000	E1000, includes connections for dry contacts, analog output and power cable. Order diode cable(s) separately per desired configuration (see below).			
	99-00101-000	19" Rack Mount Kit			
	10-00001-000	E1000 Curve Programmer (to program custom diode curve)			
Configuration	**Cables**	**10 Ft**	**15 Ft**	**20Ft**	**50 FT**
Single or Dual E1000	Compressor Input Cable	81-00044-010	81-00044-015	81-00044-020	81-00044-050
Two Cryopumps or coldheads	Dual Cryopump Diode Cable	81-00038-010	81-00038-015	81-00038-020	81-00038-050