

Applications

The TIC 500 high performance cryogenic temperature controller — a high performance instrument that can monitor and control temperatures with millikelvin resolution — is configured to suit a wide range of research and industrial applications:

- 4 sensor inputs
- 2 powered outputs
- 4 analog voltage outputs
- 6 feedback control loops
- 4 general purpose analog I/O
- 8 digital I/Os
- autotuning functions

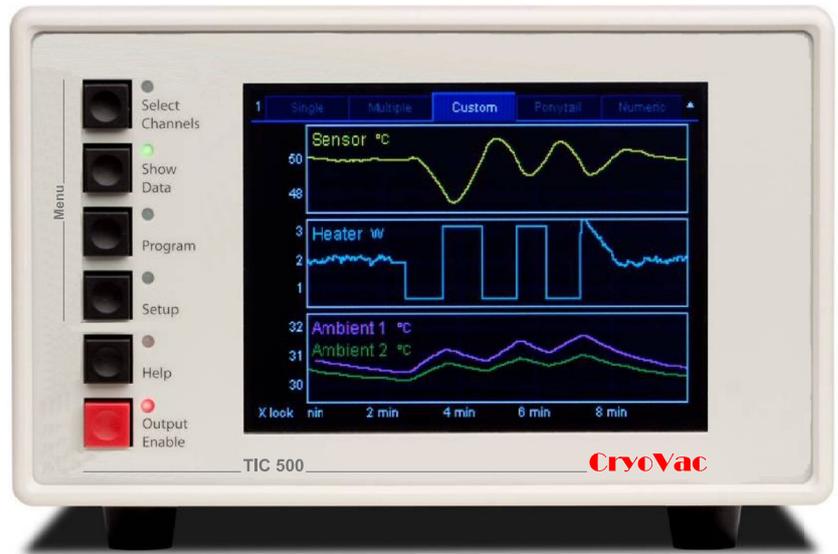
Sensor Inputs

The TIC500 offers four temperature inputs that can read RTDs, thermistors, and diodes. Each temperature input channel has its own 24-bit ADC with eleven input ranges, and is equipped with its own independent excitation current source.

Standard calibration curves for a variety of sensors are included, and custom calibration curves of up to 200 points each can be entered. Each sensor input has high and low level or rate-of-change alarms. Sensor inputs can be low-pass-filtered to reduce noise, and/or differenced with another channel.

Powered and Unpowered Outputs

The TIC 500 has two heater outputs that can each deliver up to 100 W of power to a 25 Ω heater. In addition, four analog voltage I/O channels can be used to drive heaters with the help of an external amplifier.



PID Feedback Control

With up to six feedback control loops available, the TIC 500 can provide precise temperature control of each of its heater outputs by continually adjusting the heater power. Any of the TIC 500's channels can be selected as the input for each feedback loop. Feedback time constants can be adjusted between 200 ms and 10 hrs.

Up to ten sets of PID parameters can be stored for each channel. Setpoints can be ramped at a fixed rate (or with a user program), set from an analog input.

Analog / Digital I/Os

The TIC 500 has four general-purpose ±10 V voltage I/O channels read by a 24-bit ADC and eight digital I/O channels that can interact with user programs.

Four 5 A relays can be used for process control. Three virtual channels, not connected to any physical input, allow calculated values (such as the difference between two channels, or a value calculated by a user program) to be displayed, graphed, and logged.

System		In 1	Out 1	
Name	Plot	Lopass	Status	Output
In 1	1	Off	Off	
Value	Logging	d/dt	Mode	Relay
26.22 °C	Default	Off	Off	None
Sensor	Current		Latch	Min
RTD	Forward		No	0.000 °C
Range	PCB		Mute	Max
300Ω	35.00 °C			0.000 °C
Units	Diff		Sound	Lag
Ω			None	0 s
				Type
				IEC751
				R0
				100.00
				A
				0.0039
				B
				-5.775e-7
				C
				-4.183e-12

Channel setup menu

Single	Multiple	Custom	Ponytail	Numeric
In 1	50.178 °C			
In 3	25.773 °C			
In 4	25.811 °C			

Numeric display

Numeric and Graphical Display

The color LCD display can show any combination of temperature measurements and heater outputs on graphs or numeric displays. Up to eight channels can be plotted either on a single graph with a common Y axis, or on separate graphs with independent Y axes. Touchscreen operation makes the system versatile and easy to use.

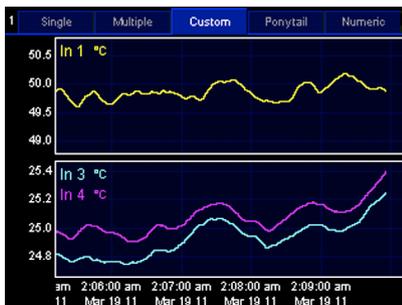
Data Logging

Up to 4096 readings per channel can be logged to the internal memory. For longer-term storage, data can be logged to USB memory sticks or hard drives.

Data logged to USB devices can be transferred to a computer. Windows applications are included to graph log files and to convert them to various ASCII text formats.

Computer Communications

Each of the front-panel controls has a corresponding text command that can be sent over USB, Ethernet, and either RS-232 or an optional GPIB interface.



Graphical display

Specifications

Temperature Controller

Min. sampling rate	1 Hz
Max. sampling rate	50 or 60 Hz (depending on AC line frequency)
Data logging rate	10 samples/second/channel to 1 sample/hour/channel (can be set independently for each channel or globally for all channels)
Display resolution	0.001 °C, °F, K, V, A, W, etc. if $-1000 < \text{displayed value} < 1000$; 6 significant figures otherwise
PID autotuning	Single step response or relay tuning with conservative, moderate, and aggressive response targets
Display	320 × 240 pixel color touchscreen; numeric and graphical data displays.
Alarms	Upper and lower temperature limits or rate-of-change limits can be set on each channel.
Computer interface	USB, Ethernet, and RS-232; GPIB (IEEE488.2) optional
Power	10 A, 88 to 132 VAC or 176 to 264 VAC, 47 to 63 Hz or DC
Dimensions	215 × 127 × 406 (WHL)
Weight	6.5 kg
Warranty	One years parts and labor on defects in material and workmanship

Analog I/O

Inputs/outputs	4 voltage I/O channels, independently configurable as inputs or outputs
Connector	4 BNC jacks
Range	±10 V
Resolution	24-bit input, 16-bit output
ADC noise	30 μVrms (at 10 samples/s)

Digital I/O

Inputs/outputs	8 optoisolated TTL lines, configurable as either 8 inputs or 8 outputs
Connector	One DB-25F

When the USB interface is used, the TIC 500 appears on the computer as a standard COM port and can be controlled by any software that is compatible with an RS-232 port.

User Programs

User programs (macros), consisting of one or more remote commands, can be uploaded to the TIC 500. This is done by either sending them through one of the communications ports or by saving them as text files on a USB memory device and then plugging the device into the TIC 500. Program macros can also be entered and edited from the front panel.

Relays

Outputs 4 independent SPDT relays

100 W DC outputs

Output Two unipolar DC current sources

Connector #6 screw terminals

Range 50 V 2 A, 50 V 0.2 A, 50 V 0.02 A, 20 V 2 A, 20 V 0.2 A, 20 V 0.02 A

Output resolution 16 bit

Accuracy ± 1 mA (2 A range)
 ± 0.02 mA (0.2 A range)
 ± 0.002 mA (0.02 A range)

Noise (rms) (25 Ω load, DC to 10 Hz)
5 μ A (2 A range)
0.5 μ A (0.2 A range)
0.05 μ A (0.02 A range)

Diodes, Thermistors and RTD inputs

Inputs Four inputs for 2-wire or 4-wire thermistor, diode, or RTD
Socket Two DB9 (female)

	Input Range	Excitation Current	Initial Accuracy	Temp. Drift (typ.) (at midrange)	Noise (rms) (at midrange)
Diodes	0 to 2.5 V	10 μ A	10 μ V + 0.01 % of rdg	± 5 ppm/ $^{\circ}$ C	3 μ V
RTDs	0 to 10 Ω	3 mA	± 0.005 Ω	± 0.0001 Ω / $^{\circ}$ C	0.0001 Ω
	0 to 30 Ω	3 mA	± 0.005 Ω	± 0.0001 Ω / $^{\circ}$ C	0.0001 Ω
	0 to 100 Ω	2 mA	± 0.008 Ω	± 0.0002 Ω / $^{\circ}$ C	0.0002 Ω
	0 to 300 Ω	1 mA	± 0.015 Ω	± 0.0004 Ω / $^{\circ}$ C	0.0003 Ω
	0 to 1 k Ω	500 μ A	± 0.05 Ω	± 0.001 Ω / $^{\circ}$ C	0.0007 Ω
	0 to 3 k Ω	200 μ A	± 0.1 Ω	± 0.003 Ω / $^{\circ}$ C	0.002 Ω
	0 to 10 k Ω	50 μ A	± 0.25 Ω	± 0.01 Ω / $^{\circ}$ C	0.007 Ω
	0 to 30 k Ω	50 μ A	± 1 Ω	± 0.02 Ω / $^{\circ}$ C	0.008 Ω
	0 to 100 k Ω	5 μ A	± 4 Ω	± 1 Ω / $^{\circ}$ C	0.12 Ω
	0 to 300 k Ω	5 μ A	± 13 Ω	± 2 Ω / $^{\circ}$ C	0.2 Ω
	0 to 2.5 M Ω	1 μ A	± 1 k Ω	± 50 Ω / $^{\circ}$ C	10 Ω
Thermistors	0 to 10 Ω	1 mA	± 0.007 Ω	± 0.0002 Ω / $^{\circ}$ C	0.0003 Ω
	0 to 30 Ω	300 μ A	± 0.03 Ω	± 0.0004 Ω / $^{\circ}$ C	0.001 Ω
	0 to 100 Ω	100 μ A	± 0.07 Ω	± 0.002 Ω / $^{\circ}$ C	0.002 Ω
	0 to 300 Ω	30 μ A	± 0.25 Ω	± 0.004 Ω / $^{\circ}$ C	0.006 Ω
	0 to 1 k Ω	10 μ A	± 0.6 Ω	± 0.01 Ω / $^{\circ}$ C	0.02 Ω
	0 to 3 k Ω	3 μ A	± 2 Ω	± 0.06 Ω / $^{\circ}$ C	0.06 Ω
	0 to 10 k Ω	1 μ A	± 6 Ω	± 0.2 Ω / $^{\circ}$ C	0.2 Ω
	0 to 30 k Ω	300 nA	± 25 Ω	± 1 Ω / $^{\circ}$ C	1.0 Ω
	0 to 100 k Ω	100 nA	± 150 Ω	± 3 Ω / $^{\circ}$ C	6 Ω
	0 to 300 k Ω	30 nA	± 1 k Ω	± 20 Ω / $^{\circ}$ C	40 Ω
	0 to 2.5 M Ω	1 μ A	± 1 k Ω	± 30 Ω / $^{\circ}$ C	10 Ω