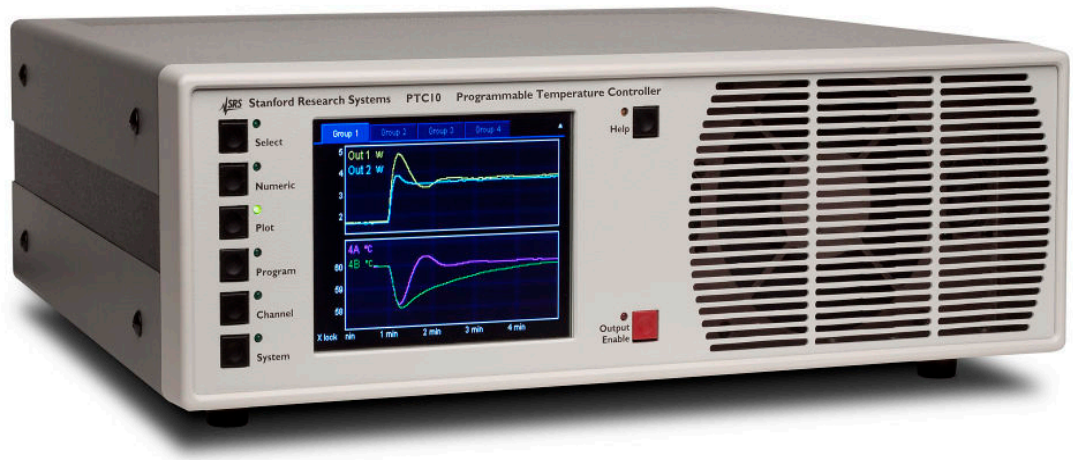
Temperature Controllers

PTC10 — Programmable temperature controller



PTC10 Temperature Controller

- **Up to 16 input channels**
- **Up to 6 PID feedback control channels**
- **50 Hz PID sampling**
- **1 mK resolution**
- **Data logging on removable flash media**
- **USB, Ethernet, RS-232 interfaces (std.)**
- **GPIB interface (opt.)**

Introducing the PTC10 Programmable Temperature Controller from SRS — the ideal instrument for measuring temperature, controlling heaters, and logging temperature data.

The PTC10 Programmable Temperature Controller is a modular system that can be configured to suit a wide range of applications. The system consists of the PTC10 Controller and up to four I/O cards — two types of input cards for RTDs and thermocouples, and two types of output cards for driving heaters. The I/O cards are ordered separately, and you can mix and match them in any way you wish.

Input Cards

The PTC320 Thermistor/Diode/RTD reader has a single input that can read a variety of resistive and diode temperature sensors including thermistors, RTDs, cryogenic diodes, and ruthenium oxide sensors.

The PTC321 RTD reader has four inputs for 100 Ω platinum RTD sensors. Each channel has a four-wire input with its own 1 mA current source for sensor excitation. The current can be reversed with each reading to cancel out stray thermocouple EFMs.

The PTC330 four-channel thermocouple input card is factory configured to read either E, J, K, N or T type thermocouples. Each channel is electrically isolated allowing thermocouples to be attached to electrically-live equipment. An internal

PTC330 Thermocouple Card

PTC430 DC Output Card

isothermal block, with its own RTD temperature sensor, provides highly accurate cold junction measurements.

Output Cards

The PTC420 AC output card is a heater driver that switches up to 5 A of 100 VAC to 240 VAC line current with a solid-state relay. The output power is controlled by switching the current on for some fraction of a 10 s cycle period and off for the remainder of the period. The PTC420 is intended to drive large heaters with response times of more than about 10 s. A PTC chassis can run up to two PTC420s at full power simultaneously.

The PTC430 DC output card delivers up to 1 A of current at 50 VDC, or up to 2 A at 20 VDC. Its unipolar output provides finer control for driving smaller, faster responding heaters.

The PTC440 TEC driver delivers ±5 A of current at ±12 VDC. This bipolar output card is optimized for driving thermoelectric coolers. It also includes a temperature sensor input that can read thermistors, RTDs, LM135, and AD590 sensors.

A PTC chassis can run up to three PTC430s and/or PTC440s at full power simultaneously.

PID Feedback

In a proportional-integral-differential (PID) feedback loop, the power supplied to a heater (the feedback output) is continually adjusted to keep a temperature reading (the input) at a predetermined value (the setpoint). The PTC10 offers up to six independent PID feedback outputs: one on each of up to two output cards, plus the four analog I/O channels. Any of the data channels can be used as the feedback input. PID feedback loops can be auto-tuned using either a single step response or a relay tuning method in which multiple steps create a temperature oscillation.

Data Acquisition and Display

All input channels are read simultaneously at rates between 1 Hz and the line frequency (50 or 60 Hz). Each input channel can be lowpass-filtered to reduce noise. Input channels can also be differenced with any other channel. Three "virtual channels", which are not connected to any physical input, can display the results of more complex calculations.

Standard calibration curves are included for popular sensor types. Custom calibration curves with up to 200 points each can also be applied to any input; the curves are stored on a removable USB memory device and are loaded by simply plugging the device into the PTC10. Sensor calibration can also be adjusted by entering an offset and gain from the front panel.

The PTC10 has an internal data log that stores up to 4096 points per channel. Data can be written to the log at intervals between 0.1 s and 1 hr. The log rate can be set independently for each channel, or a global rate can be used. Data can also be logged to removable USB memory devices like flash keys, flash card readers, and USB hard drives. In this case, the maximum number of points that can be logged is determined by the size of the memory device.

Input and output data can be displayed numerically or plotted on the LCD screen. Up to eight plots, each with up to eight data channels, can be displayed. You can zoom or pan the plots by touching or dragging your finger across the screen.

Upper/lower alarm levels or rate-of-change limits can be assigned to each input. If these limits are exceeded, an audible alarm sounds, a specified relay trips, and a specified output channel can be shut off. Alarms can be latching or non-latching.

Programmability

Remote operation is supported with USB, GPIB (opt.), RS-232, and Ethernet interfaces. All instrument functions can be controlled and read over any of the interfaces. When the USB interface is used, the PTC appears as a COM port on your PC.

The PTC10 supports user-defined macros that consist of one or more remote commands. Macros can be controlled from the front panel, and up to ten macros can run simultaneously. Macros can call other macros, and conditional statements, variables, and loops are supported. Using the PTC10's three virtual channels, macro variables can be plotted on-screen, saved to logs, and/or used as inputs for feedback loops.

Macros are a powerful tool that can be used to tailor the behavior of the PTC10 for your experiment. For example, infinite-loop macros running as background tasks can take steps to address alarm conditions, automatically switch between sensor inputs (or heater outputs) depending on the current temperature or other factors, or implement cascade feedback schemes.

PTC10 rear panel

Multi-Purpose Ports

The PTC10 has four configurable general-purpose analog I/O channels, each of which can be used either as a 24-bit, ±10V input or a 16-bit, ±10V output. The PTC10 also has eight bidirectional digital I/O lines that can interact with macros, and four relays that can be tripped by alarms, remote commands, macros, or from the front panel.

The PTC10's analog I/O channels can be used as feedback inputs, and custom calibration curves can be applied to convert their voltage readings into temperature, pressure, etc. values. If configured as an output, each analog I/O channel has its own PID feedback loop and can be interfaced with external equipment to control a heater or valve. The analog I/O channels can also be made to follow any other input or output, with scale and offset factors applied.

Flexibility

The PTC10 Programmable Temperature Controller has the flexibility to handle virtually any temperature application. It's as useful in the research lab as it is in industry. The PTC10 is the right choice for all your temperature control experiments.

Specifications

PTC10 Temperature Controller

Data acquisition rate	1 to 50 Hz
Temperature resolution	<0.001 °C
PID feedback	Both manual and auto-tuning modes are available.
Data display	320 × 240 pixel touchscreen. Both numeric and graphical data displays.
Alarms	Upper and lower temperature limits, and rate-of-change limits can be set on each channel. If exceeded, an audio alarm and a relay closure will occur.
Analog ports	
# of ports	4 configurable DAC or ADC ports
Range	±10 VDC
Resolution	24-bit input, 16-bit output
Update rate	50 Hz
Connector	BNC
Computer interface	USB, Ethernet, and RS-232. GPIB (IEEE488.2) is optional.
Power	10 A 88 to 132 VAC or 176 to 264 VAC, 47 to 63 Hz or DC
Dimensions, weight	17" × 5" × 18" (WHL), 25 lbs.
Warranty	One years parts and labor on defects in material and workmanship.

PTC320 Thermistor/Diode/RTD Reader Card

Inputs	One input for 2-wire or 4-wire thermistor, diode or RTD
Connector	6-pin 240° push-pull DIN socket

Thermistors

Range	*Excitation current*	*Initial accuracy*	*Drift*	*Noise (rms)*
30 Ω	200 µA	±0.025 Ω	±0.002 Ω/°C	0.003 Ω
100 Ω	100 µA	±0.06 Ω	±0.006 Ω/°C	0.006 Ω
300 Ω	50 µA	±0.1 Ω	±0.006 Ω/°C	0.012 Ω
1 kΩ	30 µA	±0.2 Ω	±0.01 Ω/°C	0.02 Ω
3 kΩ	20 µA	±0.6 Ω	±0.03 Ω/°C	0.03 Ω
10 kΩ	10 µA	±1.3 Ω	±0.1 Ω/°C	0.6 Ω
30 kΩ	5 µA	±4 Ω	±0.15 Ω/°C	0.1 Ω
100 kΩ	3 µA	±10 Ω	±0.5 Ω/°C	0.3 Ω
300 kΩ	2 µA	±250 Ω	±3 Ω/°C	3 Ω
2.5 MΩ	1 µA	±30 kΩ	±2000 Ω/°C	25 Ω

Diodes

Excitation current	10 µA
Initial accuracy	±100 ppm
Drift	±5 ppm/°C
Voltage input	0 to 2.5 V
Initial accuracy	10 µV + 0.01 % of reading
Drift	±5 ppm/°C
RMS noise	1.5 µV

RTDs

Range	*Excitation current*	*Initial accuracy*	*Drift*	*Noise (rms)*
30 Ω	5 mA	±0.004 Ω	±0.0006 Ω/°C	0.00012 Ω
100 Ω	2 mA	±0.008 Ω	±0.001 Ω/°C	0.0003 Ω
300 Ω	1 mA	±0.02 Ω	±0.0015 Ω/°C	0.0006 Ω
1 kΩ	500 µA	±0.04 Ω	±0.005 Ω/°C	0.0013 Ω
3 kΩ	200 µA	±0.1 Ω	±0.01 Ω/°C	0.003 Ω
10 kΩ	100 µA	±0.2 Ω	±0.03 Ω/°C	0.006 Ω
30 kΩ	50 µA	±1 Ω	±0.06 Ω/°C	0.012 Ω
100 kΩ	10 µA	±2.5 Ω	±0.2 Ω/°C	0.07 Ω
300 kΩ	5 µA	±16 Ω	±3 Ω/°C	0.25 Ω
2.5 MΩ	1 µA	±30 kΩ	±2000 Ω/°C	25 Ω

PTC321 Pt RTD Card

Temperature range	–200 °C to 850 °C
Inputs	Four 100 Ω Pt RTD 4-wire inputs
Excitation	1 mA
Accuracy	±30 mK
Noise	2 mKrms (10 samples/s)
Temp. coefficient	1.4 mK/°C
Signal conditioning	Selectable 1 and 10 second time constant digital LPFs are provided.
Signal detection	Detects open and short circuit conditions.

PTC330 Thermocouple Card

Thermocouple types	E, J, K, N or T
Temperature range	(range of calibration table with cold junction at 25 °C)
E-type	–245 °C to 1025 °C
J-type	–185 °C to 1225 °C
K-type	–245 °C to 1395 °C
N-type	–245 °C to 1325 °C
T-type	–245 °C to 425 °C
Inputs	Four thermocouple inputs
Input capacitance	<1 pF
Connector type	Omega mini thermocouple jacks
Accuracy	±500 mK (over 12 months)
Noise	20 mKrms (10 samples/s)
Temp. coefficient	20 mK/°C (type K thermocouple at 164.0 K)
CMRR	100 dB
CM isolation	250 VAC

PTC420 AC Output Card

Output voltage	120/240 VAC
Max. output current	5 A
Cycle time	Adjustable between 1 and 240 s
Max. line voltage	250 VAC
Surge current	100 A max. (non-repetitive)
Output resolution	0.1 % at 10 s cycle time
Heater resistance (min.)	24 Ω (110 VAC), 46 Ω (230 VAC)

PTC430 DC Output Card

Max. output voltage	50 VDC
Voltage ranges	20 V and 50 V
Max. output current	1 A
Current ranges	0.1 A, 0.5 A, 1 A (50 V) or 2 A (20 V)
Output resolution	16-bit (24-bit with dithering)
Accuracy	±1 mA (1 A range) ±0.1 mA (0.5 A range) ±0.01 mA (0.1 A range)
Noise (rms), 50 Ω load, DC to 10 Hz	6 µV (50 V 1 A and 20 V 2 A ranges) 1.5 µA (0.5 A range) 0.2 µA (0.1 A range)

PTC431 100 W DC Output Card

Output	One 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 µA (2 A range) 0.5 µA (0.2 A range) 0.05 µA (0.02 A range)

PTC440 TEC Driver Card

Output	One linear, bipolar DC current source
Input	One 2- or 4-wire thermistor, RTD, IC temperature sensor input
Connector	One 15-pin DB15-F

TEC Driver

Output current	–5 A to +5 A
Maximum power	60 W
Compliance volt.	12 V
Output resolution	0.15 mA
Accuracy	±5 mA

Temperature Sensor Input

Compatible sensors	
Thermistors	2- or 4-wire NTC thermistors
RTDs	4-wire platinum RTDs, 100 Ω to 1000 Ω at 0 °C
IC sensors	LM335, AD590 or equivalent
Excitation current	10 µA, 100 µA or 1 mA
Input range	
Resistance	1 Ω to 250 kΩ
Voltage	0 to 2.5 V
Current	0 to 1 mA
Electronic noise	
100 Ω Pt RTD	0.003 Ω rms = 10 mK rms (at 25 °C and 1 mA excitation)
1 kΩ thermistor	0.03 Ω rms = 0.7 mK rms (at 25 °C and 1 mA excitation) 0.2 Ω rms = 5 mK rms (at 25 °C and 100 µA excitation)
10 kΩ thermistor	0.4 Ω rms = 0.8 mK rms (at 25 °C and 100 µA excitation) 3 Ω rms = 7 mK rms (at 25 °C and 10 µA excitation)
LM135/235/335	4 mK rms
AD590/592	9 mK rms

PTC323 Diode/Thermistor/RTD Reader Card

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

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

Ordering Information

PTC10	Programmable temperature controller
Opt.01	GPIB interface
PTC320	Thermistor/Diode/RTD reader
PTC321	4-ch. Pt RTD card
PTC322	4-ch. Pt RTD card (single slot only)
PTC323	Thermistor/Diode/RTD reader
PTC330E	4-ch. E-type thermocouple card
PTC330J	4-ch. J-type thermocouple card
PTC330K	4-ch. K-type thermocouple card
PTC330T	4-ch. T-type thermocouple card
PTC330N	4-ch. N-type thermocouple card
PTC420	600 W AC output card
PTC430	50 W DC output card
PTC431	100 W DC output card
PTC440	TEC driver
O10RM	Rack mount kit