

# 346

# Cryogenic Temperature Controller



**Lake Shore**  
CRYOTRONICS



# Next-generation temperature controller



## PREORDER NOW

- Best choice for large cryogenic systems requiring increased heater power
- Temperature control from 300 mK to 1,505 K
- 10 sensor inputs — expandable to 26
- 4 PID-controlled 100 W heater outputs (400 W total) for rapid warm-up
- 4 additional PID-controlled 1 W heater outputs

## 400 W of control power with measurements down to 300 mK

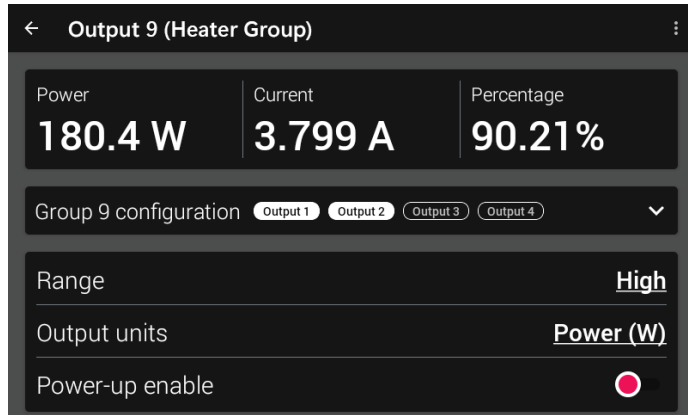
The Model 346 cryogenic temperature controller delivers rapid, precise temperature control so you can reach stable conditions faster and keep experiments on schedule. With four 100 W heater outputs, it warms up more than twice as quickly as the Model 336, minimizing downtime and maximizing productivity.

Equipped with 10 temperature sensor inputs as standard, all but the most complex systems can be fully monitored and controlled with ease. Each input can read down to 300 mK with the right Cernox or Rox sensor without self-heating, or up to 600 °C with 100  $\Omega$  platinum sensors. For more advanced systems, option cards can be added to increase the number of inputs to a maximum of 26, or push to higher temperature with the use of thermocouples.

Enhanced system control is achieved through two digital inputs for external triggering and two relays. The touchscreen interface ensures simple setup and monitoring, while the included ColdSync™ software facilitates advanced setup, initial configuration, and comprehensive data monitoring.

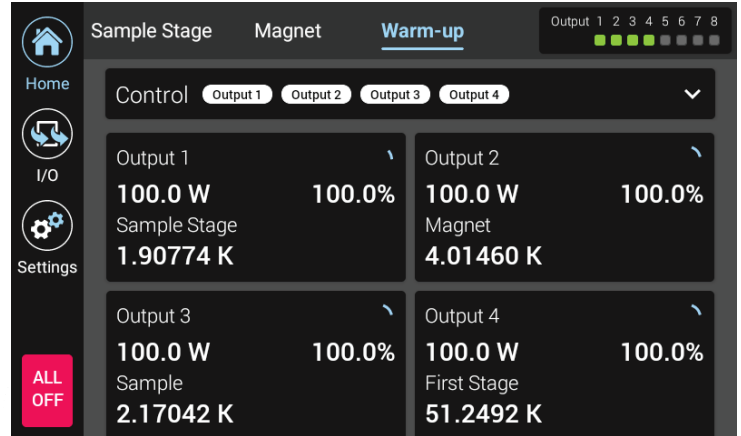
## Heater groups — for when 100 W isn't enough

Combine multiple heaters into a single, high-powered group. The system treats the group as one heater, automatically balancing output across all heaters for efficient, uniform heating—perfect for locations with high thermal mass.

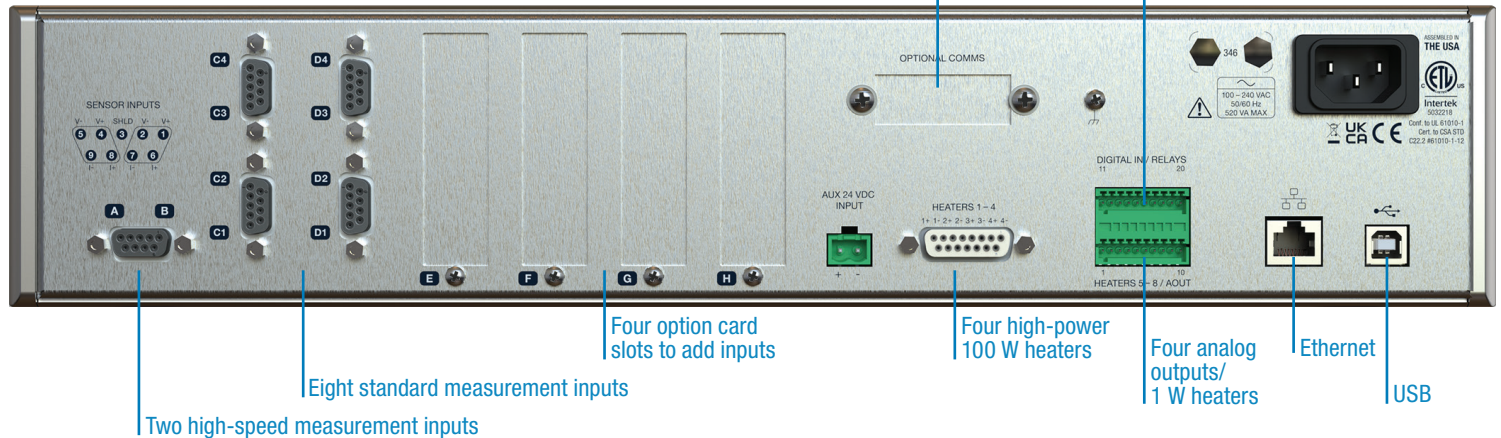


## Smarter, faster sample exchange

When it's time to warm up the system and swap in a new sample, a new mode quickly brings the system to a safe opening state without risking condensation. With one button press, warm-up mode drives heaters to room temperature, monitors each location until stable, and then checks power usage to confirm there are no cold spots. Once complete, the user is alerted.



## The back panel



## Option cards

The Model 346 features four option card slots for sensor inputs, along with an additional slot for GPIB communication. Adding an option card does not occupy any existing inputs.

### RTD/diode option card

Each option card increases the number of inputs by four. With four option card slots and 10 existing inputs, the total can be expanded to up to 26 inputs.

### Thermocouple option card

Add a single thermocouple measurement capability for temperature readings up to 1500 K.

### GPIB option card

Add GPIB communication via a dedicated option card slot, separate from the four slots designated for sensor inputs.

# Specifications

## Sensor input configuration

Sensor inputs are electrically isolated from other circuits but not each other

	Base configuration (10 sensors)		Option cards (maximum of 4 installed)	
	Inputs A and B	Inputs C1 – C4, Inputs D1 – D4	3401 RTD/diode option card	3402 thermocouple option card
Number of sensors	2	8	4	2
Supported sensors	Resistive temperature devices (RTDs) up to 100 kΩ Diodes up to 2.5 V			Thermocouple
Measurement configuration	Dedicated — 1 excitation and measurement circuit per input	Rapidly scanned — One excitation and measurement circuit for each group of 4 inputs. Each active sensor is excited and updated in turn.	Two dedicated inputs	
Update rate	100 ms	100 ms dwell time per scanned active sensor. Disabled sensor inputs skipped. Update rate will vary from 100 ms for a single active sensor per group to 400 ms when all sensors in a group are active.	100 ms	
Measurement modes	4-lead differential (I+, V+, I-, V-) 2-lead differential (I/V+, I/V-) with lead resistance compensation (future feature)			2-lead differential (V+, V-), room temperature compensated
Input connector	Normal density, socketed DE-9 D-subminiature (2 sensors per connector)			Screw terminals in a ceramic isothermal block

## Thermometry

	RTD (resistive)	Diode	Thermocouple
Excitation	Constant current with current reversal for EMF removal	Constant current	N/A — thermocouples generate voltage without current excitation
Current ranges	7 ranges between 100 nA and 1 mA	10 µA	N/A — Excitation current is not delivered by the instrument
Supported sensor examples	Cernox®, Rox™, and 100 Ω platinum sensors	DT-670 silicon diodes	Most thermocouple types, such as Type E and Type K
Pre-installed standard curves	Platinum: PT-100 Rox: RX-102A Rox: RX-103A Rox: RX-202A	Diode: DT-670	Type E Type K

**User curves:** Space for up to 40 additional user curves (200-point maximum)

**Math:** Maximum and minimum, Setpoint stabilization indicator (future)

**Filter:** Averages 2 to 64 input readings

**Additional features:** 4-lead break detection with 2-lead failover mode (future), out-of-curve extrapolation (future), boosted resolution mode (future), sensor redundancy support (future), settable output short/open thresholds



## Input specifications

Standard measurement inputs and scanner option (Model 3401)

	Sensor temperature coefficient	Input range	Excitation current	Display resolution	Measurement resolution	Electronic accuracy (at 25 °C) <sup>1,2</sup>	Measurement temperature coefficient	Electronic control stability <sup>3</sup>
Diode	— Negative	0 V to 2.5 V	10 $\mu$ A $\pm$ 0.05% <sup>4</sup>	10 $\mu$ V	10 $\mu$ V	$\pm$ 80 $\mu$ V $\pm$ 0.005% of rdg	(10 $\mu$ V + 0.0015% of rdg)/°C	$\pm$ 20 $\mu$ V
PTC RTD	+ Positive	0 $\Omega$ to 10 $\Omega$	1 mA <sup>5</sup>	0.1 m $\Omega$	0.2 m $\Omega$	$\pm$ 0.002 $\Omega$ $\pm$ 0.01% of rdg	(0.01 m $\Omega$ + 0.001% of rdg)/°C	$\pm$ 0.4 m $\Omega$
		0 $\Omega$ to 100 $\Omega$	1 mA <sup>5</sup>	1 m $\Omega$	2 m $\Omega$	$\pm$ 0.004 $\Omega$ $\pm$ 0.01% of rdg	(0.1 m $\Omega$ + 0.001% of rdg)/°C	$\pm$ 4 m $\Omega$
		0 $\Omega$ to 1 k $\Omega$	1 mA <sup>5</sup>	10 m $\Omega$	20 m $\Omega$	$\pm$ 0.04 $\Omega$ $\pm$ 0.02% of rdg	(1 m $\Omega$ + 0.001% of rdg)/°C	$\pm$ 40 m $\Omega$
NTC RTD 10 mV	— Negative	0 $\Omega$ to 100 $\Omega$	100 $\mu$ A <sup>5</sup>	1 m $\Omega$	1.5 m $\Omega$	$\pm$ 0.01 $\Omega$ $\pm$ 0.04% of rdg	(0.1 m $\Omega$ + 0.001% of rdg)/°C	$\pm$ 3 m $\Omega$
		0 $\Omega$ to 300 $\Omega$	30 $\mu$ A <sup>5</sup>	1 m $\Omega$	4.5 m $\Omega$	$\pm$ 0.01 $\Omega$ $\pm$ 0.04% of rdg	(0.3 m $\Omega$ + 0.0015% of rdg)/°C	$\pm$ 9 m $\Omega$
		0 $\Omega$ to 1 k $\Omega$	10 $\mu$ A <sup>5</sup>	10 m $\Omega$	15 m $\Omega$ + 0.002% of rdg	$\pm$ 0.1 $\Omega$ $\pm$ 0.04% of rdg	(1 m $\Omega$ + 0.001% of rdg)/°C	$\pm$ 30 m $\Omega$ $\pm$ 0.004% of rdg
		0 $\Omega$ to 3 k $\Omega$	3 $\mu$ A <sup>5</sup>	10 m $\Omega$	45 m $\Omega$ + 0.002% of rdg	$\pm$ 0.1 $\Omega$ $\pm$ 0.04% of rdg	(3 m $\Omega$ + 0.0015% of rdg)/°C	$\pm$ 90 m $\Omega$ $\pm$ 0.004% of rdg
		0 $\Omega$ to 10 k $\Omega$	1 $\mu$ A <sup>5</sup>	100 m $\Omega$	150 m $\Omega$ + 0.002% of rdg	$\pm$ 1.0 $\Omega$ $\pm$ 0.04% of rdg	(10 m $\Omega$ + 0.001% of rdg)/°C	$\pm$ 300 m $\Omega$ $\pm$ 0.004% of rdg
		0 $\Omega$ to 30 k $\Omega$	300 nA <sup>5</sup>	100 m $\Omega$	450 m $\Omega$ + 0.002% of rdg	$\pm$ 2.0 $\Omega$ $\pm$ 0.04% of rdg	(30 m $\Omega$ + 0.001% of rdg)/°C	$\pm$ 900 m $\Omega$ $\pm$ 0.004% of rdg
		0 $\Omega$ to 100 k $\Omega$	100 nA <sup>5</sup>	1 $\Omega$	1.5 $\Omega$ + 0.005% of rdg	$\pm$ 10.0 $\Omega$ $\pm$ 0.04% of rdg	(100 m $\Omega$ + 0.002% of rdg)/°C	$\pm$ 3 $\Omega$ $\pm$ 0.01% of rdg

<sup>1</sup> With current reversal enabled, for RTD measurements

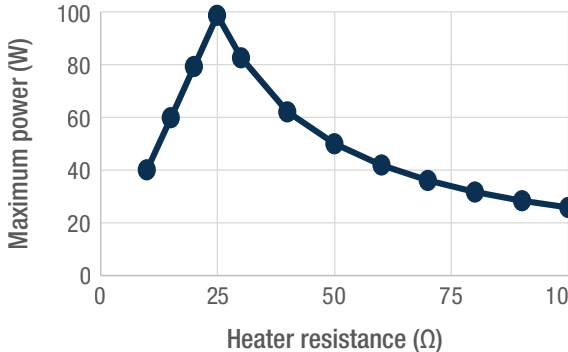
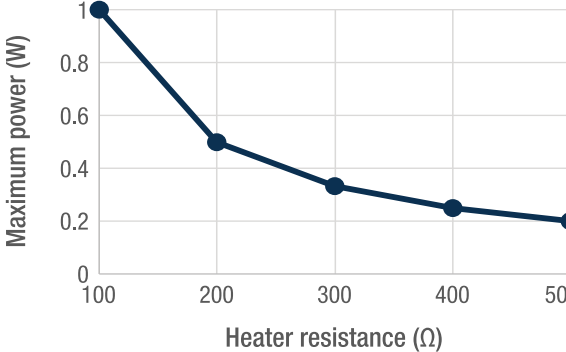
<sup>2</sup> All input accuracy specifications have a minimum confidence interval of 95% with a test uncertainty ratio of 4:1

<sup>3</sup> Control stability of the electronics only, in ideal thermal system

<sup>4</sup> Current source error has negligible effect on measurement accuracy

<sup>5</sup> Current source error is removed during calibration

Output electrical characteristics

	Outputs 1 – 4	Outputs 5 – 8																																						
Number of outputs	4	4																																						
Function	Primary heaters	Auxiliary low-power heaters Analog-out temperature reference																																						
Output type	Variable DC unipolar current source	Variable DC unipolar voltage source																																						
Ranges	Two: 200 mA and 2 A	One: 10 V																																						
Compliance <sup>6</sup>	50 V	100 mA																																						
Maximum power	<div>100 W (into 25 Ω load)</div>  <table><caption>Data for Maximum power (Outputs 1-4)</caption><tr><th>Heater resistance (Ω)</th><th>Maximum power (W)</th></tr><tr><td>10</td><td>40</td></tr><tr><td>15</td><td>60</td></tr><tr><td>20</td><td>80</td></tr><tr><td>25</td><td>100</td></tr><tr><td>30</td><td>85</td></tr><tr><td>40</td><td>65</td></tr><tr><td>50</td><td>50</td></tr><tr><td>60</td><td>42</td></tr><tr><td>70</td><td>38</td></tr><tr><td>80</td><td>32</td></tr><tr><td>90</td><td>28</td></tr><tr><td>100</td><td>25</td></tr></table>	Heater resistance (Ω)	Maximum power (W)	10	40	15	60	20	80	25	100	30	85	40	65	50	50	60	42	70	38	80	32	90	28	100	25	<div>1 W (into 100 Ω load)</div>  <table><caption>Data for Maximum power (Outputs 5-8)</caption><tr><th>Heater resistance (Ω)</th><th>Maximum power (W)</th></tr><tr><td>100</td><td>1.0</td></tr><tr><td>200</td><td>0.5</td></tr><tr><td>300</td><td>0.35</td></tr><tr><td>400</td><td>0.25</td></tr><tr><td>500</td><td>0.2</td></tr></table>	Heater resistance (Ω)	Maximum power (W)	100	1.0	200	0.5	300	0.35	400	0.25	500	0.2
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Heater load range	10 to 100 Ω	≥100 Ω																																						
Connector	Normal density socketed DA-15, D-subminiature	10-pin 2.5 mm detachable terminal block																																						
Grounding	Output referenced to chassis ground																																							
Safety limits	Curve temperature, power up heater off, short and open circuit protection																																							

<sup>6</sup> Maximum level possible before the output is not able to supply the requested output and power output will be less than communicated by the instrument

Heater groups

Multiple physical outputs can be logically combined to act like a single virtual output. This allows more than 100 W to be safely supplied to a single location, with the use of two or more 100 W heaters.

**Number of groups:** 2 (output groups 9 and 10)

**Groupable outputs:** Outputs 1 to 4

**Number of outputs per group:** 2, 3, or 4

Front panel

**Display:** 5 in capacitive touch, color TFT-LCD WVGA (800 × 480) with LED backlight

**Power switch:** SPST mains/line power switch

Analog output temperature reference

Produce a 0 V to 10 V reference based on a defined sensor reading. The temperature value corresponding to 0 V and 10 V can be configured by the user to optimize for resolution or temperature range.

**Availability:** Outputs 5 to 8

**Output range:** 0 to 10 VDC

**Accuracy:** ±2.5 mV

**Resolution:** 0.3 mV

**Data source:** Temperature or sensor units

**Scaling:** Linear, range settable



## Output temperature control characteristics

### Available control modes

	Description	Availability
Open loop	Fixed heater output; input temperature used only for temperature limit protection	All outputs
Closed-loop PID	Heater output changes dynamically to maintain the temperature of an input using PID control	All outputs
Zones	Closed-loop PID control with predefined settings for different temperature zones	Outputs 1 to 4, output groups 9 to 10
Warm-up	Coordinated control of multiple outputs to bring the whole system to room temperature	Outputs 1 to 4, output groups 9 to 10

**Closed-loop update rate:** 10/s

**Closed-loop setpoint ramping:** 0.1 K/min to 100 K/min

**Zone control:** 10 temperature zones with P, I, D, manual out, range, control input, ramp rate

### Interface

#### USB host (front panel)

**Type:** USB 3.0, mass storage class (MSC) device

**Function:** Firmware updates, diagnostic logs

**Connector:** USB Type-C™

#### USB device (rear panel)

**Type:** USB 2.0

**Function:** Command and control, emulates a standard RS-232 serial port

**Baud rate:** 921600

**Connector:** B-type USB connector

#### Ethernet

**Function:** TCP/IP command and control

**Communications protocol:** IPv4 and IPv6

**Connection:** RJ45 Gigabit Ethernet

#### Optional IEEE-488.2

**Capabilities:** SH1, AH1, T5, L4, SR1, RL1, PP0, DC1, DT0, C0, E1

**Reading rate:** To 10 rdg/s on each input

**Software support:** ColdSync™, MeasureLINK™, LabVIEW™, Python™

#### Relays

**Number:** 2

**Contacts:** Normally open (NO), normally closed (NC), and common (C)

**Contact rating:** 30 VDC at 2 A

**Operation:** Activate relays on high, low, or both alarms for any input, or manual mode

**Connector:** 10-pin 2.5mm detachable terminal block

#### Digital Inputs

**Number of inputs:** 2

**Isolation:** Optical

**Maximum low-level input voltage:** +1 V

**Minimum high-level input voltage:** +4 V

**Safe input voltage range:** -5 V to +35 V

**Operation:** Reset min/max, All off (pending)

**User-exposed +5 V supply range:** Typical 5 V  $\pm$ 10% up to 100 mA continuous

#### AUX 24 VDC input

**Function:** Provide auxiliary power to possible future option cards that may require it

**Isolation:** Isolated from all other internal instrument power supplies

**Operating range:** 24 VDC nominal, 22 VDC minimum, 26 VDC maximum

**Maximum allowed current draw:** 2.5 A

**Protections:** Over current, over voltage, under voltage, inverted polarity

### General

**Ambient temperature:** 15 °C to 35 °C at rated accuracy; 5 °C to 40 °C at reduced accuracy

**Power requirement:** 100 to 240 VAC (universal input), 50/60 Hz, 520 VA maximum

**Size:** 435 mm W  $\times$  89 mm H  $\times$  368 mm D (17 in  $\times$  3.5 in  $\times$  14.5 in), full rack

**Weight:** 6.1 kg (13.4 lb)

**Approval:** CE, CSA, NRTL mark (contact Lake Shore for availability)

**Altitude:** <2000 m

# Next-generation Cryogenic Temperature Controller



Let's talk about your application

## Ordering information

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