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OMEGA®

SERIES
CN8100

1/4 DIN
TEMPERATURE/
PROCESS
CONTROLLERS

Operating Instructions

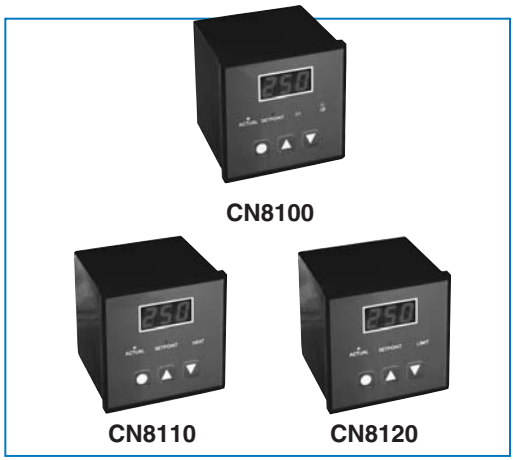

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Table of Contents

Features

Type J Input (CN8110, CN8120)

Type J or K Input (CN8100)

±0.3% FS Accuracy

Large, Easy-to-Read LED Display, Selectable for Either Setpoint or Process Temperature

Adjustable Output Hysteresis to Prevent Rapid Cycling Around Setpoint Temperature (CN8110)

Adjustable Deviation Alarm Flashes Display When Measured Temperature Exceeds or Falls Below Setpoint Temperature

NEMA 4X Front Bezel, Splash-Proof and Resistant to Dust

Discrete Status Indicators Illuminate When Temperature Display, Setpoint Display or Heat/Cool Output is Active

Approvals: UR, cUR, CE

Safety Warnings

In addition to presenting a potential fire hazard, high voltage and high temperature can damage equipment and cause severe injury or death. When installing or using this instrument, follow all instructions carefully and use approved safety controls. Electrical connections and wiring should be performed only by suitably trained personnel.

Do not locate this instrument where it is subject to excessive shock, vibration, dirt, moisture, oil, or other liquids. The safe operating temperature range for this unit is 32°F to 140°F (0°C to 60°C).

Installation

Pre-Installation Instructions

1. Inspect shipping carton for obvious signs of mishandling.
2. After removing the controller from the shipping carton, inspect it carefully for damage. Never attempt to install and use a damaged unit.
3. Verify that the ordering code number indicated on the side of the controller matches what was ordered.

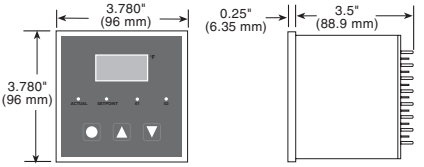

Figure 1. Case Dimensions

Prior to mounting the CN8100 in your panel, make sure that the cutout opening is of the right size, 3.622" x 3.622" (92 mm x 92 mm), and deburred to enable a smooth fit.

A minimum of 5.0" (127.0 mm) of depth behind the panel is required.

Mounting

Before installing the CN8100, ensure gasket seats evenly around edges of unit and that there are no breaks or tears in the gasket.

Insert the CN8100 through the front panel cutout, slide mounting “U” bracket around unit and secure it with the screws provided.

Gasket should be evenly compressed around all sides to provide liquid-tight mounting.

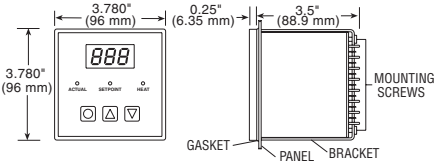

Figure 2. Mounting Diagram

Wiring

IMPORTANT: All electrical wiring connections should be made only by trained personnel using Class 1 wiring, and in strict accordance with the National Electrical Code and local regulations. Both of the incoming power lines should be fused with 2AG, 0.5 A maximum rated fuses.

The CN8100 controller has built-in circuitry to reduce the effects of electrical noise (RFI) from various sources; however, power and signal wires should always be kept separate. We recommend separating wires into one bundle for power (from line power and output) and one bundle for signal (from thermocouple).

The CN8100 power supply accepts 100 through 250 Vac and 120 through 250 Vdc line power without any switch settings or polarity considerations.

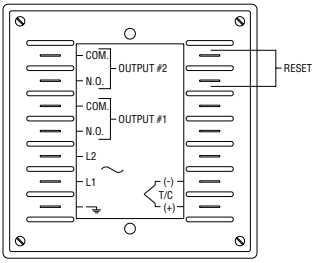

Figure 3. Wiring Connections

Operation

Omega CN8100 Digital Temperature Controllers

Just a few easy steps are required before your CN8100 can be placed into service. After completing the mounting and wiring procedures as previously instructed, set each controller parameter using the simple front-panel keys as instructed.

Power On

When power is first applied to the CN8100, all segments of the LED display, as well as the discrete indicators, will be momentarily illuminated while the instrument goes through a series of diagnostic checks to verify proper operation of the unit. A software version will then be displayed, e.g.,  . The last two digits of this code indicate the software revision supplied with your controller. Please provide this revision number when contacting us regarding your unit. This display is followed by a mnemonic code representing the model type.

Figure 4. Front Panel Controls and Indicators–Three-Digit LED Display displays measured temperature, setpoint, or parameter labels and settings.

Parameter Key

Used to access available parameters to set or change values.

Raise Key

Used to scroll up through available parameter settings or to increase values. (Hold for fast-step progression)

Lower Key

Used to scroll down through available parameter settings or to decrease values. (Hold for fast-step progression)

Discrete LED Indicators

CN8110	CN8120	CN8100
Actual: amber	Actual: amber	Actual: amber
Setpoint: amber	Setpoint: amber	Setpoint: amber
Heat: orange	Limit: orange	Output 1: orange
		Output 2: orange

CN8110 Operation

The Calibration High and Calibration Low selections are accessible only when the calibration jumper is installed as instructed on page 18 (Figure 8).

CN8110 On/Off Temperature Controller

Normal Operation

The factory default display setting of the CN8110 is for Actual Temperature ACt. The default display may be changed to setpoint temperature by selecting Setpoint SP at the Default Display dEF parameter selection. When the Default Display is changed to Setpoint, the setpoint temperature may be adjusted by using the Raise ▲ or Lower ▼ keys. The setpoint is adjustable from 32 to 905°F (0 to 485°C).

When the Default Display setting is "Actual" ACt, adjustment of the Setpoint may only be accomplished by pressing the Parameter ● Key momentarily to switch the display to Setpoint, and then using the Raise ▲ or Lower ▼ Keys to change the Setpoint Value. The display will automatically revert back to "Actual" five seconds after the last keypress.

Parameter Configuration

Your CN8110 controller's parameter selections are explained on the next page, with default settings shown in Figure 5a. To enter the configuration menu, press and hold the Parameter key ● for 10 seconds until the display changes to the parameter mode. Press the Parameter Key again to index through the available parameters. Pressing the Parameter Key for 3 seconds or allowing 60 seconds of inactivity will cause the CN8110 to exit the menu system and return to normal operating mode.

Parameter	Range °F	Range °C	Display	Options	Default °F	Default °C
Default Display			dEF	SP Act	Act	Act
Control Hysteresis	2 to 252	1 to 140	HYS		6	3
Display Offset	-126 to 126	-70 to 70	OFF		0	0
Deviation Band Alarm	OFF, 1 to 252	OFF, 1 to 140	ALr		20	11
Display Units			Unt	F C	F	
Low Calibration*	Fixed	Fixed	CLO		32	0
High Calibration*	Fixed	Fixed	CHI		905	485

*Calibration jumper must be installed.

Figure 5a. CN8110 Parameters and Default Settings

Parameter Descriptions

Default Display dEF

This parameter determines whether the CN8110's display shows the Setpoint or the actual temperature by default. Regardless of the selection made here, the operator can observe the other value by momentarily pressing the Parameter ● Key. This will cause the alternate value to be displayed for five seconds.

Control Hysteresis HYS

Control Hysteresis is adjustable between 2 and 252°F (1 to 140°C). This parameter is used by the control algorithm to prevent rapid cycling of the output around Setpoint. The default value is 4°F (2°C). This means the heat will turn OFF when the Actual Temperature exceeds the Setpoint by 2°F (1°C). Conversely, the heater will not turn ON until the Actual Temperature drops 2°F (1°C) below the Setpoint.

Display Offset OFF

Display Offset is adjustable from -126 to 126°F (-70 to 70°C). It can be used to provide limited adjustment of the displayed temperature as a compensation for offsets between the true temperature and the temperature seen by the thermocouple.

Deviation Band Alarm ALr

A Deviation Band is a pre-set number of degrees, plus and minus, around the Setpoint Value, ex. ±10°F. A Deviation Band Alarm provides an indication to the operator that the Actual Temperature has either exceeded or dropped below the chosen deviation. This parameter can be turned off OFF or adjusted from 1 to 252°F (1 to 140°C). When the process variable is outside the deviation band, the alarm is indicated by flashing the display (regardless of whether setpoint or actual temperature is displayed) and the optional alarm output is activated.

Display Units Unt

This allows the operator to have the display indicate either degrees Fahrenheit or degrees Celsius.

CN8120 Operation

CN8120 Limit Controller

Normal Operation

The factory default display setting of the CN8120 is for Actual Temperature ACt. The default display may be changed to setpoint temperature by selecting Limit Setpoint SP at the Default Display dEF parameter selection. When the Default Display is changed to Limit Setpoint, the limit setpoint temperature may be adjusted by using the Raise ▲ or Lower ▼ keys. The limit setpoint is adjustable from 32 to 905°F (0 to 485°C).

When the Default Display setting is "Actual" ACt, adjustment of the Limit Setpoint may only be accomplished by pressing the Parameter ● Key momentarily to switch the display to Limit Setpoint, and then using the Raise ▲ or Lower ▼ Keys to change the Limit Setpoint Value. The display will automatically revert back to "Actual" five seconds after the last keypress.

Parameter Configuration

Your CN8120 controller's parameter selections are explained on the next page, with default settings shown in Figure 5b. To enter the configuration menu, press and hold the Parameter key ● for 10 seconds until the display changes to the parameter mode. Press the Parameter key again to index through the available parameters. Pressing the Parameter Key for 3 seconds or allowing 60 seconds of inactivity will cause the CN8120 to exit the menu system and return to normal operating mode.

Parameter	Range °F	Range °C	Display	Options	Default °F	Default °C
Default Display			dEF	SP ACt	ACt	ACt
Limit Setpoint	32 to 905	0 to 485	LSP	Operator Selectable	72	20
Automatic Startup Reset			ASr	YES no	no	no
Display Units			Unt	F C	F	
Low Calibration*	Fixed	Fixed	CLO		32	
High Calibration*	Fixed	Fixed	CHI		905	485

*Calibration jumper must be installed

Figure 5b. CN8120 Parameters and Default Settings

Parameter Descriptions

Default Display dEF

This parameter determines whether the CN8120's display shows the Limit Setpoint or the actual temperature by default. Regardless of the selection made here, the operator can observe the other value by momentarily pressing the Parameter ● Key. This will cause the alternate value to be displayed for five seconds..

CN8120 Limit Controller

Limit Setpoint LSP

The Limit Setpoint determines the temperature at which the limit output will become inactive, interrupting power to the process. It is operator-selectable from 32° to 905°F (0° to 485°C).

Resetting (Latching) the limit output (contacts closed) can be accomplished in three ways:

(1) Automatic Startup Reset ASr latches output on power up.

(2) If ASr is not selected and the temperature is below the limit setting, holding the parameter key for 3 seconds provides a reset. (Calibration jumper [page 8] must be removed.)

(3) If ASr is not selected and the temperature is below the limit setting, a momentary contact closure across "reset" terminals resets the control.

Display Units Unt

This allows the operator to have the display indicate either degrees Fahrenheit or degrees Celsius.

CN8100 Operation

CN8100 PID Temperature Controller

Normal Operation

The factory default display setting of the CN8100 is for Actual Temperature ACt. The default display may be changed to setpoint temperature by selecting Setpoint SP at the Default Display dEF parameter selection. When the Default Display is changed to Setpoint, the setpoint temperature may be adjusted by using the Raise ▲ or Lower ▼ keys. The setpoint is adjustable from 0 to 999°F (0 to 537°C).

When the Default Display setting is "Actual" ACt, adjustment of the Setpoint may only be accomplished by pressing the Parameter ● Key momentarily to switch the display to Setpoint, and then using the Raise ▲ or Lower ▼ Keys to change the Setpoint Value. The display will automatically revert back to "Actual" five seconds after the last keypress.

Parameter Configuration

Your CN8100 controller's parameter selections are explained on the next page, with default settings shown in Figure 5c. To enter the configuration menu, press and hold the Parameter key ● for 10 seconds until the display changes to the parameter mode. Press the Parameter key again to index through the available parameters. Pressing the Parameter Key for 3 seconds or allowing 60 seconds of inactivity will cause the CN8100 to exit the menu system and return to normal operating mode.

Parameter	Range °F	Range °C	Display	Options	Default °F	Default °C
Default Display			dEF	SP Act	Act	Act
Display Offset	-126 to 126	-70 to 70	OFF		0	0
Proportional Band	1 to 995	0 to 553	Pbd	Operator Selectable	OFF	OFF
Rate	0 to 250 sec.		rAt		20	0
Reset	0 to 999 sec.		rSt		80	0
Heat Cycle Time	0 to 120 sec.		Ct.H		10	0
Cool Cycle Time	0 to 120 sec.		Ct.C		10	5
Deviation Band Alarm	Off,1 to 252	Off,1 to 140	ALr	Operator Selectable	20	OFF
Output 2 Configuration*			O2C	Pid ALr	Pid	Pid
Display Units*			Unt	F C	F	
Input Type*			Int	J CA	J	J
Low Calibration*	Fixed	Fixed	CLO		32	0
High Calibration* "J" TC "K" TC	Fixed	Fixed	CHI		959 986	515 530

*Calibration jumper must be installed.

Figure 5c. CN8100 Parameters and Default Settings

Parameter Descriptions

Default Display dEF

This parameter determines whether the CN8100's display shows the Setpoint or the actual temperature by default. Regardless of the selection made here, the operator can observe the other value by momentarily pressing the Parameter ● Key. This will cause the alternate value to be displayed for five seconds.

Display Offset OFF

Display Offset is adjustable from -126 to 126° F (-70 to 70°C). It can be used to provide limited adjustment of the displayed temperature as a compensation for offsets between the true temperature and the temperature seen by the thermocouple.

Proportional Band Pbd *

Proportional Band is a PID parameter that represents the amount of deviation of the controlled variable required to move through the full range, expressed in % of span or degrees of temperature. This parameter can also be expressed as "Gain" (the wider the band, the lower the gain).

Rate rAt *

Rate is a PID parameter (Derivative Action) that produces a corrective signal proportional to the rate at which the controlled variable is changing. It is used to correct for overshoot and undershoot.

Reset rSt *

Reset is a PID parameter (Integral Action) that produces a corrective signal proportional to the length of time and magnitude that the controlled variable has been off setpoint. It is used to accommodate load changes.

Heat Cycle Time Ct.H**

Heat Cycle Time is displayed in seconds, and can be set from 0 to 120 seconds. A setting of zero represents a heat cycle time of 300 milliseconds.

Cool Cycle Time Ct.C**

Cool Cycle Time is displayed in seconds, and can be set from 0 to 120 seconds. A setting of zero represents a cool cycle time of 300 milliseconds. This menu parameter will only be displayed if output 2 is configured to be a cool output.

* These parameters must be obtained using an industrial tuning procedure such as Ziegler-Nichols. (See page 10)

**Note: If Output Type is a mechanical relay, a cycle time of no less than 10 seconds is recommended.

Deviation Band Alarm ALr

A Deviation Band is a pre-set number of degrees, plus and minus, around the Setpoint Value, ex. ±10°F. A Deviation Band Alarm provides an indication to the operator that the actual temperature has either exceeded or dropped below the chosen deviation. This parameter can be turned off OFF or adjusted from 1 to 252°F (1 to 140°C). When the process variable is outside the deviation band, the alarm is indicated by flashing the display (regardless of whether setpoint or actual temperature is displayed and activating an output, if configured as such).

Output 2 Configuration O2C

Output 2 may be configured as either a control output or as an alarm output for the deviation band alarm. When configured for control, output 2 acts as a cool PID output. When configured for an alarm, output 2 is activated when the deviation alarm is active and deactivated when the deviation alarm is inactive.

Display Units Unt

This allows the operator to have the display indicate either degrees Fahrenheit or degrees Celsius.

Input Type Int

Sensor input type may be either a Type J or Type K thermocouple.

Calibration

Calibration CLO, CHI

Calibration of the CN8100 controller requires the operator to apply two separate fixed and specific signals (Calibration Low and Calibration High) from a reference source (thermocouple calibrator) to the controller. The Raise ▲ Key "tells" the controller to read the applied signal and use it as a reference point.

Figure 6. Location of Calibration Jumper

The Calibration High and Calibration Low selections are accessible only when the calibration jumper is installed.

Calibration Procedure

1. Prior to applying power to the unit, install the calibration jumper on the microprocessor board as shown in Figure 6.
2. With the instrument still unpowered, connect a calibration reference source to the thermocouple input terminals on the CN8100.
3. Apply power. Allow at least 15 minutes for the controller to warm up before continuing.
4. Using the Parameter ● Key, index to the Calibration Low CLO parameter. The display will alternately flash this mnemonic and the number "32" ("0" for Celsius units).
5. Adjust the reference source to output a voltage equivalent to that generated by a "J" or "K" (CN8100) thermocouple at 32°F (0°C). Allow reference to settle for 10 seconds before proceeding.
6. Press the Raise Key ▲ once to set this reference point. The display will stop flashing momentarily while the controller self-calibrates (approx. 3 seconds), and then resume flashing.
7. Press the Parameter ● Key, index to the Calibration High CHI parameter. The display will alternately flash this mnemonic and the temperature value it expects to see.

8. Adjust the reference source to output a voltage equivalent to that generated by a “J” or “K” (CN8100) thermocouple at the temperature flashing on the display. (Allow reference to settle for 10 seconds before proceeding.)
9. Repeat Step 6 for this reference point.
10. Press the Parameter ● Key for 10 seconds or allow 60 seconds of inactivity.
11. Adjust the reference source to output a voltage equivalent to that generated by a “J” or “K” (CN8100) thermocouple at 32°F (0°C). Verify that (after settling), the CN8100 indicates a measured temperature of 32°F(0°C).
12. Repeat Step 11 for the upper reference point.

Error Codes

Display	Problem	Possible Solution
E.H I	Broken thermocouple. lead wire, or defective sensor.	Verify wiring. Replace sensor.
E.L O	Input signal is below calibration of unit.	Verify input signal; check calibration.

IEC Requirement

USE OF THIS EQUIPMENT IN A MANNER NOT SPECIFIED BY THE MANUFACTURER MAY IMPAIR PROTECTION PROVIDED BY THE EQUIPMENT!

The maximum supply current is line voltage dependent:

60 mA for an 100-250 Vac input fuse rating: 2AG, 0.5 A

Output Specifications

Output 1 Type	Max current	Voltage	Leakage
-T1 (Triac)	2 A	400 Vpk	1 mA
-R1 (Relay)	5 A	380 V	—
Output 2 Type	**Max current**	**Voltage**	**Leakage**
-T2 (SSR)	0.5 A	400 Vpk	1 mA
-R2 (Relay)	5 A	380 V	—

Cleaning Instructions

1. Remove power from the unit prior to any cleaning operation.
2. Use a cotton cloth to gently and sparingly apply isopropyl alcohol only. Do not use cleaners or other solvents as they may damage the unit.
3. Allow the unit to dry completely prior to reapplying power.

Manual Tuning (Zeigler-Nichols)

Process Tuning - Heated Process (Zeigler-Nichols)

The CN8100 PID control must be manually tuned using the Zeigler-Nichols method:

A chart recorder to monitor the process temperature is useful.

1. Apply power and enter these settings:
   Proportional Band = 100
   Rate = 0
   Reset = 0
2. Enter the control setpoint temperature.
3. Enter heat cycle time appropriate to provide close control (15 seconds minimum for mechanical contactors and relays).
4. Enter cool cycle time = 0.
5. While monitoring the controlled temperature, increase (decrease) the proportional bandwidth by halving or doubling the bandwidth until minimum sustained temperature oscillation is observed.
6. Measure the time of one complete cycle of oscillation. See figure 7. Calculate rate setting; T/8 = Rate.
7. Multiply the bandwidth (from step 5) by 1.66 and enter this number as proportional band.

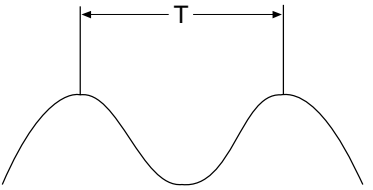

Figure 7. One complete cycle of oscillation

Technical Specifications

Operating Limits

Ambient Temperature	32°F to 140°F (0°C to 60°C)
Relative Humidity Tolerance	20% to 95%, Non-Condensing
Power	85 to 250 V, 50/60 Hz (Single-Phase) 120 to 250 Vdc

Setpoint Range

Type J Thermocouple CN8110, CN8120:	32 to 905°F (0 to 485°C)
Type J Thermocouple CN8100:	0 to 999°F (0 to 537°C)
Type K Thermocouple CN8100:	0 to 999°F (0 to 537°C)

Performance

Accuracy	±0.3% of Full Scale (±0.10% Typical), ±1 Digit
Setpoint Resolution	1°F/C
Repeatability	±1 Count
Temperature Stability	5 µV /°C (Maximum)
TC Cold-End Tracking	0.05°C /°C Ambient
Noise Rejection	100 dB Common Mode, 70 dB Series Mode
Temperature Sampling	3.7 Hz (270 ms)

Control Characteristics

Control Hysteresis	2 to 252°F (1 to 140°C)
Display Offset	-126 to 126°F (-70 to 70°C)

Mechanical Characteristics

Display	7-segment LED, alphanumeric: 3 digits
Display Height	0.56" (14.22 mm)
Color	Orange
Front-Panel Cutout	3.622" x 3.622" (92 mm x 92 mm)
Bezel Outside Dimensions	3.780" x 3.780" (96 mm x 96 mm)
Bezel Height	0.250" (6.35 mm)
Case Depth	3.515" (89.28 mm)
Weight	<15 oz (425 g)
Connections	9
Contacts	“Fast-On” .250” (6.35 mm)

Output Source (Power to Heater)

Solid-State Relay (Output 1)	120/250 Vac, Zero-Voltage Switched, 2 A Continuous/10 A Surge @ 25° C
Solid-State Relay (Output 2)	120/250 Vac, Zero-Voltage Switched, 0.5 A Continuous/10 A Surge @ 25° C
Electromechanical Relay	5 A, 250 Vac/5 A, 30 Vdc Max Switching Capacity, 150 W

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OMEGA ENGINEERING, INC. warrants this unit to be free of defects in materials and workmanship for a period of **25 months** from date of purchase. OMEGA Warranty adds an additional one (1) month grace period to the normal **two (2) years product warranty** to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product. If the unit should malfunction, it must be returned to the factory for evaluation. OMEGA's Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective it will be repaired or replaced at no charge. OMEGA's WARRANTY does not apply to defects resulting from any action of the purchaser, including but not limited to mishandling, improper interfacing, operation outside of design limits, improper repair, or unauthorized modification. This WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of being damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components which wear are not warranted, including but not limited to contact points, fuses, and triacs.

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- ✔ Turbine/Paddlewheel Systems
- ✔ Totalizers & Batch Controllers

pH/CONDUCTIVITY

- ✔ pH Electrodes, Testers & Accessories
- ✔ Benchtop/Laboratory Meters
- ✔ Controllers, Calibrators, Simulators & Pumps
- ✔ Industrial pH & Conductivity Equipment

DATA ACQUISITION

- ✔ Data Acquisition & Engineering Software
- ✔ Communications-Based Acquisition Systems
- ✔ Plug-in Cards for Apple, IBM & Compatibles
- ✔ Datalogging Systems
- ✔ Recorders, Printers & Plotters

HEATERS

- ✔ Heating Cable
- ✔ Cartridge & Strip Heaters
- ✔ Immersion & Band Heaters
- ✔ Flexible Heaters
- ✔ Laboratory Heaters

ENVIRONMENTAL MONITORING AND CONTROL

- ✔ Metering & Control Instrumentation
- ✔ Refractometers
- ✔ Pumps & Tubing
- ✔ Air, Soil & Water Monitors
- ✔ Industrial Water & Wastewater Treatment
- ✔ pH, Conductivity & Dissolved Oxygen Instruments

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