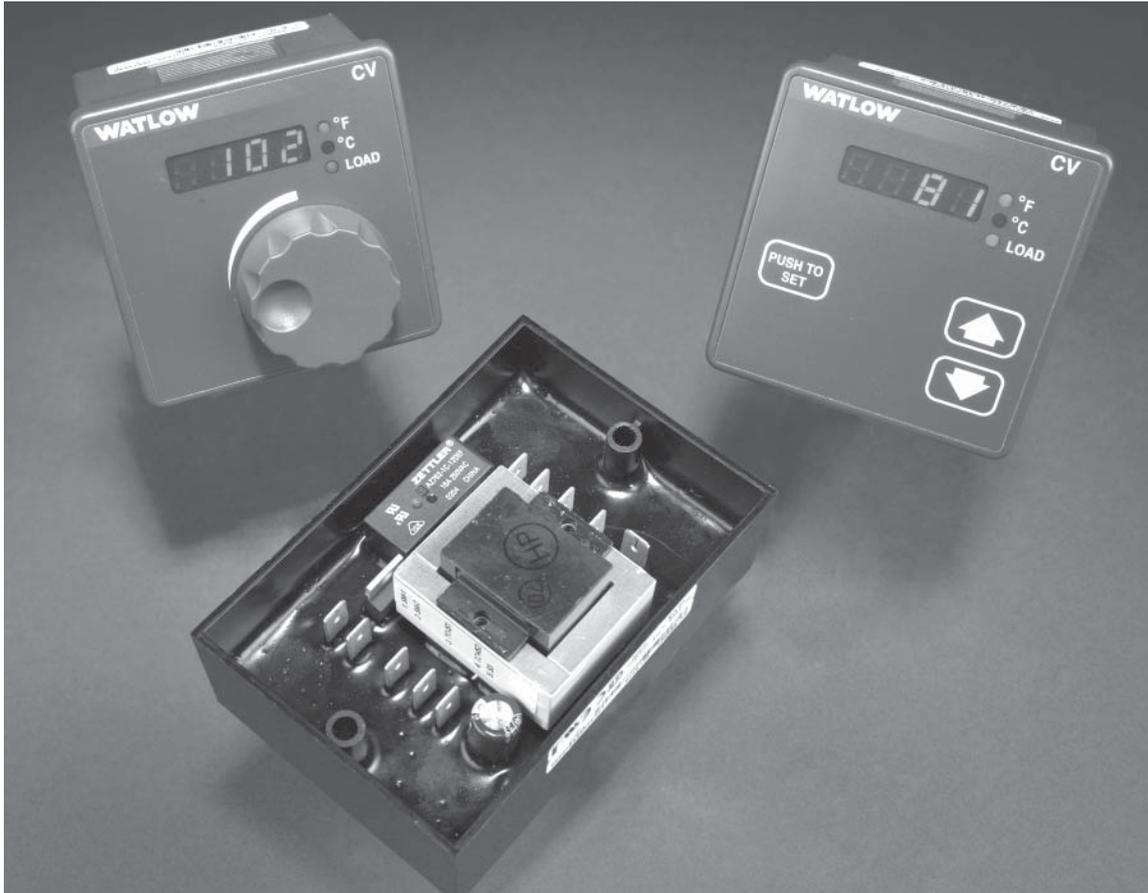


# Series C & Series TM

## User's Manual



**Series C - On-Off Temperature Controller**  
**Series TM - Temperature Indicator**



**TOTAL  
CUSTOMER  
SATISFACTION**  
3 Year Warranty



1241 Bundy Boulevard., Winona, Minnesota USA 55987  
Phone: +1 (507) 454-5300, Fax: +1 (507) 452-4507 <http://www.watlow.com>

0600-0044-0000 Rev. E



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Made in the U.S.A.

\$5.00

## Safety Information

We use note, caution and warning symbols throughout this book to draw your attention to important operational and safety information.

A “NOTE” marks a short message to alert you to an important detail.

A “CAUTION” safety alert appears with information that is important for protecting your equipment and performance. Be especially careful to read and follow all cautions that apply to your application.

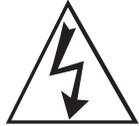
A “WARNING” safety alert appears with information that is important for protecting you, others and equipment from damage. Pay very close attention to all warnings that apply to your application.

The safety alert symbol,  (an exclamation point in a triangle) precedes a general CAUTION or WARNING statement.

The electrical hazard symbol,  (a lightning bolt in a triangle) precedes an electric shock hazard CAUTION or WARNING safety statement.



**CAUTION or  
WARNING**



**Electrical  
Shock Hazard**

**CAUTION or WARNING**

## Technical Assistance

If you encounter a problem with your Watlow controller, review your configuration information to verify that your selections are consistent with your application: inputs, outputs, alarms, limits, etc. If the problem persists, you can get technical assistance from your local Watlow representative (see back cover), by e-mailing your questions to [wintechsupport@watlow.com](mailto:wintechsupport@watlow.com) or by dialing +1 (507) 494-5656 between 7 a.m. and 5 p.m., Central Standard Time (CST). Ask for for an Applications Engineer. Please have the following information available when calling:

- Complete model number
- System wiring information
- Basic Controller User’s Manual

## Warranty

These controllers are manufactured by ISO 9001-registered processes and are backed by a three-year warranty.

## Return Material Authorization (RMA)

1. Call Watlow Customer Service, (507) 454-5300, for a Return Material Authorization (RMA) number before returning any item for repair. We need this information:
  - Ship to address
  - Contact name
  - Method of return shipment
  - Detailed description of the problem
  - Name and phone number of person returning the product.
  - Bill to address
  - Phone number
  - Your P.O. number
  - Any special instructions
2. Prior approval and an RMA number, from the Customer Service Department, is needed when returning any unused product for credit. Make sure the RMA number is on the outside of the carton, and on all paperwork returned. Ship on a Freight Prepaid basis.
3. After we receive your return, we will examine it and try to verify the reason for the return.
4. In cases of manufacturing defect, we will enter a repair order, replacement order or issue credit for material returned.
5. To return products that are not defective, goods must be in new condition, in the original boxes and they must be returned within 120 days of receipt. A 20 percent restocking charge is applied for all returned stock controls and accessories.
6. If the unit is unrepairable, it will be returned to you with a letter of explanation.
7. Watlow reserves the right to charge for no trouble found (NTF) returns.

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# 1

## Overview

Watlow's Series C family of basic temperature controllers\* provide an economical controller solution for applications where simple on/off control is needed.

These controllers are available with or without an operator interface and can be ordered in square 1/8th DIN panel mount, din rail mount, open board or potted module design configurations. Push-on, quick connect spade terminal or removable screw clamp style terminal block ordering options provide the electrical connections.

The microprocessor design platform provides improvements in the performance, repeatability, and accuracy offered by Watlow's current line of basic temperature control products.

The Series CV includes an operator interface to allow viewing and selection of the control set point. A red four-character, seven-segment LED displays the set point. It is also available with a push-to-show process option. The set point selection is made with a continuous turn, velocity-sensitive rotary encoder. Set point range temperature values are customer definable in the product configuration part number.

The Series CF offers fixed control points. These units are supplied without an operator interface. Operating set point temperature values are customer definable in the product configuration part number.

The Series TM is a temperature indicator only version. It is available in DIN rail or panel mount configurations.

The features and performance of these products make them ideally suited for a wide range of industrial control applications in the food preparation, industrial machinery, packaging and plastic markets.

Watlow's Series C and TM controllers include industry-leading service, support and a 3-year warranty.

\*Also available in an FM-approved limit version.

### Features and Benefits

#### Four-Character LED Display

- Improves Set Point adjustment accuracy.

#### Fixed or Adjustable Set Points

- Tamper Proof Operation.
- Control Flexibility.

#### Set Point Adjustment Options

- Rotary encoder.
- Tactile increment and decrement keys.

#### Push to Set Option

- Reduce accidental set point adjustments.

#### Push to Display Process Option

- Allows viewing of process value.

#### Multiple Mounting Options

- Minimizes installation time.

#### Heat or Cool Operation

- Application flexibility.

#### Fahrenheit or Celsius Operation with Indication

- Application flexibility.

#### Sensor Break Protection

- Provides positive system shutdown.

#### Agency Approvals

- Meets requirements for agency certification.
- NEMA 4X/IP65 seal panel-mount versions available.
- W.E.E.E; CE; RoHS

#### Microprocessor Based Technology

- Accurate and repeatable control.

#### Stock to Four Day Delivery

# 2

## Installation

### Installing the Open Board Controller

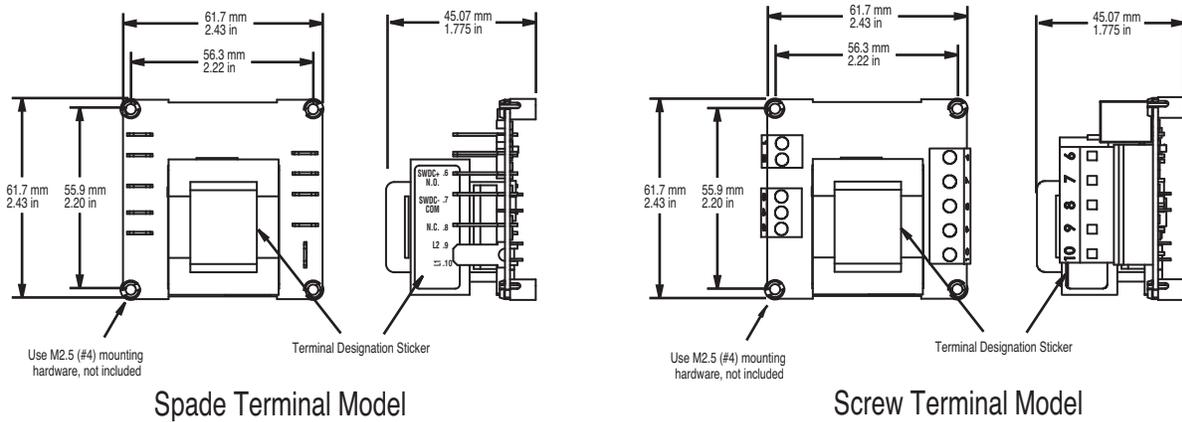


Figure 2a

1. Locate and drill four 3.2 mm (0.125 in) holes in the desired panel location. See Figure 2a for hole locations.
2. Mount the controller using four M2.5 (#4) screws.

### Installing the Potted Controller

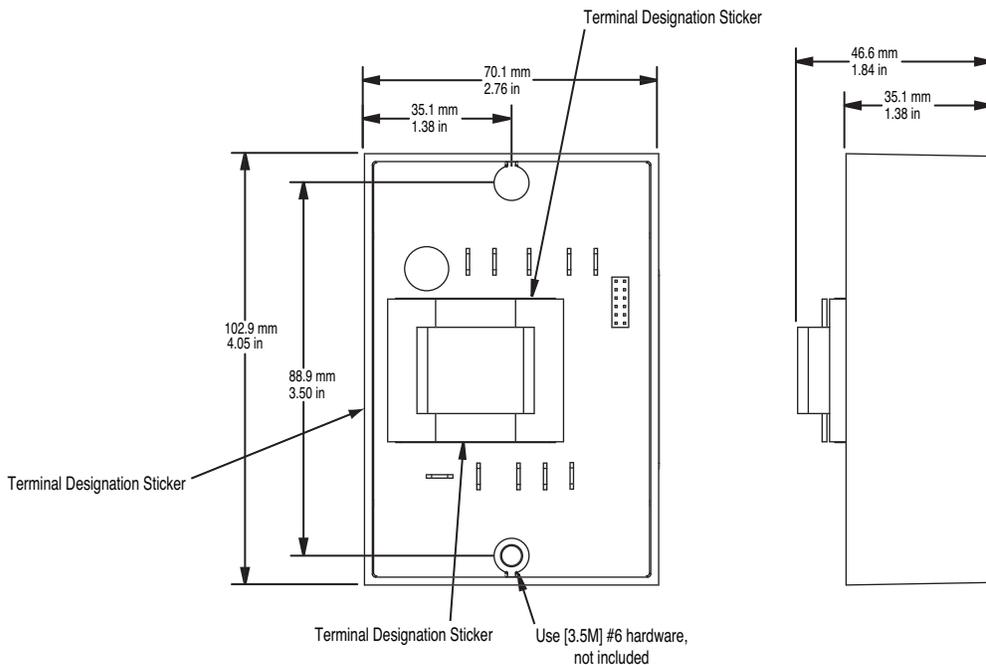
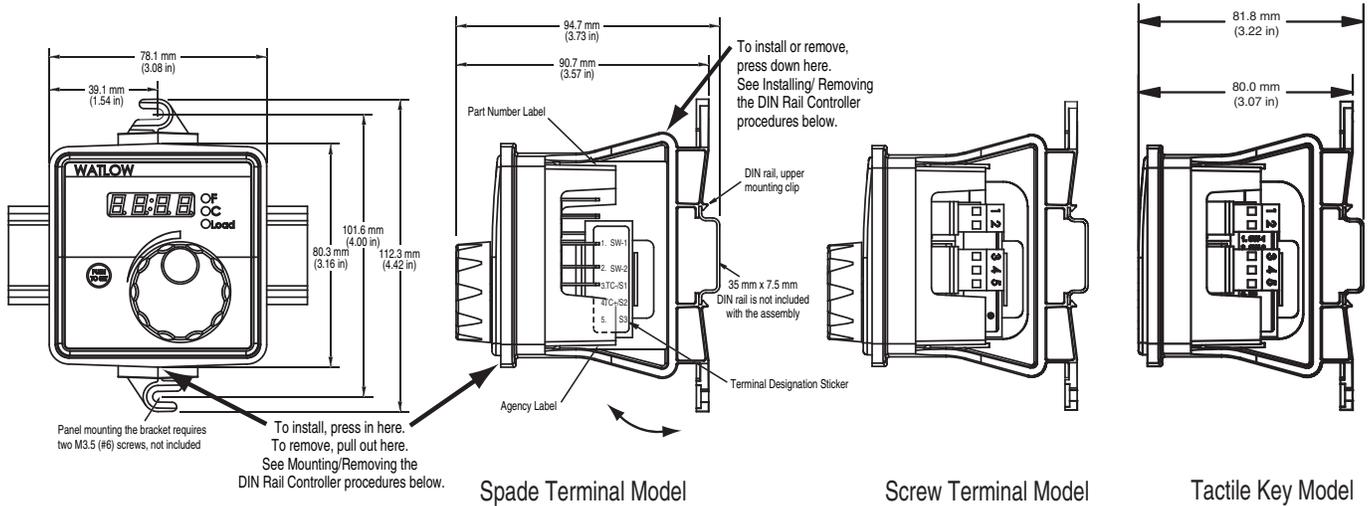


Figure 2b

1. Drill two 5 mm (0.187 in) diameter holes in the desired panel location. See Figure 2b for hole locations.
2. Mount the controller using two M3.5 (#6) screws.



**Figure 3a**  
**Sub-Panel Mounting**

1. Using the controller as a location template, mark both mounting holes.
2. Drill and tap two 2.7 mm (0.106 in) diameter holes in the desired panel location. See Figure 3a above for hole locations.
3. Mount the controller using two M3.5 (#6) screws.

### DIN Rail Mounting

1. Place the DIN rail upper mounting clip on the top edge of the DIN rail. See Figure 3a. DIN rail spec, DIN 50022, 35 mm x 7.5 mm (1.38 in x 0.30 in).
2. Press down firmly on the top back edge of the DIN rail bracket and push in on the bottom, front edge of the bracket. The controller “snaps” securely onto the rail. See Figure 3a. If the controller does not snap on, check to see if the DIN rail is bent. Minimum clipping distance is 34.8 mm (1.37 in), the maximum is 35.3 mm (1.39 in).

### Removing the DIN Rail Controller

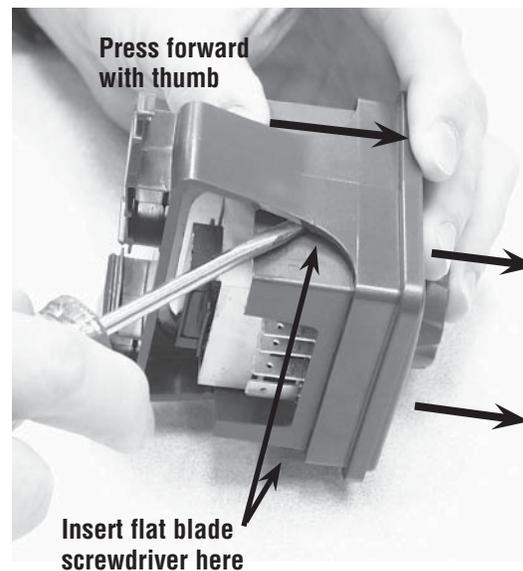
1. Remove power from the system.
2. Remove all the wiring connections from the back of the controller.
3. While pressing down on the top, back edge of the DIN rail bracket, pull forward on the bottom, front edge of the DIN rail bracket. See Figure 3a.

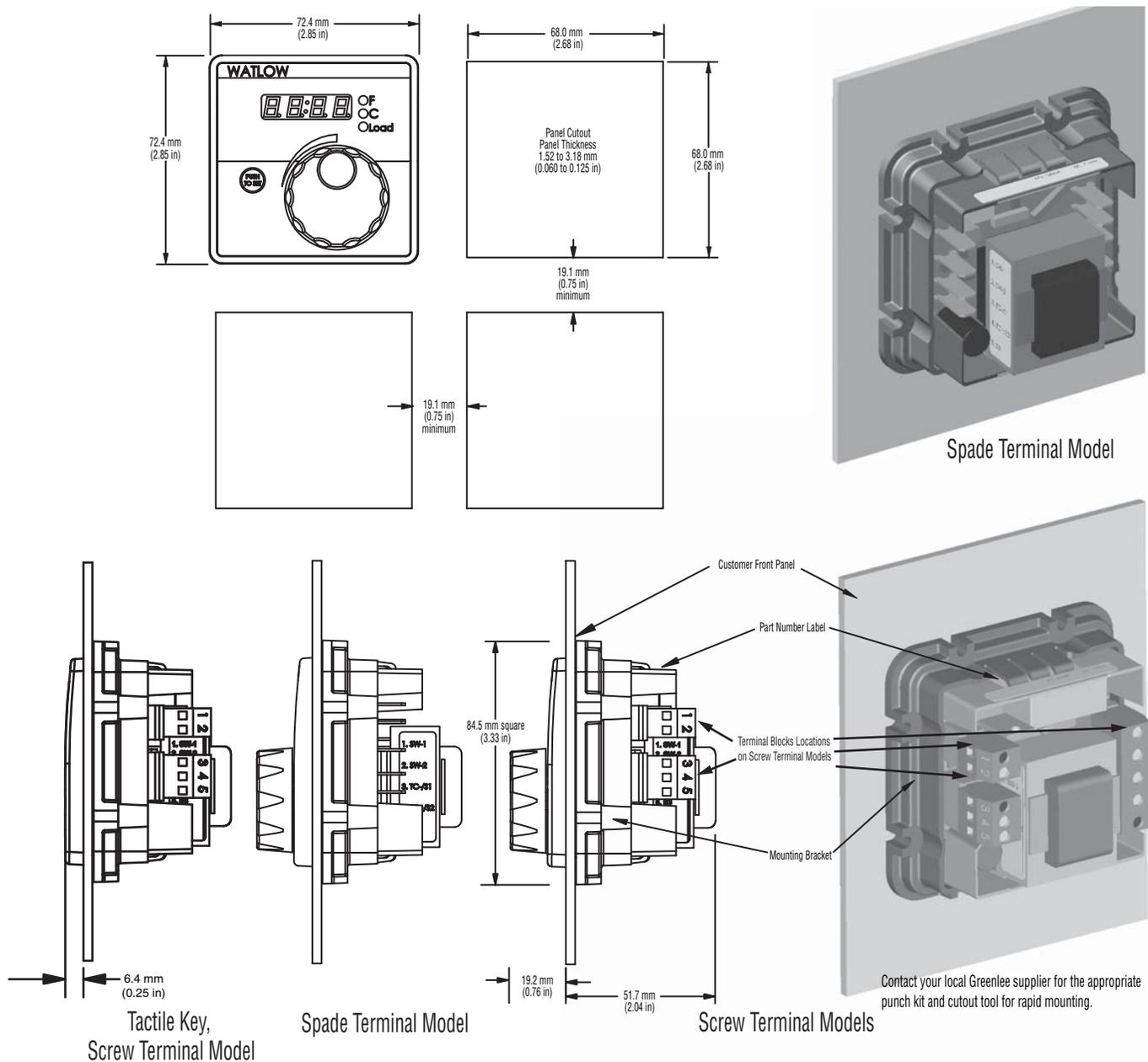
### Removing the Controller from the DIN Rail Bracket

1. Remove power from the system.
2. Remove all the wiring connections from the back of the controller.
3. Remove the DIN rail bracket from the DIN rail.
4. Insert a flat blade screwdriver between the DIN

rail bracket and the case. Rotate the screwdriver to release the DIN rail bracket hooks from the ridges on the case, while firmly pushing the controller out the front of the DIN rail bracket. Alternate back and forth between the top and then the bottom. Be sure to support the controller as it comes out of the bracket. See Figure 3b.

**Figure 3b**





**Figure 4**

## Installing the Square 1/8 DIN Panel Mount Controller

1. Make the panel cutout using the mounting dimensions above.
2. Remove mounting bracket from the back of the controller.
3. If your controller has a gasket, check to see that the gasket is not twisted, and is seated within the case bezel flush with the panel. Place the case in the cutout. Make sure the gasket is between the panel cutout and the case bezel.
4. While pressing the front of the case firmly against the panel, slide the mounting collar over the back of the control. The tabs on the collar must line up with the mounting ridges on the case for secure installation. See Figure 4. Slide the collar firmly against the back of the panel, getting it as tight as possible. To ensure a tight seal, use your thumb to lock the tabs into place while pressing the case from side to side. Don't be afraid to apply enough pressure to install the controller. The tabs on each side of the collar have teeth that latch into the ridges. Each tooth is staggered at a different height, so only one of the tabs on each side are ever locked into the ridges at a time. Confirm that the tabs on one side of the collar correspond with those on the opposite side. Make sure the two corresponding tabs are the only ones locked in the ridges at the same time. If the corresponding tabs are not supporting the case at the same time, you will not have a NEMA 4X seal.
5. Insert the control chassis into its case and press the bezel to seat it. Make sure the inside gasket is also seated properly and not twisted. The hardware installation is complete. Proceed to the wiring section.

2. Insert the controller into the panel cutout.
3. While pressing the bezel firmly against the panel, slide the mounting bracket over the back of the controller. Be sure the levers on the mounting bracket line up with the teeth on the case.
4. Press the bracket up to the back of the panel. The controller should fit tightly in the panel cutout.

## **Removing the Panel Mount Square 1/8 DIN Controller**

1. Remove power from the system.
2. Remove all the wiring connections from the back of the controller.
3. Slide a thin, wide tool (putty knife) under all three mounting tabs, top then bottom, while pushing forward on the back of the case. Be ready to support the controller as it slides out of the panel cutout.

# 3

## Wiring



### Warning:

Use National Electric (NEC) or other country-specific standard wiring and safety practices when wiring and connecting this controller to a power source and to electrical sensors or peripheral devices. Failure to do so may result in damage to equipment and property, and/or injury or loss of life.

**Note:** Insulated terminals required for quick connect style terminals.

For quick connect terminals 1, 2, 6, 7, 8, 9, and 10, AMP P/N 3-520406-2 or equivalent recommended. Use Amp crimp tool P/N 58078-3, insert 90391-3.

For quick connect terminals 3, 4, and 5, AMP P/N 2-520405-2 or equivalent recommended. Amp crimp tool P/N 58078-3, insert 58079-3.

The terminals on the back of the Series C and Series TM controllers are the same for all of the package styles. They are 6.3 mm (0.25 in) quick connect, push on style terminals or removable screw terminal block. The terminal style is an ordering option.

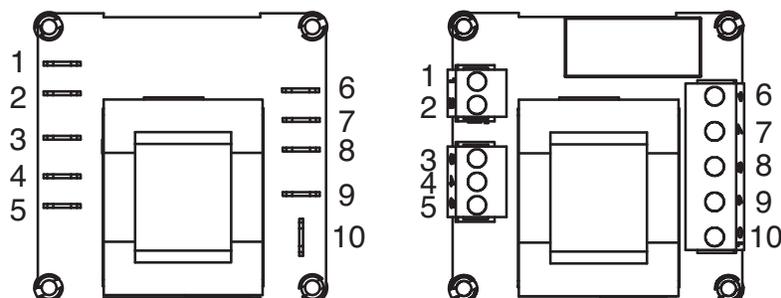
Check the part number to determine your hardware configuration. Refer to the wiring diagrams appropriate for your controller's configuration.

All outputs are referenced to a de-energized state.

### Wiring Guidelines

1. Use the correct thermocouple type per the model number on the case sticker of the unit. See dimension drawings for sticker locations.
  - Use correct thermocouple polarity. Red is usually negative.
  - If you must extend thermocouple leads, use thermocouple extension wire to minimize errors.
  - Be sure you have good crimp connections on your thermocouple connections.
  - Insulate the thermocouple mounting from the mounting surface to prevent heat migration input errors.
  - Thermocouple leads should be routed separately from any high voltage lines.
  - Long lead lengths create electrical resistance and there is not any lead resistance compensation. When using a two or three-wire RTDs, there will be an additional 2.6° C (4.7° F) error for every 1Ω of lead length resistance. That resistance when added to the resistance of the RTD element, can result in erroneous input to the temperature controller.
2. In electrically-noisy environments (heavy switching contactors, motors, solenoids, etc.), use shielded thermocouple lead wire with the shield connected at the sensor end only.
3. Use a separate thermocouple to maintain the limit function of this controller; do not parallel thermocouple input from the primary controller.
4. All wiring and fusing must conform to the National Electric Code (NEC) NFPA70 and any other locally applicable codes.
5. Fuse the independent load voltage on the L1 (hot) side and connect it to the common (C) side of the relay.

**Note:** The model number determines the connection terminal style. See below for terminal locations.





**Warning:**

Use National Electric (NEC) or other country-specific standard wiring and safety practices when wiring and connecting this controller to a power source and to electrical sensors or peripheral devices. Failure to do so may result in damage to equipment and property, and/or injury or loss of life.



**WARNING:** If high voltage is applied to a low-voltage controller, irreversible damage will occur.

**Note:** Insulated terminals required for quick connect style terminals.

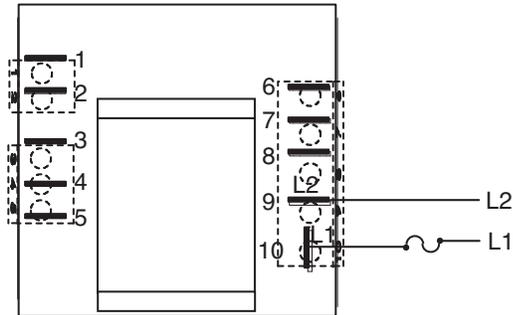
For quick connect terminals 1, 2, 6, 7, 8, 9, and 10, AMP P/N 3-520406-2 or equivalent recommended. Use Amp crimp tool P/N 58078-3, insert 90391-3.

For quick connect terminals 3, 4, and 5, AMP P/N 2-520405-2 or equivalent recommended. Amp crimp tool P/N 58078-3, insert 58079-3.

**Note:** To prevent ground loops, isolation needs to be maintained from input to output when using a switched DC output. Un-grounded thermocouples recommended.

### Figure 7a — AC Power Wiring

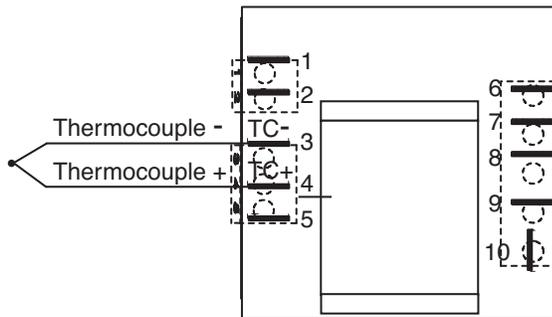
- Nominal voltage options:
  - 24V~ (ac)
  - 120V~ (ac)
  - 230 to 240V~ (ac)



### Figure 7b — Thermocouple Input

Thermocouples are polarity sensitive. The negative lead (usually red) must be connected to TC-.

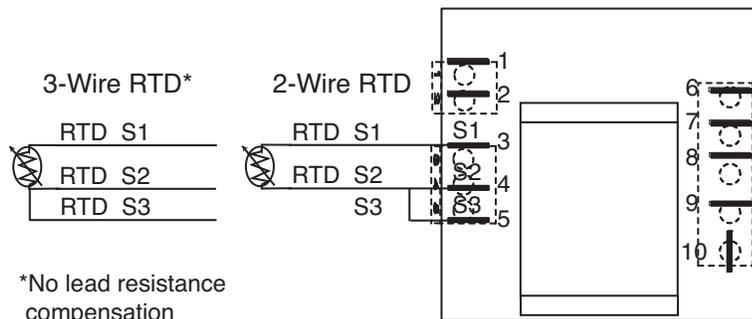
- Input impedance: >10 MΩ



### Figure 7c — RTD Input

(100 Ω Platinum DIN curve 0.00385 Ω/Ω/°C)

- Terminals S2 and S3 must be shorted for a two-wire RTD
- Nominal excitation current: 125 μA



\*No lead resistance compensation



**Warning:**

Use National Electric (NEC) or other country-specific standard wiring and safety practices when wiring and connecting this controller to a power source and to electrical sensors or peripheral devices. Failure to do so may result in damage to equipment and property, and/or injury or loss of life.

**Note:** Insulated terminals required for quick connect style terminals.

For quick connect terminals 1, 2, 6, 7, 8, 9, and 10, AMP P/N 3-520406-2 or equivalent recommended. Use Amp crimp tool P/N 58078-3, insert 90391-3.

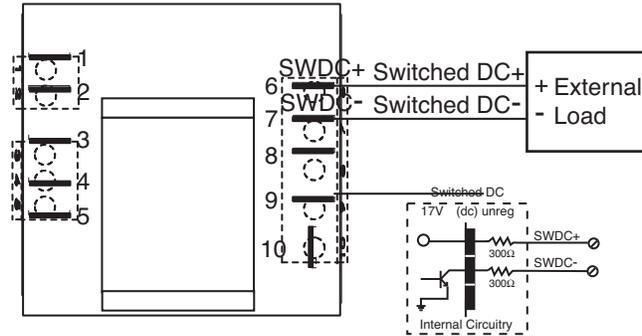
For quick connect terminals 3, 4, and 5, AMP P/N 2-520405-2 or equivalent recommended. Amp crimp tool P/N 58078-3, insert 58079-3.

**Quencharc Note:** Switching pilot duty loads (relay coils, solenoids, etc.) with the mechanical relay output options requires use of an R.C. suppressor.

Watlow carries the R.C. suppressor Quencharc brand name, which is a trademark of ITW Paktron. Watlow Part No. 0804-0147-0000.

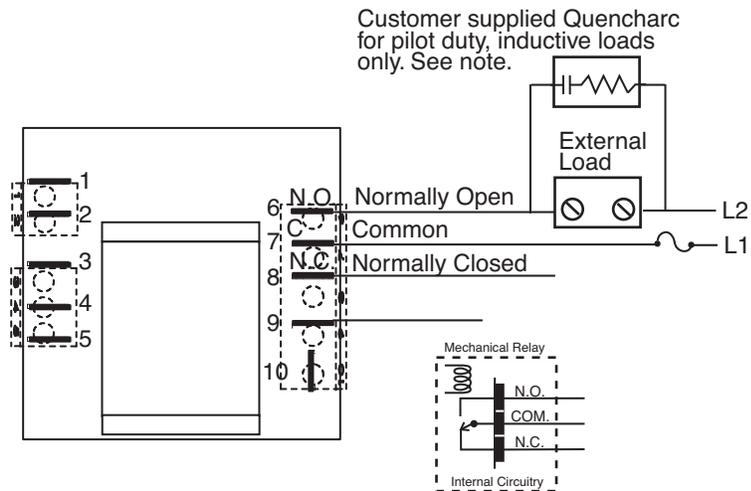
### Figure 8a — Switched DC Output

- Maximum voltage output into an infinite load, 24V<sub>DC</sub>
- Minimum output voltage at 10 mA, 5V<sub>DC</sub>
- Minimum load impedance, 500Ω
- Offstate leakage, 100μA<sub>DC</sub>
- Not recommended for switching mechanical relays
- Output supplies power



### Figure 8b — Mechanical Relay Output

- Form C contacts
- 8 A, resistive
- 250 VA pilot duty, 120/240V<sub>AC</sub>, inductive
- 240V<sub>AC</sub> maximum
- 30V<sub>DC</sub> maximum
- See Quencharc note
- For use with ac or dc
- Minimum load current 100 mA
- Output does not supply power



# System Wiring Examples

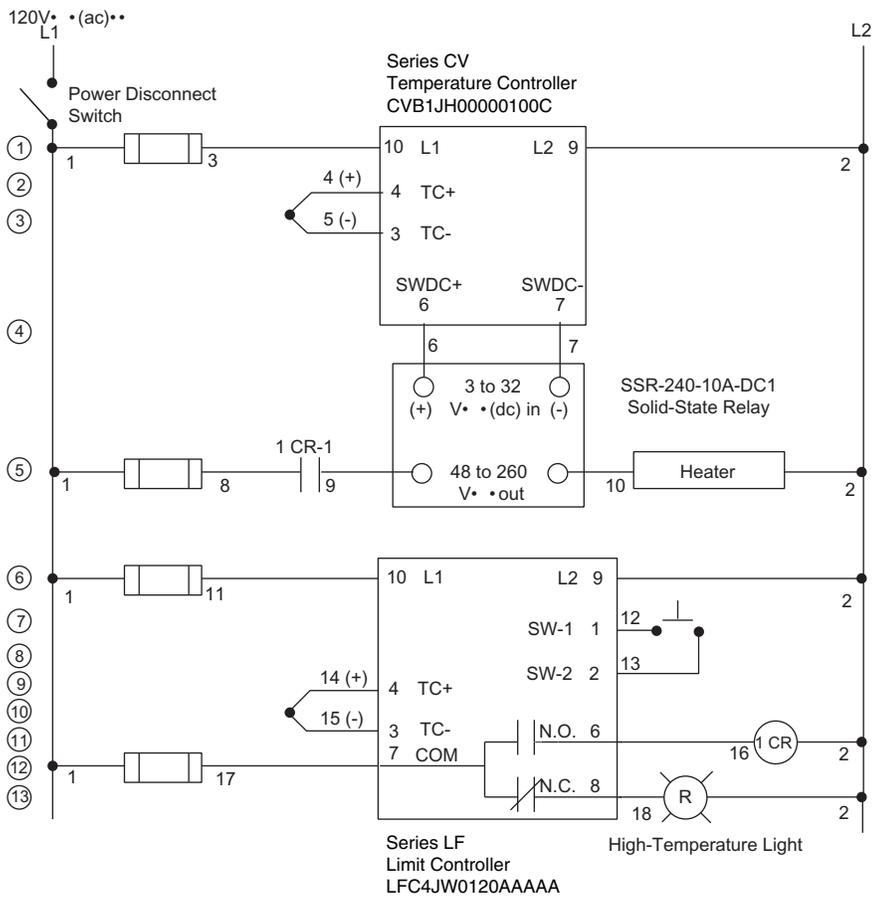
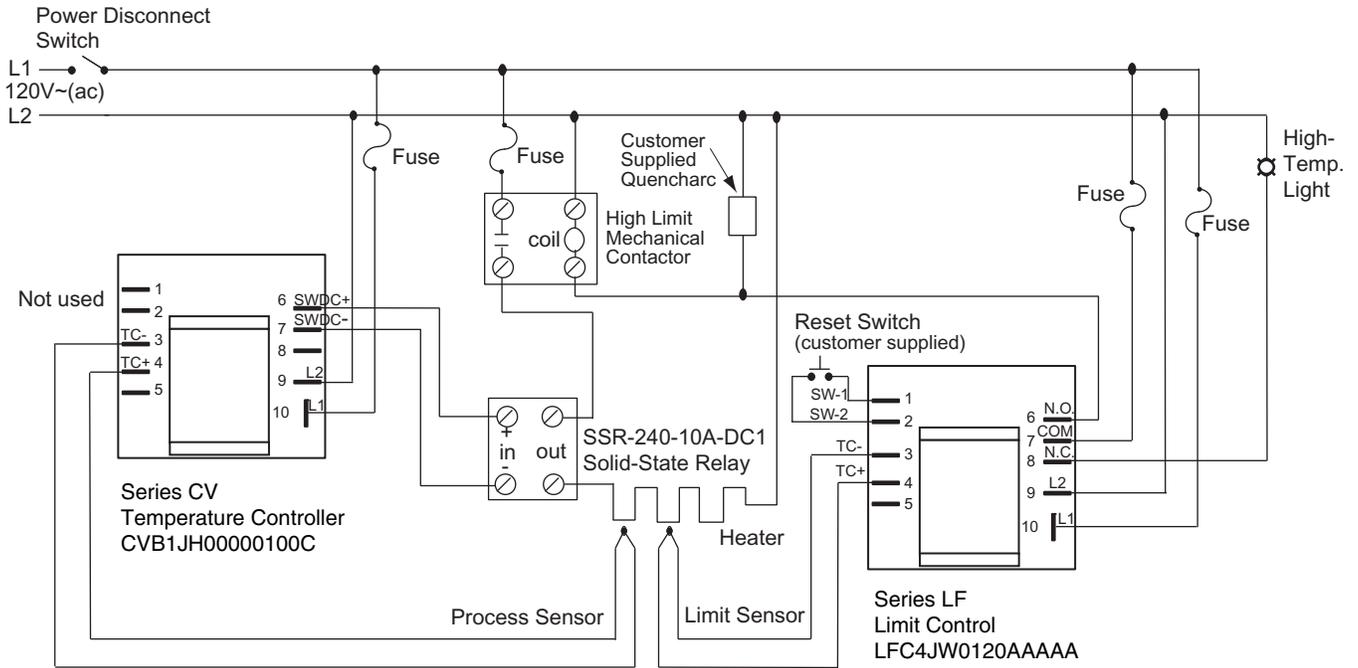


Figure 9 — System Wiring Examples

# 4

## User Interface

### Variable Set Point, Standard

CV \_\_ (1, 2, 5 or 6) \_ \_ \_ \_ \_ A

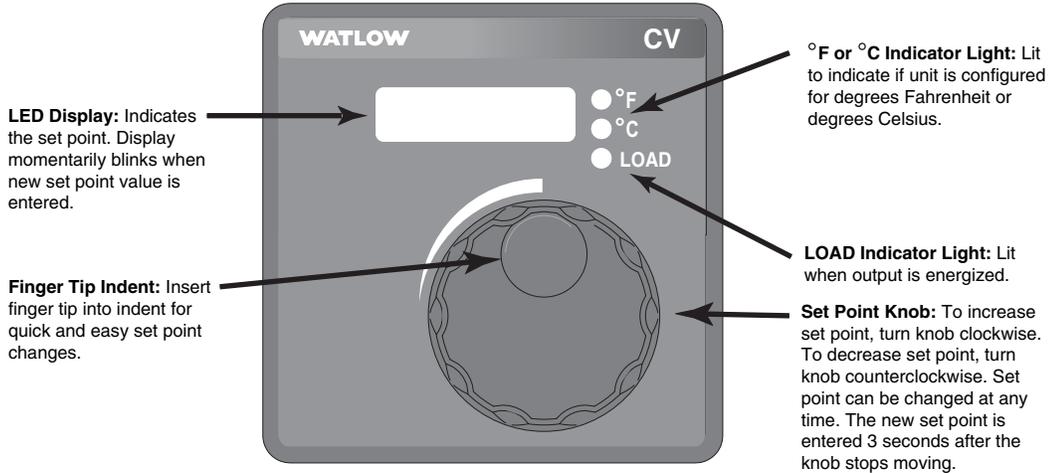


Figure 10a — Variable Set Point Standard Interface

### Variable Set Point, Standard

CV \_\_ (A, B, C or D) \_ \_ \_ \_ \_ A

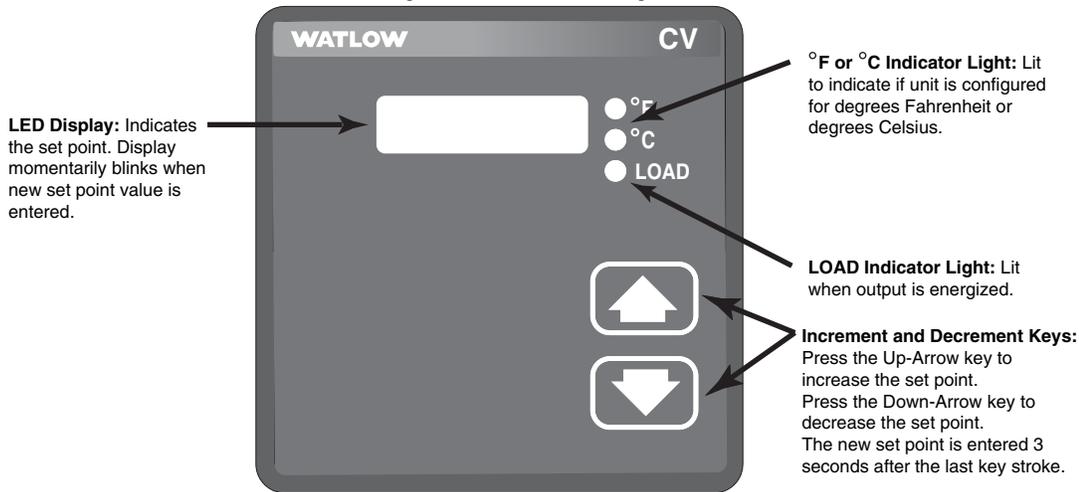


Figure 10b — Variable Set Point with Tactile Keys

To adjust the Calibration Offset on models with tactile keys, first hold down both the Increment and Decrement keys for five seconds. The display will first show **CAL** for five seconds, then it will display the Calibration Offset value. Adjust the value with the Increment and Decrement keys (range: -30 to 30°). The new value will take effect three seconds after the last key stroke. The display will blink, then return to the primary display after five seconds.

To change the temperature units on models with tactile keys, first hold down both the Increment and Decrement keys for ten seconds. The display will show **F C** for two seconds. Adjust the units with the Increment and Decrement keys. The new value will take effect three seconds after the last key stroke. The display will blink, then return to the primary display after five seconds. The set point value, process value and offset will automatically adjust to the new temperature scale.

## Variable Set Point, Push for Process CV \_ (1, 2, 5 or 6) \_\_\_\_\_ B

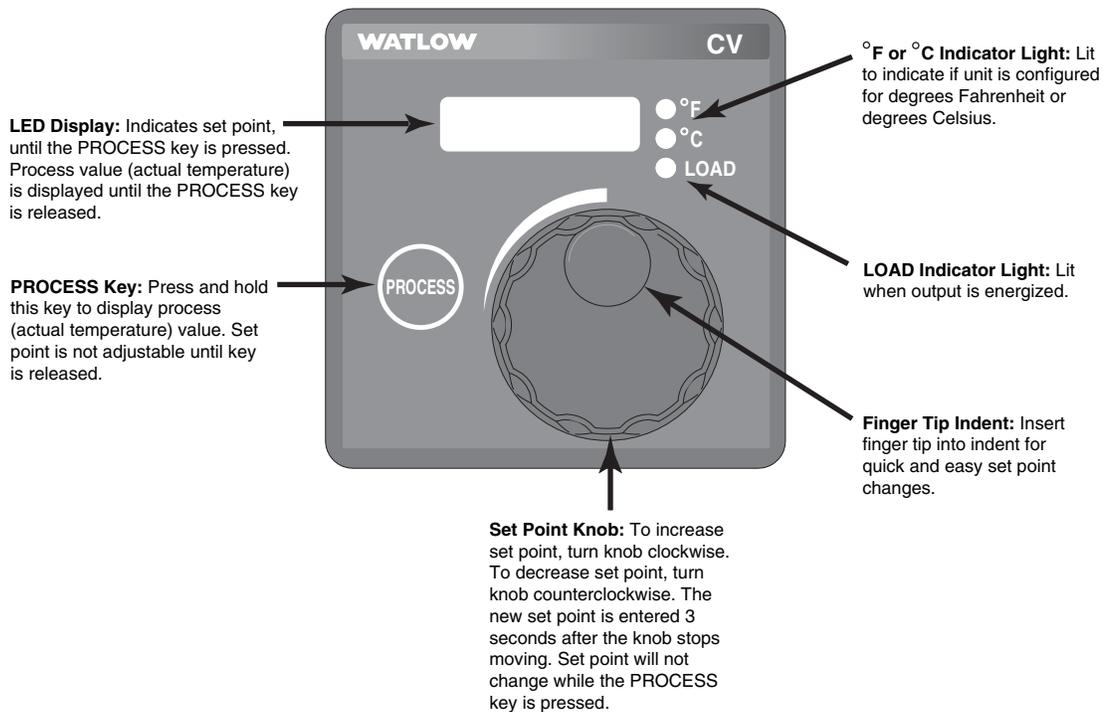


Figure 11a — Variable Set Point, Push for Process Interface

## Variable Set Point, Push for Process CV \_ (A, B, C or D) \_\_\_\_\_ B

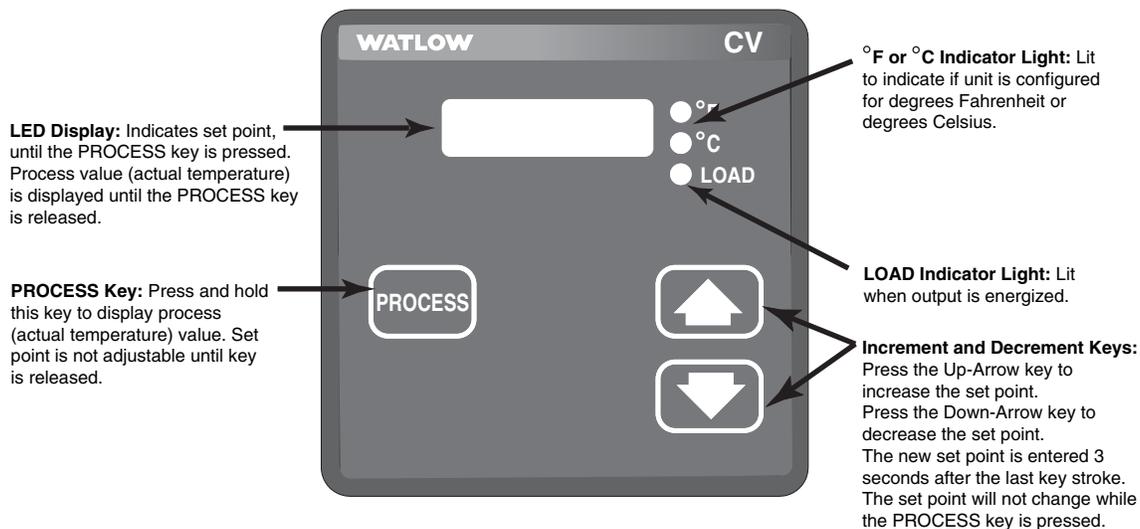


Figure 11b — Variable Set Point, Push for Process Interface with Tactile Keys

To adjust the Calibration Offset on models with tactile keys, first hold down both the Increment and Decrement keys for five seconds. The display will first show **CR** for five seconds, then it will display the Calibration Offset value. Adjust the value with the Increment and Decrement keys (range: -30 to 30°). The new value will take effect three seconds after the last key stroke. The display will blink, then return to the primary display after five seconds.

To change the temperature units on models with tactile keys, first hold down both the Increment and Decrement keys for ten seconds. The display will show **F** for two seconds. Adjust the units with the Increment and Decrement keys. The new value will take effect three seconds after the last key stroke. The display will blink, then return to the primary display after five seconds. The set point value, process value and offset will automatically adjust to the new temperature scale.

## Variable Set Point, Push to Set CV \_ (1, 2, 5 or 6) \_ \_ \_ \_ \_ C

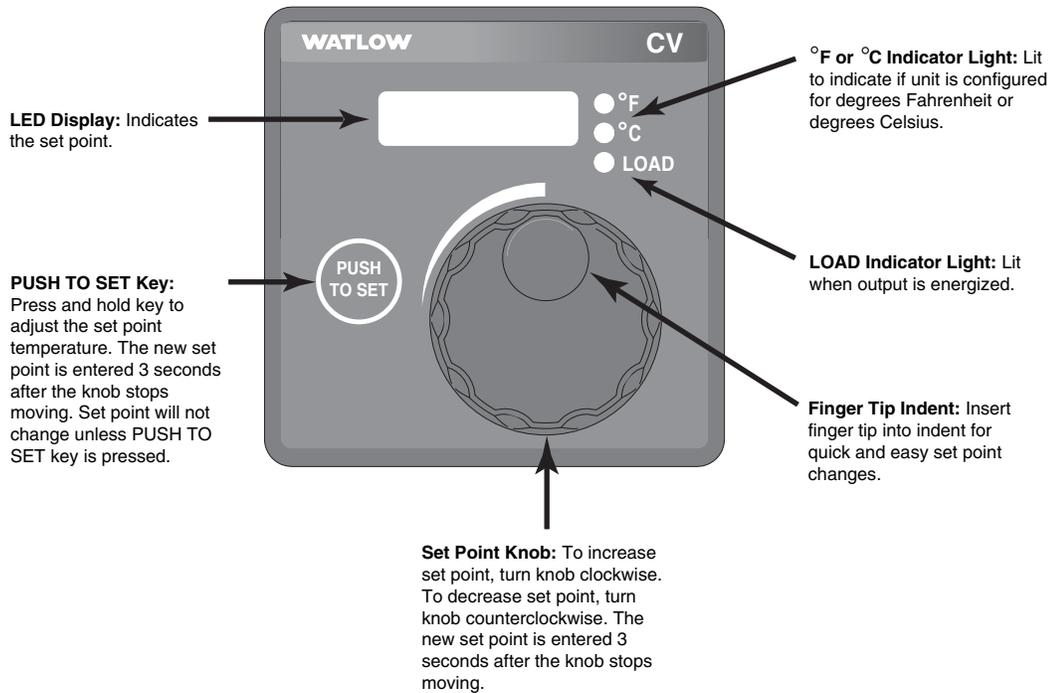


Figure 12a — Variable Set Point, Push to Set Interface

## Variable Set Point, Push to Set CV \_ (A, B, C or D) \_ \_ \_ \_ \_ C

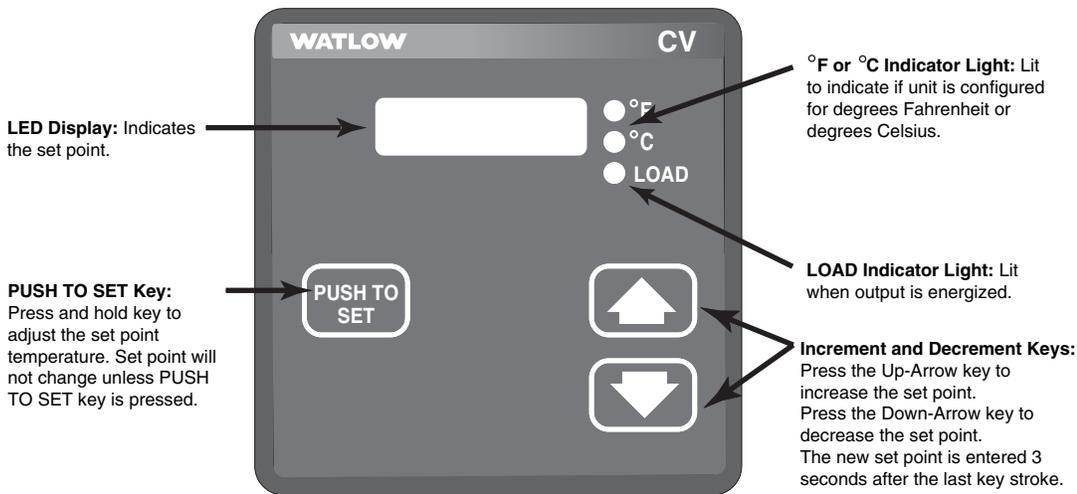


Figure 12b — Variable Set Point, Push to Set Interface with Tactile Keys

To adjust the Calibration Offset on models with tactile keys, first hold down both the Increment and Decrement keys for five seconds. The display will first show **CAL** for five seconds, then it will display the Calibration Offset value. Adjust the value with the Increment and Decrement keys (range: -30 to 30°). The new value will take effect three seconds after the last key stroke. The display will blink, then return to the primary display after five seconds.

To change the temperature units on models with tactile keys, first hold down both the Increment and Decrement keys for ten seconds. The display will show **F C** for two seconds. Adjust the units with the Increment and Decrement keys. The new value will take effect three seconds after the last key stroke. The display will blink, then return to the primary display after five seconds. The set point value, process value and offset will automatically adjust to the new temperature scale.

## Variable Set Point, Push to Set CV \_ (1, 2, 5 or 6) \_ \_ \_ \_ \_ D

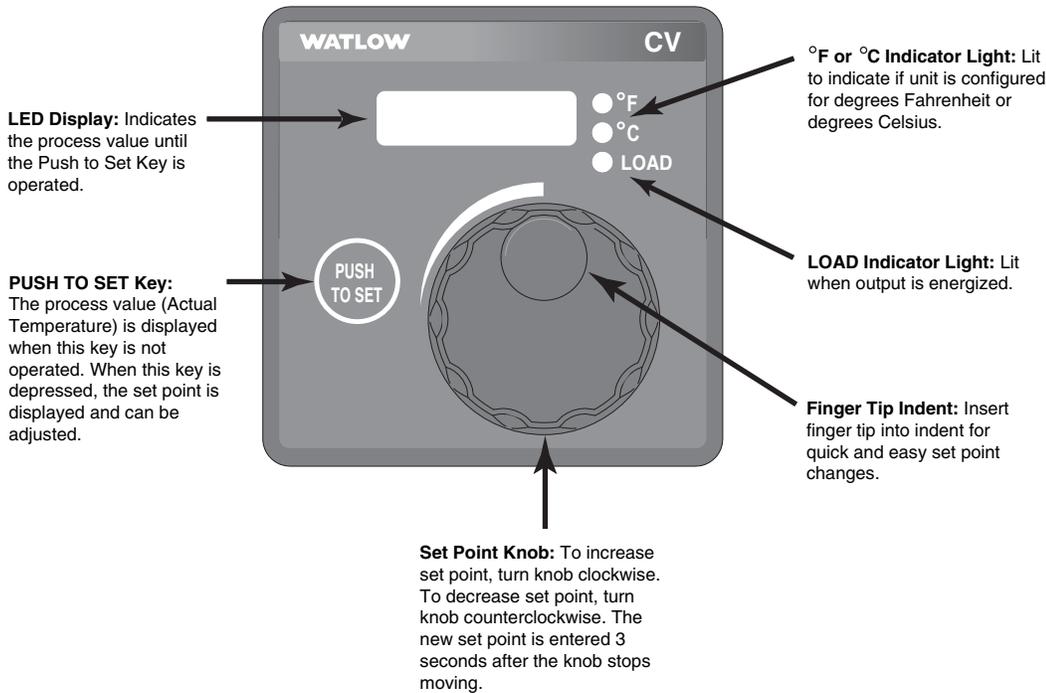


Figure 13a — Variable Set Point, Push to Set Interface

## Variable Set Point, Push to Set CV \_ (A, B, C or D) \_ \_ \_ \_ \_ D

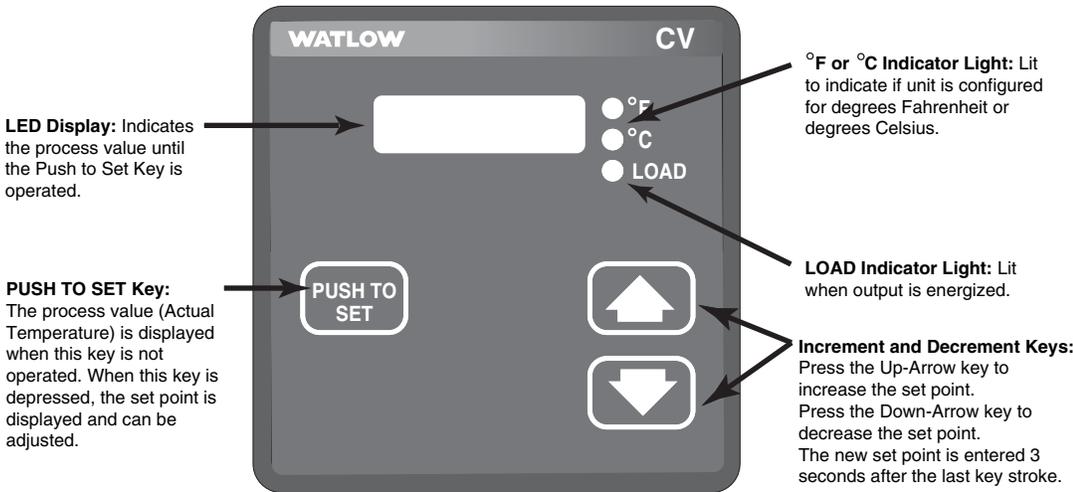


Figure 13b — Variable Set Point, Push to Set Interface with Tactile Keys

To adjust the Calibration Offset on models with tactile keys, first hold down both the Increment and Decrement keys for five seconds. The display will first show **CAL** for five seconds, then it will display the Calibration Offset value. Adjust the value with the Increment and Decrement keys (range: -30 to 30°). The new value will take effect three seconds after the last key stroke. The display will blink, then return to the primary display after five seconds.

To change the temperature units on models with tactile keys, first hold down both the Increment and Decrement keys for ten seconds. The display will show **F C** for two seconds. Adjust the units with the Increment and Decrement keys. The new value will take effect three seconds after the last key stroke. The display will blink, then return to the primary display after five seconds. The set point value, process value and offset will automatically adjust to the new temperature scale.

# Temperature Indicator TM

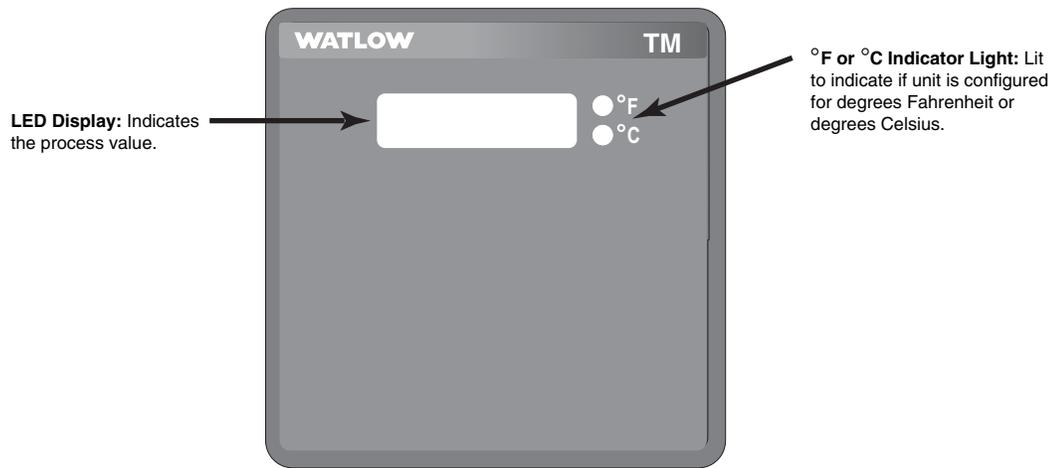


Figure 14 — Temperature Indicator Interface

# Troubleshooting

Indication	Probable Cause(s)	Corrective Action
On indicating controls, the display is not illuminated.	• Power supply switch off.	• Turn switch on.
	• Fuse blown.	• Replace fuse (check cause of failure).
	• Breaker tripped.	• Reset breaker (check cause of failure).
	• Safety interlock door switch activated.	• Close door.
	• Separate system limit control latched.	• Reset limit controller.
	• Wiring incorrect or open.	• Check wiring.
	• Power supply voltage incorrect.	• Verify input power.
	• Defective controller.	• Repair or replace controller.
<b>Troubleshooting thermocouple inputs</b>		
Temperature reading is incorrect, showing a sensor error, <b>[Err In]</b> , or LOAD LED is switching at the wrong temperature.	• Calibration offset is incorrect (tactile models only).	Check calibration offset.
	• Settings for degree C or F is incorrect.	Check model part number for degree C or F. If model has Increment/Decrement keys then C/F setting is adjustable.
	• Sensor or controller may be bad. Sensor connections may be bad.	<ul style="list-style-type: none"> <li>• Place a jumper wire across the thermocouple input terminals. The display should indicate ambient temperature. If it does, the controller is OK.</li> <li>For controllers without the ability to view process temperature: <ul style="list-style-type: none"> <li>- Decrease set point below ambient temperature, LOAD LED should be off for heating controllers and on for cooling controllers.</li> <li>- Increase set point above ambient temperature. LOAD LED should be on for heating controllers and off for cooling controllers.</li> </ul> </li> </ul>
	• Ambient temperature in the control cabinet is over 70°C.	• Measure temperature in cabinet to ensure it is below 70C. Vent cabinet or add fans if necessary.
	• Ground loop problem. Can occur when using a switched DC output and a grounded thermocouple.	• Remove power from the system. Use an ohm meter to measure resistance between output DC- and the thermocouple sheath. If there is continuity, replace sensor with an ungrounded thermocouple.
Temperature reading is decreasing, but actual process is increasing.	• Thermocouple polarity is reversed. In the US, red wire insulation denotes the negative wire.	• Check thermocouple connections. All connections, including extension wire must maintain the correct polarity. Correct polarity problems.
Temperature reading is reading low and not increasing while actual process temperature is increasing.	• Sensor is bad. Thermocouple is shorted.	• Check thermocouple connections. Check thermocouple wire insulation to make sure it is not damaged, causing the wires to short (making a new junction).
Temperature reading is offset from actual process temperature, or the output switches on or off at the wrong temperature. The offset changes with changes in process temperature.	• Copper wire was used instead of thermocouple extension wire. Connectors of metals different than thermocouple metal were used to splice or make connections.	• Check thermocouple connections. Check to make sure that only thermocouple extension wire of the correct type was used to extend thermocouple leads. Replace if necessary.

Indication	Probable Cause(s)	Corrective Action
<b>Troubleshooting RTD inputs</b>		
Temperature reading is incorrect, showing a sensor error, <b>Er In</b> , or LOAD LED is switching at the wrong temperature.	<ul style="list-style-type: none"> <li>• Calibration offset incorrect (tactile models only).</li> </ul>	Check calibration offset
	<ul style="list-style-type: none"> <li>• Settings for degree C or F is incorrect.</li> </ul>	Check model part number for degree C or F. If model has Increment/Decrement keys then C/F setting is adjustable.
	<ul style="list-style-type: none"> <li>• Sensor or controller may be bad. Sensor connections may be bad.</li> </ul>	<ul style="list-style-type: none"> <li>• Place a 110 ohm resistor across the sensor input terminals. The display should indicate 25°C (77°F). If it does, the controller is OK. Sensor or connections may be bad.</li> </ul> For controllers without the ability to view process temperature: <ul style="list-style-type: none"> <li>- Decrease set point below ambient temperature, LOAD LED should be off for heating controllers and on for cooling controllers.</li> <li>- Increase set point above ambient temperature. LOAD LED should be on for heating controllers and off for cooling controllers.</li> </ul>
	<ul style="list-style-type: none"> <li>• Ambient temperature in the control cabinet is over 70°C (158°F).</li> </ul>	<ul style="list-style-type: none"> <li>• Measure temperature in cabinet to ensure it is below 70°C (158°F). Vent cabinet or add fans if necessary.</li> </ul>
	<ul style="list-style-type: none"> <li>• Sensor connections may be bad. Excessive lead wire resistance.</li> </ul>	<ul style="list-style-type: none"> <li>• Check sensor connections. Measure lead wire resistance. There will be a 2.6°C (4.7°F) error for every ohm of lead wire resistance.</li> </ul>
<b>Troubleshooting controller outputs</b>		
Controller output signal is not on when it should be. Load LED is not on.	<ul style="list-style-type: none"> <li>• Temperature reading is incorrect on display of indicating controls or limit. See input troubleshooting.</li> </ul>	<ul style="list-style-type: none"> <li>• See input troubleshooting.</li> </ul>
	<ul style="list-style-type: none"> <li>• Set point is not set correctly.</li> </ul>	<ul style="list-style-type: none"> <li>• Verify set point setting.</li> </ul>
Controller output signal is not on when it should be. Load LED is on.	<ul style="list-style-type: none"> <li>• Output wiring is incorrect.</li> </ul>	<ul style="list-style-type: none"> <li>• Verify wiring. Relay outputs act as a switch, they do not source power. For DC output controls, voltage should be about 20VDC with no load. Greater than 5 volts with load of 500 Ω or greater.</li> </ul>
Control output signal is on when it should not be on. Load LED is on.	<ul style="list-style-type: none"> <li>• Temperature reading is incorrect on display of indicating controls or limit. see input troubleshooting.</li> </ul>	<ul style="list-style-type: none"> <li>• See input troubleshooting.</li> </ul>
	<ul style="list-style-type: none"> <li>• Set point is not set correctly.</li> </ul>	<ul style="list-style-type: none"> <li>• Verify set point setting.</li> </ul>
	<ul style="list-style-type: none"> <li>• Control output is defective.</li> </ul>	<ul style="list-style-type: none"> <li>• Repair or replace controller.</li> </ul>
Load is on when it should not be on. Load LED is off.	<ul style="list-style-type: none"> <li>• Power switching device (SSR, HG relay, mechanical relay) is shorted. Controller outputs shorted.</li> </ul>	<ul style="list-style-type: none"> <li>• Remove wires from output of control to input of power switching device. If load is still on, replace power switching device. If load turns off, replace controller or sensor. See input troubleshooting.</li> </ul>
	<ul style="list-style-type: none"> <li>• Output wiring is incorrect.</li> </ul>	<ul style="list-style-type: none"> <li>• Verify wiring.</li> </ul>

# Specifications

## Controller

- Microprocessor based, on-off control mode.
- Nominal switching hysteresis, typically 1.7°C (3°F).
- Input filter time: 1 second

## Operator Interface (model dependent)

- Four digit , 7 segment LED displays, .28" high.
- °F or °C indicator LED.
- LOAD indicator LED.
- Continuous turn, velocity sensitive rotary encoder for set point adjustment, on rotary-knob models.
- Front panel key on Push for Set Point or Push for Process options.
- No operator interface on fixed set point models.
- Increment/Decrement keys for set point adjustment on tactile key models.

## Standard Conditions For Specifications

- Rated line voltage, 50 to 60Hz, 0 to 90% RH non-condensing, 15-minute warm-up.

## Calibration ambient range: 25°C (77°F) ±3°C

## Sensor Input

### Thermocouple

- Grounded or ungrounded.
- Type E, J, K, T thermocouple types.
- >10 MΩ input impedance
- 250 nV input referenced error per 1Ω source resistance.

### RTD

- 2-wire or 3-wire platinum, 100 Ω
- DIN curve (.00385 curve)
- 125 μA nominal RTD excitation current

## Input Accuracy Span Range

Type E: -200 to 800°C or -328 to 1,470°F

Type J: 0 to 750°C or 32 to 1,382°F

Type K: -200 to 1,250°C or -328 to 2,282°F

Type T: -200 to 350°C or -328 to 662°F

RTD (DIN):-200 to 800°C or -328 to 1,472°F

## Thermocouple Input

- Calibration accuracy: ±1% of input accuracy span, ±1° at standard conditions and actual calibration ambient.  
Exception: Type T, ±2.4% of input accuracy span for -200 to 0° (-328 to 32°F)
- Temperature stability: ±0.3 degree per degree change in ambient.

## RTD Input

- Calibration accuracy ±1% of input accuracy span ±1° at standard conditions and actual calibration ambient.
- Temperature stability: ±0.2 degree per degree change in ambient

## Allowable Operating Ranges

Type E: -200 to 800°C or -328 to 1,470°F

Type J: -210 to 1,038°C or -346 to 1,900°F

Type K: -270 to 1,370°C or -454 to 2,500°F

Type T: -270 to 400°C or -454 to 750°F

RTD (DIN):-200 to 800°C or -328 to 1,472°F

## Output Types

### Switched DC (non-isolated)

- Supply voltage maximum: 24V<sub>DC</sub> (dc) into an infinite load.
- Supply voltage minimum: 5V<sub>DC</sub> (dc) at 10 mA
- Minimum load impedance: 500 Ω

### Electromechanical Relay, Form C

- Minimum load current: 100 mA
- 8 A @ 240V~ (ac) or 30V<sub>DC</sub> (dc) maximum, resistive
- 250 VA pilot duty, 120/240V~ (ac) maximum, inductive
- Use RC suppression for inductive loads
- Electrical life 100,000 cycles at rated current

## Agency Approvals

- UL®873 Recognized Temperature Controller and Indicator. File E43684.
- NEMA 4X/IP65 on panel mount package options with tactile keys for set point.
- UL®197 Reviewed for use in cooking appliances.
- W.E.E.E; CE - See Declaration of Conformity.
- ANSI Z21.23 Gas Appliance Thermostat approval.
- Temperature Control and Indicator CSA 22.2 No. 24.
- RoHS Directive (2002-95-EC)

## Terminals

- 6.4 mm (0.25 in) quick connect, push-on terminals. See order options. Refer to Wiring section for crimp-on terminal recommendations.
- Removable screw clamp style terminal blocks. See order options.
- Wire gauge 0.1 to 4 mm<sup>2</sup> (30 to 12 AWG). Strip length, 8 mm (0.30 in).
- Torque: 0.8 Nm (7 in-lb) maximum.

## Power

- 24V~ (ac) +10%; -15%; 50/60 Hz, ±5%
- 120V~ (ac) +10%; -15%; 50/60 Hz, ±5%
- 230 to 240V~ (ac) +10%; -15%; 50/60 Hz, ±5%
- 10VA maximum power consumption
- Data retention upon power failure via nonvolatile memory

## Operating Environment

- 0 to 70°C (32 to 158°F)
- 0 to 90% RH, non-condensing
- Storage temperature: -40 to 85°C (-40 to 185°F)

## Dimensions

- DIN Rail model can be DIN rail or chassis mount  
DIN rail spec DIN 50022, 35 mm x 7.5 mm (1.38 in x 0.30 in)

Style	Width	Height	Depth
<b>Open board</b>	61.7 mm (2.43 in)	61.7 mm (2.43 in)	45.1 mm (1.78 in)
<b>Potted</b>	70.1 mm (2.76 in)	102.9 mm (4.05 in)	46.6 mm (1.84 in)
<b>DIN Rail</b>	78.1 mm (3.08 in)	112.3 mm (4.42 in)	90.7 mm* (3.57 in)
<b>Square 1/8 DIN Panel</b>	72.4 mm (2.85 in)	72.4 mm (2.85 in)	Behind panel 51.7 mm (2.04 in)

\*Depth including DIN rail, 94.7 mm (3.73 in)

**Note: These specifications are subject to change without prior notice.**

# Ordering Information and Model Numbers

On-off controller, No user interface

C F

A A A A

## Set Point Type

F Fixed Set Point

## Line Voltage and Output

B 120V~ (ac), Switched DC Output  
 C 120V~ (ac), 8 Amp Relay Output  
 D 230 to 240V~ (ac), Switched DC Output  
 E 230 to 240V~ (ac), 8 Amp Relay Output  
 F 24V~ (ac), Switched DC Output  
 G 24V~ (ac), 8 Amp Relay Output

## Controller Package

1 Panel Mount, 1/8 DIN Square -Spade Terminals  
 2 DIN Rail Mount -Spade Terminals  
 3 Open Board, not potted -Spade Terminals  
 4 Potted Case -Spade Terminals  
 5 Panel Mount, 1/8 DIN Square -Screw Terminals  
 6 DIN Rail Mount -Screw Terminals  
 7 Open Board, not potted -Screw Terminals

## Sensor and Sensor Operating Range

H Type J -346 to 1900 Degrees F  
 J Type J -210 to 1038 Degrees C  
 K Type K -454 to 2500 Degrees F  
 L Type K -270 to 1370 Degrees C  
 M Type T -454 to 750 Degrees F  
 N Type T -270 to 400 Degrees C  
 P 100 Ω RTD -328 to 1472 Degrees F  
 R 100 Ω RTD -200 to 800 Degrees C  
 S Type E -328 to 1470 Degrees F  
 T Type E -200 to 800 Degrees C

## Control Mode

H Heat  
 C Cool

## Fixed Set Point Value \*

XXXX Control Set Point Value\*\*

## Overlay/Custom Options

A Standard

\*Note: Set point must fall within the sensor operating range.

\*\*Note: A (-) is used in the left digit of the operating range to indicate negative temperature values.

# Ordering Information and Model Numbers

## On-off controller, LED Display

**C V**

### Set Point Type

V Variable Set Point

### Line Voltage and Output

B 120V~ (ac), Switched DC Output  
 C 120V~ (ac), 8 Amp Relay Output  
 D 230 to 240V~ (ac), Switched DC Output  
 E 230 to 240V~ (ac), 8 Amp Relay Output  
 F 24V~ (ac), Switched DC Output  
 G 24V~ (ac), 8 Amp Relay Output

### Controller Package

1 Panel Mount, 1/8 DIN Square, Rotary Knob -Spade Terminals  
 2 DIN Rail Mount, Rotary Knob -Spade Terminals  
 5 Panel Mount, 1/8 DIN Square, Rotary Knob -Screw Terminals  
 6 DIN Rail Mount, Rotary Knob -Screw Terminals  
 A NEMA 4X Panel Mount, Tactile Keys, Spade Terminals  
 B DIN Rail Mount, Tactile Keys, Spade Terminals  
 C NEMA 4X Panel Mount, Tactile Keys, Screw Terminals  
 D DIN Rail Mount, Tactile Keys, Screw Terminals

### Sensor and Sensor Operating Range

H Type J -346 to 1900 Degrees F  
 J Type J -210 to 1038 Degrees C  
 K Type K -454 to 2500 Degrees F  
 L Type K -270 to 1370 Degrees C  
 M Type T -454 to 750 Degrees F  
 N Type T -270 to 400 Degrees C  
 P 100 Ω RTD -328 to 1472 Degrees F  
 R 100 Ω RTD -200 to 800 Degrees C  
 S Type E -328 to 1470 Degrees F  
 T Type E -200 to 800 Degrees C

### Control Mode

H Heat  
 C Cool

### Low Set Point Range Limit \*

XXXX Low Set Point Operating Range Value\*\*

### High Set Point Range Limit \*

XXXX High Set Point Operating Range Value\*\*

### Overlay/Custom Options (A through D contain the Watlow Logo on the overlay; 1 through 4 do not have the Watlow Logo on the overlay)

A Standard, displays set point only. Set point is adjustable from default display.  
 B Displays set point, and set point is adjustable. Press Process Key to display process.  
 C Displays set point. Press Push to Set Key, to allow set point to be adjusted.  
 D Displays process. Press Push to Set Key, to allow set point to be adjusted.  
 1 Standard, displays set point only. Set point is adjustable from default display.  
 2 Displays set point, and set point is adjustable. Press Process Key to display process.  
 3 Displays set point. Press Push to Set Key, to allow set point to be adjusted.  
 4 Displays process. Press Push to Set Key, to allow set point to be adjusted.

**\*Note: Set point ranges must fall within the sensor operating range.**

**\*\*Note: A (-) is used in the left digit of the operating range to indicate negative temperature values.**

# Ordering Information and Model Numbers

## Temperature Indicator

T M — — — A A A A A A A A A A —

### Line Voltage and Output

- B 120V~ (ac)
- D 230 to 240V~ (ac)
- F 24V~ (ac)

### Controller Package

- 1 Panel Mount, 1/8 DIN Square -Spade Terminals
- 2 DIN Rail Mount -Spade Terminals
- 5 Panel Mount, 1/8 DIN Square -Screw Terminals
- 6 DIN Rail Mount -Screw Terminals
- A NEMA 4X Panel Mount, Spade Terminals
- C NEMA 4X Panel Mount, Screw Terminals

### Sensor and Sensor Operating Range

- H Type J -346 to 1900 Degrees F
- J Type J -210 to 1038 Degrees C
- K Type K -454 to 2500 Degrees F
- L Type K -270 to 1370 Degrees C
- M Type T -454 to 750 Degrees F
- N Type T -270 to 400 Degrees C
- P 100 Ω RTD -328 to 1472 Degrees F
- R 100 Ω RTD -200 to 800 Degrees C
- S Type E -328 to 1470 Degrees F
- T Type E -200 to 800 Degrees C

### Overlay/Custom Options

- A Standard with Watlow Logo
- 1 Standard without Watlow Logo

# Declaration of Conformity

## Series C and Series TM



Watlow Winona, Inc.  
1241 Bundy Blvd.  
Winona, MN 55987 USA

Declares that the following product:

Designation: Series C and Series TM  
Model Numbers: CF – (B, C, D, E, F or G)(1, 2, 3, 4, 5, 6 or 7)(any letter)(H or C) – (any four numbers or – and three numbers) – (AAAA) – may be followed by additional numbers or letters  
CV – (B, C, D, E, F or G)(1, 2, 5, 6, A, B, C or D)(any letter)(H or C) – (any four numbers or – and three numbers) – (any four numbers) – may be followed by additional numbers or letters  
TM – (B, D or F)(1, 2, 5 or 6)(any letter)(A) – (AAAA) – (AAAA) – may be followed by additional numbers or letters  
Classification: CF and CV = Temperature control, TM = Indicator  
Installation Category II, Pollution degree 2  
Rated Voltage: 24 V, 120 V, 230/240 V~ (ac)  
Rated Frequency: 50/60 Hz  
Rated Power Consumption: 10 VA maximum

Meets the essential requirements of the following European Union Directives by using the relevant standards show below to indicate compliance.

### ***2004/108/EC Electromagnetic Compatibility Directive***

<b>EN 61326:1997 + A1:1998, A2:2002</b>	<b>Electrical equipment for measurement, control and laboratory use – EMC requirements (Industrial Immunity, Class B Emissions).</b>
EN 61000-4-2:1996 + A1, 1998	Electrostatic Discharge Immunity
EN 61000-4-3:1997	Radiated Field Immunity
EN 61000-4-4:1995	Electrical Fast-Transient / Burst Immunity
EN 61000-4-5:1995 + A1, 1996	Surge Immunity
EN 61000-4-6:1996	Conducted Immunity
EN 61000-4-11:1994	Voltage Dips, Short Interrupts and Variations - Immunity
EN 61000-3-2: ED.2. 2000	Harmonic Current Emissions – Class A equipment.
EN 61000-3-3:1995 + A1:1998	Voltage Fluctuations and Flicker

### ***2006-95-EC Low-Voltage Directive***

<b>EN 60730-1:2000 + A11:2002 and EN 60730-2-9:2002</b> CXX4 units	<b>Automatic electric controls for household and similar use: Particular requirements for temperature sensing controls.</b>
<b>EN 61010-1:2001</b> All other units	<b>Safety Requirements of electrical equipment for measurement, control and laboratory use. Part 1: General requirements</b>

Meets the European Union Limits for hazardous material content as defined by:

### ***2002/95/EC RoHS Reduction of Hazardous Substances Directive***

### ***2002/96/EC W.E.E Waste Electrical and Electronic Equipment Directive.***

Equipment contains metals and Polycarbonate enclosure and every effort shall be made to recycle and recover these materials.

## Declaration of Conformity

Raymond D. Feller III  
Name of Authorized Representative

Winona, Minnesota, USA  
Place of Issue

General Manager  
Title of Authorized Representative

February 2008  
Date of Issue



\_\_\_\_\_  
Signature of Authorized Representative

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