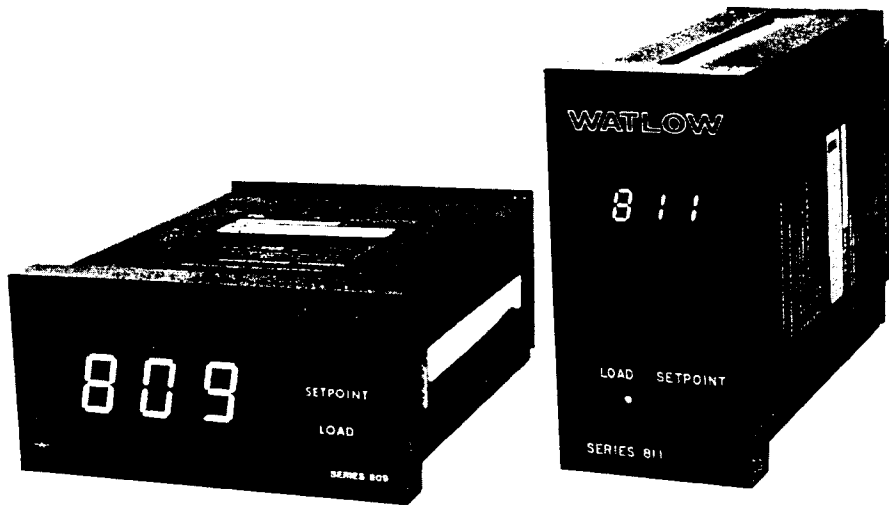


# Series 809/811



## 1/8 DIN Digital Temperature Controllers

Data Sheet



# WATLOW

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W809-DA20-8735  
August, 1987  
Supersedes:  
W809-DA10-8611

## General Description

The Watlow Series 809 and Series 811 controls are 1/8 DIN digital indicating temperature controls. The 809 is horizontally mounted while the Series 811 is mounted vertically. Both controls feature a plug-in chassis design to facilitate installation and service. The control mode is time proportioning with auto reset and rate.

The input for both controls is a single Type "J" thermocouple, and the output device is a zero-cross switching solid state relay. Set point is adjustable via a front panel mounted push-to-set assembly. Selection of °F/°C, and adjustment of control parameters are made internally.

## Specifications

### Control Mode

- PID: Proportional with auto reset and rate (integral and derivative).
- Proportional band: 5°F to 40°F, front adjust.
- Reset: Fixed, approximately 0.1 repeats per minute.
- Rate time: 0 to 5 minutes, front adjust.
- Cycle time: 2 to 20 seconds, internal adjust.

### Operator Interface

- 0.5" LEDs for the Series 809, or 0.3" LEDs for the Series 811 display the process input value and, when setpot knob is depressed, primary set point value.
- LED indication of output energized (load light).
- °F or °C selection; internal switch.

### Input

- Thermocouple Type "J" input. Isolated or grounded. Others available upon special order from the factory.
- Automatic cold junction compensation.
- Sensor break protection de-energizes output to protect system. With an open sensor, display will indicate EEE when in °F, and greater than 650° when in °C.

### Output

- Solid state relay, 0.5A @ 240VAC, opto-coupled zero crossed switching. Resistive rating only.

### Accuracy

- Calibration Accuracy:  $\pm 0.25\%$  of span at 77°F $\pm 5^\circ$ F ambient & rated line voltage  $\pm 1\%$ .
- Linearization Accuracy:  $\pm 0.25\%$  of span  $\pm 1$  digit at 77°F $\pm 5^\circ$ F ambient and rated line voltage  $\pm 1\%$ .
- Accuracy Span: 1000°F or 540°C minimum.
- Temperature Stability:  $\pm 2\mu\text{V}/^\circ\text{F}$  ambient.
- Voltage Stability:  $\pm 0.01\%$  or span  $\%$  of rated line.

### Terminals

- #6 screws on barrier strip.

### Power

- 115/230VAC  $\pm 10\%$ , 50/60Hz.
- 6 VA power consumption.

### Operating Environment

- 30 to 130°F/0 to 55°C.
- 0 to 90% RH, non-condensing.

### Dimensions

- 809 Height: 1.9 in.
- 809 Width: 3.8 in.
- 811 Height: 3.8 in.
- 811 Width: 1.9 in.
- Behind panel depth: 5.2 in.
- Weight: 1.3 lb.

## Installation

Figure 1 shows the standard case dimensions and Figure 2 shows the panel cutouts for mounting your particular control. Figures 3 and 4 on Page 4 show the front panel dimensions, and Figures 5 and 6 on Page 5 are wiring diagrams.

1. To install, turn the installation screws out to the edge of the PC edge connector. See Figure 1.
2. Carefully insert the unit into the panel cutout. See Figure 2.
3. Slide the mounting bracket back to allow the ears to spring free.
4. Tighten the installation screws to secure the unit in place.
5. To remove the unit from its enclosure, pop the lens out by inserting a small object into the lens notch and prying up. See Figures 3 or 4 on Page 4.

The interior of the unit is held in place by the PC edge connector.

Behind the lens is a black lever or "extractor" fastened to the lower PC board of the 809, or to the left board on the Series 811. See Page 6, Figure 7.

By prying this out, first by fingernail, then by finger; the leverage will force the unit out of its enclosure.

## Installation (cont.)

- To re-install the unit, swing the "extractor" to the left or upward, depending on your unit, so it is flush with the PC board.

Slide the unit into the enclosure and press firmly on the edge of the PC board until the unit is held firmly by the connector.

Replace the lens by inserting the top in first for the Series 809, or the right side of the Series 811, and press in on the opposite side.

- Wire the unit in accordance with the Wiring diagram. See Page 5, Figures 5 & 6.

## Dimensions and Mounting

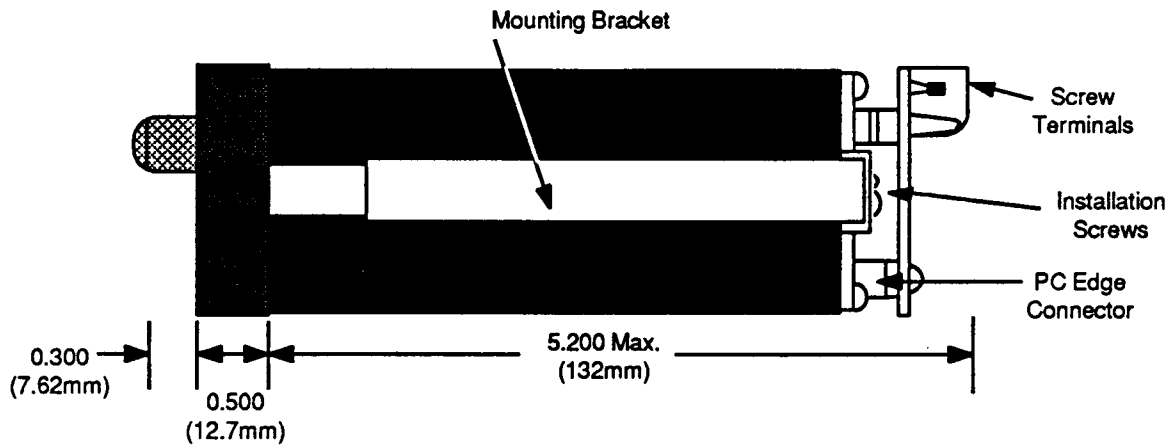


Figure 1 - Case Dimensions

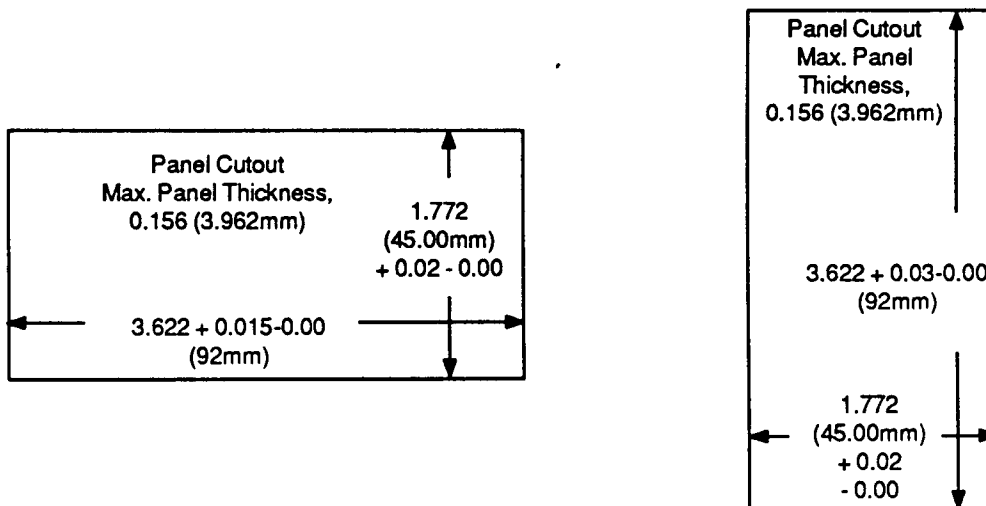


Figure 2 - Series 809 and 811 Panel Cutouts

## Dimensions

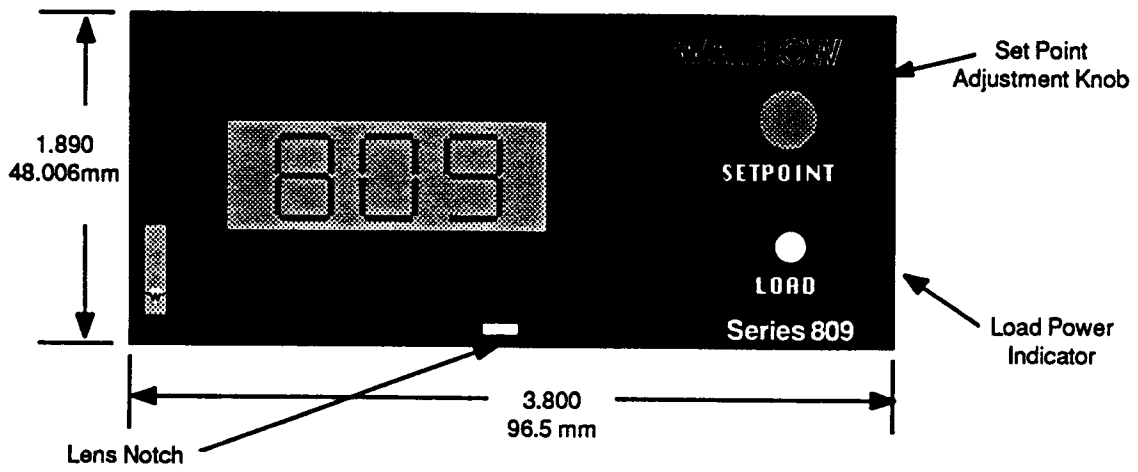


Figure 3 - Horizontal Front Panel Dimensions

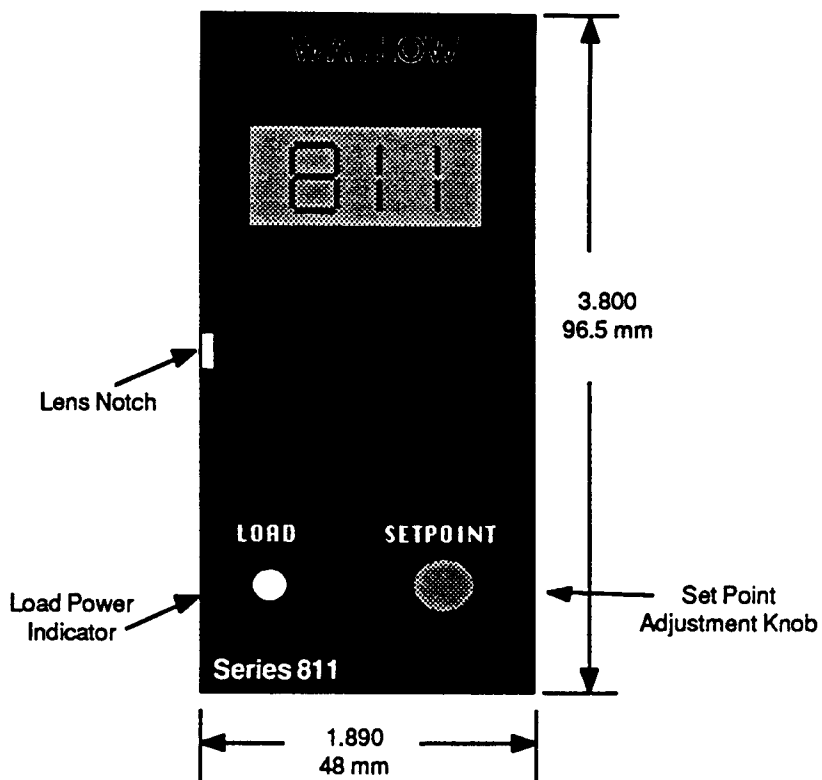
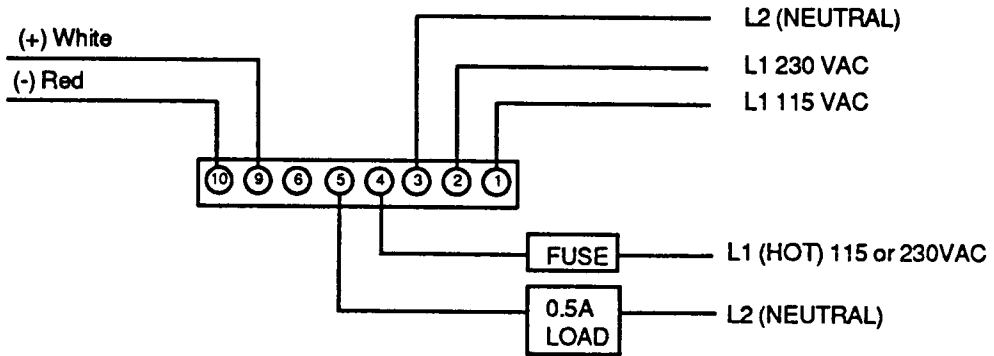
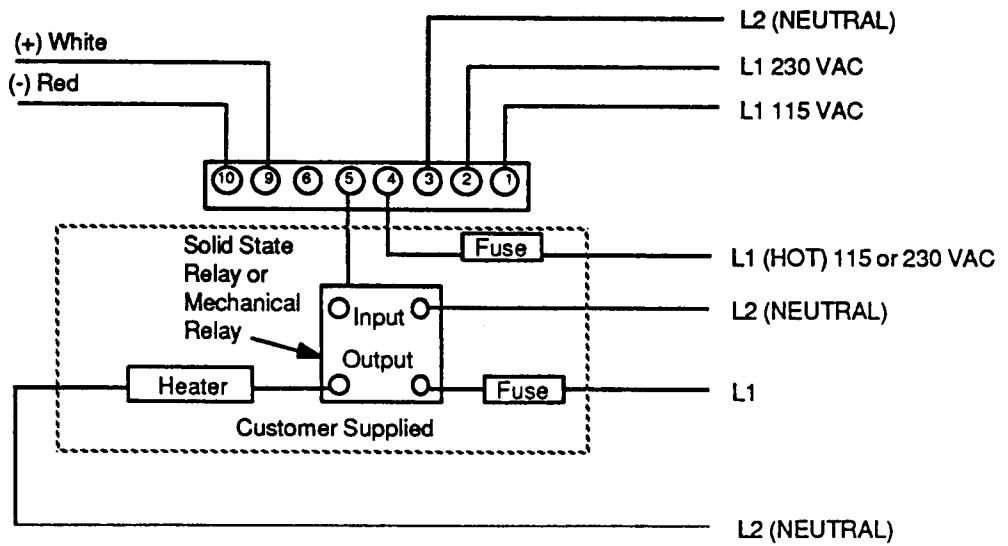


Figure 4 - Vertical Front Panel Dimensions

Terminal Designations	
1.	115 VAC Line L1
2.	230 VAC Line, L1
3.	AC Line Common, L2
4.	N.O. Solid State
5.	C Relay
6.	Not Used
9.	TC (+)
10.	TC (-)



**Figure 5 - Series 809/811 Wiring Diagram**



**Figure 6 - Series 809/811 Application Wiring Diagram**

## Field Calibration Procedure

### Equipment Required:

- Precision millivolt source.
- Digital voltmeter (DVM).
- Type "J" reference compensator with reference junction at 0°C or 32°F.
- Watlow portable digital temperature indicator, Model 6406-00C1-0601 with type "J" TC wire may be used in place of millivolt source and reference compensator.
- Extender board may be used for ease of servicing. Reference Watlow P/N A007-1022-0000.

### Set up

#### NOTE:

For proper calibration this control must be calibrated with the case it will be used in. The control and case with terminal board are a matched set, and should be calibrated together.

1. If an extender board is not available, remove the connector board from the back of the case (2 screws).
2. Connect millivolt source through the reference compensator to #9 TC + and #10 TC -.

3. Connect DVM, COM to J1 pin #6 and (+) to J2 pin #11. (This is the board interconnect located on the right side of the 809, or the bottom of the 811.)
4. Connect AC line to the proper terminals per the terminal designation sticker on the case.
5. Slide the connector board onto the control.

### Calibration

1. Set °F - °C switch to °F. It is located on the right side of the Series 809, and on the bottom of the 811 chassis. See Figure 7 for switch location. Apply power to the load.
2. Set millivolt source to 0.00mV or 32°F; adjust °F Lo pot for 0.160V on DVM and adjust Zero pot for 32 on the control display. See Figure 8 or 9 for pot locations.
3. Set millivolt source to 29.36mV or 995°F; adjust °F Hi pot for 4.975V on DVM and adjust FS pot for 995 on the control display.
4. Repeat steps 2 and 3 as required for proper indications.
5. Set °F - °C switch to °C.
6. Set millivolt source to 0.00 mV or 0°C; adjust °C Lo pot for 000 on the control display.
7. Set millivolt source to 29.36 mV or 535°C; adjust °C Hi pot for 535 on the control display.
8. Repeat steps 6 and 7 as required for proper indications.
9. Set millivolt source to 14.11 mV or 260°C; the control display should read  $260 \pm 2$ .
10. Remove the connector board from the case and install the control into the case.

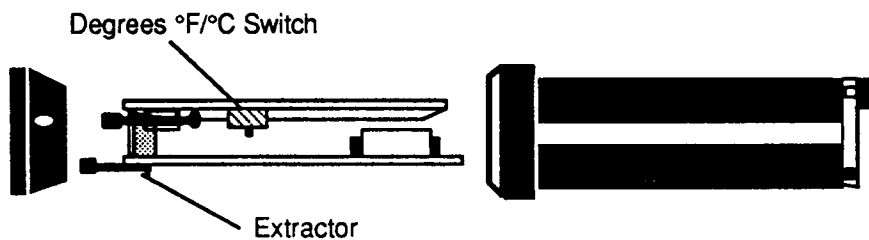


Figure 7 - °F/°C Switch Location

# Field Calibration Procedure

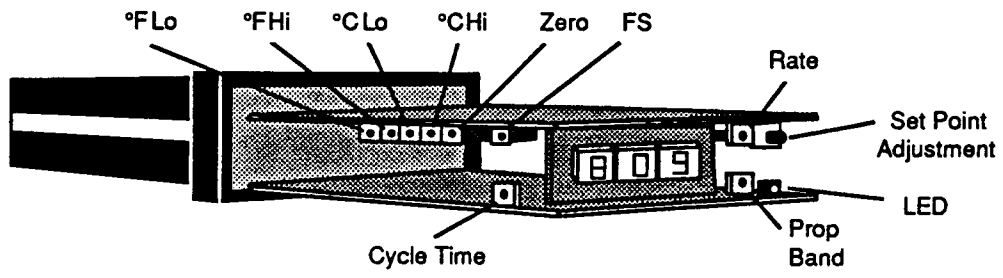


Figure 8 - Series 809 Potentiometer Locations

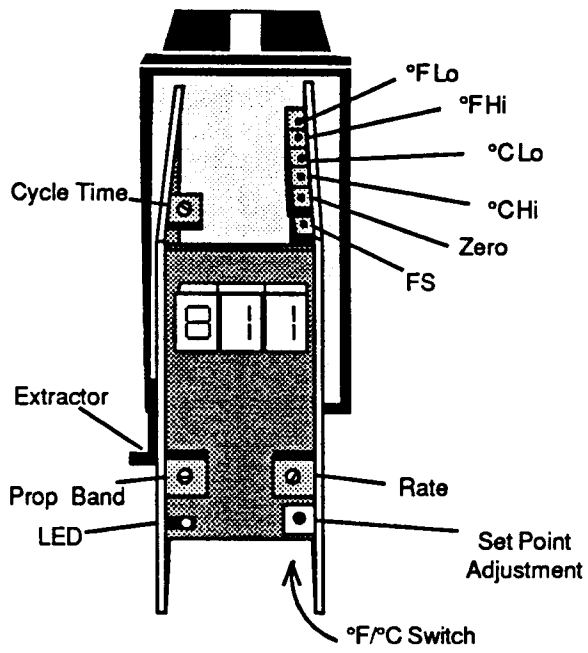


Figure 9 - Series 811 Potentiometer Locations

## Tuning

The setup procedure for most applications does not require the full PID tuning procedure if the following settings provide satisfactory control.

1. Cycle Time: 2 seconds maximum counter-clockwise; CCW.
2. Proportional Band: 25%; mid-point.
3. Rate: 50%; mid-point.

If the parameter values above are not satisfactory, follow the full tuning procedure below:

### Initial Settings:

1. Cycle Time: 2 seconds; maximum CCW.
2. Proportional Band: maximum clockwise; CW.
3. Rate: 0; maximum CCW.

Refer to Figures 8 and 9 on Page 7 for the location of each potentiometer.

### Proportional Band Adjustment:

Rotate the proportional band pot CCW 1/4 turn and observe system stability. Repeat until the process temperature begins to hunt (becomes unstable).

When hunting is observed, rotate the pot CW in small increments, until the system becomes stable. Some systems may be stable enough to allow minimum proportional band setting (maximum CCW).

### Rate Adjustment:

The rate adjustment controls overshoot as load temperature approaches set point temperature by limiting the rate of change of load temperature.

Rotate the rate pot 1/4 turn CW. Change the set point temperature 20 to 30°F/°C and observe the approach to set point. If the load temperature overshoots, repeat the procedure until optimum approach to set point is achieved.

If the rate pot is advanced too far, the system will be overdamped and approach to set point will be very sluggish.

### Cycle Time:

Cycle time is the time base used in proportioning power to the load. At a setting of 2 seconds, if 25% power is required to maintain load temperature at set point, power will be applied for 1/2 second every 2 seconds. At 10 second cycle time, power would be applied for 2.5 seconds every 10 seconds.

Best control is always achieved with faster cycle times. However, if a mechanical contactor or solenoid is used to switch power to the load, slower cycle time may be desired to minimize the wear on the mechanical components.

Figure 10 shows a time proportioning curve with auto reset and rate.

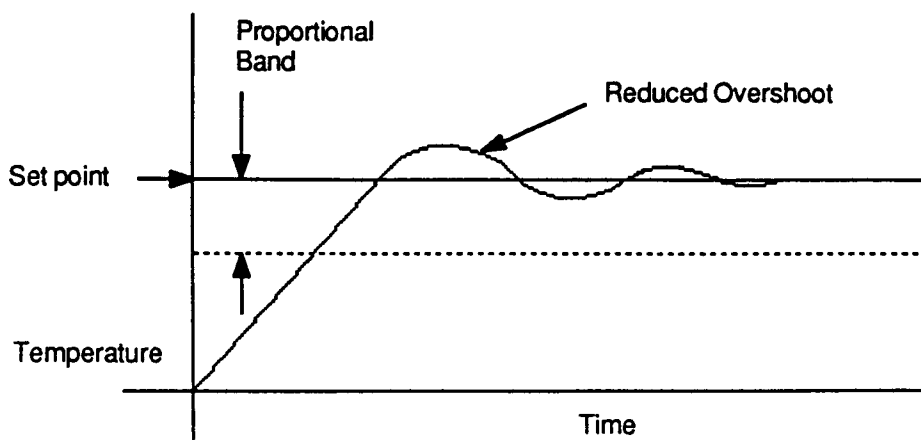
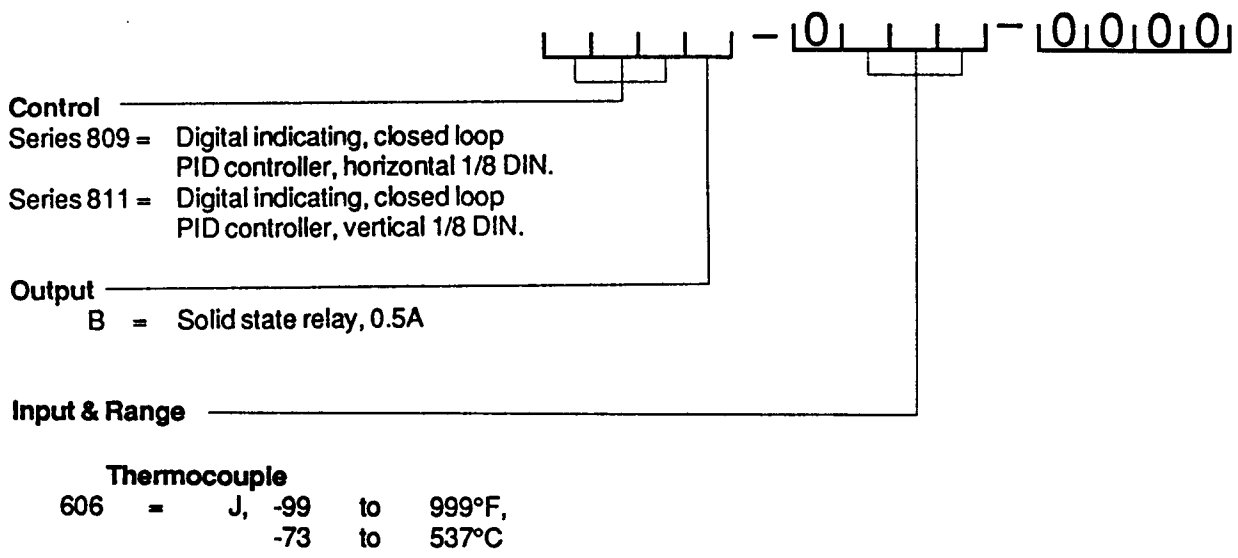


Figure 10 - PID/Time Proportioning with Auto Reset and Rate



# Model Number Information



**Related Device**  
 Extender board #A007-1022-0000.

## Troubleshooting

Problem	Probable Cause	Action
No Display	The A.C. input is not connected or is connected improperly.	Check the A.C. input connections. If not present or proper, connect per Wiring diagram. See Page 5, Figure 5 or 6.
Display Error	1. An open thermocouple, or thermocouple connection, indicated by EEE on the display in F°.	Check the thermocouple and wiring. (Repair or replace as necessary.) Note: A paper clip across terminals 9 and 10 will indicate room temperature as a quick check of the control. Return to the factory if not proper.
	2. The display indicates - - -	Check the temperature set point switch to make sure the set point is above -99° and not stuck in the depressed condition.
	3. If the temperature display is suspected of being in error.	Check for a shorted thermocouple or a poor thermocouple location. If okay, return to the factory for recalibration.
Poor temperature control	The control parameters are not adjusted properly.	Adjust proportional band, cycle time, and rate per Tuning. See Page 8.
Load will not turn ON	1. An open thermocouple.	Repair or replace.
	2. The load circuit is open.	Check the fuses, circuit breakers, and the load.
	3. A faulty unit.	Return the unit to the factory.
Load will not turn OFF	1. The polarity is reversed on the t/c.	Connect per the Wiring diagram. See Page 5, Figure 5 or 6.
	2. The load LED will not turn OFF.	Apply power and check the power to the heater or external relay after setting the control temperature lower than the indicated temperature.
	3. A faulty circuit.	Remove power. Measure the resistance between term. #4 & #5; which should read an infinite resistance with the termination disconnected.  Return the unit to the factory if all the conditions are not satisfactory.

## Warranty

Watlow Series 809 and Series 811 are warranted to be free of defects in material and workmanship for 18 months after delivery to the first purchaser for use, providing that the unit has not been misapplied.

Watlow cannot guarantee against failure, since Watlow has no control over use, and sometimes misuse. Watlow's obligations hereunder, at Watlow's option, are limited to replacement, repair, or refund of purchase price, on any parts which upon examination prove to be defective within the warranty period specified. This warranty does not apply to damage resulting from transportation, alteration, misuse, or abuse.

## Returns

The following procedure applies for any products returned to the factory:

1. You must 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
  - Ship via
  - Symptoms and/or special instructions
  - Name and phone number of person returning the material.
  - Bill-to address
  - Phone number
  - P.O. number

We will not accept a return without an RMA number. The RMA number must appear on the outside of the carton and on all paperwork. Cartons without RMA numbers will be returned. Ship on a freight prepaid basis.

2. You need prior approval and an RMA number from the Customer Service Department when you are returning an unused product for credit. Also, we must apply a 20 percent restocking charge for all returned stock controls and accessories.
3. After we receive your return, we will examine it to determine the cause for your action.
4. In cases of manufacturing defect, we will enter a repair order, replacement order, or issue credit for material.
5. If the unit is unrepairable, we will return it to you with a letter of explanation. Repair costs will not exceed 50 percent of the original cost.