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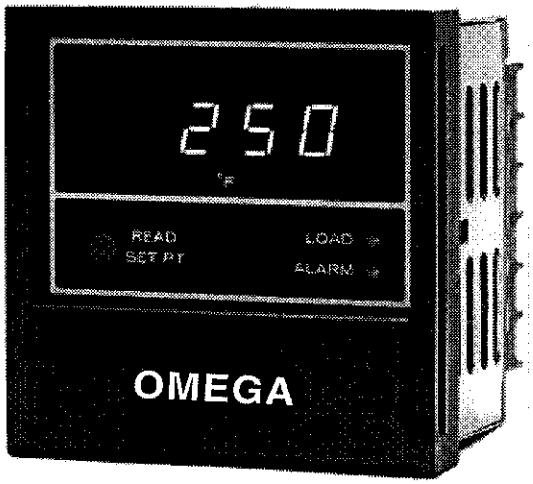
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CN3910A

On/Off Proportional Controller



OMEGA®
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Operator's Manual

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Table of Contents

Sections

Section	Topic	Page
1	Introduction to the CN3910A Controller	1
2	Installation	3
3	Operation	11
4	Calibration	19
5	Specifications	21
6	Glossary	23

Illustrations

Figure	Topic	Page
1.1	Model Identification Table	1
2.1	Removing the Back Cover	4
2.2	Mounting Dimensions	5
2.3	Mounting Diagram	5
2.4	120 Vac Instrument Power Connections	7
2.5	230 Vac Instrument Power Connections	7
2.6	Two-Relay Output Connections	9
2.7	Solid State Relay Drive Output Connection	9
3.1	Front Panel Identification	12
3.2	Set Point Limit Potentiometer	14
3.3	Deadband Jumper	15
4.1	Zero and Span Calibration Potentiometer	19

Section 1
Introduction to the CN3910A Controller

The OMEGA CN3910A controller you have purchased gives you applications flexibility and a number of control features in a compact 1/4 DIN package. Before proceeding with installation and operation of your controller, it is important that you identify the model you have purchased. This will determine how you install and wire the controller, and how you may apply it. Check the serial number tag on the inside front door flap of the controller to confirm your model number.

Figure 1.1
Model Identification

CN3910A Series

Digital Indicating, Single Set Point, On-Off/Proportional 1/4 DIN Controller		
Model No.	**Input Type**	**Temp. Range**
CN3910AJF	J	0-999°F
CN3910AJC	J	0-500°C
CN3910AKF	K	0-1999°F
CN3910AKC	K	0-1100°C

Standard control output is two normally-open SPST mechanical relays. This output is recommended for on/off applications with cycle times greater than 5 minutes. One solid state relay drive output is optional, and is recommended for proportional control applications. The suffix "/S" is added to the model no. for a unit with the optional solid state relay drive output. Standard power for the CN3910A series controllers is 120/230 VAC.

Notes:

Section 2
Installation

Unpacking Instructions

Remove the Packing List and verify that you have received all equipment, including the following (quantities in parentheses):

CN3910A On/Off Proportional Controller (1)

Operator's Manual (1)

If you have any questions about the shipment, please call the OMEGA Customer Service Department.

When you receive the shipment, inspect the container and equipment for signs of damage. Note any evidence of rough handling in transit. Immediately report any damage to the shipping agent.

Note: The carrier will not honor damage claims unless all shipping material is saved for inspection. After examining and removing contents, save packing material and carton in the event reshipment is necessary.

Storage

If the controller will not be immediately installed and placed into operation, it should be stored in a cool, dry environment in its original protective packaging until time for installation and operation. Temperature extremes and excessive moisture can damage the instrument.

Caution

The CN3910A controller, the sensor or the device that the CN3910A is switching can potentially fail, causing the process or process equipment to overheat. Overtemperature devices should be installed to provide additional process protection.

Installation Steps

Installation of the CN3910A controller requires 3 steps:

Step 1 - Accessing Internal Adjustments
Step 2 - Mounting
Step 3 - Wiring

Step 1
Accessing Internal Adjustments

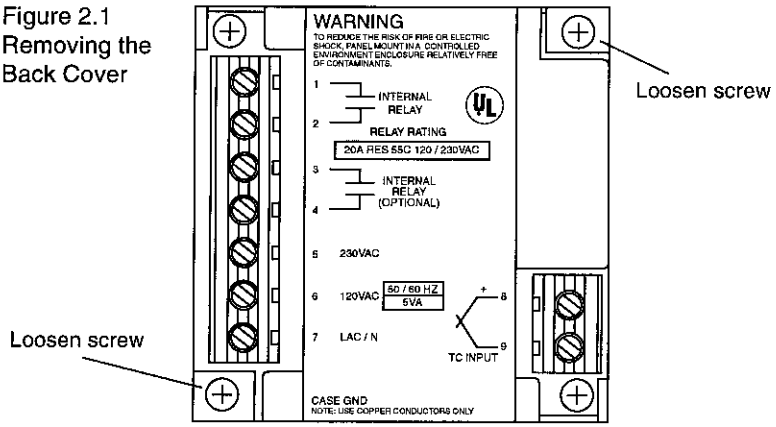
The back cover of the CN3910A can be easily removed to access any of the following internal adjustments:

- Dead Band Jumper (page 17)
- Set Point Limit Potentiometer (page 15)

The page numbers referenced above describe these internal adjustments. **Although it is not necessary, it is easier to make these adjustments prior to mounting and wiring the controller**. If you think that you may need or want to make one of these internal adjustments, read the pages referenced above **before** mounting and wiring the CN3910A.

To remove the back cover, loosen the two back cover screws shown in Figure 2.1 and lift the cover off of the controller chassis.

Figure 2.1
Removing the Back Cover



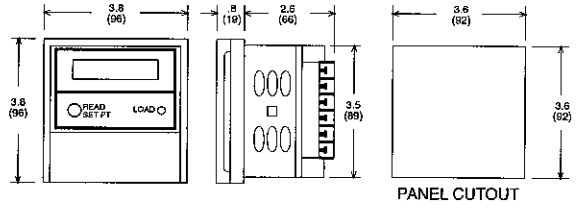
After completing the internal adjustment(s), replace the cover and re-secure the two screws.

Step 2
Mounting

The controller should be mounted in a location free from excessive dust, oil accumulations and moisture. It may be mounted in any position at ambient temperatures of 30°F to 130°F (0°C to 55°C).

Figure 2.2 gives the mounting dimensions for the controller.

Figure 2.2
Mounting
Dimensions



Measurements are shown in inches.
Millimeters are shown in parenthesis.

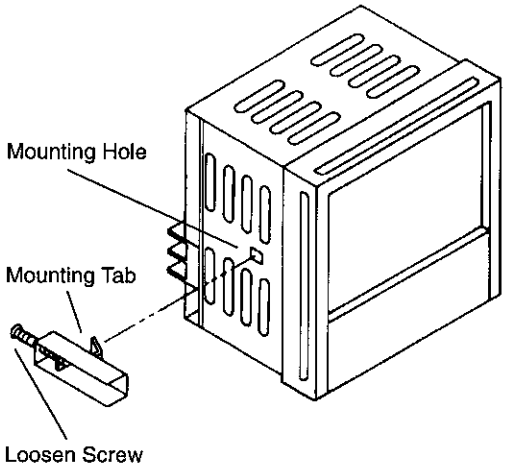
1. Cut a square mounting hole (3.6" x 3.6") in the panel or mounting surface and place the controller through the cutout.

2. Two mounting brackets are provided to secure the controller in the cutout. Loosen the screws on the two brackets. Place the mounting tabs into the mounting holes located on the sides of the controller.

3. From the rear of the controller, tighten the screws until the brackets are tight against the panel, securing the controller in the panel cutout.

4. For other mounting configurations, the mounting bracket tabs may be placed in the controller casing vent slots.

Figure 2.3
Mounting
Diagram



Important Wiring Information

To insure that the CN3910A controller performs optimally, it is imperative that you read this section and become familiar with "Good Wiring Practices" critical to eliminating electrical noise. Failure to follow good wiring practices can result in poor temperature measurement and ineffective high limit control.

Snubbers

Snubbers should be used to protect the controller from electrical noise generated by inductive loads such as motors, solenoids, coils and relays operating near the CN3910A controller. The recommended snubber is a .1uf capacitor (600 Vdc rating) in series with a 100 ohm resistor and is available from OMEGA (P/N 1821-101). The wiring diagram in this manual illustrates the snubber connection(s).

Good Wiring Practice

Read and follow these Good Wiring Practices when connecting this and any other controller:

1. Do not run sensor leadwires and power leads together in the same conduit or wire tray.

2. When planning the system wiring, be sure to consider the importance of separating wiring into functionally similar bundles—i.e. power leads, sensor leads, output signal lines, etc. If the power leads and sensor leads must cross, they should cross at a 90° angle to each other (perpendicular).

3. Locate all sources of noise in your system—motors, contacts, solenoids, etc. Then design your system such that wiring is separated as far as possible from these noise sources.

4. Shielded, twisted wire should be used for the control circuit signals if they are run in parallel with other control circuit signal wires, or if they are run distances greater than 2-3 feet.

5. To protect against noise, use shielded cables for all low power signal lines.

6. Additional information on good wiring practices is available from IEEE, 345 East 47th St., NY, NY 10017. Request IEEE Standard No. 5128-1982.

Step 3
Wiring

Make all electrical wiring connections on the back of the controller **before** power is applied to the unit.

All wiring must comply with local codes, regulations and ordinances. This instrument is intended for panel mounting and the terminals must be enclosed with a panel. Use National Electric Code (NEC) Class 1 wiring for all terminals except the sensor terminals.

Make the instrument power connections for your application type (120 Vac or 230 Vac) as shown in Figure 2.4 or 2.5.

Figure 2.4
120 Vac
Instrument Power
Connections

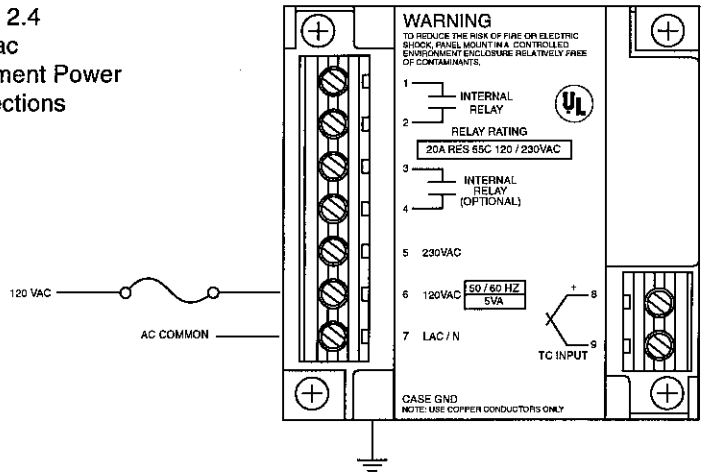
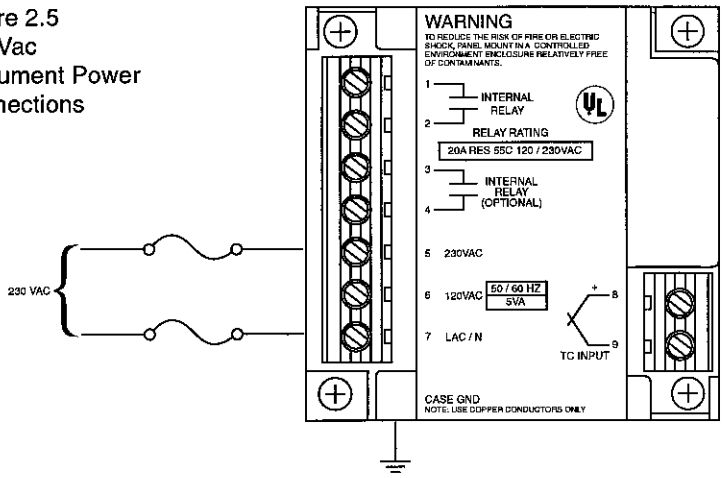


Figure 2.5
230 Vac
Instrument Power
Connections



Sensor Input Connections

The thermocouple input is connected at terminals 7 (+) and 8 (-) as indicated by the wiring decal on the back of the controller. The table below shows **typical** color coding for the thermocouples used with this controller:

T/C Type	Material	Plus(+)	Minus (-)
J	Iron/Constantan	White	Red
K	Chromega®-Alomega®	Yellow	Red

If shielded thermocouple wire is used, the shield must be grounded at one end only, preferably at the case ground (CASE GND) of the controller.

If thermocouple extension wire is required, it **must** be the same type of extension wire as the thermocouple (for example, if the thermocouple is Type J, the extension wire must be Type J).

Control Output Connection

Make the control output connection(s) for your controller type as illustrated in Figure 2.6 and 2.7.

The Output type is defined by the controller model. Standard control output is two relays. One solid state relay (SSR) drive output is optional. The suffix "/S" is added to the model no. for units with the optional SSR drive output.

Two-Relay Outputs—The two relay model may be used to drive contactors. It can also directly drive two single phase loads up to 20 amps each, or 3-phase, 2-leg loads. Snubber circuits should be connected in parallel with the contactor coils (page 6).

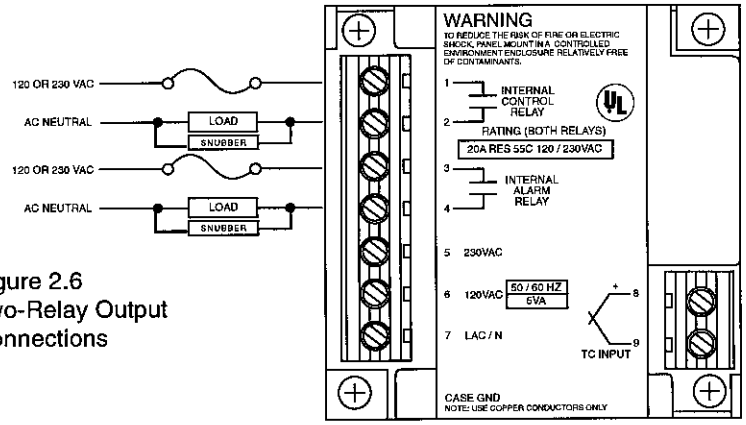


Figure 2.6
Two-Relay Output
Connections

Solid State Relay Drive Output—The solid state relay (SSR) drive output is a 20 Vdc signal that will drive SS relays (such as the OMEGA SSR240DC10 Solid State Relay) which accept 3-32 Vdc input signals. Be sure to separate the SSR wiring and all a.c. wiring.

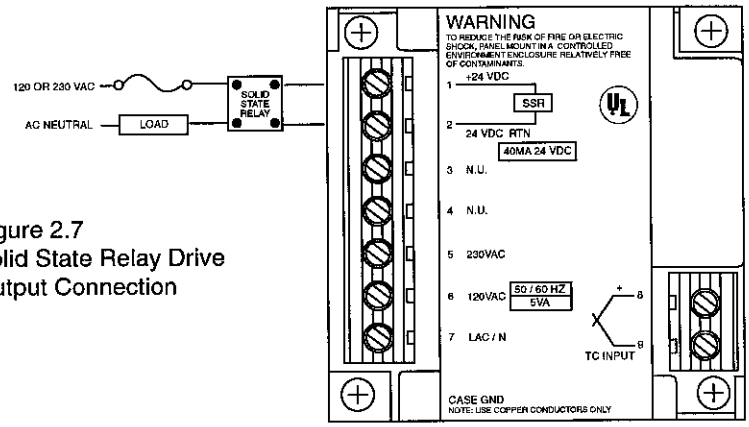


Figure 2.7
Solid State Relay Drive
Output Connection

Notes:

Section 3
Operation

Before applying power to the controller and proceeding with Operation, verify that all wiring is correct.

In this section you will learn how to make the following selections and adjustments:

Set Point
Set Point Limit
Control Mode - ON/OFF
Proportional
Dead Band
Cycle Time
Manual Reset

Initial Power-Up

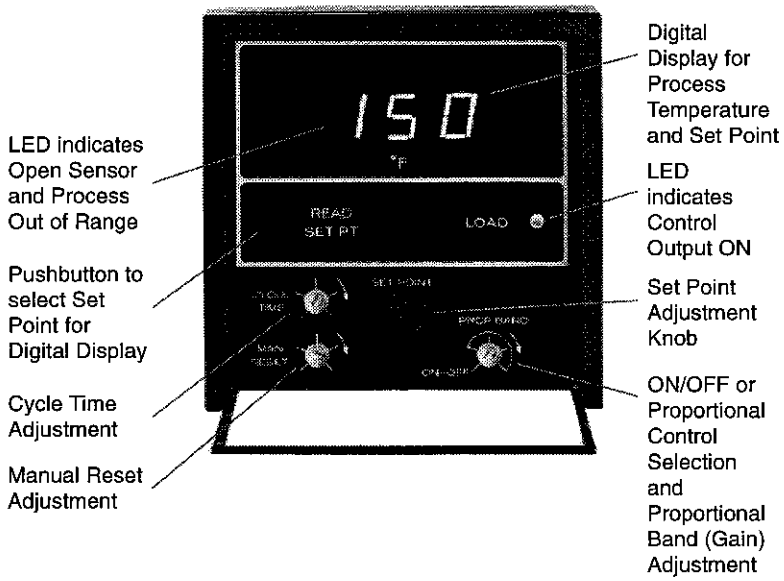
When power is applied to the CN3910A, it will begin operating using the factory set point. The process temperature as measured by the thermocouple will appear in the digital display, and the LOAD and ALARM LEDs will indicate if the control output (load) is on and an alarm condition exists.

To read the set point, simply press and hold the READ SET PT pushbutton. The set point will appear in the digital display.

The CN3910A's front panel displays and indications, and the adjustment potentiometers located behind the front door flap are shown in Figure 3.1. Familiarize yourself with the front panel before proceeding with this section.

Figure 3.1
Front Panel
Identification

CN3910A
Controller



Read Set Point—To **read** the set point, press and hold the READ SET PT pushbutton. The current set point will appear in the digital display.

Adjust Set Point—To **adjust** the set point, locate the SET POINT knob behind the front door flap. Press the READ SET PT pushbutton so that the set point is displayed, and at the same time turn the SET POINT knob until the desired set point appears in the digital display. Release the pushbutton.

NOTE: Set point adjustment can be accelerated by inserting a screwdriver in the hole in the set point knob and turning the knob with the screwdriver.

Set Point Limit—The CN3910A has a set point limit feature that allows you to preset an upper limit for the set point adjustment. The set point limit can be used to prevent dangerous overheating that could be caused by accidental or miscalculated set point settings.

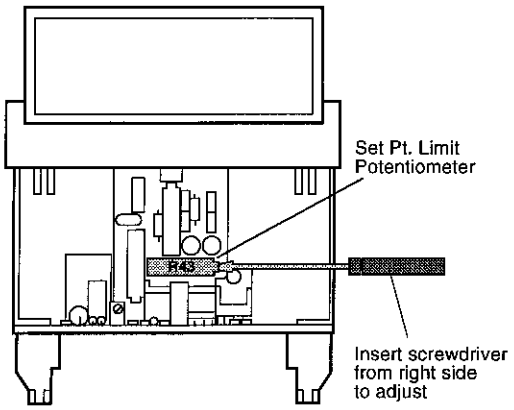
The Set Point Limit is set at 100% of sensor span when shipped from the factory (i.e. 1000°F for Type J thermocouples and 2000°F for Type K thermocouples). An internal potentiometer allows you to adjust the set point limit from a range of 100% to 20% of sensor span. To adjust the set point limit, remove the back cover of the CN3910A as described on page 4. Locate the set point limit potentiometer shown in Figure 3.2.



USE EXTREME CAUTION: The set point limit can be set with the instrument power to the controller either off or on. If the power is left on, the limit must be adjusted only by a qualified electronic technician at a test bench, using an insulated screwdriver. LINE VOLTAGE WILL BE EXPOSED.

Disconnect the control output while adjusting and verifying the set point limit to avoid dangerous overheating.

Figure 3.2 Set Point Limit Potentiometer



Controller Bottom View

To adjust the set point limit:
1. Press and hold the READ SET PT button. Turn the SET PT knob on the front faceplate to its full clockwise position (FULL ON) or until the setpoint stops changing.

2. Turn the set point limit potentiometer until the digital display reads the desired set point limit. In the full (clockwise) position, the set point limit is 100%, or more, of span.

3. After reaching the desired set point limit setting, be sure to readjust the process set point to the application's setting using the SET PT knob.

To verify the set point limit setting, attempt to adjust the set point past the set point limit.

Control Mode

Select Control Mode—The control mode, ON/OFF or Proportional, is selected with the PROP BAND potentiometer located behind the front door flap. These two control modes are defined in the Glossary, page 28.

For ON/OFF control, turn the PROP BAND potentiometer to the full counterclockwise position to the ON/OFF mark. The potentiometer is in the ON/OFF position when shipped from the factory.

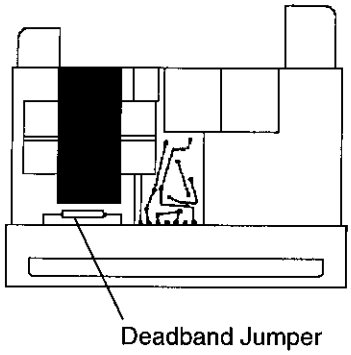
Control Mode (continued)

For Proportional control, turn the PROP BAND potentiometer clockwise to the beginning of the proportional band range (marked by notches around the potentiometer).

ON/OFF Control

Deadband—The CN3910A controller deadband setting is 2.5°F. If wider excursions from set point can be tolerated, the deadband may be changed to 10°F. To change the deadband, remove the back cover from the controller as described on page 4. Locate and remove the deadband jumper shown in Figure 3.3.

Figure 3.3 Deadband Jumper



Proportional Control

Adjust Proportional Band—The objective of the proportional band adjustment is to find the proportional band setting at which the process temperature stabilizes and does not oscillate. The temperature will most likely stabilize above or below set point (known as "offset"). This offset will be corrected by the Manual Reset adjustment.

During the proportional band adjustment procedure, the process should be allowed to reach a "steady" condition after each proportional band adjustment is made and before the next adjustment is attempted. A "steady" condition may be defined as a repeated pattern of temperature oscillations or a constant temperature.

To adjust the Proportional Band:

1. Turn the CYCLE TIME potentiometer to its full counterclockwise position.

2. Turn the MAN RESET potentiometer clockwise to mid-position.

3. Allow the process to reach a steady condition.

4. If the temperature display stabilizes and there is no temperature oscillation, the Proportional Band setting needs no further adjustment. Proceed to the Manual Reset adjustment.

5. If the temperature display is oscillating, incrementally increase (clockwise) the PROP BAND, allowing the process to reach a steady condition after each adjustment.

6. Repeat step (5) until the temperature display stabilizes and there is no oscillation. The proportional band setting needs no further adjustment.

Adjust Manual Reset—Manual Reset adjusts the offset between process temperature and set point and is adjusted with the MAN RESET potentiometer. If the process temperature stabilizes below or above set point, increase (clockwise) or decrease (counterclockwise) MAN RESET until the process temperature equals the set point temperature. Allow time for the process to respond and stabilize between adjustments.

Adjust Cycle Time—The output cycle time is adjusted differently for Relay Control Outputs and Solid State Relay Drive Outputs. The CYCLE TIME potentiometer is used to make cycle time settings. As the potentiometer is turned clockwise, the cycle time increases.

Relay Cycle Time: 15 to 60 seconds
SSR Drive Cycle Time: 1 to 30 seconds

For Relay Outputs, adjust the cycle time to the slowest cycle time that will provide satisfactory control. The full clockwise potentiometer position is the slowest cycle time setting. Use caution when setting the cycle time on contactor driven loads. A cycle time setting that is too fast will cause added wear on the contactor and shorten the contactor life.

For Solid State Relay Drive Outputs, a fast cycle time will produce better control of loads by providing fast response and little time lag. Since solid state relays have no mechanical parts that can be worn down by rapid switching, the cycle time can be adjusted as fast as desired.

Notes:

Section 4
Calibration

The CN3910A controller has been calibrated and tested at the factory prior to shipment. Calibration on receipt is not necessary.

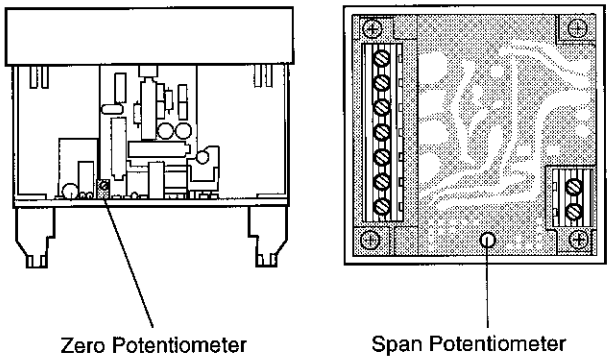
Equipment Required

A precision thermocouple simulator and a small instrument screwdriver are necessary to calibrate the controller.

Locating Calibration Adjustments

Remove the back cover from the controller as described on page 4. Figure 4.1 identifies the zero and span calibration potentiometers.

Figure 4.1
Zero and Span Calibration Potentiometers



Calibration Procedure

1. Connect the sensor simulator to terminals 7 and 8, making sure to connect the (+) to 7 and (-) to 8.

2. Set the sensor simulator to a minimum value (200°F for J T/C, 350°F for K T/C) and adjust the zero potentiometer until the digital display equals the sensor input value (200°F or 350°F).

(continued on next page)

Calibration Procedure (continued)

3. Set the sensor simulator to a maximum (900°F for J T/C, 1600°F for K T/C) and adjust the span potentiometer until the digital display equals the sensor input value (900°F or 1600°F).

4. Repeat steps 2 and 3 as many times as necessary until **both** displays equal their respective sensor input values.

5. Calibration complete.

Section 5
Specifications

Control Mode (Field Selectable)	ON/OFF or Proportional

Control Adjustments

Control Set Point	0 to 999°F (0 to 500°C)
Set Point Limit	20 to 100% of sensor span
Deadband	2.5°F, field changeable to 10°F
Proportional Band	5 to 100°F nominal, adjustable
Manual Reset	Adjustable over 100% of the proportional band
Output Cycle Time (Adjustable)	SSR Drive Output—1 to 30 seconds Relay Output—15 to 60 seconds
Control Action	Reverse acting (heating)
Set Point Accuracy	+/-0.1% of span

Control Outputs

Dual Relays	Two normally-open, SPST, each rated at 120 or 240 Vac (resistive load): 20 amps, 150,000 operations 15 amps, 200,000 operations 5 amps, 800,000 operations Mechanical life, 10 million operations
Solid State Relay Drive	Transistor output of 20 Vdc at 40 mA

Input Specifications

Type J Thermocouple	0 to 999°F, 0 to 500°C
Type K Thermocouple	0 to 1999°F, 0 to 1100°C
Input Loop Resistance	Up to 150 ohms
Cold Junction Compensation	Automatic, typically less than 0.1°F per 1°F over ambient 50 to 120°F

Indications

Open Sensor Indication	Red LED lamp for J thermocouple input, "1" illuminates for K thermocouple input Upscale burnout, output turns off
Control Output Indication	Yellow LED "LOAD" Lamp
Accuracy of Indication	+/-0.5% of span over mid-80% of scale
Resolution	1°F
Repeatability	+/-0.1% of span
Alarm Output	Red "ALARM" LED

General

Instrument Power	120 or 230 Vac, +10%, -15%, 50/60 Hz, 10 VA nominal power consumption
Operating Environment	30 to 130°F with relative humidity less than 95% non-condensing
Dimensions	Requires 3.6" x 3.6" (92 mm x 92 mm) panel cutout Depth behind panel of 2.6" (66 mm) Projection at front of panel 0.8" (20 mm)
Mounting	Two screw-in mounting brackets to secure controller in panel cutout
Influence of Line Voltage Variation	Maximum change of +/-1°F for +/-10% nominal line voltage

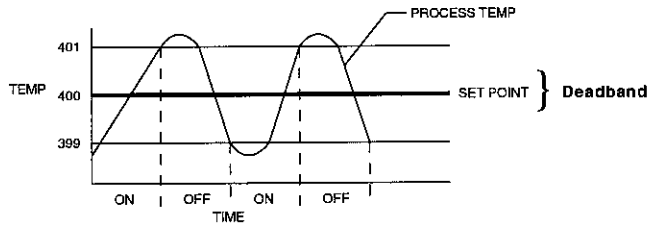
Noise Rejection

Common Mode	Less than 2°F with 230 Vac, 60Hz applied from sensor input to instrument case
Series Mode	Less than 2°F with 100 mV, peak to peak series mode noise

Section 6
Glossary

Deadband

In ON/OFF control, the deadband represents an area about set point in which no control action takes place, and determines at what temperature the control output switches ON and OFF.



Narrow deadband settings give more accurate control but result in more frequent output switching, which can cause early failure of electromechanical contactors.

Deadband on the 3910 controller is 2.5°F, and can be changed to 10°F by clipping an internal jumper (see page 17 for instructions).

Manual Reset

Manual reset applies to proportional control. Manual reset allows the adjustment of the control output in an amount sufficient to return the process variable to the process set point. Increasing the manual reset setting increases temperature; therefore, if the process temperature is stabilizing below set point, increase the manual reset. Manual reset is sometimes called the "trim" or "droop" setting.

ON/OFF Control

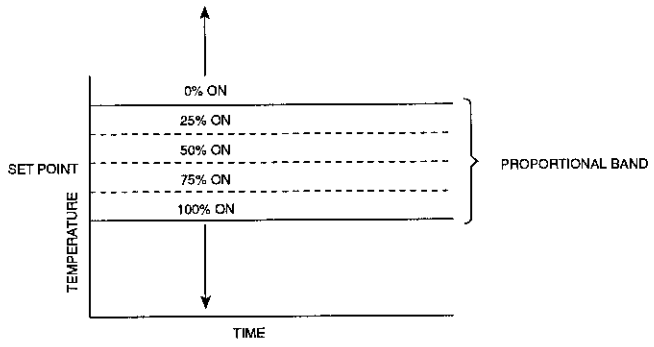
With ON/OFF control, the temperature is controlled about the set point by turning the output 100% ON or 100% OFF at set point. ON/OFF control is recommended for loads that cannot tolerate rapid cycling, such as pumps, air conditioning, etc. See **Deadband** for more information on ON/OFF control.

Proportional Control

Proportional control is a type of control action that proportions its control output to maintain a set point, instead of merely turning it full ON or full OFF, as with ON/OFF control. See **Proportional Band** for more information on Proportional Control.

Proportional Band

The Proportional Band is the temperature range about set point where the proportional control action is active from 0% to 100% of output.



Set Point Limit

The Set Point Limit feature allows you to preestablish an upper limit for the set point adjustment. This prevents dangerous overheating of the process.

Notes:

Notes:

WARRANTY

OMEGA warrants this unit to be free of defects in materials and workmanship and to give satisfactory service for a period of **13 months** from date of purchase. OMEGA Warranty adds an additional one (1) month grace period to the normal **one (1) year 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. However, 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 or which are damaged by misuse are not warranted. These include contact points, fuses, and triacs.

OMEGA is glad to offer suggestions on the use of its various products. Nevertheless, OMEGA only warrants that the parts manufactured by it will be as specified and free of defects.

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