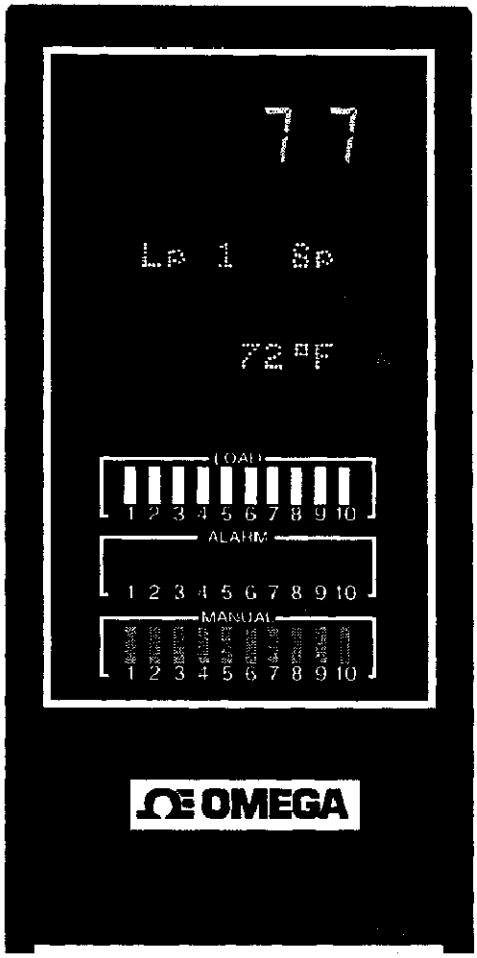
CN3390

Multi-Loop Temperature/ Process Controller



OMEGA®
An OMEGA Technologies Company

Operator's Manual

M-1494/0396
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OMEGA®
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It is the policy of OMEGA to comply with all worldwide safety and EMC/EMI regulations that apply. OMEGA is constantly pursuing certification of its products to the European New Approach Directives. OMEGA will add the CE mark to every appropriate device upon certification.

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

- CN3390 Controller (1)
- QuickInfo Reference Guide (1)
- Snubbers for Triac and Relay Outputs (10)

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.

Unpacking Instructions

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1 – Before You Install

Typical Application

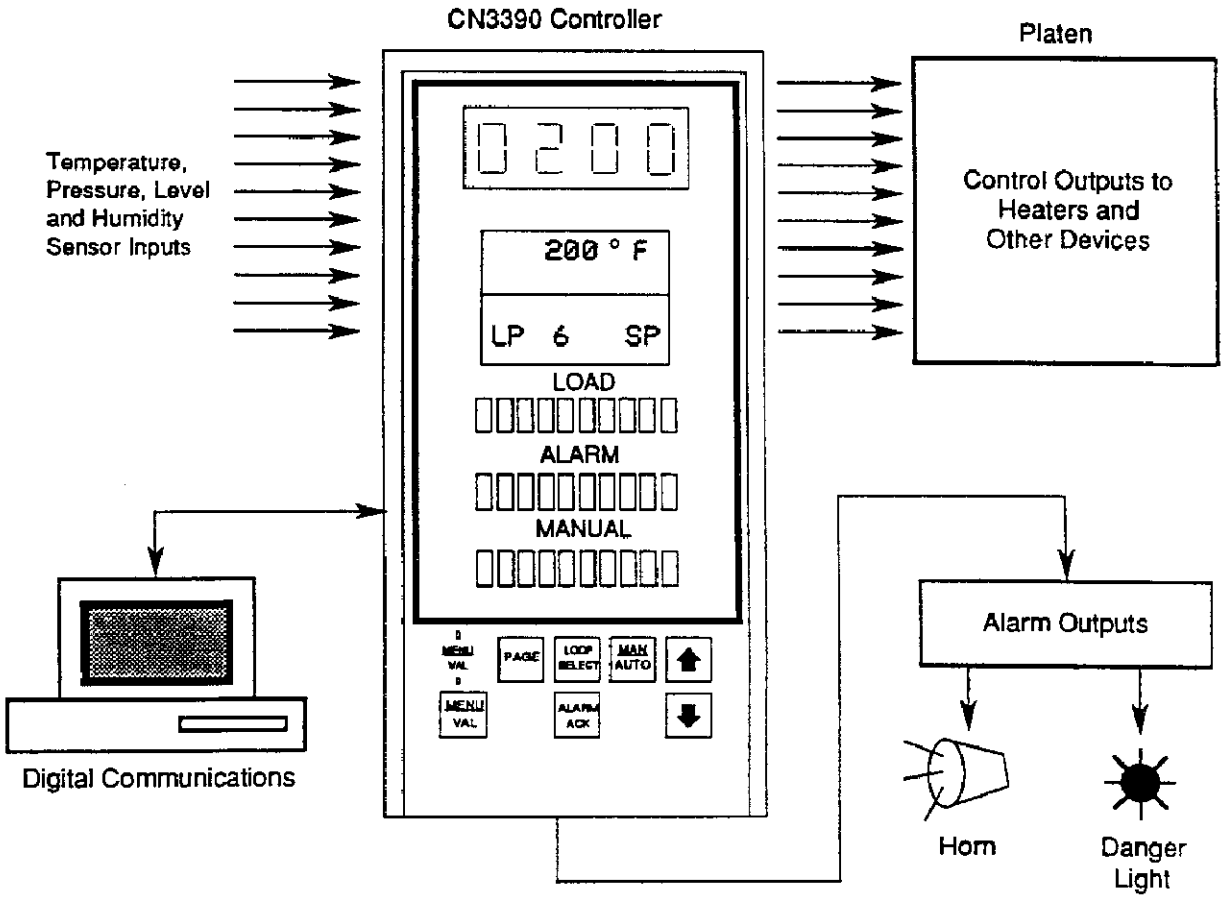
Model Identification

Model Codes

Important Information

This section will tell what you need to know to begin using your CN3390 Multi-Loop controller. Anyone who will install, program or operate the CN3390 controller should use this manual as a guide to learning how to safely and properly install the instrument, and how to program and operate it so that its many features are maximized.

Figure 1.1 Multiple Loop Temperature Control Application



■ Model Identification

Before beginning the installation process, it is critical that you identify the controller model you have purchased. Both wiring and programming are very specific to the input and output types of the controller. By taking time to properly identify the unit, installation and programming will proceed quickly and easily.

Your controller model number is written on the tag located on the bottom of the instrument. The model number tag on the front door of the controller applies only to the front display and is not indicative of the controller features/options installed. Write the model number here and following the Model Identification tables below, identify the controller characteristics.

Features and Specifications

- **Open Sensor and Out-of-Range Conditions:** Programmable for 0-100% output.
- **Digital Communications Option:** RS-232C single drop, isolated; RS-422A, RS-485 multi-drop, isolated; baud rate 300, 600, 1200, 2400, 4800, 9600, 19,200; data string ASCII, asynchronous, one start, one parity, seven data and one stop bit or binary.
- **Instrument Power:** 120 or 230 Vac + 10%, -15%, 50 to 60 Hz, 7 VA nominal power consumption.
- **Operating Environment:** 30° to 130°F (0° to 55°C) ambient temperature with relative humidity less than 95% non-condensing.
- **Dimensions:** 12.5" W x 11.5" D x 3.75" L (318 x 292 x 95mm)

To Order (Specify Model Number)	
Model Number	**Description**
CN3390-(*)	Ten loop controller

* Insert output codes from Control Outputs Table; choose 5 in any combination.

Control Outputs (No Add'l Charge, Except FI)	
Output Code	**Description**
R	Relay
T	1 A SSR
F	4-20 mA (non-isolated)
FI (**)	4-20 mA (isolated)
DC	20 Vdc Pulse

** Add $260 to base price for ten outputs. $52 for each 2 loop board.

Sensor Inputs	
Type	**Range**
J Iron-Constantan	-100° to 1400°F -73° to 650°C
K Chromega®* Alomega®	-100° to 2100°F -73° to 1149°C
E Chromega Constantan	-100° to 1100°F -73° to 593°C
T Cooper-Constantan	-350° to 750°F -212° to 399°C
R Pt/13%Rh-Pt	50° to 3000°F 10° to 1649°C
S Pt/10%Rh-Pt	50° to 3000°F 10° to 1649°C
100Ω Pt RTD	-200° to 1000°F -128° to 538°C
Current, 4-20mA	Field Scalable 0.0 to 100%

* Accuracy with controller at 77°F ambient unless stated otherwise.

Options	
Ordering Suffix	**Description**
-1	Ten open collector alarm output
-2	RS-232, RS-422, RS-485 digital communications
-3	All of the above (suffix -1 and -2)

Accessories and Spare Parts	
Model No.	**Description**
3390A-R	Dual relay output module
3390A-T	Dual 1A SSR output module
3390A-F	Dual 4-20 mA output module (non-isolated)
3390A-FI	Dual 4-20 mA output module (isolated)
3390A-DC	Dual pulse 20 Vdc output module
3390A-10ALM	10 relay alarm output board (must have 1 option or CN3390-INTALM)
3390A-1ALM	Single relay alarm output board
3390A-FRONT	Front panel display (controller not included)
3390A-INTALM	Internal alarm board
3390A-RS	RS-232, RS-422, RS-485 Digital Communications
CN3200-SOFT	Software for Digital Communications Option
3390A-CAB18	18-inch remote mounting cable
3390A-CAB60	60-inch remote mounting cable
3390A-CAB180	180-inch remote mounting cable
1821A-101	Noise suppression kit for mechanical relay modules driving ac contactors or solenoids

IMPORTANT!

Read this manual carefully and thoroughly before attempting installation, programming and operation of the CN3390 controller. Improper wiring, or configuration and selection of parameter values could result in damage to equipment, the controller and possibly even personal injury. It is your responsibility to assure that the controller is safely installed and configured.

Electronic components are sensitive to electrostatic discharge. Proper handling techniques should be used when installing the unit or during any modifications.

2 – Installation

■ Inspection and Unpacking

Remove the packing list and verify that all equipment has been received. If there are any questions about the shipment, please call the OMEGA Customer Service Department at 1-800-622-2378 or 203-359-1660.

Upon receipt of shipment, inspect the container and equipment for any signs of damage. Take particular note of any evidence of rough handling in transit. Immediately report any damage to the shipping agent.

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

What Comes with Your CN3390

Included with your CN3390 Controller is:

- User's Manual (M1494)
- *QuickInfo* quick reference guide
- 10 Snubbers for Triac and Relay Outputs only.

■ Mounting

The CN3390 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).

Subpanel Mounting

Subpanel mounting is illustrated in Figure 2.1.

Figure 2.2 gives the mounting dimensions for the controller.

Drill four mounting holes in the subpanel mounting surface and bolt the controller directly to the subpanel.

Figure 2.1
Subpanel Mounting
Illustration

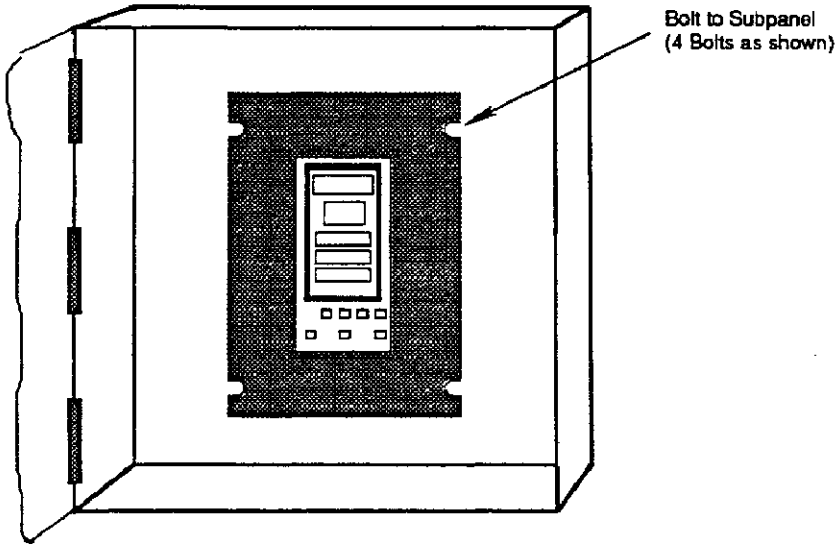
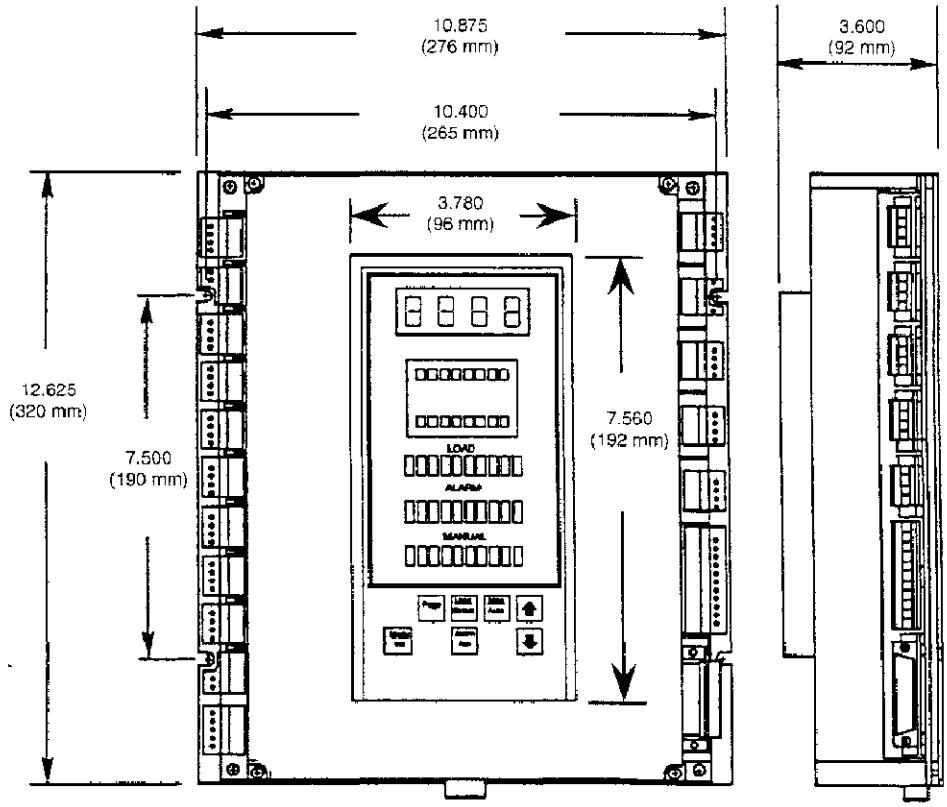


Figure 2.2
Mounting Dimensions



Measurements are in inches

Panel Door and Remote Display Mounting

The control panel (faceplate) of the CN3390 controller may be removed to allow the control panel to be mounted on the panel door exterior, with the controller chassis mounted inside the panel. Likewise, the control panel may be remotely mounted up to 15 feet away from the controller chassis. These two mounting configurations are illustrated in Figures 2.3 and 2.4.

Remote mounting the control panel separately from the controller chassis requires a remote mounting cable. This cable is available from Omega in 5 foot (P/N 3390A-CAB60) and 15 foot (P/N 339A-CAB180) lengths. Panel door mounting requires an 18 inch door mounting cable (P/N 3390A-CAB18).

Figure 2.3
Panel Door Mounting

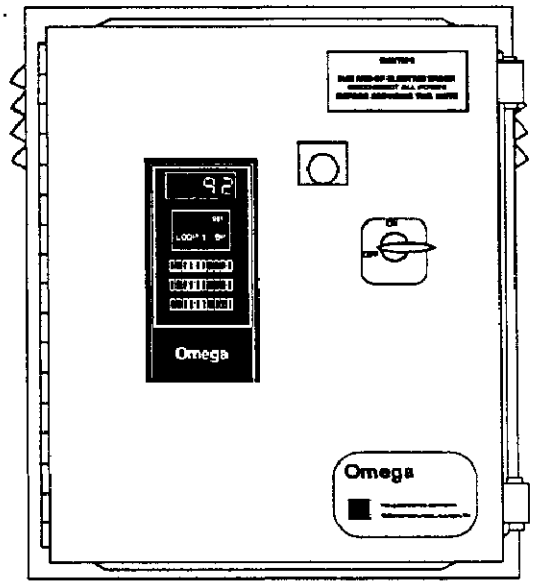
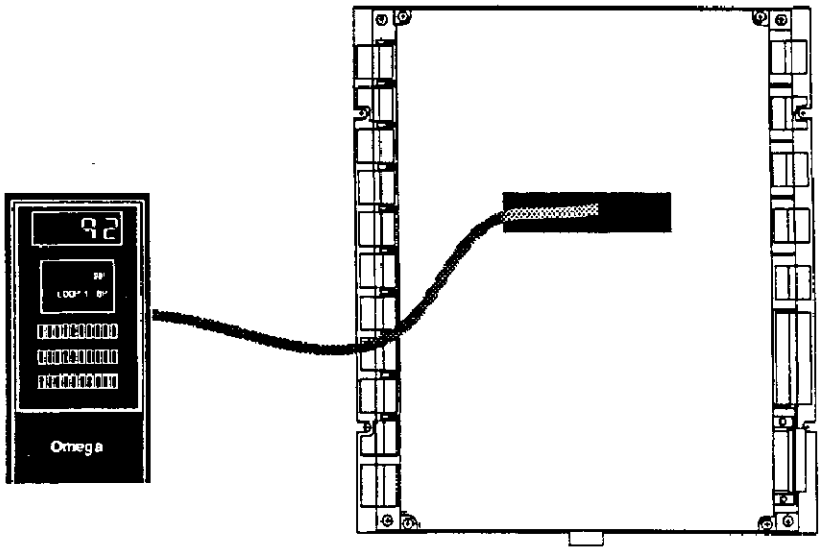


Figure 2.4
Remote Control
Panel Mounting



Remote Display Mounting Instructions

To mount the front panel display separately from the controller chassis:

1. **Remove the front panel display from the controller chassis.** Loosen the holding screw located under the front door flap. The front panel display is plugged onto the chassis, so grasp it firmly around the edge and gently pull to unplug it.

2. **Mount the controller chassis inside the panel or in the desired remote location.** Follow Figure 2.2 for mounting dimensions and the instructions on page 6 for subpanel mounting.

3. **Mount the front panel display.** The connector protrudes from the rear of the control panel. Cut a hole in the panel door or remote location large enough to accommodate the connector (Figure 2.5). Drill three screw holes as per the template and mounting dimensions given in Figure 2.5. Insert the front panel display into the cutout and install screws from behind the display.

4. **Connect the front panel display to the controller chassis.** Plug the 5- foot connection cable onto the connector located on the back of the control panel. Plug the other end of the cable to the connector on the front of the controller chassis.

■ Sensor Input Jumper Selection

Each of the 10 loops (channels) of the CN3390 controller is capable of accepting any one of three types of sensor inputs:

- Thermocouple types J, K, E, T, R and S
- RTD, 100 ohm Platinum, alpha = .00385
- 4-20 mA

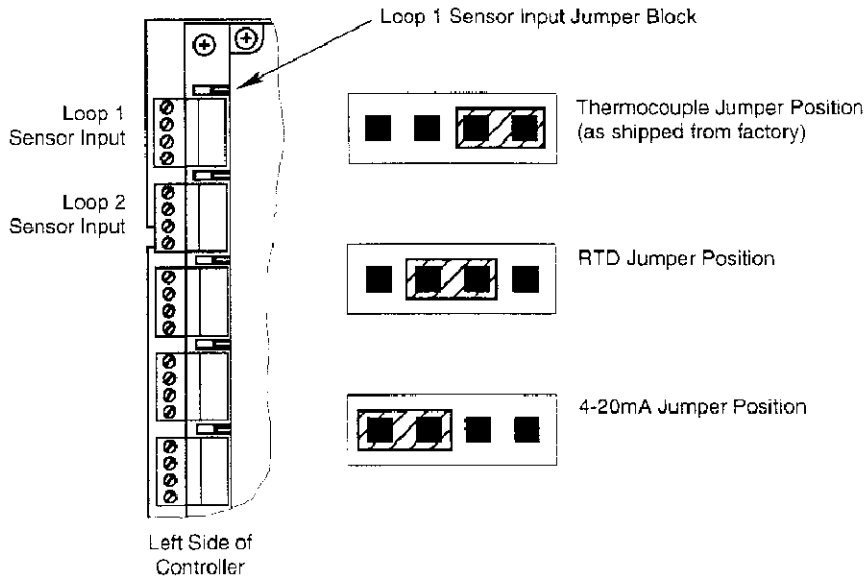
The input sensor type for each loop is distinguished by:

- position of the sensor input jumper
- wiring
- sensor type programmed on PAGE 11/MENUs 6-24

Note that each sensor input loop is distinguished by 4 terminals on a removable connector (along the left side of the controller). Next to each connector is a jumper for selection of the input type. When shipped from the factory, the jumpers are in the thermocouple (T/C) position. Move the jumper for each loop that will receive RTD or 4-20 mA inputs.

Figure 2.6, page 10, shows the location of the sensor input wiring connectors and the three possible positions of the sensor input jumper- thermocouple, RTD or 4-20 mA.

■ Figure 2.6
Sensor Input
Jumper Positions



Wiring

Important Wiring Information!

To insure that the OMEGA® CN3390 controller performs optimally, it is imperative that you read this section and become familiar with standard wiring practices critical to eliminating electrical noise. Failure to follow these recommended wiring practices can result in poor temperature measurement and ineffective 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 CN3390. The recommended snubber is a .1uf capacitor in series with a 220 ohms resistor. Snubbers are available from Omega (P/N 1821-101).

When using the Alarm Outputs, or Triac and Relay Control Outputs to drive a contactor coil or other inductive load, the snubbers should be connected in parallel with the contactor coil. Install the snubbers as shown in the individual wiring diagrams for each output type, Figure 2.12 and 2.13.

Good Wiring Practices

Follow **Good Wiring Practices** when connecting any controller:

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

2. When planning the system wiring, separate wiring into functionally similar bundles - power leads, sensor leads, output signal lines, etc. If power and sensor leads must cross, they should do so at 90° angles (perpendicular).

3. Locate sources of noise in your system - motors, contacts, solenoids, etc. Design your system so wiring is separated 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 low power signal lines.

6. More information on good wiring practices is available from IEEE, 345 East 47th St., NY, NY 10017. Request IEEE Standard No. 518-1982.

Wiring Connections

Make all wiring connections to the controller before power is applied.

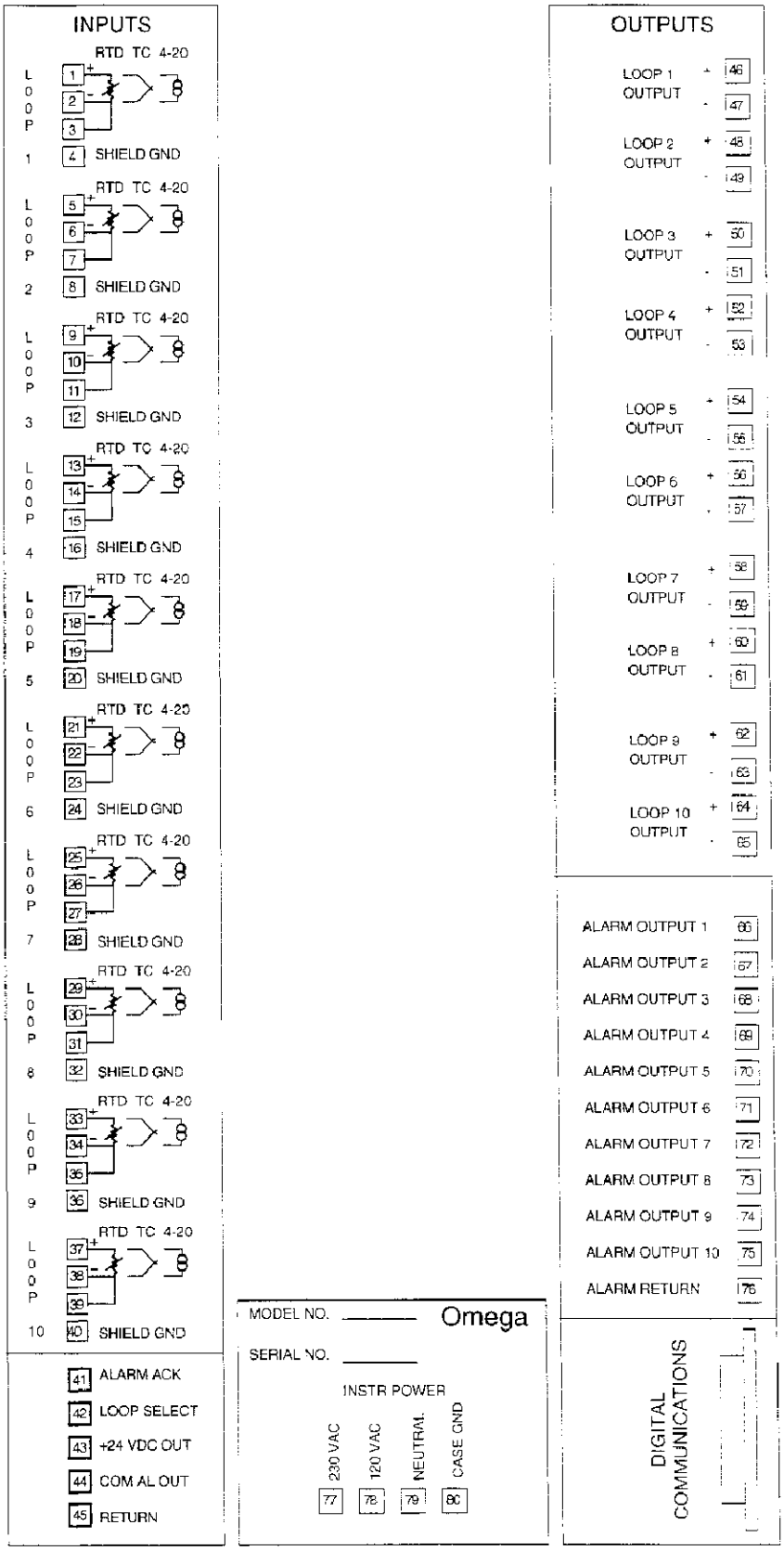
All wiring must comply with local codes, regulations and ordinances. This instrument is intended for panel mounting and the terminals must be enclosed within a panel. Use National Electric Code (NEC) Class 1 wiring for all terminals except the sensor terminals.

Check the label on the bottom of the controller to verify the model number. The wiring decals on the sides of the controller show the wiring terminations. All wires will be connected to the terminals on the sides of the controller. Specific wiring instructions for different input and output types are given in this section.

Detailed wiring instructions for Digital Communications and Alarm Outputs options are given in the separate sections covering each of these topics.

Using the proper size wire for rated circuits, make the wiring connections as shown in Figure 2.7. Detailed sensor input and control output wiring diagrams follow.

Figure 2.7
Terminal
Identification



■ Sensor Inputs Wiring

Note that each sensor input loop is distinguished by 4 terminals on a removable connector. This allows for easy removal of the instrument, leaving field wiring intact — simply unplug the connectors.

Sensor Input Wiring Notes

- Sensor leads (thermocouple, RTD, voltage or current) should not be run together in the same conduit as power wiring.
- Twisted pair shielded wire is recommended for sensor connections.
- False process readings can occur if the sensor wire is exposed to electrical noise.
- If thermocouple extension wire is required, it must be the same type as the thermocouple (i.e. if a Type T thermocouple is used, then Type T extension wire must be used).
- If shielded thermocouple wire is used, the shield must be grounded at one end only, preferably at the shield ground terminal on the controller, as shown in Figure 2.8.
- Three-wire (3) RTDs are recommended for greatest accuracy.
- Standard shielded copper wire is recommended for RTD extensions.

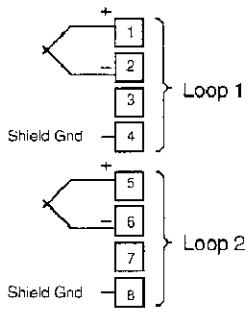
Thermocouple Inputs

It is important to observe polarity (+,-) when connecting thermocouple leadwires.The table below shows typical color coding for the thermocouples used with this instrument.

T/C Type	Material	Polarity (+)	Polarity (-)
J	Iron/Constantan	White	Red
K	Chromel/Alumel	Yellow	Red
E	Chromel/Constantan	Purple	Red
T	Copper/Constantan	Blue	Red
R	Plat, 13% Rhodium/Plat	Black	Red
S	Plat, 10% Rhodium/Plat	Black	Red

Make the thermocouple wiring connections to terminals 1-40 as shown in Figure 2.8 on the following page.

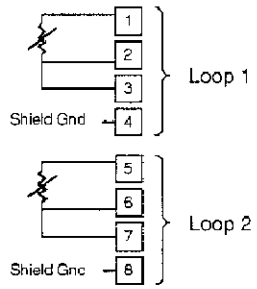
Figure 2.8
Thermocouple
Connections



3 – Wire RTD Inputs

When making the 3– wire RTD input connection, it is important to make the resistance of all three extension leadwires equal by using the same gauge and same length of wire for optimum leadwire compensation. Omega recommends 3–wire RTD's for greatest accuracy, and standard shielded copper wire for RTD extensions.

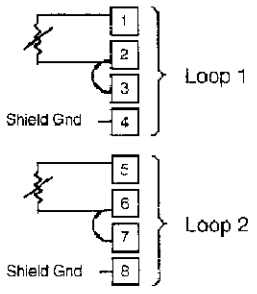
Figure 2.9
3 – Wire RTD
Connections



2 – Wire RTD Inputs

If using a 2–wire RTD input, use heavier gauge leadwires to reduce leadwire resistance. Any leadwire resistance adds directly to sensor resistance, thus adding error to the process temperature measure. It is also necessary to jumper Terminals 2 & 3 on the instrument to complete a 2–wire hook-up.

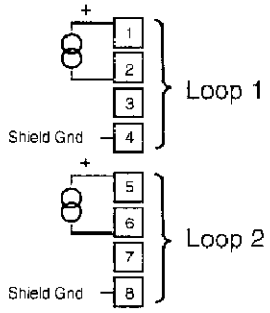
Figure 2.10
2 – Wire RTD
Connections



Current Inputs

All 10 loops of the CN3390 controller have the capability of accepting a 4-20 mA current input signal. Make the sensor input connections to terminals 1-40 as shown in Figure 2.11.

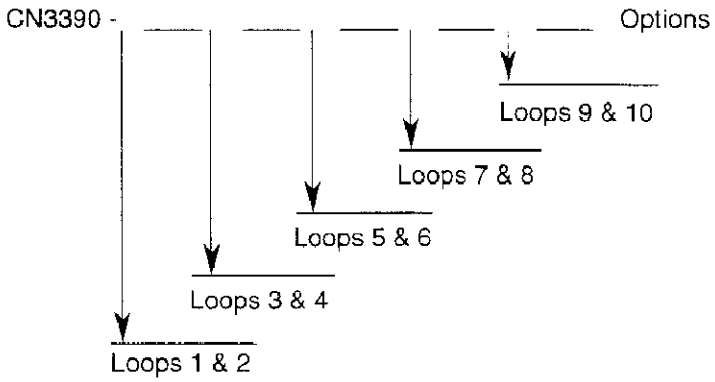
Figure 2.11
Current Inputs



■ Output Wiring

Your CN3390 controller has up to five control output modules. Each module accomodates 2 control loops (one pair) of the same type. The control output type for each pair of loops is specified in the controller model number.

Identify Individual Loop Output Types



Output Code	Output Type
R	Relay
T	1A SSR
F	4-20mA (non-isolated)
FI	4-20mA (isolated)
DC	20 Vdc Pulse

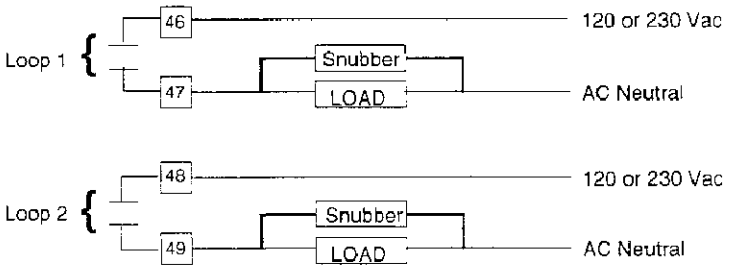
You may change or add the output type of any pair by replacing the control output modules. See page 20, "Installing Control Output Modules."

Relay Output Connections Code 1

A relay output is generally used to drive small resistive loads (<1 amp at 120 volts or <0.5 amps at 230 volts) or a contactor. When driving a contactor coil or other inductive load, we recommend that you install an appropriately rated a.c. snubber circuit (Omega P/N 1821-101) in parallel with the contactor coil to protect the controller from electrical noise, as discussed earlier in this manual (see page 10).

Make the wiring connections for relay output as shown in Figure 2.12.

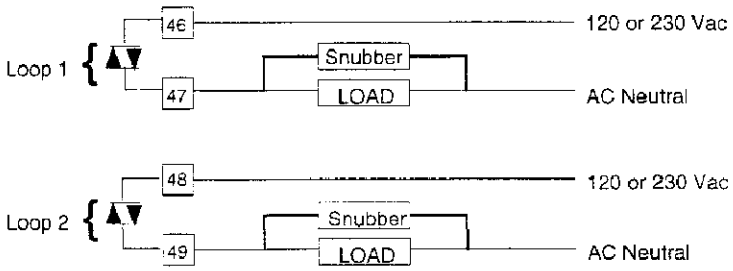
Figure 2.12
Relay Output
Connections



Triac Output Connections Code 2

A triac output generally drives a small load (less than 1 amp) or the coil of a contactor. Since triacs are solid state devices (no contacts), they will perform much longer than a mechanical relay. When driving a small load directly, triacs can cycle faster than a conventional relay to maintain tighter control. See Figure 2.13 for triac output connections.

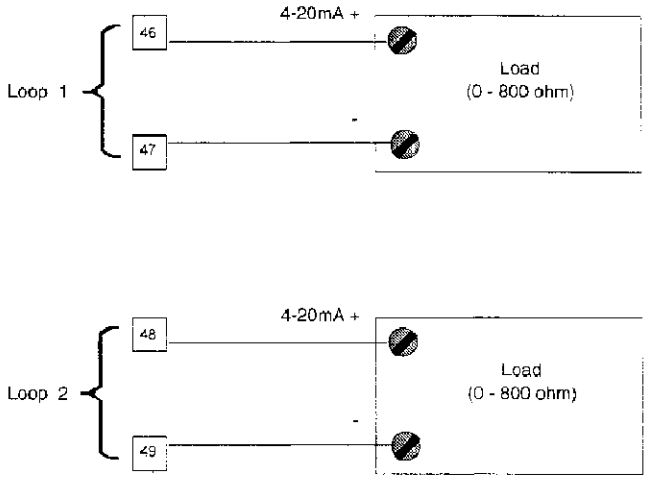
Figure 2.13
Triac Output
Connections



Non-Isolated Current Output Connections Code 4

The 4–20 mA signal is an industrial standard method of transmitting and receiving information. To use this output, it must be connected to a device that accepts a 4-20mA signal and has input impedance of less than 800 ohms. Make the output connection in accordance with Figure 2.14 on the following page.

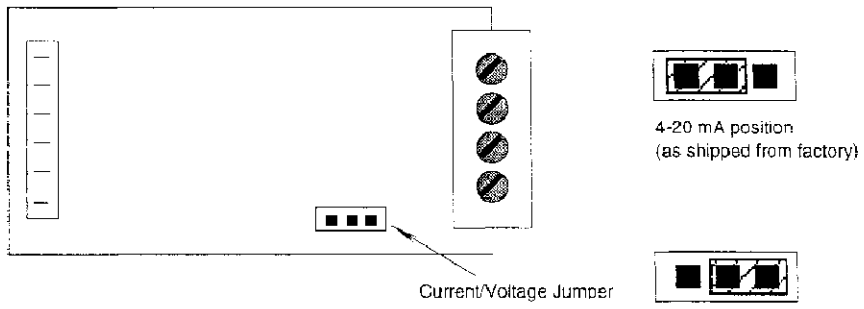
Figure 2.14
Non-Isolated 4–20 mA
Output Connections



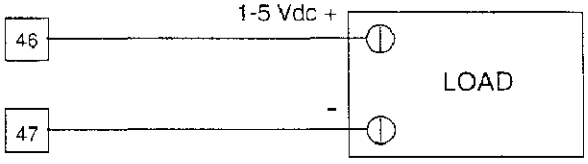
Changing 4-20 mA Current to 1-5Vdc Voltage

The non-isolated current output may be changed to a 1-5Vdc output by moving a jumper on the output card. Locate the jumper as shown in Figure 2.15 and move it to the 1-5 Vdc position.

Figure 2.15
Changing Non-Isolated
Current Output
to 1-5 Vdc
Voltage Output



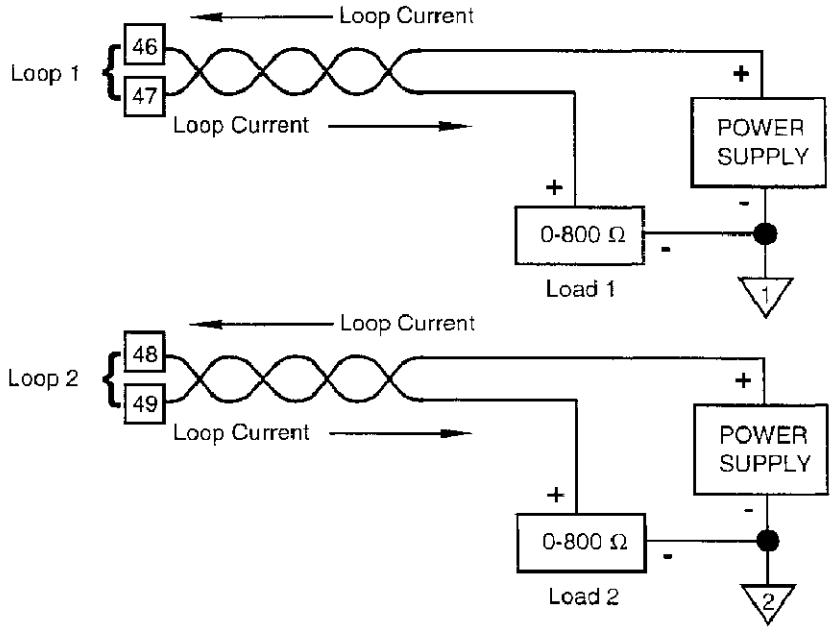
1-5 Vdc Output
Connections



Isolated Current Output Connections Code 5

If using the 4–20 mA isolated output, an external power supply must be used for isolation. If the load impedance is ≤400 ohms, use a 24 Vdc power supply. If the load impredance is ≤800 ohms, but greater than 400 ohms, use a 36 Vdc power supply. Make the isolated output and power supply connections as shown in Figure 2.16.

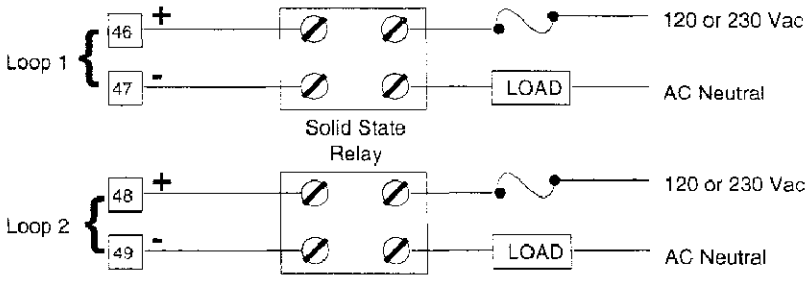
Figure 2.16
Isolated 4-20 mA
Output Connections



Solid State Relay Output Connections Code 7

The Solid State Relay (SSR) Drive output drives solid state relays, such as the Omega 4115 or 4117 Power Modules, which accept 3 to 32 Vdc input ON signals and 0 Vdc OFF signals. See Figure 2.17 for Solid State Relay Drive Output connections.

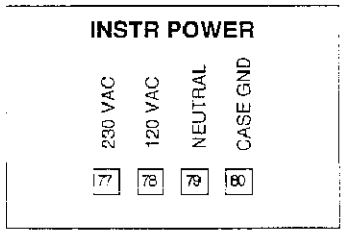
Figure 2.17
Solid State Relay
Output Connections



■ Instrument Power Wiring

Make the instrument power connections to terminals 77–80 as shown in Figure 2.18.

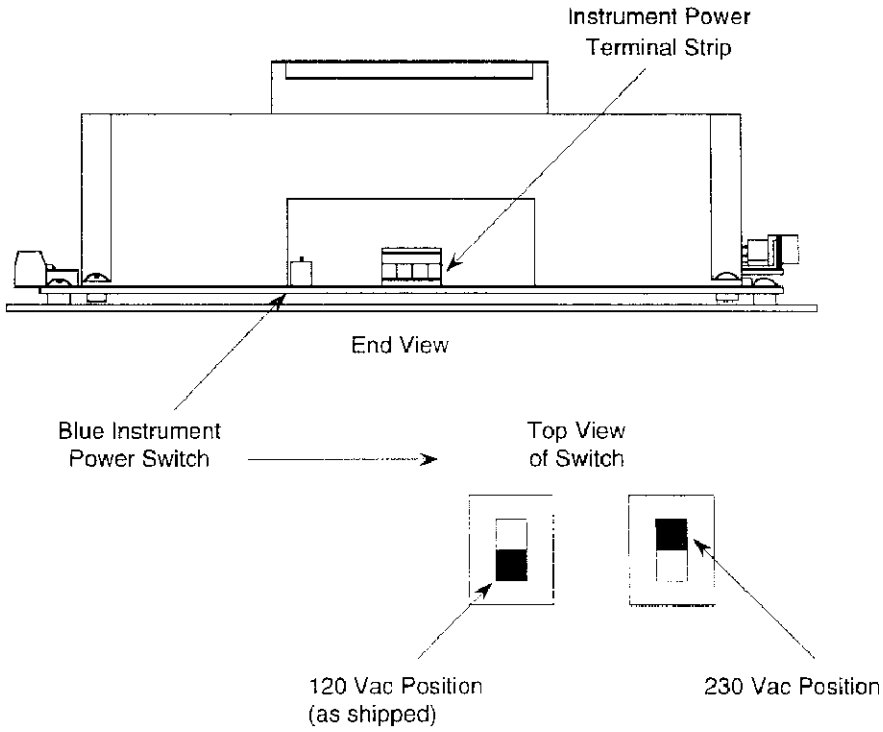
Figure 2.18
Instrument Power
Connections



120/230 Volt Instrument Power

The CN3390 controller is equipped to receive both 120 and 230V instrument power input. When shipped from the factory, the instrument power switch is in the 120V position. If your application requires 230V, locate the switch and move it to the 230V position, as shown in Figure 2.19.

Figure 2.19
120/230 Volt
Instrument Power Switch



■ Wiring: Alarm Outputs and Alarm Relay Board

Before making the alarm wiring connections, it is important that you understand the alarm features and how they function. Specific wiring instructions are given in Section 5 – Alarms.

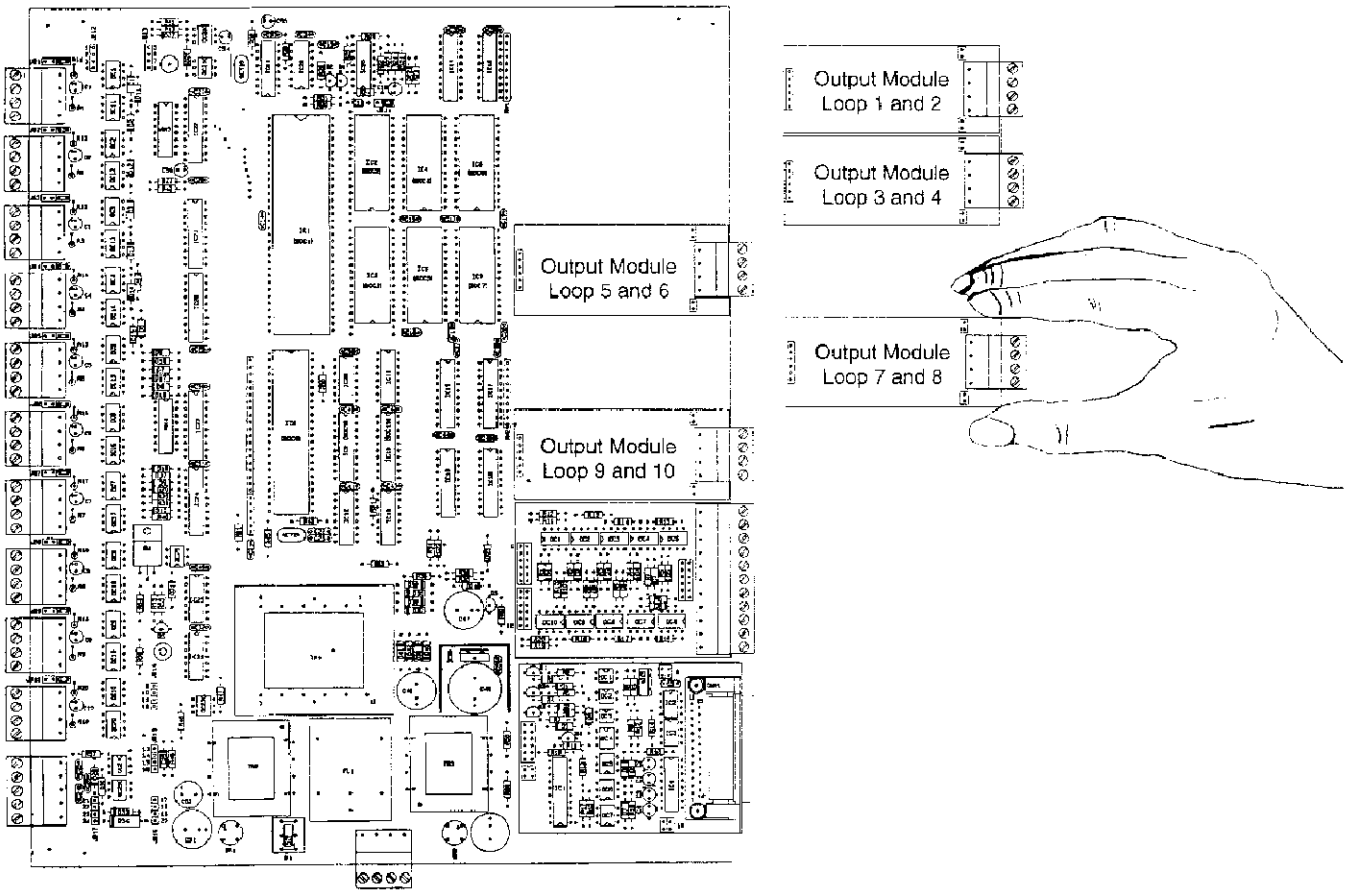
■ Wiring: Digital Communications

Specific wiring instructions for the Digital Communications option are given in Section 7 – Digital Communications.

Installing Output Modules

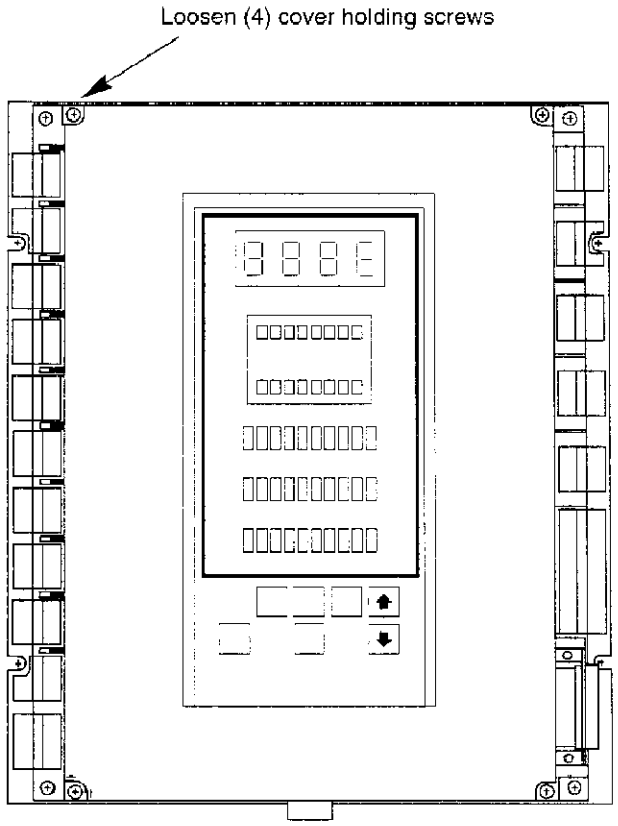
Your CN3390 controller was shipped with a maximum of five output modules installed. The types of the output modules for each pair of loops is identified by the model number (see page 15). The location of each output module is identified in Figure 2.20.

Figure 2.20
Output Modules



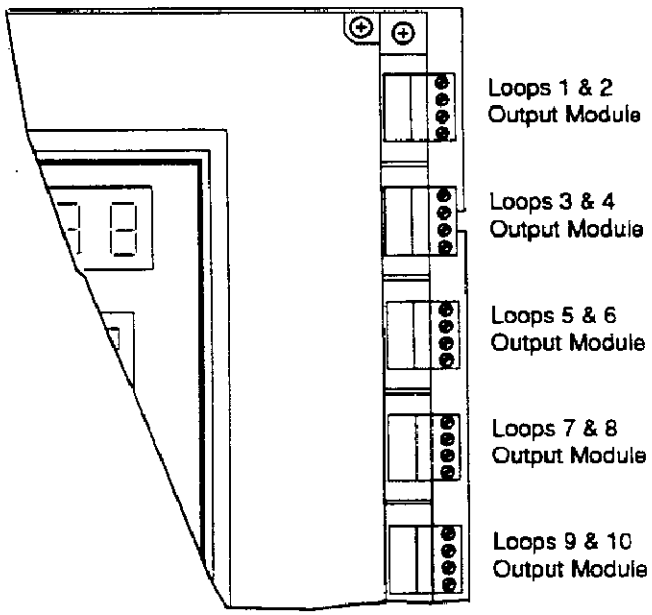
To change or install an output module(s), you must remove the housing from the controller chassis. This is illustrated in Figure 2.21 below.

Figure 2.21
Removing the
Instrument Cover



The locations of the five control output modules are shown in Figure 2.22 below.

Figure 2.22
Locating the Control
Output Modules



After locating the output module to be changed, unplug it from the connector posts and replace it with the new output module.

After changing an output module, be sure to change the control output wiring and any applicable programmed output parameters before putting the controller back into operation! Damage to the output board can occur if incorrect voltages are supplied.

You may also want to change cycle time if using proportional control, since cycle time varies with control output type. Recommended cycle times are:

- Relay. . . . . .30 seconds
- Triac. . . . . 1 second
- SSR Drive. . . . . 1 second
- 4–20 mA. . . . . 0.3 seconds

Installing the Alarm Relay Board

Instructions for installing the optional alarm relay board, P/N 3390A-10ALM, are given in Section 5 – Alarms.

Installing Digital Communications Circuit Board

If you purchased the CN3390 controller with the Digital Communications option, the circuit board will be installed when you receive the controller. If you are purchasing the circuit board separately and need to install it in the controller, follow the installation instructions given in Section 7 – Digital Communications.

3 – Operation

■ Pushbuttons and Indications

All of the program control steps and configuration entries are easily accomplished with the front panel pushbuttons. The digital displays and status lights provide a constant overview of the process. Figure 3.1 summarizes the functions of the pushbuttons and displays.

Loop Select Mode

After the power-up sequence, the controller will be in the Loop Select Mode. The display will display the Loop 1:

- Process Variable
- Set Point and Units
- Loop Number

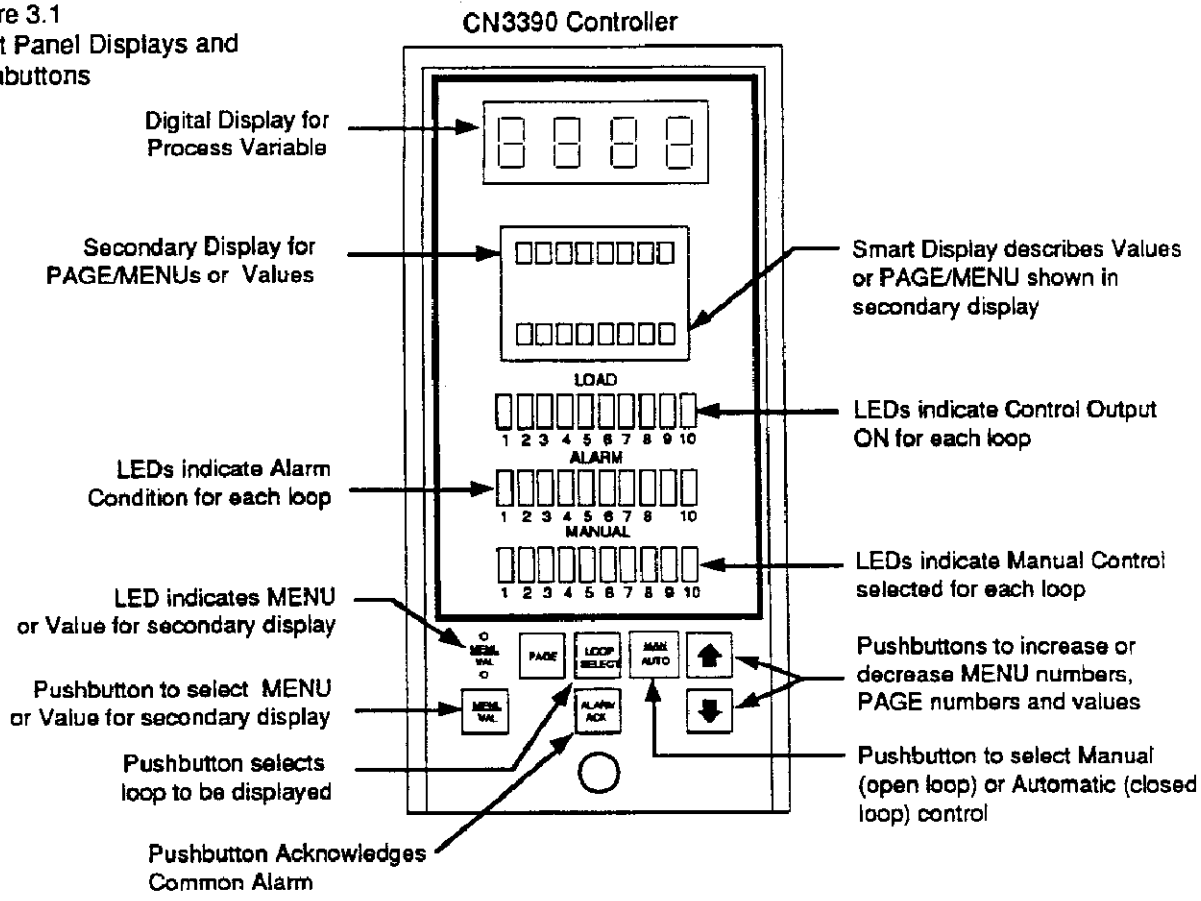
To see parameters for another loop, you must push the LOOP SELECT button to increment to the next loop.

Scanning Display Feature

With the Auto Scan feature, enabled via PAGE 11/MENU 2, the controller continuously scans and displays these three parameters for all 10 loops every 20 seconds (2 seconds per loop). Pressing the LOOP pushbutton will "freeze" the display at the current loop, until LOOP is pressed again to restart the scanning.

Once the Auto Scan feature is enabled, the controller waits approximately 60 seconds before the scanning actually starts.

Figure 3.1
Front Panel Displays and Pushbuttons



■ PAGE/MENU Programming

All control parameters, selections and calibration procedures for the CN3390 are accomplished through simple MENU selections. These MENU selections are organized into PAGES. On each PAGE you will find a specific set of related functions, and each of these functions has a corresponding MENU number.

This organization allows you to go directly to the parameter to be adjusted, without stepping through a long series of unrelated entries. Figure 3.2 illustrates the concept behind the PAGE/MENU structure.

PAGE/MENU Tables

The detailed contents of each individual MENU number on a PAGE are presented in the PAGE/MENU Tables. These tables give the MENU number, alphanumeric command cue, available settings, factory settings and security levels for every adjustment or selection to be made. A sample of part of a PAGE/MENU Table is shown in Figure 3.4.

Figure 3.4
Sample of
PAGE/MENU Table

PAGE 11 General Operation

Alpha	MENU	Selection	Available Settings	Factory Setting	Sec.
LP 7 Unt	19	Loop #7 Units	Degree F Degree C 0 to 100.0% 0.00 to 99.99%	Degree F	C
LP 8 Sen	20	Loop #8 Sensor Input	J TC K TC E TC T TC R TC S TC 100 Ω RTD 4–20mA	J TC	
LP 8 Unt	21	Loop #8 Units	Degree F Degree C 0 to 100.0% 0.00 to 99.99%	Degree F	
LP 9 Sen	22	Loop #9 Sensor Input	J TC K TC E TC T TC R TC S TC 100 Ω RTD 4–20mA	J TC	
LP 9 Unt	23	Loop # 9 Units	Degree F Degree C 0 to 100.0% 0.00 to 99.99%	Degree F	

Location of PAGE/MENU Tables in this Manual

PAGE/MENU Tables for PAGEs 0 - 11 are found in Section 4, pages 31-38. PAGEs 12-27 are found in the sections specific to their function (i.e. Calibration, 4-20mA Input Scaling, etc.)

■ Security Levels

Every parameter or selection in the PAGE/MENU tables has a corresponding PAGE/MENU number. Each PAGE/MENU number is assigned one of five Security Levels, A-E. In each Level you may view certain PAGE/MENU numbers, and adjust certain PAGE/MENU numbers. This allows you to select the Security Level most appropriate for your operating environment, prohibiting unauthorized access to or accidental changing of control parameters.

Entering the Security Code

The Security Code is entered in PAGE 11/MENU 1 to determine which PAGE/MENUs may be **viewed** and which may be adjusted.

The controller is set at Security Level C (code 458) when you receive it from Omega.

Figure 3.5 defines the PAGE/MENU numbers that correspond to each of the five Security Levels, A – E.

Figure 3.5
Security Levels and
PAGE/MENU Contents

Security Level	Allows Adustment of:	PAGE/MENU
A	Status Display	P0 / M1–40
	Security Lock	P11 / M1
B	Process Set Point	P1–10 / M1–2
	Manual Reset	
	Security Level A	
C	PID Control Parameters	P1–10 / M3–5
	Deadband	P1–10 / M6
	Output Limits	P1–10 / M7
	Cycle Time	P1–10 / M8
	Control Mode	P1–10 / M9
	Control Action	P1–10 / M10
	Alarm Types and Set Points	P1–10 / M11–18
	Auto/Manual Disintegration Time	P1–10 / M19
	General Operation Set Up	P11/M2-26
	Map Loop Alarms to Alarm Outputs	P12-13 / M1–10
	Auto-Tuning Loops 1–10	P14 / M1–10
	Security Levels A and B	
D	Loops 1–10 Set Point Limits	P11 / M27–46
	Map Fatal Errors to Common Alarm	P1–10 / M47
	Digital Communications Set-up	P15 / M1–11
	Security Levels A, B and C	
E	Sensor Out of Range Action	P1–10 / M20–22
	Controller Reset	P11 / M48
	Gang Calibrate Similar Channels	P16 / M1
	Calibrate Loops 1–10	P17–26 / M1–7
	Custom Scale 4-20 mA Current Input	P27 / M 1–40
	Security Levels A, B, C and D	

Figure 3.6 lists the Security Codes for each of the five Security Levels, along with the Levels which can be **viewed** and **adjusted**.

Figure 3.6
Security Codes and
View/Adjust Levels

Security Level	Security Code	View Level	Adjust Level
A	- - -	A, B, C	A
B	123	A, B, C	A, B
C	458	A, B, C	A, B, C
D	352	A, B, C, D	A, B, C, D
E	736	A, B, C, D, E	A, B, C, D, E

■ Programming Example

Now that you understand the basic PAGE/MENU programming structure, displays and pushbuttons, you are ready to practice programming.

It is important that you take time to perform this programming example, since it will teach you how to move between PAGES and MENU numbers, and how to adjust the MENU values.

IMPORTANT!

Disable the external load circuit power before proceeding with the Programming Example!

Initial Power-up

After the CN3390 has been installed and the power turned on, it will begin to operate utilizing the factory settings. The digital displays will read "3390 Ten Loop Control". After a short delay, the upper display will indicate the Loop 1 process variable (in °F) and the lower display will indicate the factory-set set point (0°F). Since the secondary display value is a set point for Loop 1, the English display will read "Set Point 1". Other LEDs indicate operating status, such as alarm condition and control output.

Programming Example Example Setup

In the following steps, you will learn how to adjust a PAGE/MENU setting.

Action:	Displays:	Explanation:
Press PAGE	STATUS PAGE 0	You have entered the PAGE Select Mode. Use the ↑ and ↓ pushbuttons to move to the next/previous PAGE.
Press ↑	GENERAL PAGE 11	Increment up PAGE 11, General Operations.
Press MEN/VAL	SEC CODE PAGE 11: M 1	Now that you are on PAGE 11, pressing MEN/VAL will put you in the MENU select Mode. Use the ↑ and ↓ pushbuttons to move to next/previous MENU.
Press ↑	LP SCAN P11: M2	You are now PAGE 11 / MENU 2, Loop Scan, the desired PAGE.
Press MEN/VAL	LP SCAN No Scan	Pressing MEN/VAL will allow you to see current value and then select the new value for Loop Scan (No scan, Autoscan)
Press ↑	LP SCAN AutoScan	Value changes to Autoscan. Selection is made.
Press MEN/VAL	LP SCAN P11: M2	You have exited PAGE 11 / MENU 2 adjustment. Proceed to next adjustment, or do nothing and controller will time out and go to the loop scan mode.

■ Auto/Manual Operation

MAN AUTO

The CN3390 controller can be switched between Automatic and Manual control by:

1. selecting the desired loop using the LOOP SELECT pushbutton
2. pressing the MAN AUTO pushbutton twice on the front panel

On initial power-up, the controller always begins operating in the automatic control mode (closed loop). The Auto/Manual set-up, PAGE 11/ MENU 26, must be "enabled" to allow you to select Manual control via the front panel MAN/AUTO pushbutton. When the MAN/AUTO pushbutton is pressed, manual control (open loop) is selected.

When any Loop is in the Manual control mode, the "Manual" LED for that Loop will be illuminated. Automatic control for the loop selected can be resumed by pressing MAN/AUTO pushbutton to toggle back to the automatic control mode.

If the manual LED is illuminated for a loop, the control output Loop can be manually raised and lowered with the ⬆ and ⬇ pushbuttons if PID control is selected for that Loop on PAGE 1-10 / MENU 9. This capability is of particular importance in process applications that must be brought on line manually and to determine optimum control settings. If ON/OFF control is selected on PAGE 1-10 / MENU 9, the ⬇ and ⬆ pushbuttons force the control output ON and OFF.

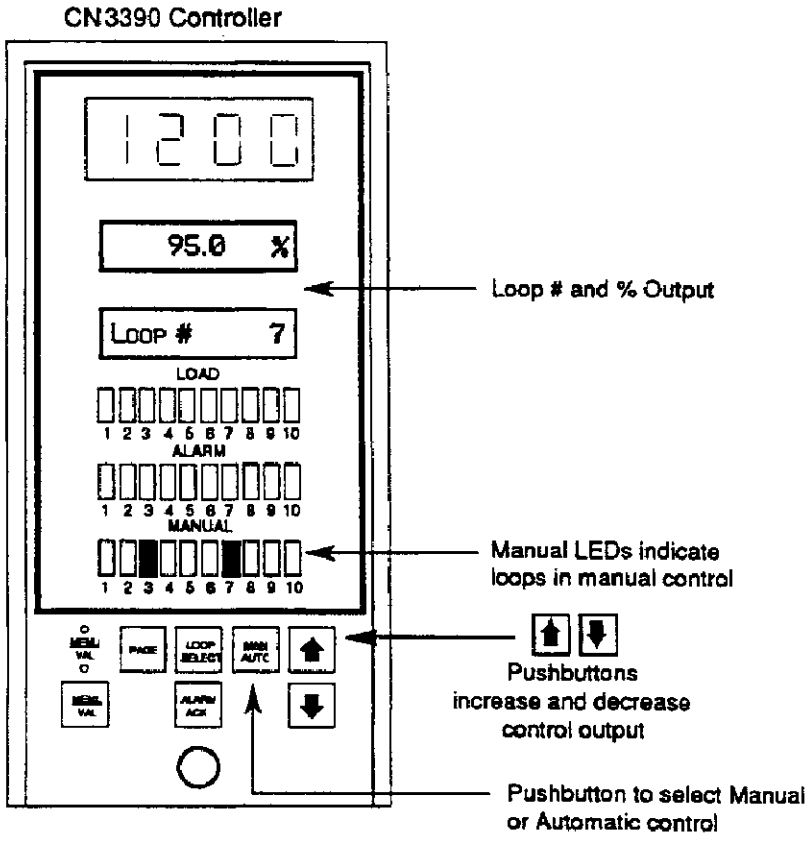


Figure 3.7
Pushbuttons and Displays in Manual Control Mode

4 – PAGE/MENU Tables

This section contains detailed information for PAGE 0 through PAGE 11.

PAGE 0 - Display Page

PAGE 1 - 10 - Control Parameters for Loops 1-10

PAGE 11 - General Control Operations

Programming PAGEs specific to certain functions are located in the section of this manual that addresses the function:

Section	Topic	Programming PAGEs
5	Alarms	12, 13
6	Self-Tuning	14
7	Digital Comm.	15
8	Calibration	16 – 26
9	Custom Scaling of Analog Input	27

PAGE 0: Status Page 0

Menu Description	Menu	Display Selection	Security
LP 1 SP	1	Loop 1 Set Point	
LP 1 PV	2	Loop 1 Process Variable	
LP 1 Out	3	Loop 1 Output % ON	
LP 1 ALM	4	Loop 1 Alarm Status	
LP 2 SP	5	Loop 2 Set Point	
LP 2 PV	6	Loop 2 Process Variable	
LP 2 Out	7	Loop 2 Output % ON	
LP 2 ALM	8	Loop 2 Alarm Status	
LP 3 SP	9	Loop 3 Set Point	
LP 3 PV	10	Loop 3 Process Variable	
LP 3 Out	11	Loop 3 Output % ON	
LP 3 ALM	12	Loop 3 Alarm Status	
LP 4 SP	13	Loop 4 Set Point	
LP 4 PV	14	Loop 4 Process Variable	
LP 4 Out	15	Loop 4 Output % ON	
LP 4 ALM	16	Loop 4 Alarm Status	
LP 5 SP	17	Loop 5 Set Point	
LP 5 PV	18	Loop 5 Process Variable	
LP 5 Out	19	Loop 5 Output % ON	
LP 5 ALM	20	Loop 5 Alarm Status	
LP 6 SP	21	Loop 6 Set Point	
LP 6 PV	22	Loop 6 Process Variable	
LP 6 Out	23	Loop 6 Output % ON	
LP 6 ALM	24	Loop 6 Alarm Status	
LP 7 SP	25	Loop 7 Set Point	
LP 7 PV	26	Loop 7 Process Variable	
LP 7 Out	27	Loop 7 Output % ON	
LP 7 ALM	28	Loop 7 Alarm Status	
LP 8 SP	29	Loop 8 Set Point	
LP 8 PV	30	Loop 8 Process Variable	
LP 8 Out	31	Loop 8 Output % ON	
LP 8 ALM	32	Loop 8 Alarm Status	
LP 9 SP	33	Loop 9 Set Point	
LP 9 PV	34	Loop 9 Process Variable	
LP 9 Out	35	Loop 9 Output % ON	
LP 9 ALM	36	Loop 9 Alarm Status	
LP 10 SP	37	Loop 10 Set Point	
LP 10 PV	38	Loop 10 Process Variable	
LP 10 Out	39	Loop 10 Output % ON	
LP 10 ALM	40	Loop 10 Alarm Status	

PAGE 1 - 10: Control Operations

PAGE 1 = Loop 1 **PAGE 6 = Loop 6**
PAGE 2 = Loop 2 **PAGE 7 = Loop 7**
PAGE 3 = Loop 3 **PAGE 8 = Loop 8**
PAGE 4 = Loop 4 **PAGE 9 = Loop 9**
PAGE 5 = Loop 5 **PAGE 10 = Loop 10**

Alpha	MENU	Selection	Available Settings	Factory Setting	Sec.
SEt Pt1	1	Set Point	Instrument Sensor Range	Sensor Minimum	B
Man RST	2	Manual Reset	-100.0 to 100.0 (#/2 + % of the Prop Band)	0.0	

PID Control Parameters: In MENUs 3-5 you will define the 3 PID control parameters. See Appendix I, Control Theory Tutorial, for detailed descriptions of these parameters. If you will not be using the controller as a PID controller, but rather as an ON/OFF controller, it is not necessary to make MENU selections in MENUs 3–5.

Prop Bnd	3	Proportional Band	0.1 to 999.9 % span	5.0 %	
Auto RSt	4	Automatic Reset	0.00 to 99.99 repeats/min.	0.00	
RatE	5	Rate	0 Sec. to 1000 Sec.	0	

ON/OFF Control Parameters: In MENU 6 you will make the Deadband setting for ON/OFF control operation. If you will not be using the controller as ON/OFF, it is not necessary to make this selection.

Deadband	6	Deadband	(0.01 Increments of Sensor Range up to 25%)	0.01	C

General Control Operation Selections: The following settings define the control operation and should be made for both ON/OFF and PID control.

Out Lm	7	Output Limit	0.0 % to 100.0 %	100% ON	C
Cyc TiME	8	Output Cycle Time*	0.1 SEC to 65.0 SEC	*See note below	
Ctrl ModE	9	Control Mode**	Loop Disabled		
			PID	PID	
			ON/OFF		
Action	10	Control Action	Reverse (heating)	Reverse (heating)	
			Direct (cooling)		

* Cycle Time varies with the output type of your controller. Recommended settings are:
  - Relay = 30 sec. Triac and SSR Drive = 1 sec. 4-20 mA = 0.3 sec.
  - See Appendix I for more detailed information.

** Loop(s) disabled via MENU 9 will display "_ _ _ _" four dashes in the upper process variable display when the loop is selected for display and/or the controller scans that channel.

Alarm #1 and #2 Set-Up: In MENUs 1 –14 you will define alarm set points and types for both Alarms. Detailed descriptions of alarm types are given in Appendix I, Control Theory Tutorial.

AlM1 SP	11	Alarm1 Set Point	Instrument Sensor Range	Sensor Range Maximum
AlM2 SP	12	Alarm 2 Set Point	Instrument Sensor Range	Sensor Range Minimum

PAGE 1 - 10: Control Operations

PAGE 1 = Loop 1
PAGE 2 = Loop 2
PAGE 3 = Loop 3
PAGE 4 = Loop 4
PAGE 5 = Loop 5
PAGE 6 = Loop 6
PAGE 7 = Loop 7
PAGE 8 = Loop 8
PAGE 9 = Loop 9
PAGE 10 = Loop 10

Alpha	MENU	Selection	Available Settings	Factory Settings	Sec.
AL M1 TYP	13	Alarm 1 Type	Hi Alarm Lo Alarm + Dev - Dev +/- Dev No Alarm	Hi Alarm	C
AL M2 TYP	14	Alarm 2 Type	Hi Alarm Lo Alarm + Dev - Dev +/- Dev No Alarm	Lo Alarm	
AL M1 DB	15	Alarm 1 Deadband	0.01 Increments of Sensor Range to 25%	0.25%	
AL M2 DB	16	Alarm 2 Deadband	0.01 Increments of Sensor Range to 25%	0.25%	
AL M2 CoM	17	Alarm 1 Mapped to Common Alarm	Disabled Enabled	Disabled	
AL M2 CoM	18	Alarm 2 Mapped to Common Alarm	Disabled Enabled	Disabled	
DISINTEG	19	Disintegration Time	1 Sec. to 100 Sec.	10 Sec.	

Out of Range/Open Sensor Ouput Value: The following settings allow you to select a control output value that will be in effect if an out-of-range or open sensor occurs in the loop. Percentage (%) outputs apply only if PID control is selected at MENU 9. If ON/OFF control is selected at MENU 9, a setting of 100% will turn the control output ON, and a setting of 0-99% turns the output OFF.

OVEr RnG	20	Sensor Overrange-Control Output Value*	0.0 to 100.0%	0%	E
UndEr RnG	21	Sensor Under-range-Control Output Value*	0.0 to 100.0%	0%	
FotoI Err	22	Open Sensor or EEPROM Error-Control Output Value**	0.0 to 100.0%	0%	

*Sensor out of range or open sensor errors will be displayed with loop number. EEPROM errors will be displayed with PAGE and MENU #.

PAGE 11: General Operations

Alpha	MENU	Selection	Available Settings	Factory Setting	Sec.
SEc CodE	1	Security Lock	0–9999	458 = Level C	A
LP Scan	2	Scan All Channels	No Scan Auto Scan	0 = No Scan	C

Gang Programming: MENUs 3, 4, and 5 allow you to gang program control and alarm set points—program the same setpoint value for all 10 loops with 1 MENU setting.

GanS SP	3	Gang Program— Set Points	Ready ↑ Program Finished	Ready	C
GanS AL1	4	Gang Program— Alarm 1 Setpoints	Ready ↑ Program Finished	Ready	
GanS AL2	5	Gang Program— Alarm 2 Setpoints	Ready ↑ Program Finished	Ready	

Loop Sensor Type and Units: In MENUs 6–25 you will program the sensor input type and units of indication (°F, °C, %) for each of the 10 control loops.

LP1SEn	6	Loop #1 Sensor Input	J TC K TC E TC T TC R TC S TC 100 Ω RTD 4–20 mA	J TC	C
LP1Unt	7	Loop #1 Units	Degree F Degree C 0 to 100.0% 0.00 to 99.99%	Degree F	
LP2SEn	8	Loop #2 Sensor Input	J TC K TC E TC T TC R TC S TC 100 Ω RTD 4–20 mA	J TC	
LP2Unt	9	Loop #2 Units	Degree F Degree C 0 to 100.0% 4 = 0.00 to 99.99%	Degree F	
LP2SEn	10	Loop #3 Sensor Input	J TC K TC E TC T TC R TC S TC 100 Ω RTD 4–20 mA	J TC	

PAGE 11: General Operations

Alpha	MENU	Selection	Available Settings	Factory Setting	Sec.
LP3 Unt	11	Loop #3 Units	Degree F Degree C 0 to 100.0% 0.00 to 99.99%	Degree F	C
LP4 SEn	12	Loop #4 Sensor Input	J TC K TC E TC T TC R TC S TC 100 Ω RTD 4–20mA	J TC	
LP4 Unt	13	Loop #4 Units	Degree F Degree C 0 to 100.0% 0.00 to 99.9%	Degree F	
LP5 SEn	14	Loop #5 Sensor Input	J TC K TC E TC T TC R TC S TC 100 Ω RTD 4–20mA	J TC	
LP5 Unt	15	Loop # 5 Units	Degree F Degree C 0 to 100.0% 0.00 to 99.9%	Degree F	
LP6 SEn	16	Loop #6 Sensor Input	J TC K TC E TC T TC R TC S TC 100 Ω RTD 4–20mA	J TC	
LP6 Unt	17	Loop # 6 Units	Degree F Degree C 0 to 100.0% 0.00 to 99.9%	Degree F	
LP7 SEn	18	Loop #7 Sensor Inputs	J TC K TC E TC T TC R TC S TC 100 Ω RTD 4–20mA	J TC	

PAGE 11 General Operation

Alpha	MENU	Selection	Available Settings	Factory Setting	Sec.
LP 7 Unt	19	Loop #7 Units	Degree F Degree C 0 to 100.0% 0.00 to 99.99%	Degree F	C
LP 8 SEn	20	Loop #8 Sensor Input	J TC K TC E TC T TC R TC S TC 100 Ω RTD 4–20mA	J TC	
LP 8 Unt	21	Loop #8 Units	Degree F Degree C 0 to 100.0% 0.00 to 99.99%	Degree F	
LP 9 SEn	22	Loop #9 Sensor Input	J TC K TC E TC T TC R TC S TC 100 Ω RTD 4–20mA	J TC	
LP 9 Unt	23	Loop # 9 Units	Degree F Degree C 0 to 100.0% 0.00 to 99.99%	Degree F	
LP 10 SEn	24	Loop #10 Sensor Input	J TC K TC E TC T TC R TC S TC 100 Ω RTD 4–20mA	J TC	
LP 10 Unt	25	Loop # 10 Units	Degree F Degree C 0 to 100.0% 0.00 to 99.99%	Degree F	

AUTO/MANUAL Set-Up: MENU 26 must be "Enabled" to allow you to select Manual control via the front panel MAN/AUTO pushbutton.

Manual	26	Auto/Manual SetUp	Disabled Enabled	Disabled	C

PAGE 11: General Operations

SET POINT LIMITS: MENUs 27-46 allow you to establish upper and/or lower limits for the process setpoint, Loops 1-10.

Alpha	MENU	Selection	Available Settings	Factory Settings	Sec.
SP 1UL	27	Loop #1 Set Point Upper Limit	Sensor Range	Range Max	D
SP 1LL	28	Loop #1 Set Point Lower Limit	Sensor Range	Range Min	
SP 2UL	29	Loop #2 Set Point Upper Limit	Sensor Range	Range Max	
SP 2LL	30	Loop #2 Set Point Lower Limit	Sensor Range	Range Min	
SP 3UL	31	Loop #3 Set Point Upper Limit	Sensor Range	Range Max	
SP 3LL	32	Loop #3 Set Point Lower Limit	Sensor Range	Range Min	
SP 4UL	33	Loop #4 Set Point Upper Limit	Sensor Range	Range Max	
SP 4LL	34	Loop #4 Set Point Lower Limit	Sensor Range	Range Min	
SP 5UL	35	Loop #5 Set Point Upper Limit	Sensor Range	Range Max	
SP 5LL	36	Loop #5 Set Point Lower Limit	Sensor Range	Range Min	
SP 6UL	37	Loop #6 Set Point Upper Limit	Sensor Range	Range Max	
SP 6LL	38	Loop #6 Set Point Lower Limit	Sensor Range	Range Min	
SP 7UL	39	Loop #7 Set Point Upper Limit	Sensor Range	Range Max	
SP 7LL	40	Loop #7 Set Point Lower Limit	Sensor Range	Range Min	
SP 8UL	41	Loop #8 Set Point Upper Limit	Sensor Range	Range Max	
SP 8LL	42	Loop #8 Set Point Lower Limit	Sensor Range	Range Min	
SP 9UL	43	Loop #9 Set Point Upper Limit	Sensor Range	Range Max	
SP 9LL	44	Loop #9 Set Point Lower Limit	Sensor Range	Range Min	
SP 10UL	45	Loop #10 Set Point Upper Limit	Sensor Range	Range Max	
SP 10LL	46	Loop #10 Set Point Lower Limit	Sensor Range	Range Min	

MAP FATAL ERRORS TO ALARM: MENU 47

FatAl CoM	47	Map Fatal Errors to Common Alarm	Disabled Enabled	Enabled	D
RESEt	48	Initiate Reset	Ready ⬆ Reset	Ready ⬆	E
OPEn SEn	49	Must Be Set To 0	0	0	

5 – Alarms

■ Descriptions

Loop Alarms

Each of the ten control loops has 2 alarm set points—Alarm #1 and Alarm #2—for a total of 20 alarms. Each alarm type is programmed in the PAGE/MENU settings (PAGEs 1–10). When an alarm occurs, the front face Alarm LED for the loop is illuminated.

Alarm Outputs

The CN3390 controller has an alarm output option. It consists of 10 non-latching open-collector transistor alarm outputs. The 20 individual loop alarm set points may be mapped to any one of the ten alarm outputs, and multiple alarms may be mapped to a single alarm output. The alarm mapping is programmed on PAGE 12 (Alarm #1) and PAGE 13 (Alarm #2).

Common Alarm

The CN3390 has one common alarm transistor output to which any alarm may be mapped. When an alarm condition occurs in a loop, and that alarm is mapped to the common alarm, the alarm LED will flash and the alarm output will energize.

The common alarm is a latching alarm. To acknowledge a latching common alarm, the Alarm Acknowledge pushbutton is provided. The Acknowledge pushbutton will turn off the common alarm output and, if the alarm condition continues to exist, the alarm LED will be illuminated (steady, not flashing). When the alarm condition no longer exists, the light will go off.

■ Alarm Types

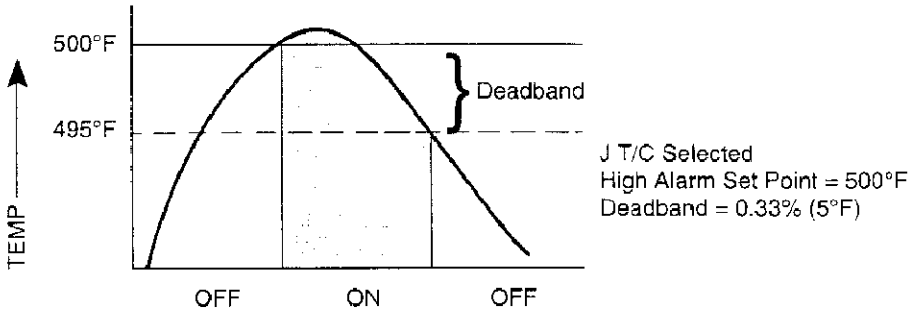
There are 5 alarm types available for each alarm on the CN3390 controller. The alarm type is selected on the Control and Alarm Parameters PAGE for each loop (PAGEs 1-10):

- High
- Low
- + Deviation
- - Deviation
- +/- Deviation

The deadband on each of the alarms is programmable.

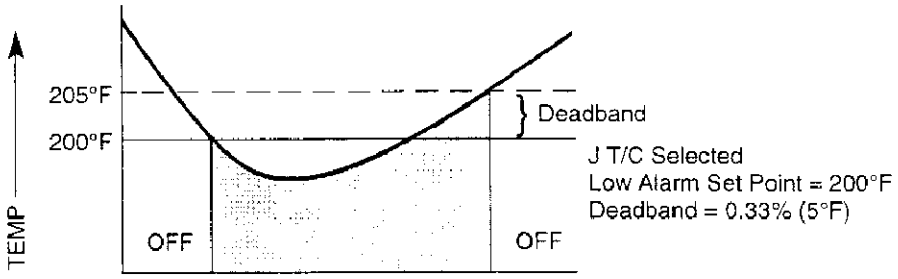
High Alarm

This alarm is a high absolute alarm that actuates when the process temperature is **equal to or greater than the Alarm Set Point.**



Low Alarm

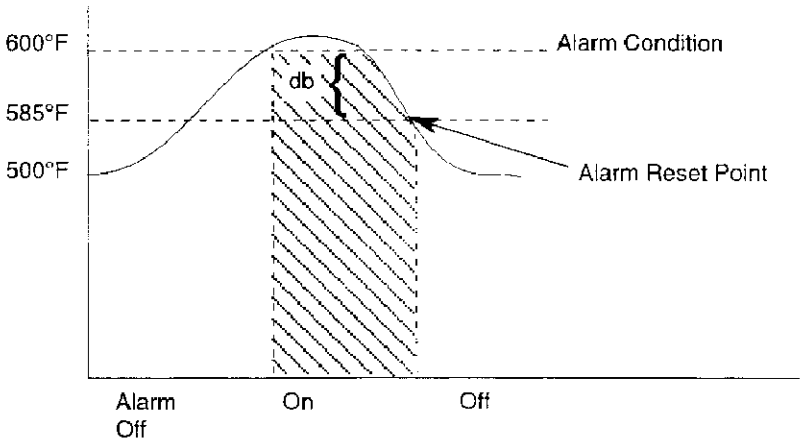
The low absolute alarm actuates when the process temperature is **equal to or less than the Alarm Set Point.**



+ Deviation Alarm

This alarm actuates when the process temperature is **equal to or greater than the Process Set Point plus the Alarm Set Point.** When the Process Set Point is moved, the deviation alarm moves with it, maintaining the same deviation from set point.

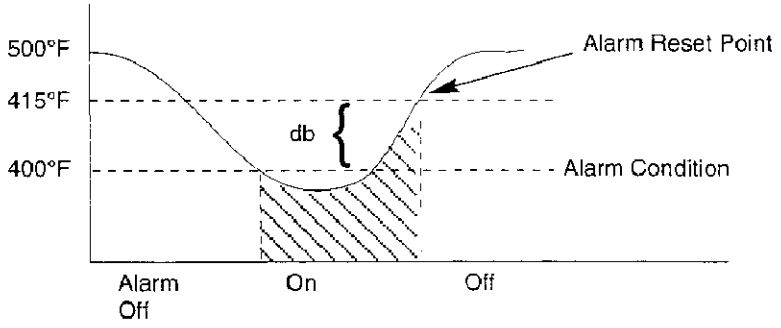
Process SP = 500°F
Alarm SP = 100°F
Alarm db = 1% sensor span (type J T/C would be = 15°F)



- Deviation Alarm

Similar to the deviation alarm described above, the (-) deviation alarm actuates when the process variable is **equal to or less than the Process Set Point less the Alarm Set Point.**

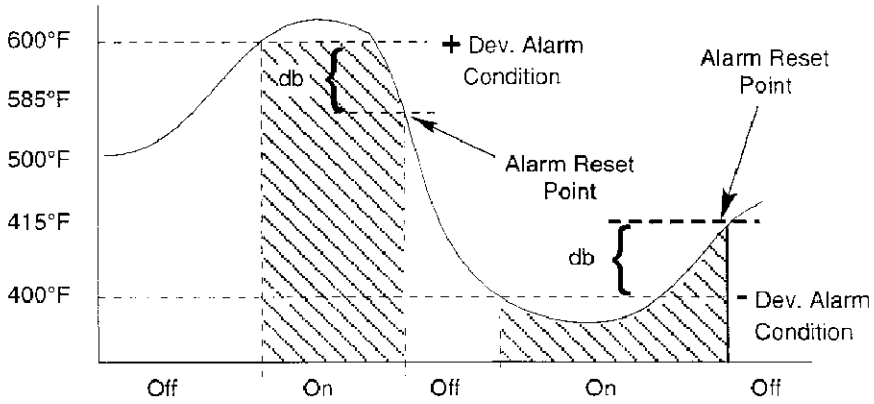
Process SP = 500°F
Alarm SP = 100°F
Alarm db = 1% sensor span (type J T/C would be = 15°F)



+/- Deviation Alarm

This deviation alarm is actuated whenever process temperature **deviates from the Process Set Point more than the predetermined (Alarm Set Point) amount in either a positive or negative direction.**

Process SP = 500°F
Alarm SP = 100°F
Alarm db = 1% (or 15°F if type J)



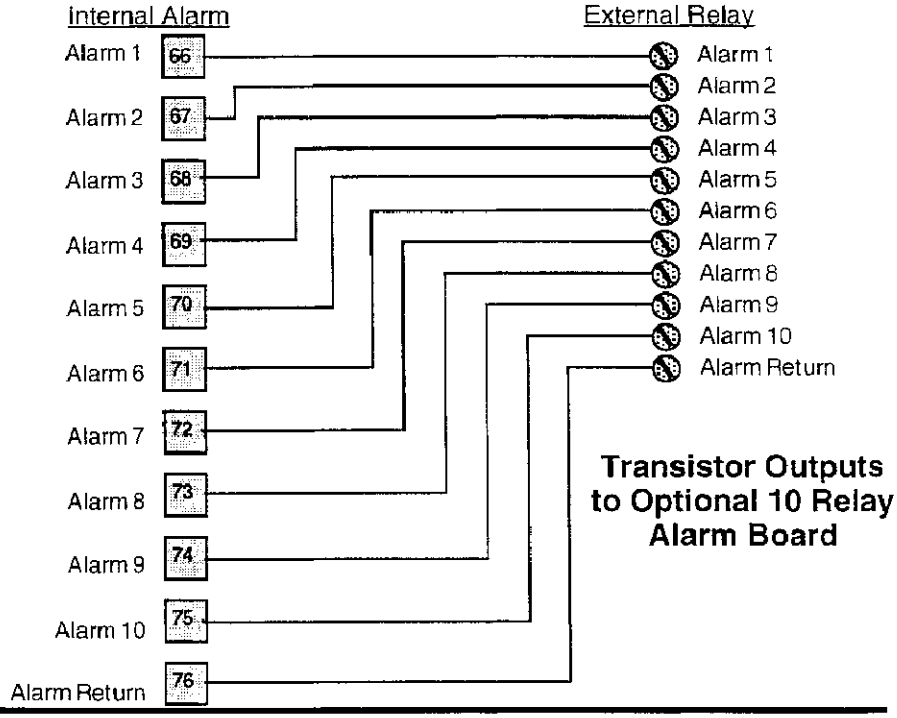
■ Wiring

Alarm Outputs

If you purchased the Alarm Option CN3390- (*) -1 or -3, these optional open-collector transistor alarm outputs may be connected to an external relay or an optional 10 relay output board via terminals 66-75. Individual 24 Vdc relays (P/N 3390A-1ALM) and the Optional External Alarm Relay board (P/N 3390A-10ALM) are available from Omega. The Alarm Relay Board is equipped with its own 24Vdc power supply .
Detailed Mounting Dimensions and Wiring Instructions for the External Alarm Relay Board are found on pages 109 and 110.

Fig. 5.1 shows transistor alarm output connections to external relay board.

Figure 5.1
Transistor-Alarm Output Connections to External 10–Relay Alarm Board



The controller's 24Vdc supply output may be used to power a single external relay (connect supply output at terminal 43). If additional relays are being used, external power supplies are required.

Figure 5.2 illustrates connection of the alarm transistor outputs to external alarm relays.

Figure 5.2
Individual Remote Relay
Wiring Using External
Power Supply

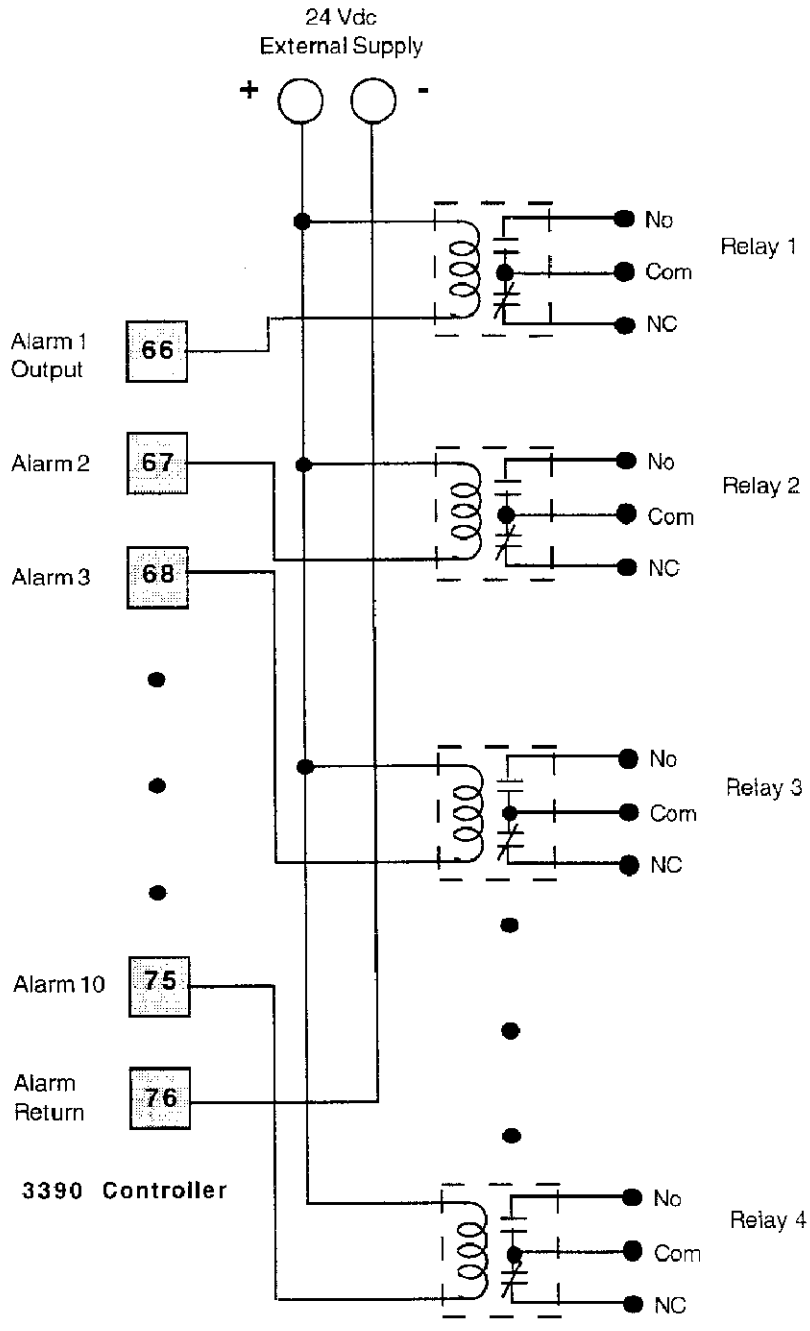
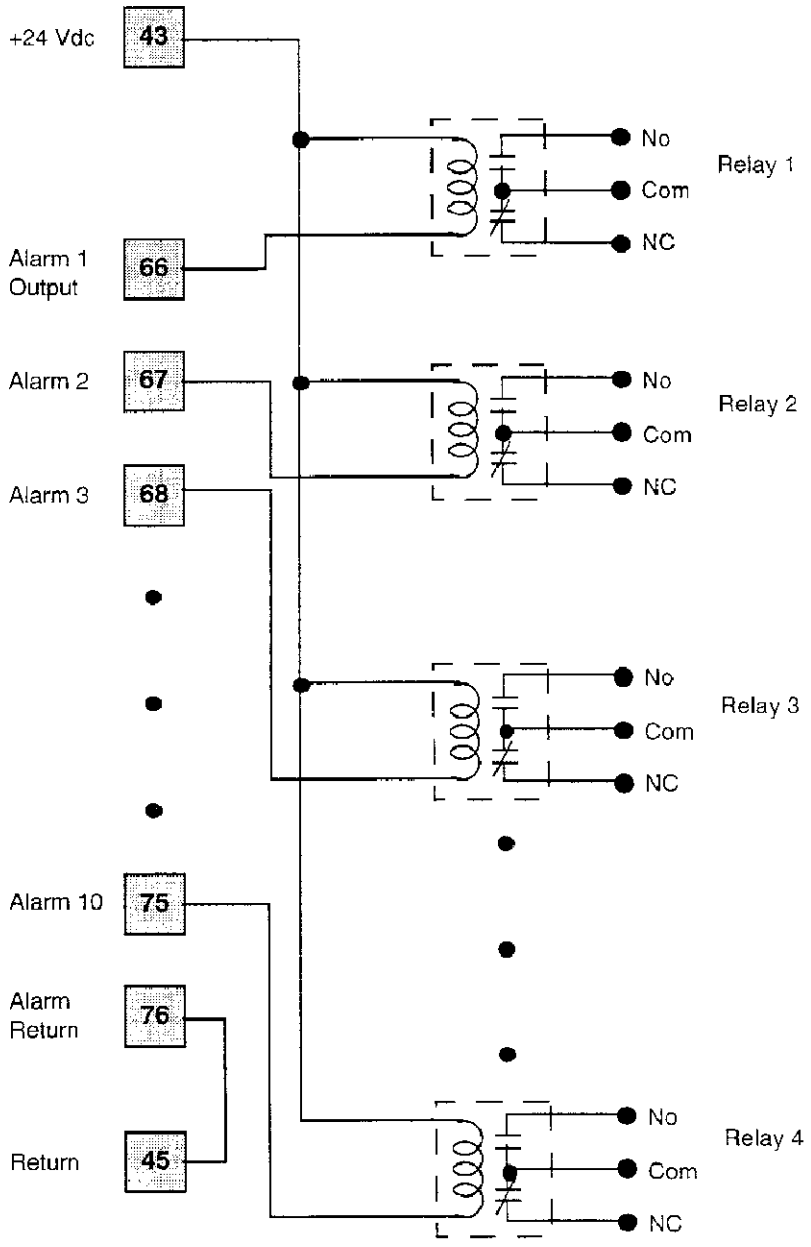


Figure 5.3 illustrates connection of the alarm transistor outputs to external alarm relays using the internal power supply.

Figure 5.3
Individual Remote Relay
Wiring Using Internal
Power Supply



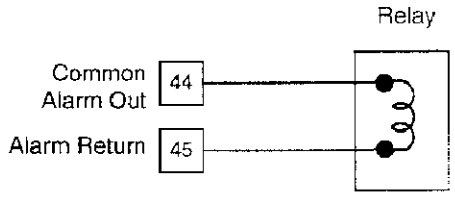
Note: **The internal 24Vdc power supply is available for external use but the load is limited to 200mA.** It is important to evaluate the mA requirement of all external relays, typically 200mA will drive five control relays.

Common Alarm

The common alarm output connection is made at terminals 44 and 45, as shown in Figure 5.4. The controller's internal 24Vdc power supply is used to power an external common alarm relay.

Figure 5.4
Common Alarm
Connections

Using 24 Vdc Internal Supply



■ Programming Set-Up

The Alarm #1 and Alarm #2 parameters for each loop are established on the Control and Alarm Parameters PAGE for each loop (PAGE 1-10), MENUs 11-18. Note that if an alarm is not mapped to the common alarm or alarm output board, the only action taken when an alarm condition occurs is illumination of the alarm LED.

PAGE 1-10
Control and Alarm Parameters Loops 1-10

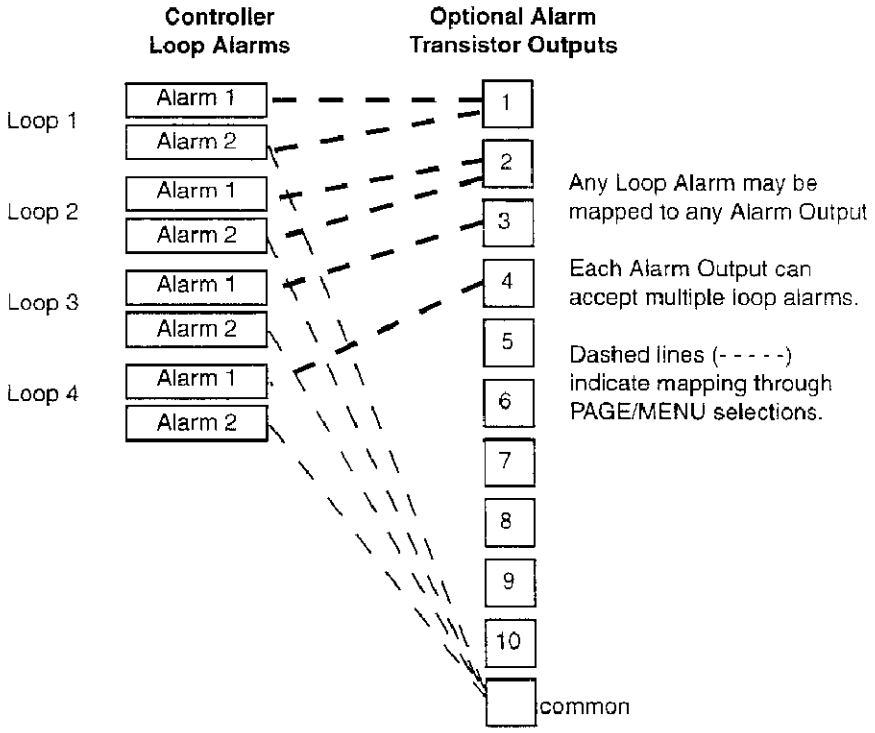
Alpha	MENU	Selection	Available Setting	Factory Setting	Sec.
AL M1 SP	11	Alarm #1 Set Point	Instrument Sensor Range	Range Maximum	C
AL M2 SP	12	Alarm #2 Set Point	Instrument Sensor Range	Range Minimum	
AL M1 TYP	13	Alarm #1 Type	No Alarm Hi Alarm	Hi Alarm	
AL M2 TYP	14	Alarm #2 Type	Lo Alarm + Dev - Dev +/- Dev	Lo Alarm	
AL M1 DB	15	Alarm #1 Deadband	0.01 Increments of Sensor Range (up to 25%)	0.25	
AL M2 DB	16	Alarm #2 Deadband	0.01 Increments of Sensor Range (up to 25%)	0.25	
AL M1 CoM	17	Alarm #1 Mapped to Common Alarm	Disable Enable	Disabled	
AL M2 CoM	18	Alarm #2 Mapped to Common Alarm	Disable Enable	Disabled	

■ Mapping to Outputs

Each of the 20 loop alarms may be mapped to any one of the 10 alarm outputs. If the loop alarms are not mapped to the common alarm or an external relay, the only action that will take place when the alarm condition occurs is illumination of the alarm LED.

The following diagram illustrates how the Alarms may be mapped to the outputs. **Notice that any alarm may be mapped to any single alarm output, and each output can accept multiple alarms. Each alarm may also be mapped to the common alarm.**

Figure 5.5
Mapping Alarms
to Alarm Outputs



Alarm #1 Mapping is established on PAGE 12 and Alarm #2 Mapping is established on PAGE 13.

PAGE 12
Alarm #1 Mapping to Alarm Outputs

Alpha	MENU	Selection	Available Setting	Factory Setting	Sec.
LP 1 MAP	1	Loop 1 Map	Al Out 1–10	1	C
LP 2 MAP	2	Loop 2 Map	Al Out 1–10	2	
LP 3 MAP	3	Loop 3 Map	Al Out 1–10	3	
LP 4 MAP	4	Loop 4 Map	Al Out 1–10	4	
LP 5 MAP	5	Loop 5 Map	Al Out 1–10	5	
LP 6 MAP	6	Loop 6 Map	Al Out 1–10	6	
LP 7 MAP	7	Loop 7 Map	Al Out 1–10	7	
LP 8 MAP	8	Loop 8 Map	Al Out 1–10	8	
LP 9 MAP	9	Loop 9 Map	Al Out 1–10	9	
LP 10 MAP	10	Loop 10 Map	Al Out 1–10	10	

PAGE 13
Alarm #2 Mapping to Alarm Outputs

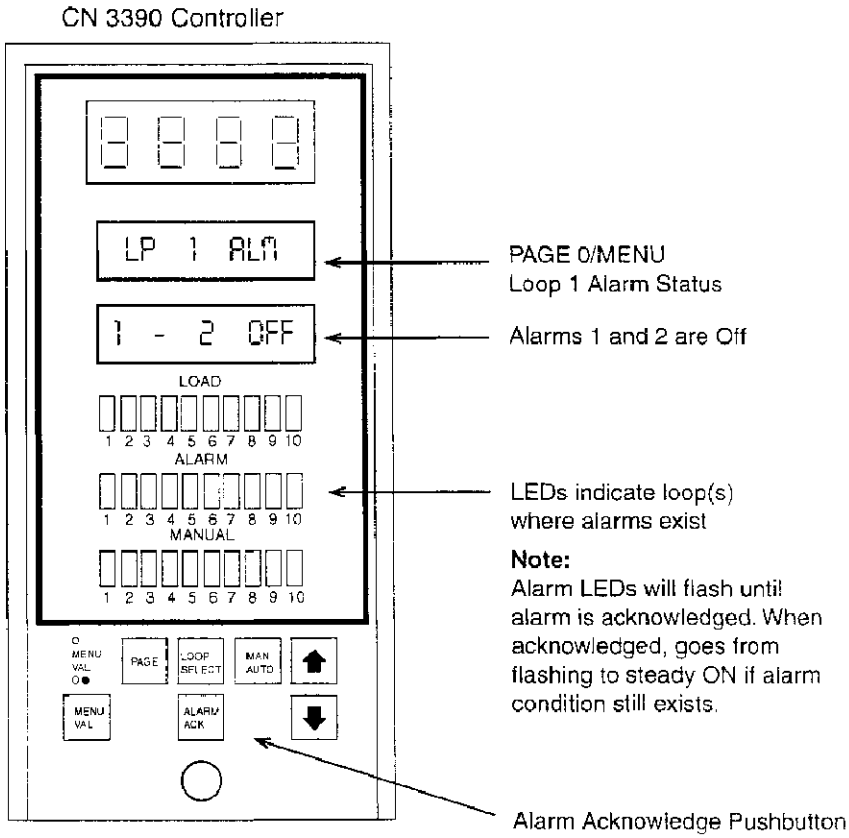
Alpha	MENU	Selection	Available Setting	Factory Setting	Sec.
LP 1 MAP	1	Loop 1 Map	AI Out 1–10	1	C
LP 2 MAP	2	Loop 2 Map	AI Out 1–10	2	
LP 3 MAP	3	Loop 3 Map	AI Out 1–10	3	
LP 4 MAP	4	Loop 4 Map	AI Out 1–10	4	
LP 5 MAP	5	Loop 5 Map	AI Out 1–10	5	
LP 6 MAP	6	Loop 6 Map	AI Out 1–10	6	
LP 7 MAP	7	Loop 7 Map	AI Out 1–10	7	
LP 8 MAP	8	Loop 8 Map	AI Out 1–10	8	
LP 9 MAP	9	Loop 9 Map	AI Out 1–10	9	
LP 10 MAP	10	Loop 10 Map	AI Out 1–10	10	

■ Alarm Operation

Loop Alarms

When an alarm (#1 or #2) occurs in a loop, the Alarm LED for that loop will be illuminated. If the alarm is mapped to the common alarm, the LED for that loop will flash until the alarm is acknowledged and the alarm condition no longer exists. If the alarm condition still exists when the acknowledge pushbutton is pressed, the light will be steady illuminated (not flashing) and will stay illuminated until the alarm condition no longer exists.

Figure 5.6
Alarm Displays
and Pushbuttons



Display Alarm Status

To display the alarm status for a particular loop, go to PAGE 0 and select the MENU for "Alarm" for the loop. The secondary alphanumeric display will indicate the alarm status:

Condition	Display
No alarms	1 - 2 OFF
Alarm #1 On	1 ON
Alarm #2 On	2 ON
Both Alarms On	1 - 2 ON

Common Alarm

Because the Common Alarm is a latching alarm, the "Alarm Ack" push-button must be pressed to clear an alarm indication (flashing alarm LED). If the alarm condition still exists when it is acknowledged, the LED will remain illuminated (steady), but will not flash, and will remain illuminated until the alarm condition no longer exists.

The common alarm output may be attached to an external output relay which can activate a horn, light or other alarm annunciation device.

■ Optional Relay Output Board

An optional Alarm Relay Output Board (P/N 3390A-10ALM) may be connected to provide up to 10 alarm relay outputs. The output board consists of a 24 Vdc power supply to power the coils of the relay open collector output and 10 relays.

Figure 5.7
Mounting Diagram

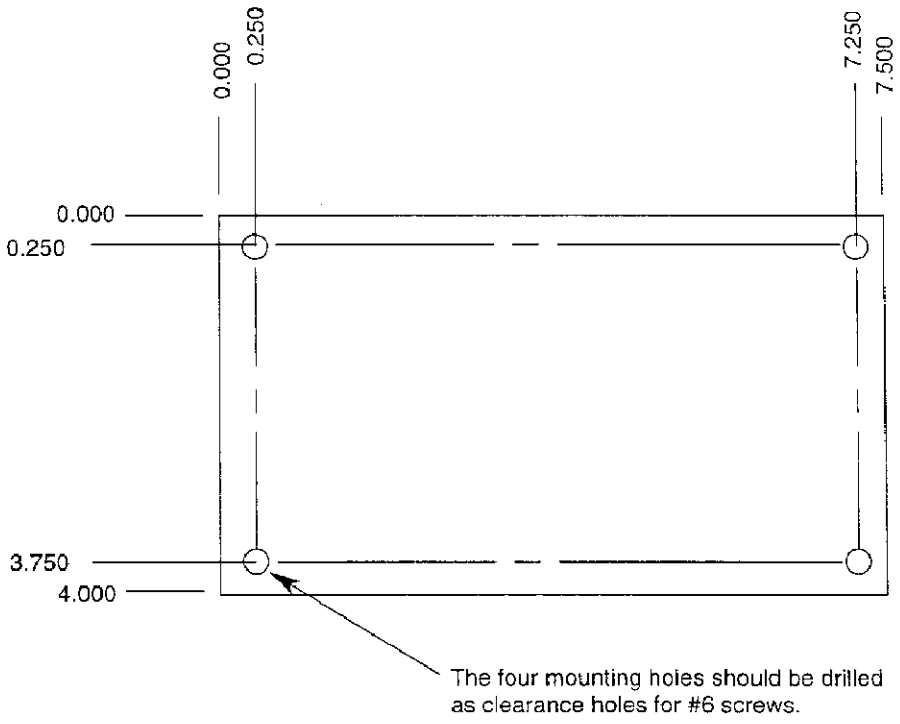
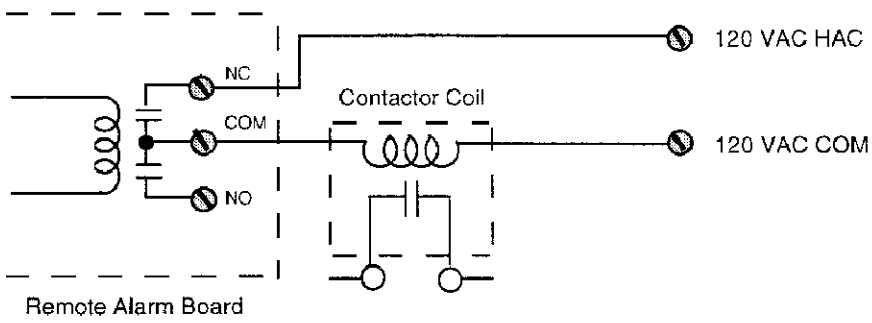
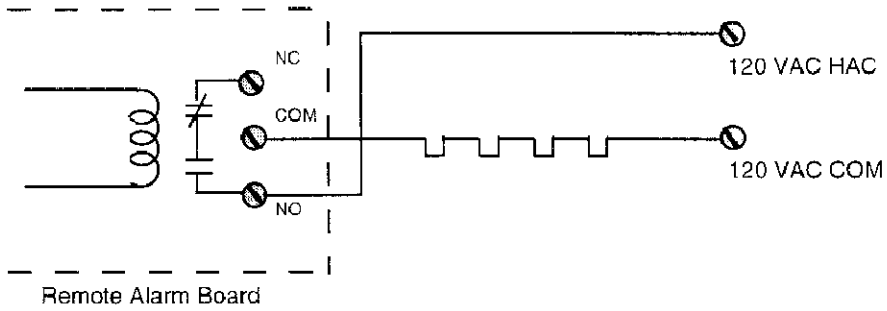


Figure 5.8
Wiring Diagram:
Ten Channel Remote
Relay Alarm Output

Normally Closed Wiring Example



Normally Open Wiring Example



6 – Tuning

■ Descriptions

The CN3390 controller has Self-Tuning features which you may or may not choose to use. Self-Tuning means that the controller automatically determines PID constants (proportional band, automatic reset and rate) based on the controller's monitoring of the process characteristics. You may choose to go through a Manual Tuning procedure whereby you will observe the process characteristics and make calculations of the PID constants. Instructions for both Self-Tuning and Manual Tuning are given in this section. Self-Tuning may be selected for any of the 10 control loops of the CN3390 controller. The Self-Tuning selections are made on PAGE 14.

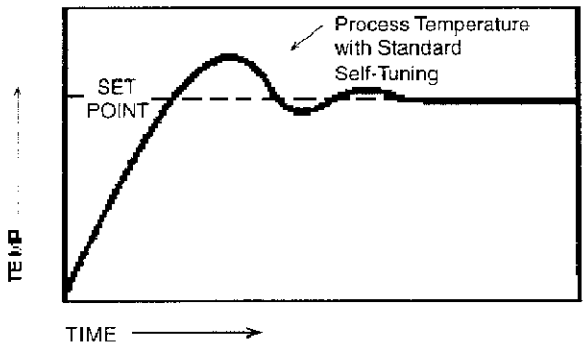
The Self-Tuning feature on the CN3390 provides for Cold Start Self-Tuning. Cold Start Self-Tuning should be used only on initial process start up when the process is actually "cold", meaning that there is a significant temperature difference between the "cold" process temperature and the set point (the set point temperature difference is greater than or equal to 5% of the instrument sensor span). For example, if the input type is a J thermocouple, a difference of 75°F (5% of 1500°) would be significant enough to permit Cold Start Self-Tuning (i.e. set point = 150°, and process temperature = 57°).

If Cold Start is selected, when power is applied to the controller, the control output will come on 100% (or the maximum output if the output limit is set at less than 100%), and as the temperature rises, the controller will examine the characteristics of the system and calculate the appropriate PID constants. It then loads these constants into memory and begins using them immediately. When these PID constants are being determined, the TUNE LED is illuminated to give you visual indication that the self-tuning process is active.

Self-Tuning Algorithms

The CN3390 is equipped with two different tuning algorithms from which you must choose: Standard (1/4 Decay) and Overdamped. The Standard tuning algorithm (Ziegler-Nichols' 1/4 decay ratio) establishes PID constants that will bring the process to set point as quickly as possible. An example of this process curve is shown below:

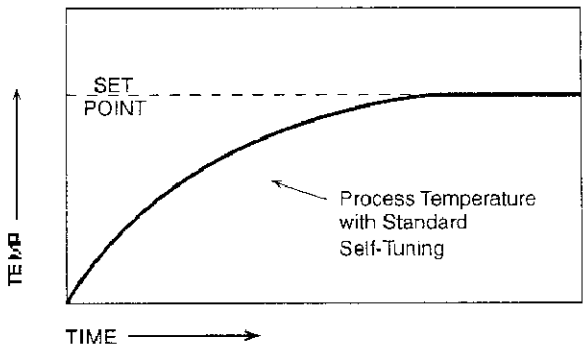
Figure 6.1
Standard Tuning
Process Curve



Cold Start Self-Tuning Standard Tuning brings the process to set point as quickly as possible.

This is the algorithm most commonly used, and is practical for most applications. If, however, the process cannot tolerate the overshoot (excursion beyond set point) associated with Standard tuning, then the Overdamped tuning algorithm should be selected. Although the Overdamped method takes longer for the process to actually reach set point, it does eliminate the overshoot associated with Standard tuning, as diagrammed below:

Figure 6.2
Overdamped Tuning
Process Curve



Overdamped Tuning slows the process heat up to avoid an overshoot beyond set point.

Initiating or Disabling Self-Tuning

1. Decide which loops will be programmed as Self-Tuning.
2. Choose the Tuning algorithm (Standard or Overdamped) most appropriate for your process.
3. With load power disconnected, go to PAGE 14/MENUs 1-10; make the appropriate selection, based on the PAGE/MENU Table below.
4. Go to PAGE 11/MENU 48 and push ⬆ to initiate reset. Or, remove the instrument power, connect the load power and re-power up. It is critical that you initiate reset to reinitiate the self-tuning feature.

PAGE 14
Control Operations

Alpha	MENU	Selection	Available Setting	Factory Setting	Sec.
LP1 Tun	1	Loop 1 Self-Tune	Tune Off	0	C
LP2 Tun	2	Loop 2 Self-Tune	Qtr Damp		
LP3 Tun	3	Loop 3 Self-Tune	Overdamp		
LP4 Tun	4	Loop 4 Self-Tune			
LP5 Tun	5	Loop 5 Self-Tune			
LP6 Tun	6	Loop 6 Self-Tune			
LP7 Tun	7	Loop 7 Self-Tune			
LP8 Tun	8	Loop 8 Self-Tune			
LP9 Tun	9	Loop 9 Self-Tune			
LP10 Tun	10	Loop 10 Self-Tune			

Note: When a loop is actually self-tuning, the MANUAL LED on the controller front panel will flash to indicate that self-tuning is taking place.

Manual Tuning Instructions

The following procedure gives you basic instructions for manual PID tuning. In applications where the CN3390 is being used as a Proportional (P), Proportional with Integral (PI) or Proportional with Integral and Derivative (PID) controller, the following tuning procedure will help you determine the parameter setting(s) that will provide optimum process stability. These parameter values, once determined, are entered on PAGEs 1-10:

- Proportional Band ——— PAGEs 1-10/MENU 3
- Automatic Reset ——— PAGEs 1-10/MENU 4
- Rate ——— PAGEs 1-10/MENU 5

Definitions of these three parameters are given in Appendix I, Control Theory Tutorial.

Tuning Procedure

The Tuning Procedure consists of three steps:

Step 1 – Determining Ultimate Proportional Band
Step 2 – Determining Ultimate Period
Step 3 – Calculating Parameters-Proportional Band (P), Automatic Reset (I), and Rate (D)

Step 1

The controller should be tuned while operating in the process as a Proportional only (P) controller. It is important that Automatic Reset (PAGE 1/MENU 4) and Rate (PAGE 1/MENU 5) be set at 0.00 and 0, respectively.

Following the Step 1 chart, on the next page, the Proportional Band setting is gradually increased/decreased until process temperature begins a steady, small oscillation that is slightly unstable. The Proportional Band setting where this steady, small oscillation occurs is referred to as the Ultimate Proportional Band (expressed in % of span). This slightly unstable condition is the objective of Step 1.

Stable = steady process temperature does not increase or decrease greatly with time, no oscillation (except oscillation due to output cycle time).

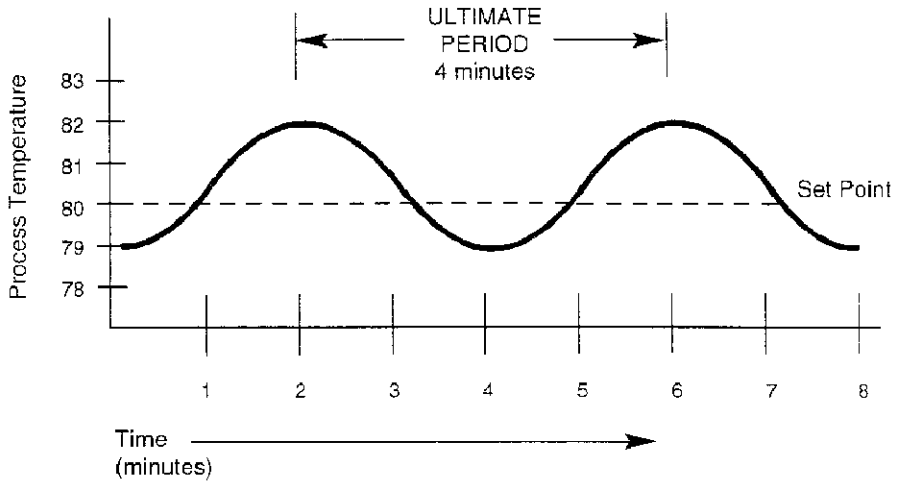
Unstable = process temperature has extreme, unstable excursions.

Slightly Unstable = process temperature has steady, small, even oscillations.

The stable process temperature is most desirable for normal operation, while unstable is the least desirable. The slightly unstable condition generated in this flowchart allows determination of Ultimate Proportional Band and Ultimate Period.

Step 2
Ultimate Period

Once the Ultimate Proportional Band setting is determined, and the process temperature is reacting in a steady, small oscillation, the Ultimate Period is determined. The Ultimate Period is the time (in minutes) from peak-to-peak maximum temperature in the process temperature curve. Graph your process temperature curve like the example shown below to determine your Ultimate Period.

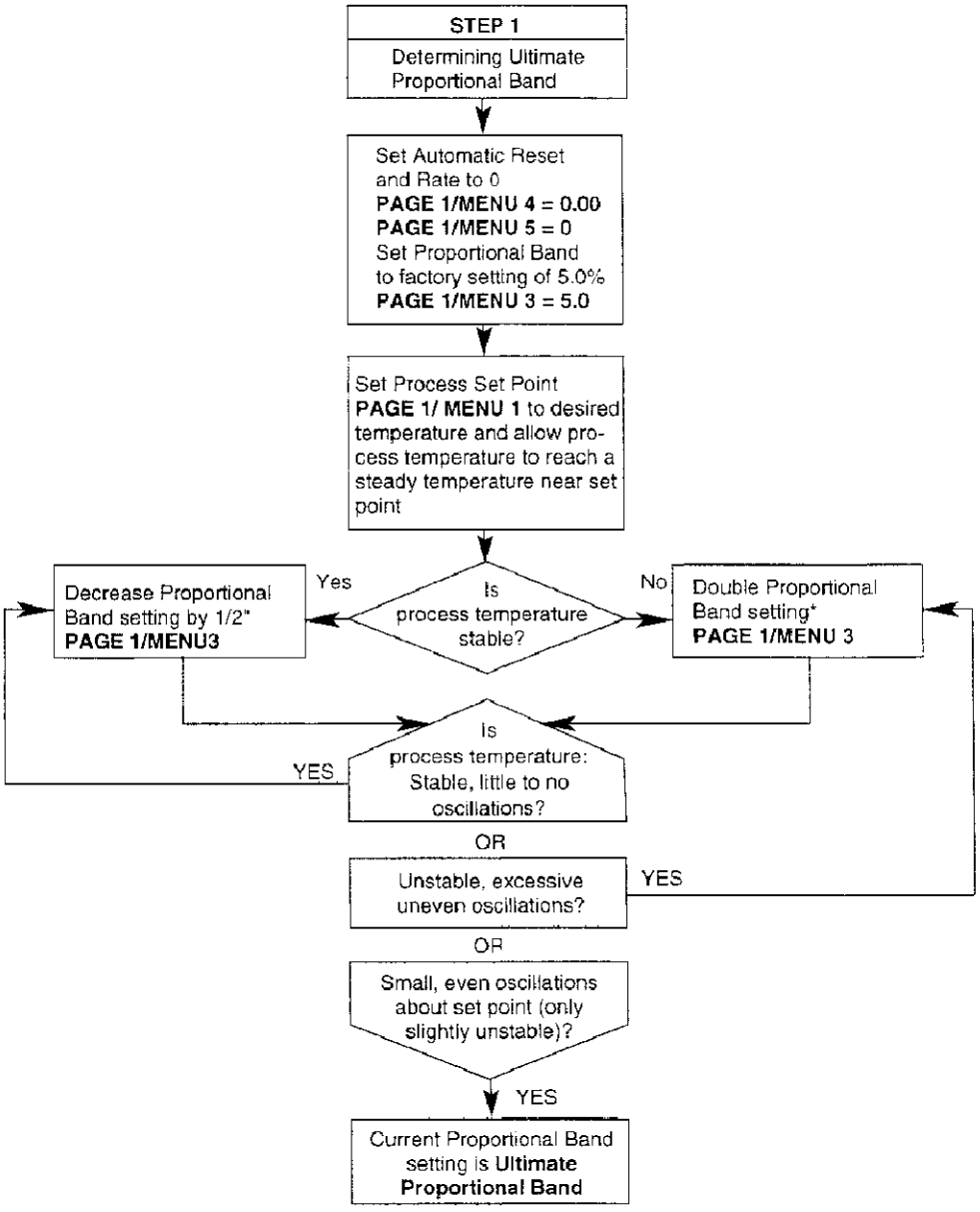


Step 3
Calculating Parameters

The process values Ultimate Proportional Band (PB) and Ultimate Period (Period) are applied to equations to determine Proportional Band, Automatic Reset, and Rate. Select the appropriate control mode for your application (P, PI, PID) in the table below, and follow the equations below the mode to calculate your PID Parameters.

Parameter	P	PI	PID
Proportional Band	2 x PB	2.22 x PB	1.67 x PB
Automatic Reset		1.2 / Period (min)	2.0 / Period (min)
Rate			Period (sec) / 8

Step 1 Chart



*Note that by simply doubling and halving settings, an optimum "slightly unstable" condition may never be reached. The operator must use discretion in increasing and decreasing settings to reach the optimum slightly unstable condition.

7 – Digital Communications

■ Descriptions

The Digital Communications option gives the CN3390 controller the ability to interface with computers, dumb terminals, printers and recorders. Isolated RS232, RS422 and RS485 are all supported. This option is found on controllers with the following model numbers:

CN3390-*****2
CN3390-*****3

When this option is present, it may be used in one of four modes:

Terminal Interface Mode
Automatic Data Logging Mode
Computer Interface Mode
ASCII Line Mode

All modes are described in the Digital Communications User's Manual (M-1596) that is supplied with controllers containing the Digital Communication Option. The mode that you choose is selected in the Digital Communications programming, PAGE 15, MENU 1.

Computer Interface and ASCII Line Modes

The Computer Interface and ASCII Line Modes implement communications that can address up to 255 Omega controllers on a RS422A/485 multidrop line. The protocols for these two modes are described in the Digital Communications User's Manual.

Standard Software Package

If a prepackaged software program is preferred for multidrop digital communication with up to 255 OMEGA® controllers (including the CN3390), OMEGA® offers a remote operator interface software package. This standard software package operates on an IBM-PC or compatible computer and communicates with the controllers via a serial interface port. Instructions for using this software package are given in the User's Manual provided with the software purchase.

Terminal Interface Mode

The ASCII terminal interface mode allows you to change PAGE/MENU settings, view them, and even lock out the controller front panel pushbutton selections. Because all of the software for this function is internally stored in the CN3390 controller, nothing more than an ASCII dumb terminal is required.

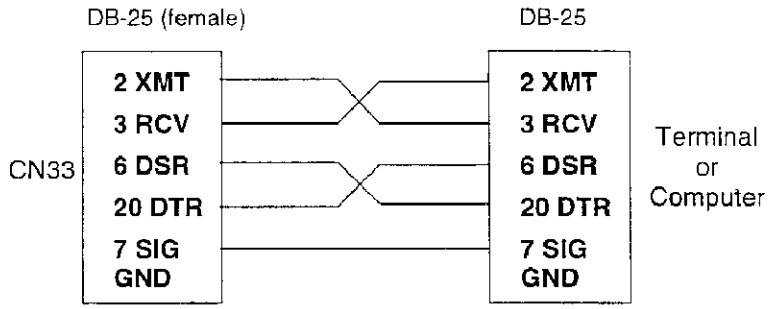
Automatic Data Logging Mode

The Automatic Data Logging option is designed to provide a record or print out of selected MENU variables. The data logging function works with an ASCII printer or terminal.

■ Digital Communications Wiring

Wiring connections for the digital communications interface are made on the Digital Communications Connector using a shielded serial interface cable fitted with a male 25-pin connector (DB-25). Standard connector pin assignments are given in the following diagram.

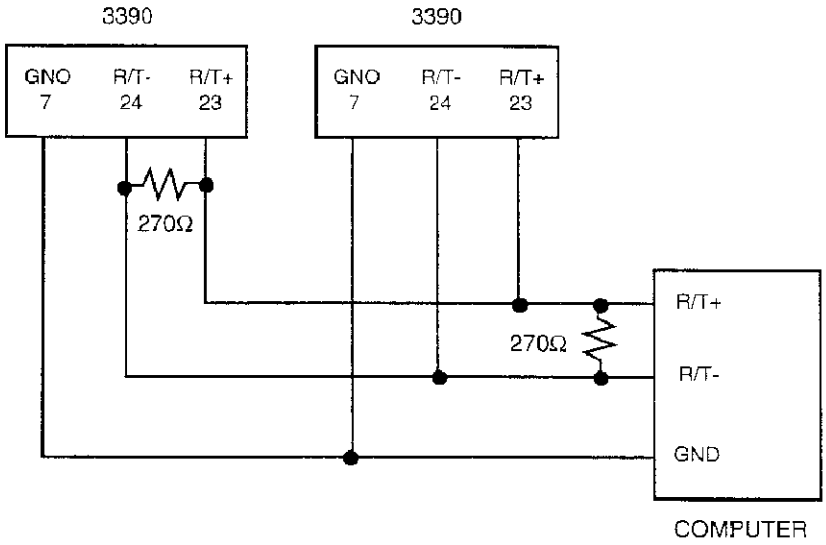
Figure 7.1
Digital Communications Connector
Pin Assignments



When the serial interface connection is complete, plug the DB-25 connector into the **MODEM** or **COMM** port on your terminal (or printer if using Automatic Data Logging).

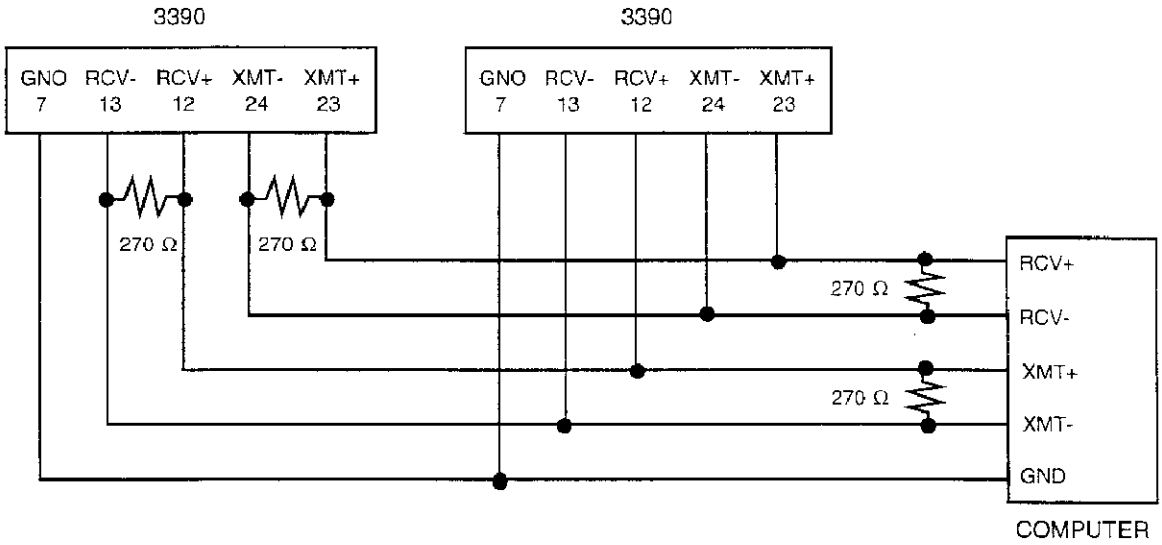
Be sure that the terminal is turned off before you connect the controller.

Figure 7.2
Wiring for RS485
(2-Wire) Digital
Communications



NOTE : 270Ω resistors recommended across receive line on computer and last controller.

Figure 7.3
Wiring for RS422A
(4 wire) Digital Communications



NOTE : 270Ω resistors recommended across receive line on computer and last controller.

Controller Menu Settings

The following Menus contains the settings for using the Digital Communications options. Menu 1 contains the Mode (or protocol).

PAGE 15
Digital Communications

Alpha	MENU	Selection	Available Setting	Factory Setting	Sec.
ModE	1	Mode Selection	Off Terminal Auto Log Comp. Inf ASCii Ln	Off	D

Menus 2-5 are active only when the Autolog Mode (automatic data logging) is selected in Menu 1. Menus 3 and 4 select which menus on Page 0 will be logged. Menu 5 refers to the character length of each Menu description.

LoGInt	2	Autolog Interval	1-9999 min.	1 min.
FroMM#	3	Start MENU Number	1-40	1
ToM#	4	End MENU Number	1-40	40
ChrLnGth	5	Character Length	Under 17 Over 16	Over 16

Menus 6 and 7 are active when the Terminal Mode is selected in Menu 1. The Home and Clear Screen characters refer to the dumb terminal settings.

HoMEChar	6	Home Character	0 to 255	30
Clr Chor	7	Clear Screen Character	0 to 255	26

Menus 8-10 must be selected any time Digital Communications is active.

CoMTYPE	8	Communications Type	RS232C RS422A RS485	RS232C
BoudRotE	9	Baud Rate	300 600 1200 2400 4800 9600 19.2K	19.2K
PortY	10	Parity	None Odd Even	None

Menu 11 must be selected any time changes are made on the Digital Commnunications PAGE for the changes to be implemented.

REconFiG	11	Reconfigure Serial Port	Ready ⬆ Reconfig	Ready ⬆

Menu 12 needs to be set if the Computer Interface or Ascii Linc Mode are selected in Menu 1.

AddrESS	12	Multidrop Address	0-255	1

■ Automatic Data Logging Mode

Operation

The Automatic Data Logging print out below was generated with an RS232-C input printer. The MENU variables were selected from PAGE 0, with MENU 1 as the beginning MENU to log, and MENU 8 as the end MENU to log.

You may select as few as 1 MENU number to log, or as many as all 40 MENU numbers. Details for the Automatic Data Logging Set Up and Operation are given below.

Figure 7.4
Automatic Data Logging
Sample Print Out

```
MENU 1 = LOOP 1 PROCESS SET POINT
MENU 2 = LOOP 1 PROCESS VARIABLE
MENU 3 = LOOP 1 OUTPUT STATUS
MENU 4 = LOOP 1 ALARM STATUS
MENU 5 = LOOP 2 PROCESS SET POINT
MENU 6 = LOOP 2 PROCESS VARIABLE
MENU 7 = LOOP 2 OUTPUT STATUS
MENU 8 = LOOP 2 ALARM STATUS
```

Programming

The Automatic Data Logging function is enabled and defined on PAGE 15/MENU 1–5, listed below. Enable the Automatic Data Logging mode, select the time interval and choose the first and last MENU number variables from PAGE 0/MENU 1–40.

The logging interval will always begin 1 minute after power-up of the controller. No operator interface is required for automatic data logging.

Note: For printers with a line width of less than 17 characters, select the appropriate value at MENU 5.

PAGE 15
Digital Communications

Alpha	MENU	Selection	Available Setting	Factory Setting	Sec.
MODE	1	Mode Selection	Off Terminal Auto Log Comp. Inf ASCii Ln	Off	D
LOG INT	2	Autolog Interval	1-9999 min.	1 min.	
FROM M#	3	Start MENU Number	1-40	1	
TO M#	4	End MENU Number	1-40	40	
CHRLNGTH	5	Character Length	Under 17 Over 16	Over 16	

■ Terminal Interface Mode

Terminal Interface Programming

Programming the terminal interface is very simple. Simply go to PAGE 15 and make selections in MENU numbers 1,5,6,7,8,9 and 10 shown below (MENU numbers 2-5 are intentionally omitted and apply only to the automatic data logging mode).

PAGE 15
Digital Communications

Alpha	MENU	Selection	Available Setting	Factory Setting	Sec.
ModE	1	Mode Selection	Off Terminal Auto Log Comp Inf ASCii Ln	Off	D
HoMEChar	6	Home Character	0 to 255	30	
Clr Char	7	Clear Screen Character	0 to 255	26	
CoM TYPE	8	Communications Type	RS232C RS422A RS485	RS232C	
BaudRatE	9	Baud Rate	300 600 1200 2400 4800 9600 19.2K	19.2K	
PortY	10	Parity	None Odd Even	None	
REconFiG	11	Reconfigure Serial Port	Ready ⬆ Reconfig	Ready ⬆	
AddrESS	12	Multidrop Address	0-255	1	

Terminal Interface Operation

The CN3390 digital communications interface consists of 7 basic operational commands and a HELP command. After you have powered up the controller, made the digital communications MENU selections on PAGE 15 and turned on the terminal, you should get a prompt (*) on the terminal screen. If you do not, check your terminal/computer manual to make sure that the baud rate and parity settings agree with those you entered on PAGE 15.

In the operational command prompts that you see on the screen, there are 4 abbreviations used:

<CR> = Carriage Return or Enter Key
<LF> = Line Feed or ↓ (down arrow) Key
<SPACE BAR> = Space Bar
Control or Ctrl Key

Command: HELP

This command gives you a listing of all of the digital communications interface commands. Type "H" or "HELP" at the prompt and press the Return or Enter key:

- **Operator Input** *H

- **Terminal Displays**

C or CHANGE page#, Menu#
P or PAGE# Page#
S or SHOW Start page#, End page#
D or DISPLAY Start menu#, End menu#
A or ACCESS Security code
L or LOCK
U or UNLOCK

Command: ACCESS

This command allows you to adjust the security level access of your terminal. Adjusting the security level via the terminal does not affect the security level of the front panel controller pushbuttons. If a sufficient level of access is not entered, you may be able to only view a MENU setting and not change it.

To adjust the access level, simply make one of the following entries at the prompt and press the Return or Enter key.

- **Operator Input** *A 736

Command: DISPLAY

The DISPLAY command is designed to display and continuously update the values on PAGE 0 - the status display PAGE.

- **Operator Input**

*D

- **Terminal Display**

Control Loop	Process Set Point	Process Variable	Control Output	Alarm 1	Alarm 2
1	-100 F	83 F	0.0 %	Off	Off
2	-100 F	83 F	0.0 %	Off	Off
3	-100 F	83 F	0.0 %	Off	Off
4	-100 F	83 F	0.0 %	Off	Off
5	-100 F	83 F	0.0 %	Off	Off
6	-100 F	83 F	0.0 %	Off	Off
7	-100 F	83 F	0.0 %	Off	Off
8	-100 F	83 F	0.0 %	Off	Off
9	-100 F	83 F	0.0 %	Off	Off
10	-100 F	83 F	0.0 %	Off	Off

Command: CHANGE

The CHANGE command allows you to view and enter new MENU values on each page via the terminal (assuming that you have the proper Security Level accessed). For instance, to change the contents of PAGE 2/MENU 1.

- **Operator Input**

*C 2, 1

- **Terminal Display**

PAGE # 2 MENU #1 Set Pt 2 min. value: -100 max. value: 1400
current value . . . . . -100
current value 99
Enter new value:

A <CR> command will end the CHANGE command, whereas <SPACE> command allows you to go to the previous MENU number. A <LF> or ↓ will increment to the next MENU number. This is helpful if you are changing several MENU settings on the same PAGE.

Command: PAGE

The PAGE command simply lists the PAGE number and the general contents of the MENU numbers on that PAGE. Like the CHANGE command, you can go to the next PAGE number with a <LF> or [↓] command, and to the previous PAGE number with a <SPACE> command. Following is an example of the PAGE command.

- **Operator Input**

*P 10

- **Terminal Display**

Page: 10 control and Alarm Parameters Loop10
Page: 11 General Operations
Page: 12 Alarm #1 Mapping, Loops 1 – 10
Page: 13 Alarm #2 Mapping, Loops 1 – 10
Page: 14 Auto Tuning
Page: 15 Digital communications
Page: 16 Cold Junction Calibration

Command: SHOW

The SHOW command will allow you to display the complete MENU contents of a PAGE or range of PAGES. Simply specify the beginning PAGE and the ending PAGE, then press the Enter or Return key. (Using the same PAGE number as the beginning and end will show that one PAGE only).

- **Operator Input**

*S 1, 1

- **Terminal Display**

Page: 1 Control and Alarm Parameters Loop 1

Menu # 1	Set Pt 1	99 F
Menu # 2	Man Rst	0.0
Menu # 3	Prop Bnd	5.0%
Menu # 4	Auto Rst	0.00
Menu # 5	Rate	0 SEC
Menu # 6	Deadband	0.01%
Menu # 7	Out Lim	100.0%
Menu # 8	Cyc Time	1.0 SEC
Menu # 9	CtrlMode	Disabled
Menu # 10	Action	Indirect
Menu # 11	Alm1 SP	-95 F
Menu # 12	Alm2 SP	-100 F
Menu # 13	Alm1 TYP	Hi Alarm
Menu # 14	Alm2 TYP	Lo Alarm
Menu # 15	Alm1 DB	0.25%
Menu # 16	Alm2 DB	0.25%
Menu # 17	Alm1 Com	Enabled
Menu # 18	Alm2 Com	Enabled
Menu # 19	Disinteg	10 SEC
Menu # 20	Over Rng	0.0%
Menu # 21	UnderRng	0.0%
Menu # 22	FatalErr	0.0%

At any time during the execution of the SHOW command, you may give the following commands:

^S (Control S) = Pause
^Q (Control Q) = Resume After Pause
^X (Control X) = Abort (returns system back to * prompt)

Command: LOCK

The LOCK command allows you to lock out the CN3390's front panel pushbuttons, thus disabling any control adjustments from the controller. Simply type the command "LOCK" at the prompt and press the Return key.

- **Operator Input** *LOCK

Command: UNLOCK

The UNLOCK command simply unlocks the front panel pushbuttons, allowing adjustments to be made from the controller front panel.

- **Operator Input** *UNLOCK

8 – Calibration

Gang Calibration

Recover Original Calibration

QUICK Step Calibration - CJC

QUICK Step Calibration - Sensor Inputs

Manual Calibration

When is Calibration Required?

The CN3390 controller is factory calibrated before shipment to you, therefore, it is not necessary to calibrate the controller when you receive and install it. Periodic calibration checks or adjustments of the unit should not be required under normal operating conditions. Omega recommends that you recalibrate the controller in the following instances:

- all instruments in your facility are periodically calibrated to one device (metrology)
- a measurement system component fails

Calibration PAGE/MENU Tables

Each loop of the CN3390 controller is calibrated on a separate PAGE in the PAGE/MENU programming:

QUICK STEP and Manual Calibration

All calibration is performed in the PAGE/MENU programming. A simple "QUICK STEP" calibration of the full range sensor inputs for each of the 10 loops is performed via PAGE 17-26/MENU 3-4.

Manual Calibration, PAGE 17-26/MENU 5-6, is provided for manual calibration of the sensor inputs in applications where the process requires extreme fine tuning over a limited range, or where an "artificial offset" from actual process temperature is desired.

■ Gang Calibration

Gang Calibration allows you to "copy" the Loop #1 calibration to all other loops of a similar input sensor type. Gang programming is performed on PAGE 16.

PAGE 16: Gang Calibration

Alpha	MENU	Selection	Available Setting	Factory Setting	Sec.
GanG Cal	1	Gang Calibration Similar Sensor Input Loops	Ready ⬆ Program FINISHED	Ready ⬆	D

■ Recover Original Calibration

This function allows you to recalibrate the controller back to its original factory calibration settings, in the event that it is severely out of calibration due to poor technique or unauthorized calibration. Although the factory calibration settings are recovered, this does not guarantee original calibration accuracy. The Calibration Recovery should be used as a "starting point" for recalibration, should the unit become severely out of calibration. Recovery of factory calibration is performed at MENU 17-26/PAGE 7.

Calibration Recovery Procedure

Factory Calibration Recovery is performed on PAGE 17-26/MENU 7. This portion of the PAGE 17-26 PAGE/MENU Table follows:

PAGE 17-26: Calibration

Alpha	MENU	Selection	Available Setting	Factory Setting	Sec.
REcoVEr	7	Recover Original Calibration	Start ⬆ Recover FINISHED	Ready ⬆	D

Reestablishing Calibration Constants

To reestablish the factory calibration constants:

1. **Disconnect load power.**
2. Go to PAGE 17-26/MENU 7. The lower digital display should read "Ready".
3. Press the ⬆ and the display will read "Recover". The controller will automatically recalibrate and the display will go back to reading "Finished".

■ Important Calibration Notes

1. **Disconnect load power when calibrating.**
2. RTD and Current/Voltage inputs should be calibrated using copper (Cu) wire, and thermocouple inputs should be calibrated using thermocouple extension wire (of the same type as the thermocouple you are calibrating). Thermocouples can be calibrated using copper wire, but equivalent microvolt values are used for span minimum and maximum instead of temperature values in °F.
3. Substitute a precision sensor simulator (thermocouple simulator or resistance decade box) for the sensor inputs. The controller should be allowed to warm-up with the appropriate sensor simulator connected for at least one hour prior to calibration.
4. To access the calibration, you will need to be at LEVEL D Security. Enter Security Code "352" at PAGE 11/MENU 1.
5. The sensor type selected on PAGE 11 must match the sensor type being calibrated.

Cold Junction Compensation (CJC) Calibration

In most cases, the Cold Junction Compensation (CJC) Calibration is necessary only after repair to the CJC circuit or a drastic change in ambient operating conditions. CJC Calibrations are required for thermocouple inputs, and are not required for RTD or Analog inputs.

1. Measure input sensor positive (+) terminal temperature using an independent and accurate thermometer (for Loop #1 CJC measure terminal #1, for Loop #2, measure terminal #5).
2. Enter the input sensor positive(+) terminal temperature in PAGE 17-26 / MENU 1.
3. Go to MENU 2 for CJC Calibration Steps. The display should read "Ready.
4. Press ⬆ and the display will read "Cal", then "Finished" indicating that CJC calibration is complete.

PAGE 17-26:
QUICK STEP Calibration

Alpha	MENU	Selection	Available Setting	Factory Setting	Sec.
CJc TEMP	1	CJC Temperature	0.1°F to 150.0°F	75.0°F	D
CJc Cal	2	CJC Calibration Steps	Ready ⬆ CJC Cal Finished	Ready ⬆	

Zero Voltage Method CJC Calibration

1. Using a thermocouple simulator and thermocouple extension wire, connect the simulator to the loop for which the CJC calibration is being performed. The type of thermocouple being simulated is not important with this method.
2. Connect a digital voltmeter across the thermocouple connection at the terminal of the loop being calibrated. The meter should have a minimum resolution of 0.01 millivolts.
3. Adjust the thermocouple simulator until the reading on the digital voltmeter is 0.00 mV.
4. Enter the temperature value of the simulator at MENU 1 on the calibration PAGE corresponding to the loop being calibrated (PAGEs 17-26).
5. Proceed to MENU 2 and press the up pushbutton to initiate a CJC calibration for the loop. The display will return a "Finished" message when the calibration is complete.

Sensor Input Calibration

To perform QUICK STEP calibration, you must first enter the sensor simulator type that you are using at PAGE 17-26/MENU 3.

QUICK STEP calibration is performed via MENU numbers 4 as shown in the following PAGE/MENU table.

PAGE 17-26:
QUICK STEP Calibration

Alpha	MENU	Selection	Available Setting	Factory Setting	Sec.
	3	QuickCal	0/40 mV (J, K, E) -5/20 mV (T) 0/20 mV (R, S) Cu Wire TC Sim RTD Sim 4/20 mA	0/40 mV	D
	4	Cal Step	MinRdy ⬆ Cal Min Max Rdy ⬆ Cal Max Finished	MinReady ⬆	

Note: Copper wire should be used for 0/40 mV, -5/20 mV and 0/20 mV calibrations.

Calibration Instruction

1. Enter the Calibration Input Sensor Type at MENU 3. For example, if you are calibrating for a type T thermocouple using a -5 to 20 mV input source, enter "2".
2. Go to MENU 4. Set input to -5.00 mV and wait 30 seconds for the electronics to fully stabilize.
3. Press [⬆] one time. The display will read "Min In."
4. Set the input to 20.00 mV. Wait for 30 seconds to allow the electronics to stabilize.
5. Press [⬆] one time. The display will read "Max In."
6. Press [⬆] one last time. The display will read "Finished."

If cablibrating using a thermocouple simulator does not result in an accurate measurement, recalibrate the cold junction compensation (code 1) and retry the sensor calibration. This should result in an accurate tracking of the T/C input.

■ Manual Calibration

If you have already completed the QUICK STEP calibration, you do not need to perform manual calibration unless your application requires calibration over a limited range or an offset from actual process input.

Manual calibration is very much like manual trimmer pot adjustments of other instruments, except that a "pot" is not turned. Instead of turning a "pot", the sensor input value, which is displayed in the upper digital display, is adjusted with the [^] and [V] pushbuttons until the sensor input value and the displayed value are equal.

For each sensor loop there are 2 corresponding MENU numbers—MENU 5 for zero and MENU 6 for span. It is usually necessary to repeat the zero and span calibration adjustments several times until the displayed values equal their respective input values.

Manual Calibration Instructions

PAGE 17-26 / MENU 5 (zero) and MENU 6 (span) allow for the zero and span calibration adjustments. In these instructions, assume that a T thermocouple input is used, and you will calibrate over the range -350°F to 750°F.

1. Access MENU 5 for the sensor minimum (zero) calibration. Press MENU/VAL to select the value to be displayed.
2. Set the sensor simulator to the zero calibration value of -350°F (or equivalent ohms when calibrating an RTD). Wait 30 seconds to allow the electronics to stabilize.
3. Press the [^] or [V] pushbutton until the display value equals the sensor input value.
4. Access MENU 6 for sensor maximum (span) calibration. Press MENU/VAL to select the value to be displayed.
5. Set the sensor simulator to the span calibration value of 750°F. Wait 30 seconds to allow the electronics to stabilize.*
6. Press [^] or [V] until the upper display equals the sensor input value.
7. Repeat steps 1-8 until both values equal their respective sensor input values.

PAGE 17-26: Calibration

Alpha	MENU	Selection	Available Setting	Factory Setting	Sec.
ZEro CAl	5	Zero Manual Calibration	752		D
SPAn CAl	6	Span Manual Calibration	160		

9 – Custom Scaling Analog Input

■ Description

When using the 4-20 mA sensor input, you may want to adjust the controller displays to fit your actual application. For example, the display may be adjusted so that a 4-20 mA transmitter sending a pressure signal could actually represent the process variable in 0 to 500 psi.

For these special applications where you may want or need to specify a non-standard sensor input range, PAGE 27 allows you to specify non-standard sensor ranges for any of the 10 control loops.

For each loop you may specify:

- number of decimal points, 0-3
- units of measurement, °F, °C, %, no units
- minimum sensor range
- maximum sensor range

■ Programming

To custom scale the 4-20 mA and make adjustments on PAGE 27, Level E security is required (code 736). Make the selections for the control loop(s) following the PAGE/MENU table on the next page.

PAGE 27:
Analog Input Custom Scaling

Alpha	MENU	Selection	Available Setting	Factory Setting	Sec.
LP1DP	1	Loop 1 Decimal Points	0 = XXXX 1 = XXX.X 2 = XX.XX 3 = X.XXX	1 = XXX.X	E
LP1Ut	2	Loop 1 Units	Degree F Degree C Percent % No Units	Percent	
LP1Lo	3	Loop 1 Low End Range	-999 to 3000	0.0%	
LP1Hi	4	Loop 1 High End Range	-999 to 3000	100.0%	
LP2DP	5	Loop 2 Decimal Points	0 = XXXX 1 = XXX.X 2 = XX.XX 3 = X.XXX	1 = XXX.X	E
LP2Ut	6	Loop 2 Units	Degree F Degree C Percent % No Units	Percent	
LP2Lo	7	Loop 2 Low End Range	-0.999 to 3.000	0.0%	
LP2Hi	8	Loop 2 High End Range	-0.999 to 3.000	100.0%	
LP3DP	9	Loop 3 Decimal Points	0 = XXXX 1 = XXX.X 2 = XX.XX 3 = X.XXX	1 = XXX.X	E
LP3Ut	10	Loop 3 Units	Degree F Degree C Percent % No Units	Percent	
LP3Lo	11	Loop 3 Low End Range	-0.999 to 3.000	0.0%	
LP3Hi	12	Loop 3 High End Range	-0.999 to 3.000	100.0%	
LP4DP	13	Loop 4 Decimal Points	0 = XXXX 1 = XXX.X 2 = XX.XX 3 = X.XXX	1 = XXX.X	E
LP4Ut	14	Loop 4 Units	Degree F Degree C Percent % No Units	Percent	
LP4Lo	15	Loop 4 Low End Range	-999 to 3000	0.0%	
LP4Hi	16	Loop 4 High End Range	-999 to 3000	100.0%	

PAGE 27:
Analog Input Custom Scaling

Alpha	MENU	Selection	Available Setting	Factory Setting	Sec.
LP5DP	17	Loop 5 Decimal Points	0 = XXXX 1 = XXX.X 2 = XX.XX 3 = X.XXX	1 = XXX.X	E
LP5Ut	18	Loop 5 Units	Degree F Degree C Percent % No Units	Percent	
LP5Lo	19	Loop 5 Low End Range	-999 to 3000	0.0%	
LP5Hi	20	Loop 5 High End Range	-999 to 3000	100.0%	
LP6DP	21	Loop 6 Decimal Points	0 = XXXX 1 = XXX.X 2 = XX.XX 3 = X.XXX	1 = XXX.X	E
LP6Ut	22	Loop 6 Units	Degree F Degree C Percent % No Units	Percent	
LP6Lo	23	Loop 6 Low End Range	-999 to 3000	0.0%	
LP6Hi	24	Loop 6 High End Range	-999 to 3000	100.0%	
LP7DP	25	Loop 7 Decimal Points	0 = XXXX 1 = XXX.X 2 = XX.XX 3 = X.XXX	1 = XXX.X	E
LP7Ut	26	Loop 7 Units	Degree F Degree C Percent % No Units	Percent	
LP7Lo	27	Loop 7 Low End Range	-999 to 3000	0.0%	
LP7Hi	28	Loop 7 High End Range	-999 to 3000	100.0%	
LP8DP	29	Loop 8 Decimal Points	0 = XXXX 1 = XXX.X 2 = XX.XX 3 = X.XXX	1 = XXX.X	E
LP8Ut	30	Loop 8 Units	Degree F Degree C Percent % No Units	Percent	
LP8Lo	31	Loop 8 Low End Range	-999 to 3000	0.0%	
LP8Hi	32	Loop 8 High End Range	-999 to 3000	100.0%	

PAGE 27:
Analog Input Custom Scaling

Alpha	MENU	Selection	Available Setting	Factory Setting	Sec.
LP 9 DP	33	Loop 9 Decimal Points	0 = XXXX 1 = XXX.X 2 = XX.XX 3 = X.XXX	1 = XXX.X	E
LP 9 Ut	34	Loop 9 Units	Degree F Degree C Percent % No Units	Percent	
LP 9 Lo	35	Loop 9 Low End Range	-999 to 3000	0.0%	
LP 9 Hi	36	Loop 9 High End Range	-999 to 3000	100.0%	
LP 10 DP	37	Loop 10 Decimal Points	0 = XXXX 1 = XXX.X 2 = XX.XX 3 = X.XXX	1 = XXX.X	E
LP 10 Ut	38	Loop 10 Units	Degree F Degree C Percent % No Units	Percent	
LP 10 Lo	39	Loop 10 Low End Range	-999 to 3000	0.0%	
LP 10 Hi	40	Loop 10 High End Range	-999 to 3000	100.0%	

10 – Error Messages and Troubleshooting

■ Troubleshooting Guide

The Troubleshooting Guide on the following pages gives simple solutions to common problems. Should you have a problem with your controller, it is a good idea to check this Guide for possible corrections before contacting the factory.

Corrections are listed in the order in which they should be performed.

Troubleshooting Guide

Symptom	Probable Cause	Correction
Power applied, display does not light and controller does not function	1. No power applied 2. Power loss transient	1. Check power wiring and fusing 2. Power down and re-power up
Display reads "HHHH" or "LLLL"	1. Open sensor 2. Out of calibration	1. Check sensor wiring (pp.13-14) 2. Check sensor types selected at PAGE 11 3. Attach sensor simulator and verify calibration (pp. 67-68)
Process does not heat up	1. No power being applied to the load 2. Incorrect control action	1. Verify output wiring (pp. 15-18) 2. Verify that load is not open—output module properly installed 3. Check "control action" entered at PAGE 1/MENU 10 4. Check "control mode" entered at PAGE 1/MENU 9
Erratic operation	1. Intermittent sensor connections 2. Controller failure (internal electronics)	1. Check sensor wiring or substitute sensor simulator 2. Power down and re-power 3. Contact factory
Process not in control	1. Incorrect "control action" selected 2. Not tuned correctly	1. Check "control action" entered at PAGE 1/MENU 10 2. See Tuning, Section 6 to verify PID parameters entered at PAGE 1/MENU 3-5
Instrument continually goes through power-up reset	1. Sensor incorrectly wired 2. Internal electronic failure	1. Check sensor wiring (p.13) 2. Contact factory

Troubleshooting Guide

Error Messages	Probable Cause	Correction
TunE Err LooP #	1. Auto tuning is selected but cannot tune because process is out-of-range 2. Difference between process variable and setpoint is less than 5% of sensor range (span) 3. Controller has unsuccessfully attempted self-tuning for 10 hours	1. Select "off" for auto-tuning on PAGE 14 for loop where error is occurring
OVErRnGE LooP #	1. Process variable has exceeded the maximum sensor range by the over-range % for the sensor type*	1. Check Sensor Wiring.
UndrRnGE LooP #	1. Process variable has exceeded the minimum sensor range by the under-range % for the sensor type*	1. Check Sensor Wiring.
EEPR ERR P# M#	1. Data error in the EEPROM	1. Readjust value for P# M# displayed.
EEPR ERR SERVICE	1. Data error in non-user section of the EEPROM	1. Contact Factory
URITE ERR SERVICE	1. EEPROM write error	1. Contact Factory
A/D ERR SERVICE	Contact Factory	Contact Factory
INVALID SPAN	1. Same input value for both zero and span entered during calibration 2. The same value for low and high end points entered for the 4-20 mA input, PAGE 27	1. Recalibrate using the correct values 2. Re-enter the correct values on PAGE 27 for the 4-20 mA input

11-Specifications

■ Control Modes (Field Selectable)

Automatic	ON/OFF
	Proportional
	Proportional with automatic reset/integral and/or rate/derivative (PID, PI, PD)
Manual	Bumpless, balanceless transfer with Proportional Control
	Disintegration time = 1 to 100 seconds

■ Control Adjustments (Field Selectable)

Control Set Point	Instrument sensor range (°F, °C, %)
Set Point Limits	Instrument sensor range
Deadband	0.01 to 25% of sensor span
Proportional Band	0.1 to 999.9% of sensor span
Automatic Reset	0.00 to 99.99 repeats/minute
Rate	0 to 1000 seconds
Output Cycle Time	0.1 to 60.0 seconds
Output Limit	0 to 100% ON

■ Control Outputs (Field Changeable)

Total five (5) output modules, 2 control loops per output module

Relay Normally open contact rated 1.0 Amp at 120 Vac or 0.5 Amps at 230 Vac (resistive load)—not recommended for driving unsnubbed contactors

Triac 1 Amp continuous, 10A in-rush current at 120 or 230 Vac (resistive load)

Current / Voltage

Non-Isolated
- 4 to 20 mA into 0 to 800 ohm load

Isolated
- 4 to 20 mA into 0 to 400 ohm load with 24V power supply
- 4 to 20 mA into 800 ohm load with 36V power supply

Solid State Relay Drive Transistor output of 20 Vdc nominal at 40 mA

■ Alarm Outputs

Two (2) field assignable alarms per loop, each can be mapped to any one of ten (10) alarm outputs

Ten (10) open collector transistor outputs, sink 50 mAdc at 50 Vdc

One (1) common latching alarm relay output, source 40 mAdc at 24 Vdc

Alarm Modes

High, range 100% of span, non-latching
Low, range 100% of span, non-latching
+ Deviation, 0 to 250°F above control setpoint
- Deviation, 0 to 250°F below control setpoint
+/- Deviation, 0 to 250°F above/below control setpoint

Reset Differential 0 to 25% instrument sensor range, 0.01 increments

■ Alarm Relay Board (Option)

Ten (10) relays, rated 10A at 120V, form C contacts

Includes 24 Vdc power supply (unregulated) to power relay coils

Requires 120 Vac or 240 Vac input

■ Input Specifications

Sensor Type	Range °F	Range °C	Accuracy
Thermocouple			
Type J	-100 to 1400	-73 to 650	+/-2°F
Type K	-100 to 2100	-73 to 1149	+/-2°F
Type E	-100 to 1100	-73 to 593	+/-2°F
Type T	-350 to 750	-212 to 399	+/-2°F at > -80°C +/-5°F at < -80°C
Type R	50 to 3000	10 to 1649	+/-5°F
Type S	50 to 3000	10 to 1649	+/-5°F
RTD, 100ohm Pt	-200 to 1000	-128 to 538	+/-2°F
Current, 4-20 mA in to 250 ohms	Field Scalable (0.0 to 100.0%)	Field Scalable (0.0 to 100.0%)	+/- 0.1% span

Input Sample Rate 2 samples per second

Readout Stability Typically better than +/- 0.10°F per °F change in ambient temperature

For Type J, K, E Thermocouple

- +/- 0.10°F per °F ambient change

For Type T Thermocouple

- +/- 0.7°F per °F ambient change at > 80°C sensor temperature
- +/- 0.50°F per °F ambient change < -80°C sensor temperature

For Types R and S Thermocouples

- +/- 0.20°F per °F ambient change

For RTD

- +/- 0.05°F per °F ambient change

For 4-20mA

- +/- 0.01% per °F ambient change

■ Open Sensor and Out-of-Range Condition

Programmable control action and display

■ Effect of Input Leadwire Resistance

Type J +1°F for up to 1000 ft. of 18 AWG extension wire
K +5°F for up to 1000 ft. of 18 AWG extension wire
E +4°F for up to 1000 ft. of 18 AWG extension wire
R +3°F for up to 1000 ft. of 18 AWG extension wire
S +3°F for up to 1000 ft. of 18 AWG extension wire
T +1°F at temperatures > -80°C
+2°F at temperatures < -80°C for less than 150 ohms resistance

RTD +/- 0.01°F per ohm balanced leadwire resistnace

External Influences on Readout	Common Mode Voltage (120Vac)	Series Mode Voltage (100mVpp	RFI (4W, 464 Mltz)	Line Voltage
J T/C	+/- 2°F	+/- 2°F	+/- 5°F	+/- 4°F
K T/C	+/- 2°F	+/- 2°F	+/- 7°F	+/- 6°F
E T/C	+/- 2°F	+/- 2°F	+/- 5°F	+/- 4°F
T T/C	+/- 2°F	+/- 2°F	+/- 5°F	+/- 6°F
R T/C	+/- 2°F	+/- 2°F	+/- 8°F	+/- 15°F
S T/C	+/- 2°F	+/- 2°F	+/- 8°F	+/- 15°F
RTD	+/- 2°F	+/- 2°F	+/- 4°F	+/- 4°F
4-20mA	+/- 0.1%	+/- 0.1%	+/- 0.5%	+/- 0.5%

Digital Communications Option

RS-232C Single-drop, non-isolated

RS-422A, RS-485 Multi-drop, isolated

Baud Rate 300, 600, 1200, 2400, 4800, 9600 and 19,200

Instrument Power

120 or 230 Vac, +10%, -15%, 50 to 60 Hz

7 vA nominal power consumption

Operating Environment

30 to 130°F (0 to 55°C) ambient temperature with relative humidity less than 95%, non-condensing

Dimensions

12.625 x 10.875 x 3.600 inches
320 x 276 x 92 mm

12 – Accessories

Accessories	Part Number
10-Relay Alarm Output Board	3390A-10ALM
Single Relay Alarm Output Board	3390A-1ALM
10 Loop Transistor Logic Output Board	3390A-INTALM
Front Panel Display (controller not included)	3390A-FRONT
Remote Mounting Cables	
• 18" length	3390A-CAB18
• 5' length	3390A-CAB60
• 15' length	3390A-CAB180
Output Modules	
• Relay	3390A-R
• Triac	3390A-T
• 4-20 mA (isolated)	3390A-FI
• 4-20 mA (non-isolated)	3390A-F
• DC Pulse	3390A-DC
Snubbers (recommended for Triac/Relay outputs)	1821-101
Digital Communications Board	3390A-RS
Remote Operator Interface Software	CN3200-SOFT

Appendix I Control Theory Tutorial

This Tutorial contains detailed descriptions of specific control parameters and other selections made through the PAGE/MENU programming of the CN3390 controller. The purpose of this Tutorial is to help you better understand the selections and settings you are making, thus increasing the applications effectiveness of your controller.

The list is alphabetized for quicker reference, and references to other definitions are made to help you understand the interrelationships of selections/parameters. Notice that "Proportional", "PID" and "ON/OFF" appear below some of the parameters, indicating that these parameters apply only to Proportional, PID or ON/OFF control.

Automatic Reset PID
PAGE 1 - 10/MENU 4

Automatic Reset (Integral) is expressed in repeats per minute. A value of 0.00 disables the Automatic Reset function and enables the Manual Reset function (PAGE 1-10/MENU 2). Adjustment of Automatic Reset should be made while the process is being controlled.

Automatic Reset is basically a control action that automatically eliminates offset between set point and process temperature. An Automatic Reset setting that is too large will cause severe overshoot during start-up if the controller is operating as a PI controller. Likewise, a setting that is too low will not allow the process temperature to return to set point quickly enough. An anti-reset windup feature is incorporated in the CN3390 controller to minimize process overshoot by inhibiting the reset action during warm-up or cool-down.

Control Action
PAGE 1 - 10/MENU 10

The direction of the control action determines the relationship between increasing or decreasing output as the process temperature increases. With **direct-acting** control (cooling), the value of the output increases as the process temperature increases. For **reverse-acting** control (heating), the value of the output decreases as the process temperature increases.

Cycle Time
Proportional/PID
PAGE 1 - 10/MENU 8

Cycle Time is the time it takes to complete a full ON to OFF to ON cycle in a time proportioning control system. For most processes, a fast cycle time (less than 5 seconds) will produce better control of loads with fast response and little time lag. You should be very careful when setting the cycle time on contactor driven loads, as a faster cycle time will cause added contactor wear. Magnetic contactors should not be switched at cycle times less than 30 seconds.

The cycle time must be set for both time-proportioned output types (relay, triac, solid state relay drive) and analog proportional outputs (4-20 mA/1-5 Vdc). Omega recommends the following cycle time settings:

Relay Output. . . . . 30.0 seconds

Triac Output. . . . . .1.0 seconds (for direct loads), increase time if the triac drives a magnetic contactor

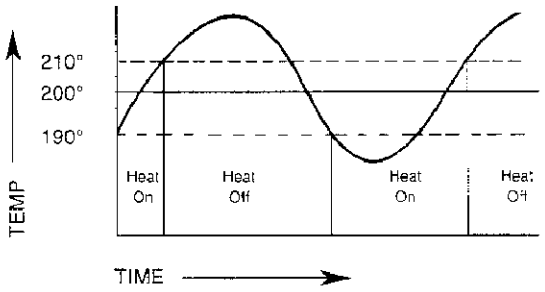
4-20 mA Current Output. . . . . .0.3 seconds *

Solid State Relay Drive Output. . . . 1.0 seconds

* The Current Output cycle time **must** be set at 0.3 seconds for correct operation.

Deadband ON/OFF
PAGE 1 - 10/MENU 6

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 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 is adjustable from 1 to 100°F. This adjustment is always made in °F, even if °C has been chosen for display of the process temperature. If the process variable is expressed in % (as would be typical with an analog input), the deadband is adjustable from 0 to 6.25%.

Disintegration Time Proportional Control
PAGE 1 - 10/MENU 19

The Disintegration Time setting applies to the Auto/Manual control function if the control mode is Proportional or Proportional with derivative (Automatic Reset = 0). It is designed to allow "bumpless transfer" when going from Manual control to Automatic control. When the switch from Manual to Automatic control is made, the output will gradually change from the last manual output value to the output value calculated by the proportional control calculation. The time required to complete this change is defined as disintegration time.

Disintegration time is adjustable from 1 to 100 seconds. The higher setting (longer time), the slower the output changes when going from Manual control to Automatic.

Manual Reset Proportional Control
PAGE 1 - 10/MENU 2

Manual Reset applies to Proportional (P) control only. It compensates for deviations from set point resulting from sustained, long term process load changes. Manual reset allows 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 the control output, therefore, if the process temperature is stabilizing below set point, increase the manual reset to increase the heat output.

ON/OFF Control
PAGE 1 - 10/MENU 9

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.

Out of Range Control Options
PAGE 1 - 10/MENU 20-22

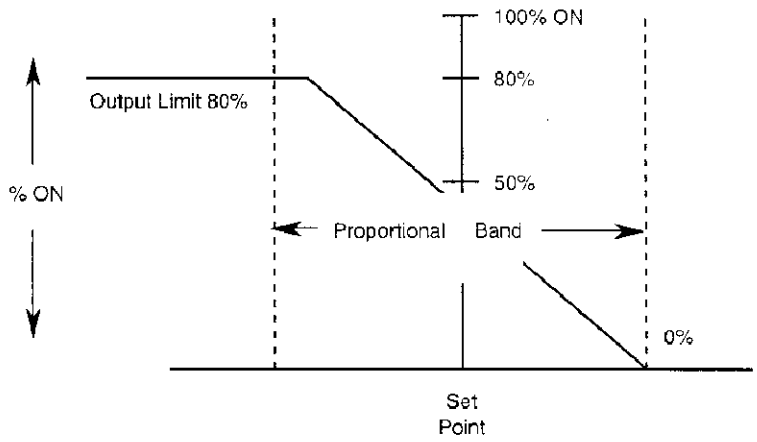
The Out of Range Control Options allow you to determine what action the control output will take when the process value is off scale. This feature is particularly useful with 4-20 mA inputs to initially get the process up to set point temperature.

For example, if the input sensor scale is:
4 mA = 1000°F
20 mA = 2000°F

At start-up, the process value would be significantly below scale (under range) and the output would remain off. By selecting 100% Output, the load would come on 100% to bring the process up to temperature.

Output Limit
Proportional/PID
PAGE 1 - 10/MENU 7

The PID control output can be limited by the Output Limit setting. The purpose of Output Limit is to prevent dangerous over-heating (or over-cooling). This limit can be set from 0.0 to 100.0% of full ON. If the limit is set at 80.0%, then a time-proportioned output would remain ON no longer than 80% of the time (a 4-20 mA output would never exceed 16.8 mA). A setting of 100% allows full output. The output limit is not applicable in the ON/OFF mode.



PID Control
PAGE 1 - 10/MENU 9

PID control is basic Proportional Control enhanced by Integral Control and Derivative Control. The Integral (I) part of PID control, or automatic reset, automatically eliminates offset between set point and actual process temperature due to long term load changes. Derivative, or rate, is an anticipatory action that allows the controller to react more quickly to sudden changes in the process temperature.

Proportional Band
Proportional/PID
PAGE 1 - 10/MENU 3

The Proportional Band is the temperature range about set point where the proportional control action is active. It is adjustable from 0.1% to 999.9% of span. Most applications require a Proportional Band setting between 1.0 and 20.0% of temperature span.

Proportional Control
PAGE 1 - 10/MENU 9

A type of control action that proportions its control output instead of merely turning it full ON or full OFF. See Proportional Band and Manual Reset for further information.

Rate PID
PAGE 1 - 10/MENU 5

Rate (derivative) allows the controller to react more quickly to sudden changes in process temperature. Rate measures the rate of change of the process temperature, anticipates its severity and makes output corrections to maintain a steady return to temperature. If the proportional band, reset and rate are not properly coordinated with the process' characteristics, the process loop may be unstable. Rate can also be used without automatic reset (integral) for PD control with manual reset.

Since Rate is an anticipatory action, it can actually over-ride the cycle time setting. For example, a heating process loop is operating at set point in steady state with an output cycle time of 30 seconds and output at 50% (15 seconds ON, 15 seconds OFF). If the 15 second OFF time has just begun when cold material is added to the process, causing the temperature to drop suddenly, a large enough rate setting will cause the 15 second off-time to immediately end and the output to again turn ON.

Appendix II
PAGE/MENU
Tables - Condensed

This section contains the 28 PAGEs of programming information, PAGEs 0-27, without any of the detailed information or explanation given in the individual Sections of the User's Manual.

This Appendix is intended for your use after you have read the manual completely and fully understand the PAGE/MENU selections.

PAGE 0: Status Page 0

Alpha	Menu	Display Selection	Security
LP1SP	1	Loop 1 Set Point	
LP1PV	2	Loop 1 Process Variable	
LP1Out	3	Loop 1 Output % ON	
LP1ALM	4	Loop 1 Alarm Status	
LP2SP	5	Loop 2 Set Point	
LP2PV	6	Loop 2 Process Variable	
LP2Out	7	Loop 2 Output % ON	
LP2ALM	8	Loop 2 Alarm Status	
LP3SP	9	Loop 3 Set Point	
LP3PV	10	Loop 3 Process Variable	
LP3Out	11	Loop 3 Output % ON	
LP3ALM	12	Loop 3 Alarm Status	
LP4SP	13	Loop 4 Set Point	
LP4PV	14	Loop 4 Process Variable	
LP4Out	15	Loop 4 Output % ON	
LP4ALM	16	Loop 4 Alarm Status	
LP5SP	17	Loop 5 Set Point	
LP5PV	18	Loop 5 Process Variable	
LP5Out	19	Loop 5 Output % ON	
LP5ALM	20	Loop 5 Alarm Status	
LP6SP	21	Loop 6 Set Point	
LP6PV	22	Loop 6 Process Variable	
LP6Out	23	Loop 6 Output % ON	
LP6ALM	24	Loop 6 Alarm Status	
LP7SP	25	Loop 7 Set Point	
LP7PV	26	Loop 7 Process Variable	
LP7Out	27	Loop 7 Output % ON	
LP7ALM	28	Loop 7 Alarm Status	
LP8SP	29	Loop 8 Set Point	
LP8PV	30	Loop 8 Process Variable	
LP8Out	31	Loop 8 Output % ON	
LP8ALM	32	Loop 8 Alarm Status	
LP9SP	33	Loop 9 Set Point	
LP9PV	34	Loop 9 Process Variable	
LP9Out	35	Loop 9 Output % ON	
LP9ALM	36	Loop 9 Alarm Status	
LP10SP	37	Loop 10 Set Point	
LP10PV	38	Loop 10 Process Variable	
LP10Out	39	Loop 10 Output % ON	
LP10ALM	40	Loop 10 Alarm Status	

PAGE 1 - 10: Control Operations

PAGE 1 = Loop 1 **PAGE 6 = Loop 6**
PAGE 2 = Loop 2 **PAGE 7 = Loop 7**
PAGE 3 = Loop 3 **PAGE 8 = Loop 8**
PAGE 4 = Loop 4 **PAGE 9 = Loop 9**
PAGE 5 = Loop 5 **PAGE 10 = Loop 10**

Alpha	MENU	Selection	Available Settings	Factory Setting	Sec.
SEt Pt1	1	Set Point	Instrument Sensor Range	Range Min.	B
Man RSt	2	Manual Reset	-100.0 to 100.0	0.0	B
ProP Bnd	3	Proportional Band	0.1 to 999.9 % span	5.0 %	C
Auto RSt	4	Automatic Reset	0.00 to 99.99 repeats/min.	0.00	C
RatE	5	Rate	0 Sec. to 1000 Sec.	0	
DEadBand	6	Deadband	0.01 increments of sensor range up to 25%	0.01	C
Out LiM	7	Output Limit	0.0 % to 100.0 %	100% ON	C
CYc TiME	8	Output Cycle Time*	0.1 SEC to 65.0 SEC	See Page 33	
Ctrl ModE	9	Control Mode	Loop Disabled	PID	
			PID		C
			ON/OFF		
Action	10	Control Action	Reverse (heating)	Reverse	C
			Direct (cooling)	(heating)	
AL M1 SP	11	Alarm1 Set Point	Sensor Range	Sensor Range Max	C
AL M2 SP	12	Alarm 2 Set Point	Sensor Range	Sensor Range Min	C
AL M1 TYP	13	Alarm 1 Type	No Alarm	Hi Alarm	C
			Hi Alarm		
			Lo Alarm		
			+ Dev		
			- Dev		
			+/- Dev		
AL M2 TYP	14	Alarm 2 Type	No Alarm	Lo Alarm	C
			Hi Alarm		
			Lo Alarm		
			+ Dev		
			- Dev		
			+/- Dev		
AL M1 DB	15	Alarm 1 Deadband	0.01 Increments of Sensor Range to 25%	0.25%	

PAGE 1 - 10: Control Operations

PAGE 1 = Loop 1
PAGE 2 = Loop 2
PAGE 3 = Loop 3
PAGE 4 = Loop 4
PAGE 5 = Loop 5
PAGE 6 = Loop 6
PAGE 7 = Loop 7
PAGE 8 = Loop 8
PAGE 9 = Loop 9
PAGE 10 = Loop 10

Alpha	MENU	Selection	Available Settings	Factory Settings	Sec. C
AL M2 DB	16	Alarm 2 Deadband	0.01 Increments of Sensor Range to 25%	0.25%	
AL M1 CoM	17	Alarm 1 Mapped to Common Alarm	Disabled Enabled	Disabled	
AL M2 CoM	18	Alarm 2 Mapped to Common Alarm	Disabled Enabled	Disabled	
DiSintEG	19	Disintegration Time	1SEC to 100SEC	10 SEC	C
OVEr RnG	20	Sensor Overrange-Control Output Value	0.0 to 100.0%	0.00%	E
UndEr RnG	21	Sensor Under-range-Control Output Value	0.0 to 100.0%	0.00%	E
FaiL oPEr	22	Open Sensor or EEPROM Error-Control Output Value	0.0 to 100.0%	0.00%	E

PAGE 11: General Operations

SEc CodE	1	Security Lock	0–9999	458 = Level C	A
LP Scan	2	Scan All Channels	No Scan Auto Scan	No Scan	C
GanG SP	3	Gang Program—Set Points	Ready ⬆ Program Finished	Ready ⬆	C
GanG AL1 AL1	4	Gang Program—Alarm 1 Setpoints	Ready ⬆ Program Finished	Ready ⬆	
GanG AL2 AL2	5	Gang Program—Alarm 2 Setpoints	Ready ⬆ Program Finished	Ready ⬆	
LP1 SEn	6	Loop #1 Sensor Input	J TC K TC E TC T TC R TC S TC 100 Ω RTD 4–20 mA	J TC	C
LP1 Unit	7	Loop #1 Units	Degree F Degree C 0 to 100.0% 0.00 to 99.99%	Degree F	

PAGE 11: General Operations

Alpha	MENU	Selection	Available Settings	Factory Setting	Sec.
LP 2 SEn	8	Loop #2 Sensor Input	J TC K TC E TC T TC R TC S TC 100 Ω RTD 4–20 mA	J TC	C
LP 2 Unt	9	Loop #2 Units	Degree F Degree C 0 to 100.0% 0.00 to 99.99%	Degree F	
LP 3 SEn	10	Loop #3 Sensor Input	J TC K TC E TC T TC R TC S TC 100 Ω RTD 4–20 mA	J TC	
LP 3 Unt	11	Loop #3 Units	Degree F Degree C 0 to 100.0% 0.00 to 99.99%	Degree F	C
LP 4 SEn	12	Loop #4 Sensor Input	J TC K TC E TC T TC R TC S TC 100 Ω RTD 4–20mA	J TC	
LP 4 Unt	13	Loop #4 Units	Degree F Degree C 0 to 100.0% 0.00 to 99.9%	Degree F	
LP 5 SEn	14	Loop #5 Sensor Input	J TC K TC E TC T TC R TC S TC 100 Ω RTD 4–20mA	J TC	
LP 5 Unt	15	Loop #5 Units	Degree F Degree C 0 to 100.0% 0.00 to 99.9%	Degree F	

PAGE 11: General Operations

Alpha	MENU	Selection	Available Settings	Factory Setting	Sec. C
LP 6 SEn	16	Loop #6 Sensor Input	J TC K TC E TC T TC R TC S TC 100 Ω RTD 4–20mA	J TC	
LP 6 Unt	17	Loop # 6 Units	Degree F Degree C 0 to 100.0% 0.00 to 99.9%	Degree F	
LP 7 SEn	18	Loop #7 Sensor Inputs	J TC K TC E TC T TC R TC S TC 100 Ω RTD 4–20mA	J TC	
LP 7 Unt	19	Loop #7 Units	Degree F Degree C 0 to 100.0% 0.00 to 99.99%	Degree F	C
LP 8 SEn	20	Loop #8 Sensor Input	J TC K TC E TC T TC R TC S TC 100 Ω RTD 4–20mA	J TC	
LP 8 Unt	21	Loop #8 Units	Degree F Degree C 0 to 100.0% 0.00 to 99.99%	Degree F	
LP 9 SEn	22	Loop #9 Sensor Inputs	J TC K TC E TC T TC R TC S TC 100 Ω RTD 4–20mA	J TC	
LP 9 Unt	23	Loop #9 Units	Degree F Degree C 0 to 100.0% 0.00 to 99.99%	Degree F	

PAGE 11 General Operation

Alpha	MENU	Selection	Available Settings	Factory Setting	Sec.
LP 10 SEn	24	Loop #10 Sensor Input	J TC K TC E TC T TC R TC S TC 100 Ω RTD 4–20mA	J TC	C
LP 10 Unt	25	Loop # 10 Units	Degree F Degree C 0 to 100.0% 0.00 to 99.99%	Degree F	
Manual	26	Auto/Manual SetUp	Disabled Enabled	Disabled	

PAGE 11: General Operations

SP 1 UL	27	Loop #1 Set Point Upper Limit	Sensor Range	Sensor Range Max	D
SP 1 LL	28	Loop #1 Set Point Lower Limit	Sensor Range	Sensor Range Min	D
SP 2 UL	29	Loop #2 Set Point Upper Limit	Sensor Range	Sensor Range Max	D
SP 2 LL	30	Loop #2 Set Point Lower Limit	Sensor Range	Sensor Range Min	D
SP 3 UL	31	Loop #3 Set Point Upper Limit	Sensor Range	Sensor Range Max	D
SP 3 LL	32	Loop #3 Set Point Lower Limit	Sensor Range	Sensor Range Min	D
SP 4 UL	33	Loop #4 Set Point Upper Limit	Sensor Range	Sensor Range Max	D
SP 4 LL	34	Loop #4 Set Point Lower Limit	Sensor Range	Sensor Range Min	D
SP 5 UL	35	Loop #5 Set Point Upper Limit	Sensor Range	Sensor Range Max	D
SP 5 LL	36	Loop #5 Set Point Lower Limit	Sensor Range	Sensor Range Min	D
SP 6 UL	37	Loop #6 Set Point Upper Limit	Sensor Range	Sensor Range Max	D
SP 6 LL	38	Loop #6 Set Point Lower Limit	Sensor Range	Sensor Range Min	D
SP 7 UL	39	Loop #7 Set Point Upper Limit	Sensor Range	Sensor Range Max	D
SP 7 LL	40	Loop #7 Set Point Lower Limit	Sensor Range	Sensor Range Min	D
SP 8 UL	41	Loop #8 Set Point Upper Limit	Sensor Range	Sensor Range Max	D
SP 8 LL	42	Loop #8 Set Point Lower Limit	Sensor Range	Sensor Range Min	D

PAGE 11 General Operation

Alpha	MENU	Selection	Available Settings	Factory Settings	Sec.
SP 9 UL	43	Loop #9 Set Point Upper Limit	Sensor Range	Sensor Range Max	D
SP 9 LL	44	Loop #9 Set Point Lower Limit	Sensor Range	Sensor Range Min	D
SP 10 UL	45	Loop #10 Set Point Upper Limit	Sensor Range	Sensor Range Max	D
SP 10 LL	46	Loop #10 Set Point Lower Limit	Sensor Range	Sensor Range Min	D
FotoL MoP	47	Map Fatal Errors to Common Alarm	Disabled Enabled	Enabled	D
SYStEM RSt	48	Initiate Reset	Ready ⬆ Reset	Ready ⬆	E
OPEn SEn	49	Must set to 0	0	0	

PAGE 12
Alarm #1 Mapping to Alarm Outputs

Alpha	MENU	Selection	Available Setting	Factory Setting	Sec.
LP 1 MoP	1	Loop 1 Map	AI Out 1–10	1	C
LP 2 MoP	2	Loop 2 Map	AI Out 1–10	2	
LP 3 MoP	3	Loop 3 Map	AI Out 1–10	3	
LP 4 MoP	4	Loop 4 Map	AI Out 1–10	4	
LP 5 MoP	5	Loop 5 Map	AI Out 1–10	5	
LP 6 MoP	6	Loop 6 Map	AI Out 1–10	6	
LP 7 MoP	7	Loop 7 Map	AI Out 1–10	7	
LP 8 MoP	8	Loop 8 Map	AI Out 1–10	8	
LP 9 MoP	9	Loop 9 Map	AI Out 1–10	9	
LP 10 MoP	10	Loop 10 Map	AI Out 1–10	10	

PAGE 13
Alarm #2 Mapping to Alarm Outputs

Alpha	MENU	Selection	Available Setting	Factory Setting	Sec.
LP 1 MoP	1	Loop 1 Map	AI Out 1–10	1	C
LP 2 MoP	2	Loop 2 Map	AI Out 1–10	2	
LP 3 MoP	3	Loop 3 Map	AI Out 1–10	3	
LP 4 MoP	4	Loop 4 Map	AI Out 1–10	4	
LP 5 MoP	5	Loop 5 Map	AI Out 1–10	5	
LP 6 MoP	6	Loop 6 Map	AI Out 1–10	6	
LP 7 MoP	7	Loop 7 Map	AI Out 1–10	7	
LP 8 MoP	8	Loop 8 Map	AI Out 1–10	8	
LP 9 MoP	9	Loop 9 Map	AI Out 1–10	9	
LP 10 MoP	10	Loop 10 Map	AI Out 1–10	10	

PAGE 14
Control Operations

Alpha	MENU	Selection	Available Setting	Factory Setting	Sec.
LP1Tun	1	Loop 1 Self-Tune	Tune Off	Tune Off	C
LP2Tun	2	Loop 2 Self-Tune	Qtr Damp		
LP3Tun	3	Loop 3 Self-Tune	Overdamp		
LP4Tun	4	Loop 4Self-Tune			
LP5Tun	5	Loop 5 Self-Tune			
LP6Tun	6	Loop 6 Self-Tune			
LP7Tun	7	Loop 7 Self-Tune			
LP8Tun	8	Loop 8 Self-Tune			
LP9Tun	9	Loop 9 Self-Tune			
LP10Tun	10	Loop 10 Self-Tune			

PAGE 15
Digital Communications

Alpha	MENU	Selection	Available Setting	Factory Setting	Sec.
ModE	1	Mode Selection	Off Terminal Auto Log Comp Inf Ascii Ln	Off	D
LoGInt	2	Automatic Data Log Interval	1 to 9999	1 min.	
FroMM#	3	First PAGE/MENU # to Display	1 to 40	1	
ToM#	4	Last PAGE 0/MENU # to Display	1 to 40	40	
ChrLnGth	5	Character Length	Under 17 Over 16	 Over 16	
HoMEChar	6	Home Character	0 to 255	30	
ClrChar	7	Clear Screen Character	0 to 255	26	
CoMTYPE	8	Communication Type	RS232C RS422A RS485	RS232C	
BoudRotE	9	Baud Rate	300 600 1200 2400 4800 9600 19.2K	19.2K	
PorLY	10	Parity	None Odd Even	None	
REconFiG	11	Reconfigure Serial Port	Ready ⬆ Reconfigure	Ready ⬆	
AddrESS	12	Multidrop Address	1-255	1	

PAGE 16:
Gang Calibration

Alpha	MENU	Selection	Available Setting	Factory Setting	Sec.
GanG Cal	1	Gang Calibration Similar Sensor Input Loops	Ready ⬆ Program FINISHED	Ready ⬆	D

PAGE 17-26:
QUICK STEP Calibration

Alpha	MENU	Selection	Available Setting	Factory Setting	Sec.
CJC TEMP	1	CJC Temperature	0.1°F to 150.0°F	75.0°F	D
CJC Cal	2	CJC Calibration Steps	Ready ⬆ CJC Cal Finished	Ready ⬆	
	3	QuickCal	0/40 mV -5/20 mV 0/20 mV Cu Wire TC Sim RTD Sim 4/20 mA	0/40 mV	D
	4	Cal Step	MinRdy ⬆ Cal Min MaxRdy ⬆ Cal Max Finished	MinRdy ⬆	
ZEro Cal	5	Zero Manual Calibration	-32768 to 32767	Calibrated Values	D
SPan Cal	6	Span Manual Calibration	0 to 65535	Calibrated Values	
REcoVEr	7	Recover Original Calibration	Start ⬆ Recover FINISHED	Ready ⬆	D

PAGE 27:
Analog Input Custom Scaling

Alpha	MENU	Selection	Available Setting	Factory Setting	Sec.
LP1DP	1	Loop 1 Decimal Points	0 = XXXX 1 = XXX.X 2 = XX.XX 3 = X.XXX	1 = XXX.X	E
LP1Ut	2	Loop 1 Units	Degree F Degree C Percent % No Units	Percent	
LP1Lo	3	Loop 1 Low End Range	-999 to 3000	0.0%	
LP1Hi	4	Loop 1 High End Range	-999 to 3000	100.0%	
LP2DP	5	Loop 2 Decimal Points	0 = XXXX 1 = XXX.X 2 = XX.XX 3 = X.XXX	1 = XXX.X	E
LP2Ut	6	Loop 2 Units	Degree F Degree C Percent % No Units	Percent	
LP2Lo	7	Loop 2 Low End Range	-999 to 3000	0.0%	
LP2Hi	8	Loop 2 High End Range	-999 to 3000	100.0%	E
LP3DP	9	Loop 3 Decimal Points	0 = XXXX 1 = XXX.X 2 = XX.XX 3 = X.XXX	1 = XXX.X	
LP3Ut	10	Loop 3 Units	Degree F Degree C Percent % No Units	Percent	
LP3Lo	11	Loop 3 Low End Range	-999 to 3000	0.0%	
LP3Hi	12	Loop 3 High End Range	-999 to 3000	100.0%	E
LP4DP	13	Loop 4 Decimal Points	0 = XXXX 1 = XXX.X 2 = XX.XX 3 = X.XXX	1 = XXX.X	
LP4Ut	14	Loop 4 Units	Degree F Degree C Percent % No Units	Percent	
LP4Lo	15	Loop 4 Low End Range	-999 to 3000	0.0%	
LP4Hi	16	Loop 4 High End Range	-999 to 3000	100.0%	

PAGE 27:
Analog Input Custom Scaling

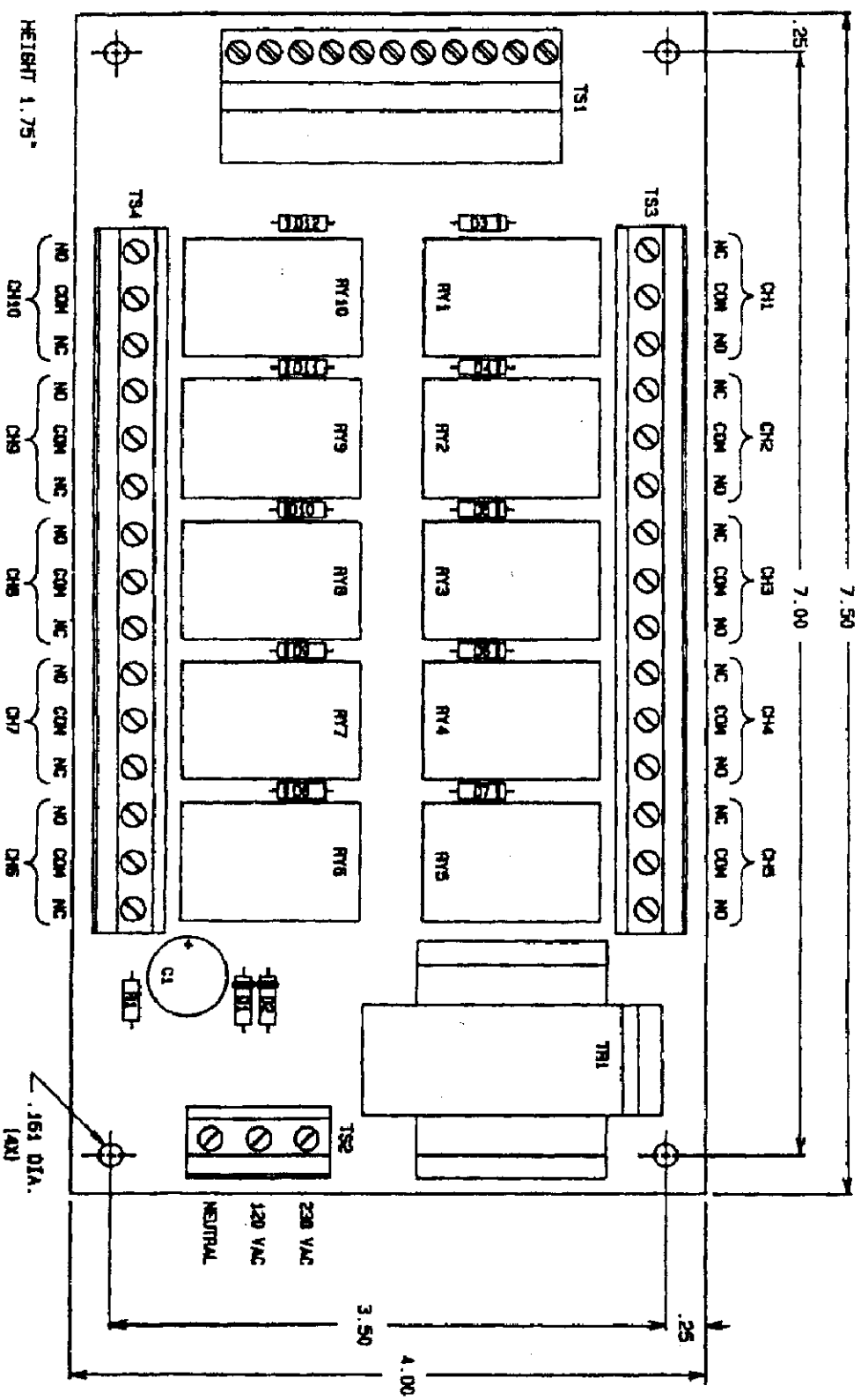
Alpha	MENU	Selection	Available Setting	Factory Setting	Sec.
LP5DP	17	Loop 5 Decimal Points	0 = XXXX 1 = XXX.X 2 = XX.XX 3 = X.XXX	1 = XXX.X	E
LP5Ut	18	Loop 5 Units	Degree F Degree C Percent % No Units	Percent	
LP5Lo	19	Loop 5 Low End Range	-999 to 3000	0.0%	
LP5Hi	20	Loop 5 High End Range	-999 to 3000	100.0%	
LP6DP	21	Loop 6 Decimal Points	0 = XXXX 1 = XXX.X 2 = XX.XX 3 = X.XXX	1 = XXX.X	E
LP6Ut	22	Loop 6 Units	Degree F Degree C Percent % No Units	Percent	
LP6Lo	23	Loop 6 Low End Range	-999 to 3000	0.0%	
LP6Hi	24	Loop 6 High End Range	-999 to 3000	100.0%	
LP7DP	25	Loop 7 Decimal Points	0 = XXXX 1 = XXX.X 2 = XX.XX 3 = X.XXX	1 = XXX.X	E
LP7Ut	26	Loop 7 Units	Degree F Degree C Percent % No Units	Percent	
LP7Lo	27	Loop 7 Low End Range	-999 to 3000	0.0%	
LP7Hi	28	Loop 7 High End Range	-999 to 3000	100.0%	
LP8DP	29	Loop 8 Decimal Points	0 = XXXX 1 = XXX.X 2 = XX.XX 3 = X.XXX	1 = XXX.X	E
LP8Ut	30	Loop 8 Units	Degree F Degree C Percent % No Units	Percent	
LP8Lo	31	Loop 8 Low End Range	-999 to 3000	0.0%	
LP8Hi	32	Loop 8 High End Range	-999 to 3000	100.0%	

PAGE 27:
Analog Input Custom Scaling

Alpha	MENU	Selection	Available Setting	Factory Setting	Sec.
LP 9 DP	33	Loop 9 Decimal Points	0 = XXXX 1 = XXX.X 2 = XX.XX 3 = X.XXX	1 = XXX.X	E
LP 9 Ut	34	Loop 9 Units	Degree F Degree C Percent % No Units	Percent	
LP 9 Lo	35	Loop 9 Low End Range	-999 to 3000	0.0%	
LP 9 Hi	36	Loop 9 High End Range	-999 to 3000	100.0%	
LP 10 DP	37	Loop 10 Decimal Points	0 = XXXX 1 = XXX.X 2 = XX.XX 3 = X.XXX	1 = XXX.X	E
LP 10 Ut	38	Loop 10 Units	Degree F Degree C Percent % No Units	Percent	
LP 10 Lo	39	Loop 10 Low End Range	-999 to 3000	0.0%	
LP 10 Hi	40	Loop 10 High End Range	-999 to 3000	100.0%	

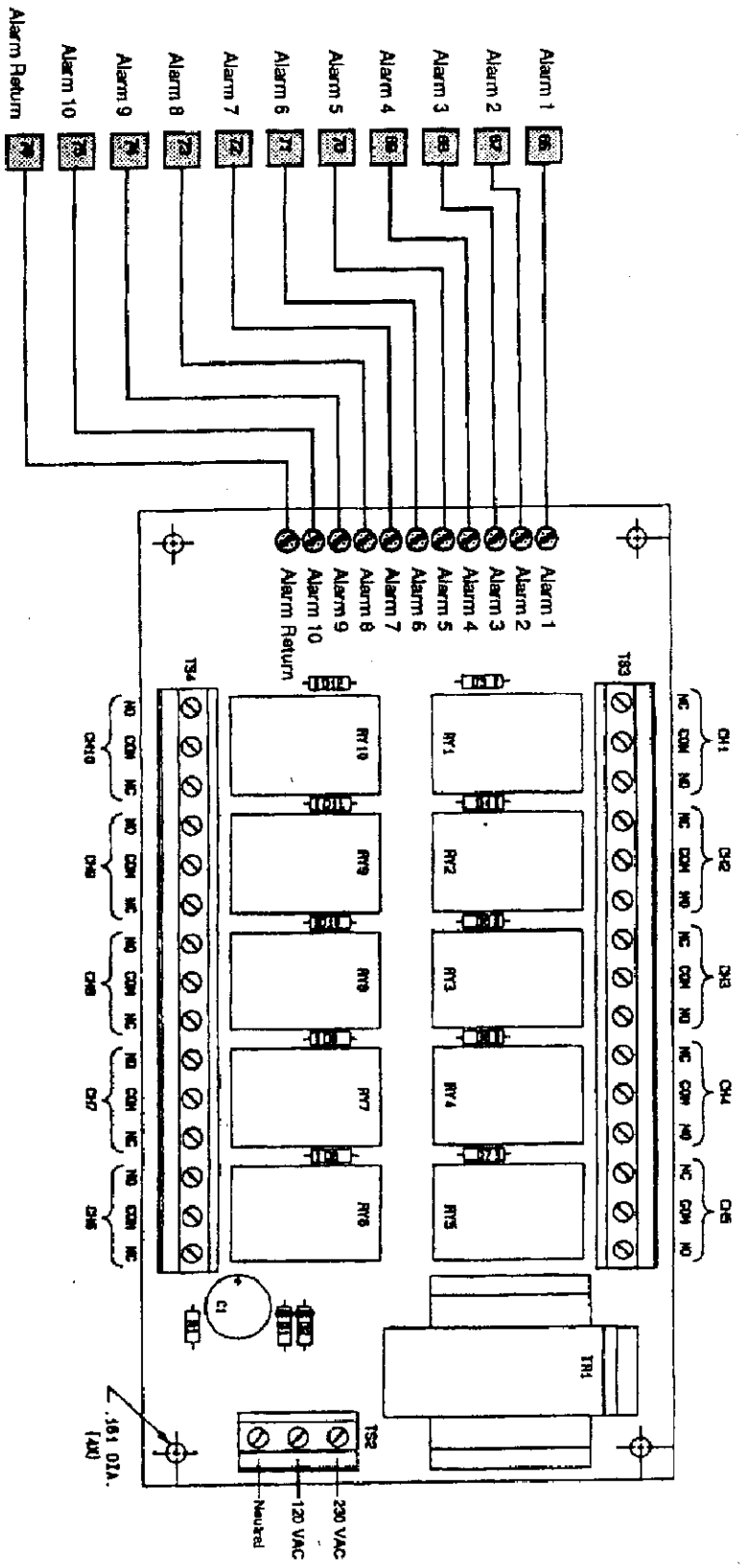
Appendix III

Mounting Dimensions for CN3390 Controller External Alarm Relay Board



See Section 5, page 44 for complete installation and application information.

Wiring Instructions for CN3390 Controller External Alarm Relay Board



MADE IN USA WARRANTY/DISCLAIMER

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 pleased 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.

OMEGA MAKES NO OTHER WARRANTIES OR REPRESENTATIONS OF ANY KIND WHATSOEVER, EXPRESSED OR IMPLIED, EXCEPT THAT OF TITLE AND ALL IMPLIED WARRANTIES INCLUDING ANY WARRANTY OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED.

LIMITATION OF LIABILITY: The remedies of purchaser set forth herein are exclusive and the total liability of OMEGA with respect to this order, whether based on contract, warranty, negligence, indemnification, strict liability or otherwise, shall not exceed the purchase price of the component upon which liability is based. In no event shall OMEGA be liable for consequential, incidental or special damages.

CONDITIONS: Equipment sold by OMEGA is not intended to be used, nor shall it be used: (1) as a "Basic Component" under 10 CFR 21 (NRC), used in or with any nuclear installation or activity; or (2) in medical applications or used on humans. Should any Product(s) be used in or with any nuclear installation or activity, medical application, used on humans, or misused in any way, OMEGA assumes no responsibility as set forth in our basic WARRANTY / DISCLAIMER language, and additionally, purchaser will indemnify OMEGA and hold OMEGA harmless from any liability or damage whatsoever arising out of the use of the Product(s) in such a manner.

RETURN REQUESTS / INQUIRIES

Direct all warranty and repair requests/inquiries to the OMEGA ENGINEERING Customer Service Department. BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, PURCHASER MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OMEGA'S CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned AR number should then be marked on the outside of the return package and on any correspondence.

FOR **WARRANTY** RETURNS, please have the following information available BEFORE contacting OMEGA:

1. P.O. number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

FOR **NON-WARRANTY** REPAIRS OR **CALIBRATION,** consult OMEGA for current repair/calibration charges. Have the following information available BEFORE contacting OMEGA:

1. P.O. number to cover the COST of the repair/calibration,
2. Model and serial number of the product, and
3. Repair instructions and/or specific problems relative to the product.

OMEGA's policy is to make running changes, not model changes, whenever an improvement is possible. This affords our customers the latest in technology and engineering.

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- Transducers & Strain Gages
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- Displacement Transducers
- Instrumentation & Accessories

FLOW/LEVEL

- Rotameters, Gas Mass Flowmeters & Flow Computers
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- pH Electrodes, Testers & Accessories
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- Metering & Control Instrumentation
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- pH, Conductivity & Dissolved Oxygen Instruments