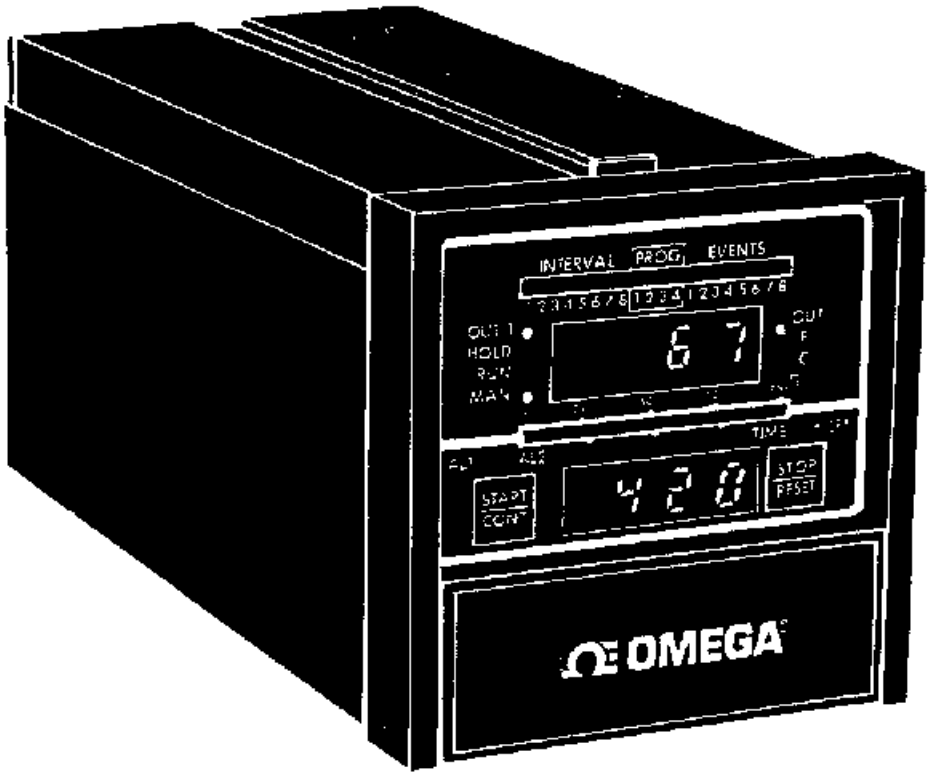
CN3220

Temperature/Process Controller



OMEGA®
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Operator's Manual
M1536/0792

User's Manual
0037-75156

List of Figures

SECTION 1
GENERAL INFORMATION

THE BIG PICTURE

The OMEGA CN3220 Ramp/Soak Temperature and Process Controller is designed to handle the simplest single loop control applications as well as sophisticated ramp/soak applications. To most effectively implement the controller in your application, it is important that you take time to see the **"Big Picture"** — the type of controller you have purchased, and how the programming and configuration is organized. This will make it even easier and quicker for you to get your controller up and running!

Figure 1.1
Simple Single Loop
Control Application

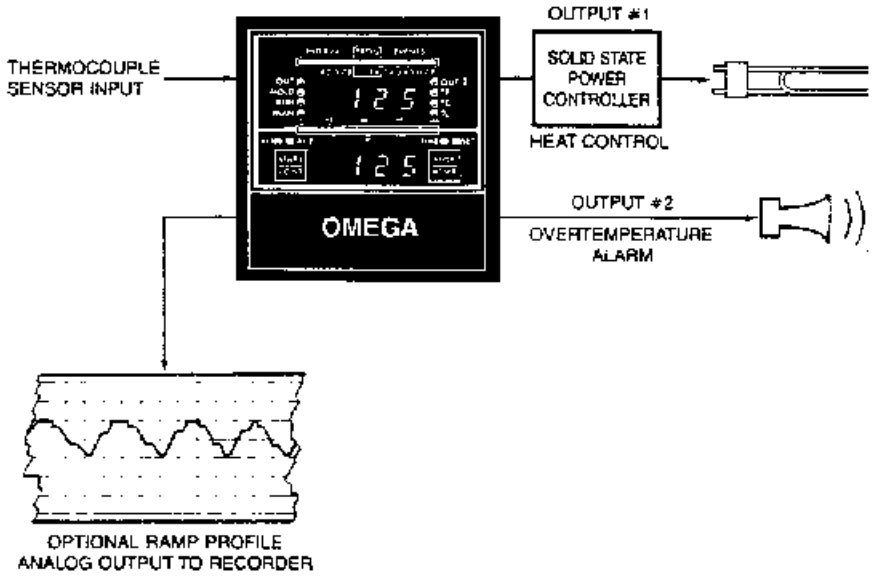
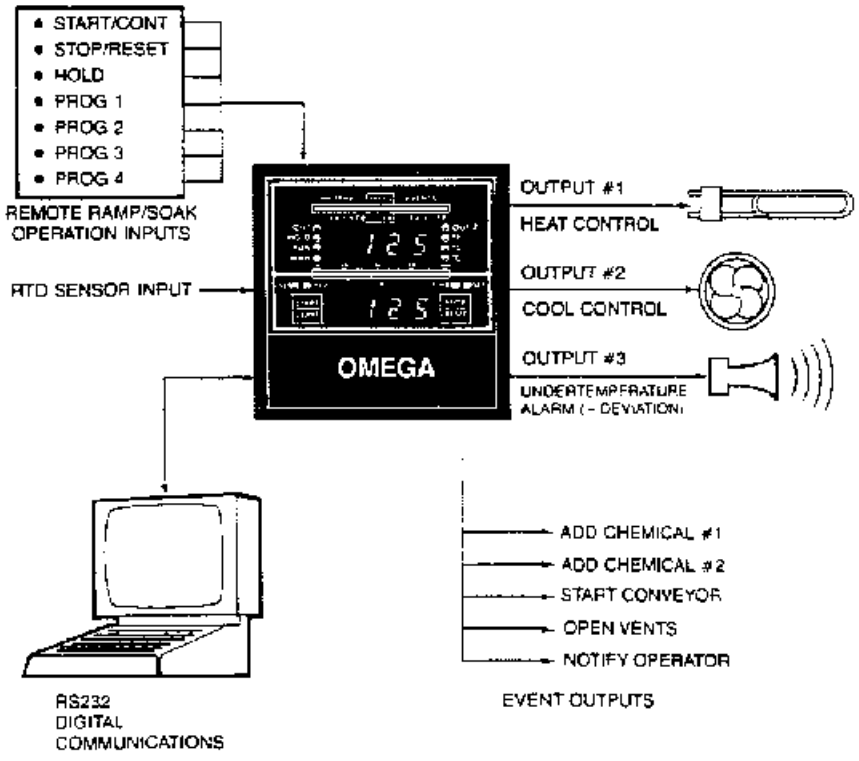


Figure 1.2
Complex Process
Control Application



Auxiliary Analog and Digital Inputs/Outputs and Digital Communications Options

Order Suffix	Remote Setpoint Input	Process or Ramp Profile Analog Output	8 Event Outputs, 8 Inputs	Digital Communications RS-232, RS-422A, RS-485**	
-1	✔				
-2		✔			
-3	✔	✔			
-4			✔		
-5			✔	Terminal*	
-6			✔		Terminal*
-7		✔	✔		
-8		✔	✔	Terminal*	
-9	✔	✔	✔	Terminal*	
-A			✔	Computer**	
-B			✔		Computer**
-C		✔	✔	Computer**	
-E	✔	✔	✔	Computer**	

*Terminal mode utilizes any ASCII terminal. No software necessary for the terminal mode.

**Computer mode utilizes a computer to communicate in either single drop or multi-drop with the aid of the CN3200-SOFT OMEGA Software package (IBM compatible) or customer developed software.

Sensor Inputs

	Type	Range
J	Iron-Constantan	-100° to 1400°F -73° to 760°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	Platinum/Platinum 13% Rhodium	50° to 3000°F 10° to 1649°C
S	Platinum/Platinum 10% Rhodium	50° to 3000°F 10° to 1649°C
	100Ω Pt RTD	-200° to 1000°F -128° to 538°C
	Voltage Current	1 to 5 Vdc* 4 to 20mA

NOTE: TC1, TC2 and CV input types are also available as isolated input curcuit. Add suffix "IS" to input code.

*0.00% to 99.9% can be scaled to any range in field.

Accessories

Model No.	Description
CN3200-R	Relay Output Module
CN3200-T	1 A SSR Output Module
CN3200-F	4-20 mA Output Module
CN3200-DC	Pulse 20 Vdc Output Module
CN3200-FRONT	Splash Cover
CN3200-BR	Surface Mounting Brackett
CN3200-SOFT	Software package for use with -A, -B, -C, -E digital communications option
1821-101	Noise Suppression Kit for Mechanical Relay Models Driving ac Contactors or Solenoids

Output Type (No Add'l Charge)

Output Type	Heating or Cooling Output #1	Cooling, Alarm or Event Output #2
ac SSR	T1	T2
4-20 mA	F1	F2
dc Pulse	DC1	DC2

NOTE: standard output(s) is normally open 5 A mechanical relay (5 A at 120 Vdc, 2.5 A at 230 Vdc)

Alarm/Event Output Option

Output Type	Ordering Suffix
Relay	R3
ac SSR	T3
dc Pulse	DC3

SECTION 2
INSTALLATION

Inspection and Unpacking

On receipt of your CN3220 controller, immediately make note of any visible damage to the shipment packaging and record this damage on the shipping documents. Unpack the controller and carefully inspect it for obvious damage due to shipment. Immediately report any damage to the shipping agent. Remove the packing list and verify that all equipment has been received. If there are any questions about the shipment, call OMEGA Customer Service Department at 1-800-622-2378 or (203) 359-1660.

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

Removing the CN3220 from its Case

The CN3220 instrument chassis can be easily removed from its case either before or after mounting and wiring. Some applications require internal jumper changes, which makes it necessary to remove the controller chassis from the case. If input cards or output modules are to be installed, it is also necessary to remove the controller from its case.

To remove the chassis, lower the front door flap and loosen the screw. Pull the chassis out from the case to expose the controller circuit cards. See Figure 2.1 below.

NOTE

If your controller has any of the Auxiliary Digital Input/Output or Communications Options, you must unplug the **Digital Interface Connector** from the back of the controller for installation and wiring the Digital Signals Connector. This is illustrated in Figure 2.2 below. After installing the controller in the mounting surface, replace the connector.

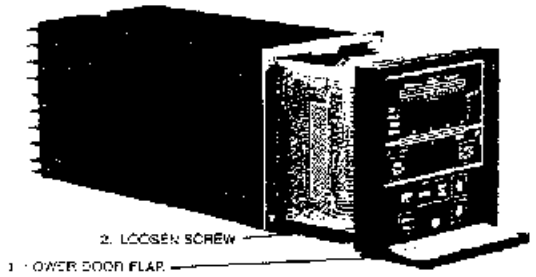


Figure 2.1
Removing the CN3220 Chassis from Case

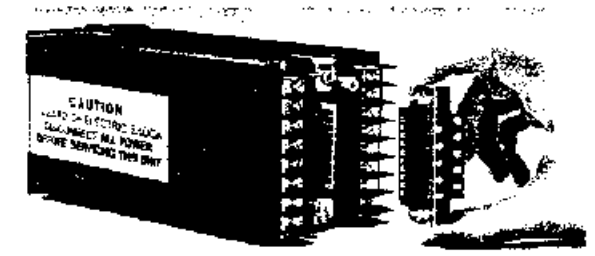


Figure 2.2
Unplugging the Digital Interface Connector

MOUNTING

The CN3220 controller should be mounted in a location free from excessive dust, oil accumulations and moisture. It may be mounted in any position at ambient temperatures of 30°F to 130°F (0°C to 55°C).

Figure 2.3 gives the mounting dimensions for the controller. Cut out the square mounting hole and install the unit in accordance with the mounting diagram Figure 2.4. Remove the Digital Signals Connector (if your unit has one) and loosen the mounting brackets' captive screws at the rear of the controller, sliding the mounting bracket off the controller, and placing the controller through the square panel cutout. Replace the mounting brackets and tighten the screws to secure the controller firmly against the mounting surface. Reattach the Digital Interace Connector with the screws provided.

Figure 2.3
Mounting Dimensions

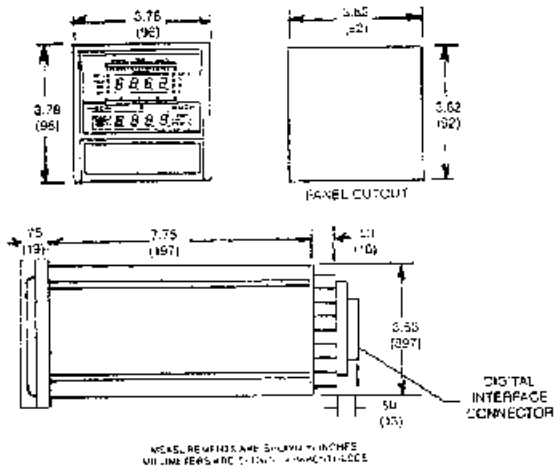
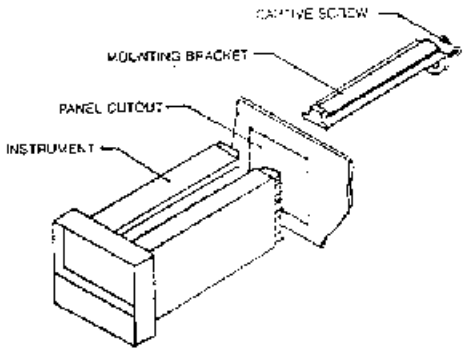


Figure 2.4
Mounting Diagram



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IMPORTANT WIRING INFORMATION!

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

To insure that the OMEGA CN3220 controller performs optimally, it is imperative that you read this section and become familiar with several wiring practices critical to eliminating electrical noise. Failure to follow these recommended wiring practices can result in poor temperature control and ineffective controller application.

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 CN3220. Snubbers are available from OMEGA (Part No. 1821-101).

When using the Alarm Output or Triac Control Output 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.

Good Wiring Practice

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

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

2. When planning the system wiring, be sure to consider the importance of separating wiring into like bundles - i.e. power leads, sensor leads, output signal lines, etc.

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

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

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

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

WIRING

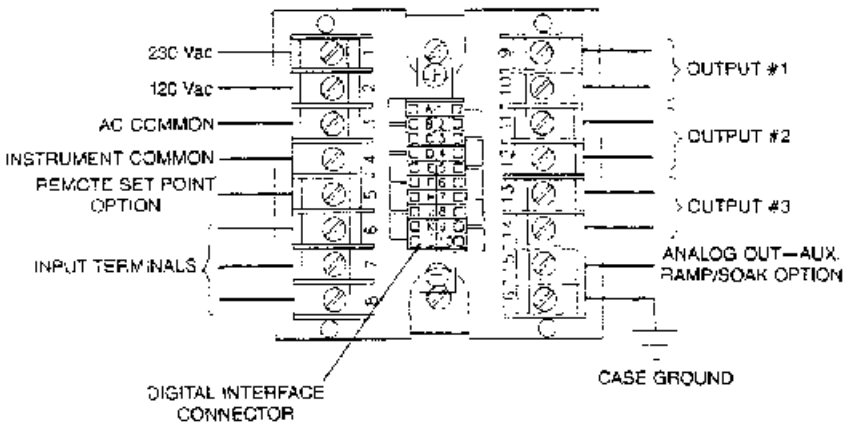
Make all electrical wiring connections on the back of the controller **before** power is applied to the unit.

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

Check the wiring decal on the side of the unit to verify the model number. The wiring decal also shows wiring terminations. All wires will be connected to the terminals on the back of the case. Specific wiring instructions for different input and output types are given in this section.

Detailed wiring instructions for Digital Communications, Event Inputs/Outputs, Remote Setpoint and Analog Output options are given in separate sections covering each of these topics.

Figure 2.5
Wiring Terminal Identification



Using the proper size wire for rated circuits, make the wiring connections as shown in Figure 2.5.

SENSOR INPUT WIRING

The model CN3220 controller is supplied with one of three types of input cards, as identified by the unit model number.

CN3220 - _____

Code	Sensor Type
TC1, TC2	Thermocouple
CV	Current/Voltage
P1	RTD
TC1-IS, TC2-IS	Isolated Thermocouple
CV-IS	Isolated Current/Voltage

Check the model number on the side of your unit to verify the input type.

NOTE

If the sensor input card is changed, the controller must be recalibrated and reconfigured. The CN3220 is factory calibrated and shipped with the selected sensor card installed (sensor J, K, E, and T use the same sensor card). For example, if a unit is set up for type J thermocouple, types K,E,and T thermocouple can also be used by simply changing the sensor selection MENU number, and recalibration would not be required. See "Changing Input Cards," page 11, if it is necessary to change the input type/cards.

NOTE

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 making sensor connections. False process readings can occur if the sensor wire is exposed to external electrical noise.

Thermocouple Input Codes TC1, TC1-IS, TC2, TC2-IS

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

T/C	Material	±	-
J	Iron/Constantan	White	Red
K	Chromel/Alumel	Yellow	Red
E	Chromel/Constan.	Purple	Red
T	Copper/Constan.	Blue	Red
R	Plat,13% Rhodium/Plat	Black	Red
S	Plat,10% Rhodium/Plat	Black	Red

Make the thermocouple wiring connections to terminals 6 and 7 as shown in Figure 2.6 below.

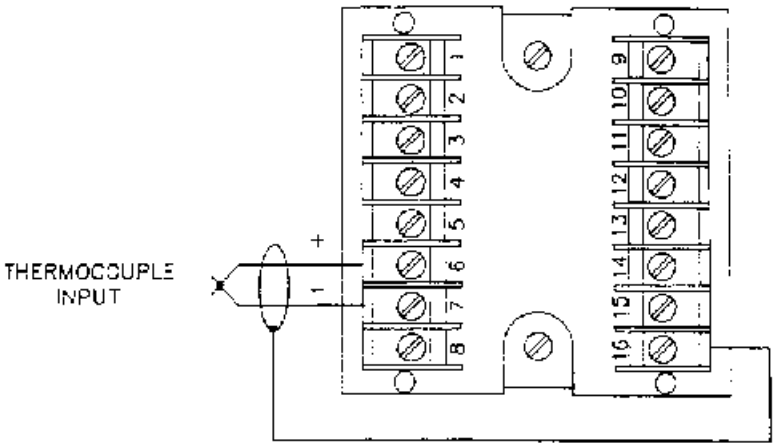


Figure 2.6
Thermocouple Connections

NOTES

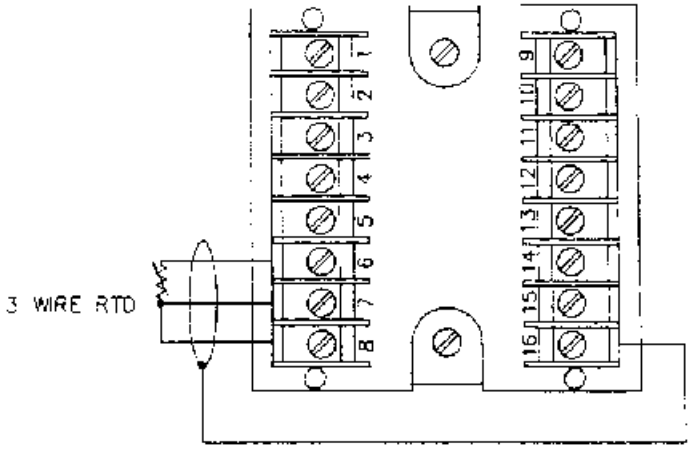
1. If thermocouple extension wire is required, it must be the same type as the thermocouple (i.e. if a Type J thermocouple is used, then Type J extension wire must be used).
2. If shielded thermocouple wire is used, the shield must be grounded at one end only, preferably at terminal 16 on the controller, as shown in Figure 2.6 above.
3. The CN3220 must be programmed to accept the thermocouple type being used (J,K,E,T or R,S). Instructions for programming the thermocouple type are given in Section 3 - Operation. Refer to PAGE 1/MENU 4 of the PAGE/MENU Table for selection of thermocouple type.

RTD Input Code P1

3-Wire RTD - With 3-wire RTD input, it is important to make the resistance of all three extension leadwires equal by using the same gauge of wire for optimum leadwire compensation. OMEGA recommends 3-wire RTDs for greatest accuracy, and standard shielded copper wire for RTD extensions.

Make the wiring connections in accordance with Figure 2.7.

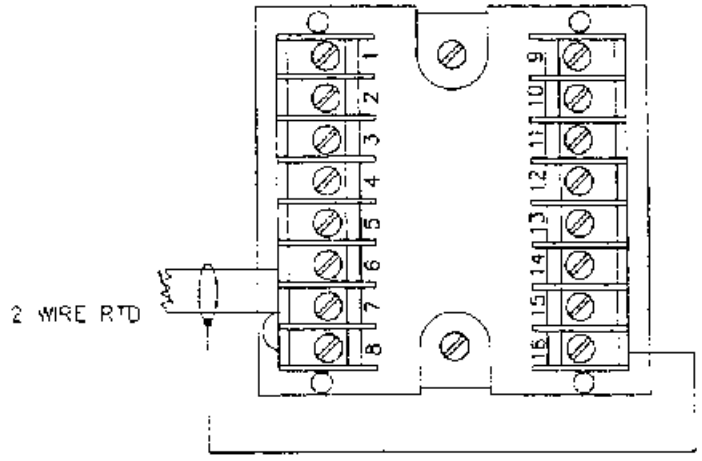
Figure 2.7
Three-Wire RTD Connections



2-Wire RTD - 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 measurement. It is also necessary to jumper Terminals 7 & 8 on the instrument to complete a 2-wire hookup.

Make the 2-wire RTD connections in accordance with Figure 2.8 below.

Figure 2.8
Two-Wire RTD Connections



Current/Voltage Input Codes CV, CV-IS

Controller models CN3220-CV (or CV-IS) are shipped with the 4-20 mA Current input selected. To change the input to 1-5 Vdc, an internal jumper on the input card must be changed. Remove the controller chassis from the case (as instructed on page 5) and locate the Current/Voltage input card illustrated in Figure 2.9 below.

Figure 2.9
Locating Current/Voltage Input Card

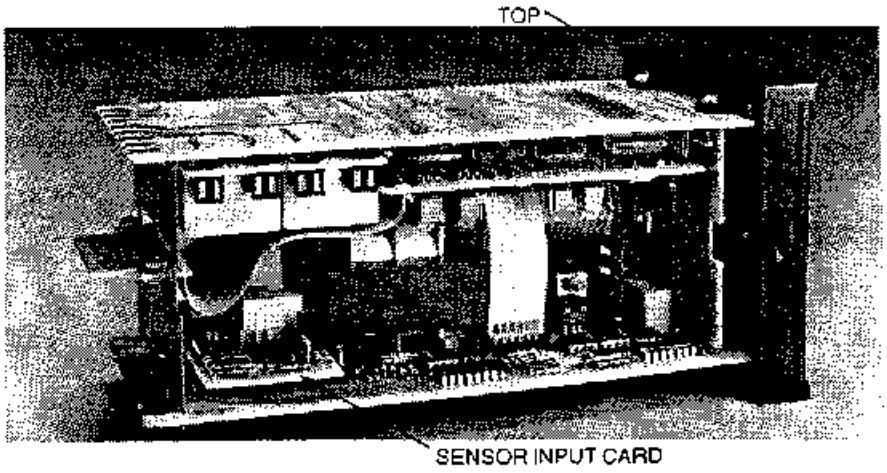
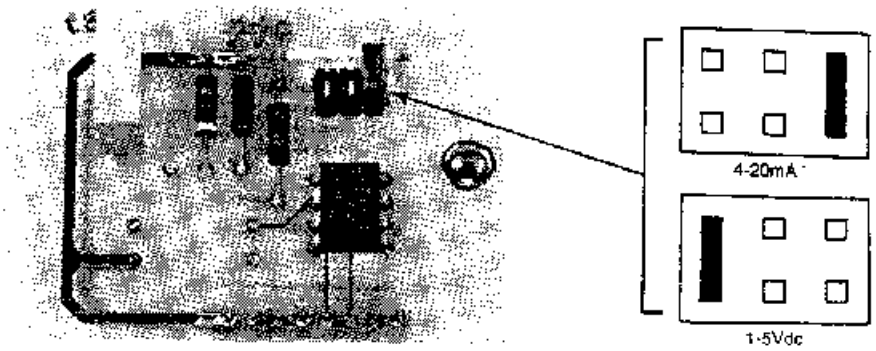


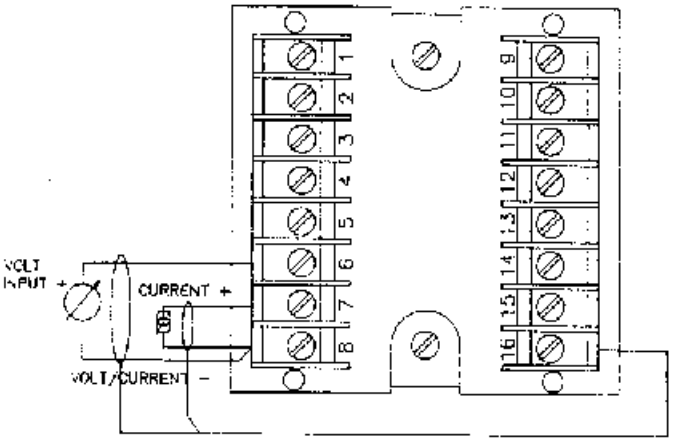
Figure 2.10 illustrates both the 4-20 mA jumper position and 1-5 Vdc jumper position. Place the jumper in the appropriate position for your application.

Figure 2.10
Current/Voltage Input
Card Jumper Positions



Make the Current/Voltage wiring connections as shown in Figure 2.11.

Figure 2.11
Current/Voltage
Input Connections



Changing Input Cards

The CN3220 controller is shipped with the appropriate input card already installed. Should it become necessary to change the input type, the input card can be changed. **If it is necessary to change from one type of sensor input to another (for example, RTD to thermocouple, or thermocouple to Current), the controller must be recalibrated for the new sensor card, and the sensor selection in PAGE 1 MENU 4 must be changed.**

To change the input card, remove the controller chassis from its case and locate the input card as illustrated in Figure 2.14. The following Figure 2.12 identifies the three types of input cards:

Figure 2.12
Input Cards

THERMOCOUPLE RTD CURRENT/VOLTAGE

To change the input card, you must first remove the standoff screw that secures the input card in the controller chassis (see Figure 2.13 below). Gently but firmly unplug the installed input card from the connection pins and replace it with the new input card, then replace the standoff screw. This procedure is illustrated in Figures 2.13 and 2.14 below.

Figure 2.13
Input Card Standoff Screw

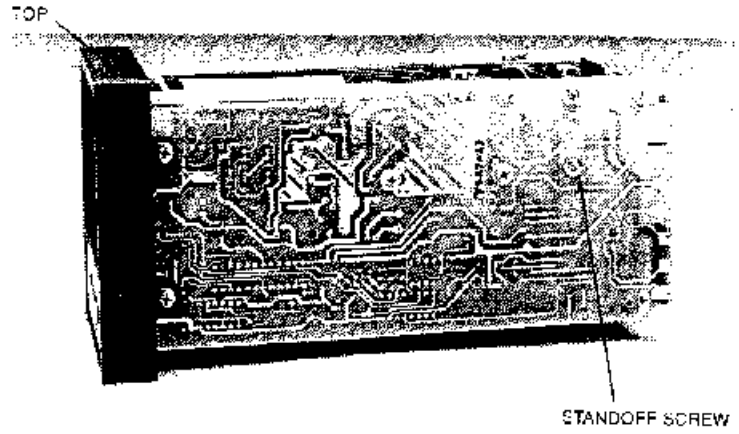
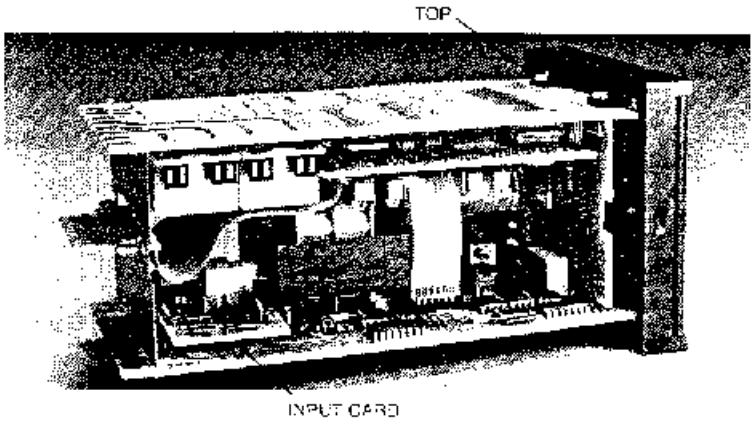


Figure 2.14
Changing Input Cards



Unplug input card and replace. Secure with standoff screw.

OUTPUT WIRING

Your CN3220 controller has one, two or three Outputs, as defined by the model number. Each of the three outputs may function as follows:

Output #1 - Heat Control
Output #2 - Cool Control
Output #3 - Alarm 1 or Event A

Output #1 - Heat Control
Output #2 - Alarm 1 or Event A
Output #3 - Alarm 2 or Event B

Output #1 - Cool Control
Output #2 - Alarm 1 or Event A
Output #3 - Alarm 2 or Event B

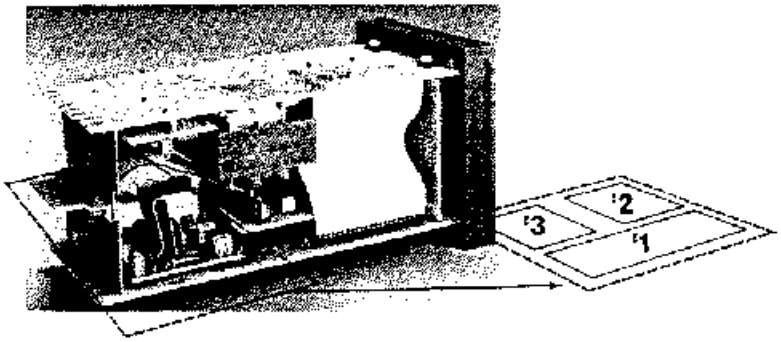
*Current/Voltage outputs (Code F1, F2) cannot be configured as Alarm outputs.

You will program each of the outputs to function as you choose using the PAGE/MENU programming.

Output Modules

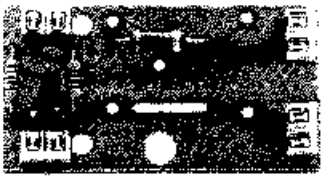
For each Output #1, #2 and #3, there is a separate output module. These output modules are located in the positions shown below.

Figure 2.15
Output Module Positions

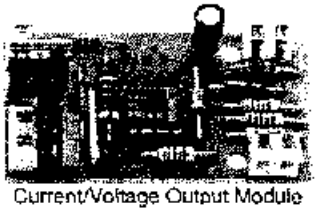


Each of the four types of output modules is identified in Figure 2.16 below.

Figure 2.16
Output Modules

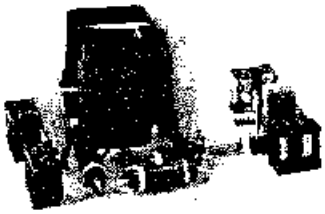


Pulse 20 Vdc Output Module
Part No. CN3200-DC



Current/Voltage Output Module
Part No. CN3200-F

Relay Output Module
Part No. CN3200-R



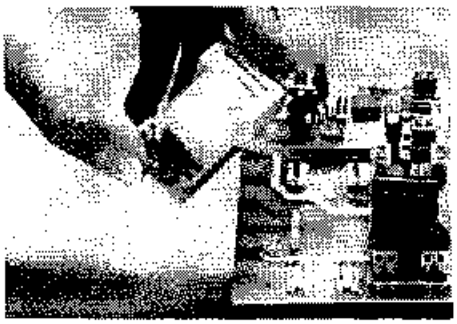
1 A SSR Output Module
Part No. CN3200-T

Changing Output Modules

The CN3220 controller is shipped to you with the appropriate output modules already installed. It is possible, that with a change in application, you may find it necessary to replace an existing output module with another output module.

To change an output module, remove the instrument chassis from the instrument case as described earlier in the section on page 5. Unplug the output module from the 4 connector posts and replace it with another output module, as illustrated in Figure 2.17.

Figure 2.17
Changing an Output Module



NOTE

Be sure to change the load wiring (i.e.120V to 4-20 mA) and any programmed output parameters before putting the controller back into operation! Damage to the output board can occur if incorrect voltages are supplied.

Relay Output Connections

A relay output is generally used to drive small resistive loads (<5 amps at 120 volts or <2.5 amps at 230 volts) or a contactor. When driving a contactor coil or other inductive load we recommend that an appropriately rated a.c. snubber circuit (OMEGA Part No. 1821-101) is connected in parallel with the contactor coil. Snubbers are recommended to protect the controller from electrical noise generated by the inductive load as discussed earlier in this section.

ake the wiring connections for relay outputs as shown in Figure 2.18.

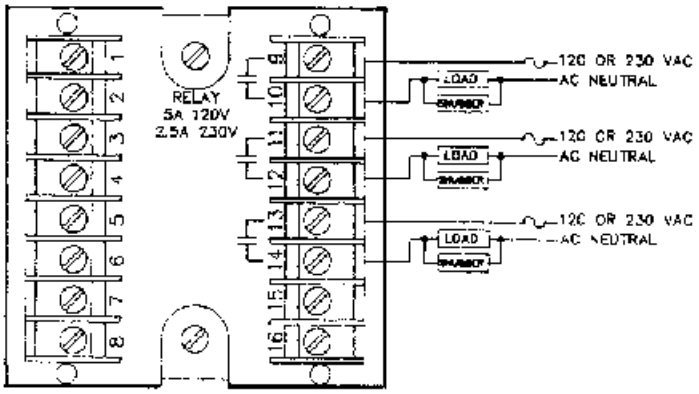


Figure 2.18
Relay Output Connections

ac SSR Output Connections

A triac (ac SSR) output generally drives a small load (less than 2 amps) 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 2.19 for triac output connections.

NOTE

Snubbers should be used to protect the controller from electrical noise (OMEGA Part No. 1821-101). See the Important Wiring Information presented earlier in this section.

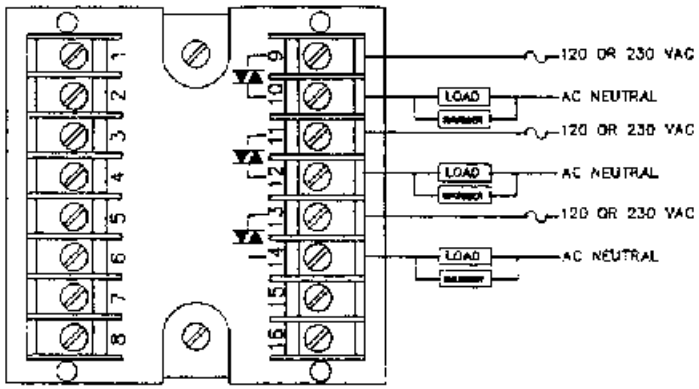


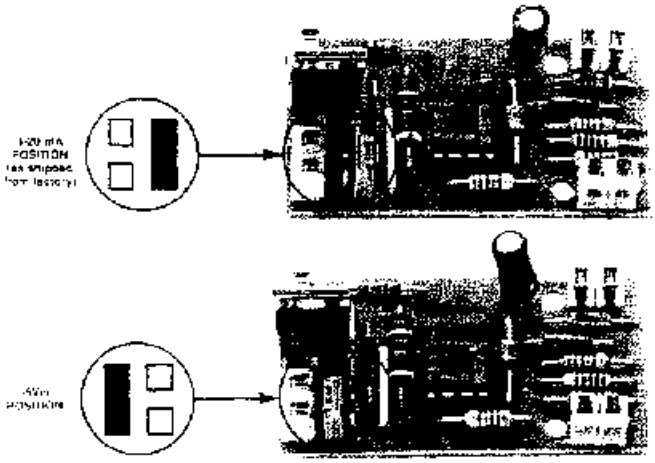
Figure 2.19
ac SSR Output Connections

Current/Voltage Output Connections

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 4-20 mA signal and has input impedance of less than 800 ohms. In a similar manner, the 1-5 Vdc voltage output requires that the CN3220 be connected to a device that accepts a 1-5 Vdc signal.

The output may be changed from a 4-20mA signal to a 1-5Vdc signal by simply moving a jumper on the output module. The controller is shipped with the 4-20mA signal selected. Identify the Current/Voltage Output Modules as described on the previous page, and position the jumper in the 1-5 Vdc position as shown below.

Figure 2.20
4-20 mA/1-5 Vdc
Jumper Positions

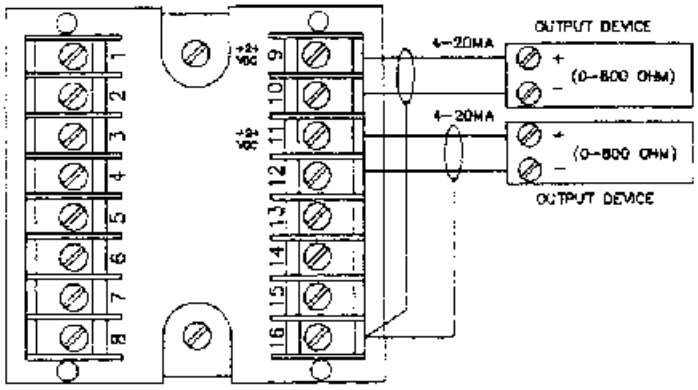


NOTE

If Output #2 is a Current output (Code F2), it cannot be used as an alarm since the analog output does not have the capability of ON/OFF control required for Alarm Outputs.

Make the current/voltage output connections in accordance with Figure 2.21.

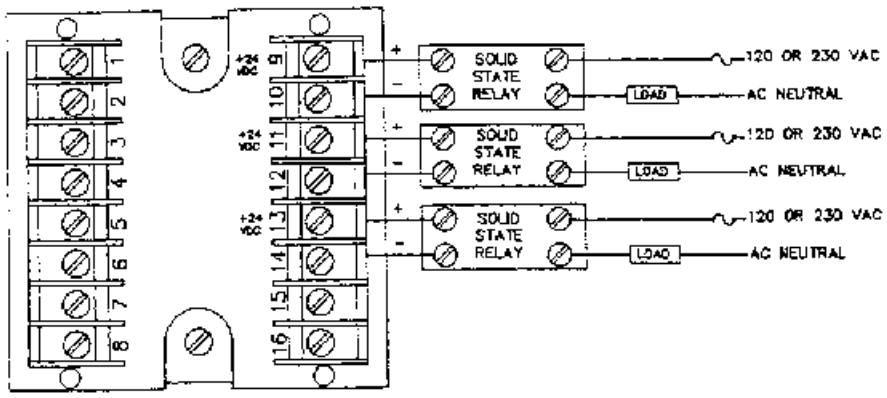
Figure 2.21
4-20 mA/1-5 Vdc
Output Connections



dc Pulse Output Connections

The dc Pulse Output drives solid state relays, such as the OMEGA SSR 240 DC10, which accept 3 to 32 Vdc input ON signals and 0 Vdc OFF signals. See Figure 2.22 for dc Pulse Output connections.

Figure 2.22
dc Pulse
Output Connections



OPTIONS WIRING CONNECTIONS

Specific wiring instructions for each of the following options are given in the following sections:

SECTION 3
OPERATION

PAGE/MENU PROGRAMMING

All control parameters, program settings, and calibration procedures for the CN3220 controller 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 unnecessary entries.

Figure 3.2 lists the contents of the 13 PAGES in terms of the related functions of the MENU numbers they contain.

Figure 3.1
PAGE/MENU Contents

PAGE	PAGE NAME	PAGE CONTENTS
0	Display	Select the value to be displayed in the lower digital display during normal operation.
1	General Operation	Security Level Configuration, Ramp/Soak Program Selection, Sensor Selection, Process Units, Set Point Limits, Auto/Manual Operation, Error Codes and Troubleshooting
2	Control Settings	Set Point, Control Mode, PID Control Parameters, Alarm Parameters
3	Factory Configuration	Only accessible by factory.
4	Ramp/Soak Program 1	Interval Set Points, Time Spans, Time Units, Looping, Linkage, Event Outputs, Guaranteed Soak, Auxiliary Set Points
5	Ramp/Soak Program 2	
6	Ramp/Soak Program 3	
7	Ramp/Soak Program 4	
8	Display Configurations	Reconfiguration of Time, % and Event Indicators, and Analog Bar Graph Display.
9	Digital Communications	Automatic Data Logging, Terminal Interface.
10	Remote Set Point and Process Analog Output Set Up	Enables/Disables Remote Set Point Input feature, Assigns Process or Ramp Profile Analog Output
11	Calibration	Automated Calibration Procedure for all sensor types, and Cold Junction Compensation
12	Sensor Input Set Up (4-20 mA)	Units of Indication, Over-Range and Under-Range, Selection of Decimal Point Location, and Units for Process Input (4-20 mA most commonly)

PAGE/MENU TABLES

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

Figure 3.3 lists the five Security Codes for each of the Security Levels, and the Levels which can be viewed and adjusted.

Figure 3.3
Security Codes and
View/Adjust Levels

SECURITY LEVEL	SECURITY CODE	VIEW LEVEL	ADJUST LEVEL
A	---	A, B, C, D	A
B	123	A, B, C, D	A, B
C	903	A, B, C, D	A, B, C
D	458	A, B, C, D	A, B, C, D
E	362	A, B, C, D, E	A, B, C, D, E
F	736	A, B, C, D, E, F	A, B, C, D, E, F

What's Next?

Next, you will learn how to operate the controller to access these PAGE/MENU functions and what the displays will tell you.

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 and ramp/soak profile conditions. Figure 3.4 shows the controller displays and status lights in a normal operating mode, and Figure 3.5 summarizes the functions of the pushbuttons and displays.

Figure 3.4
Front Panel Displays
During Normal Operation

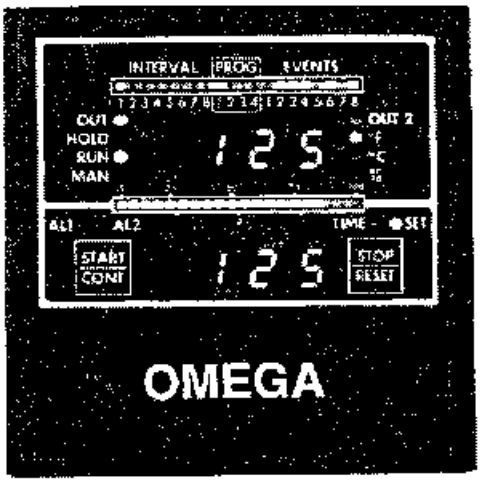
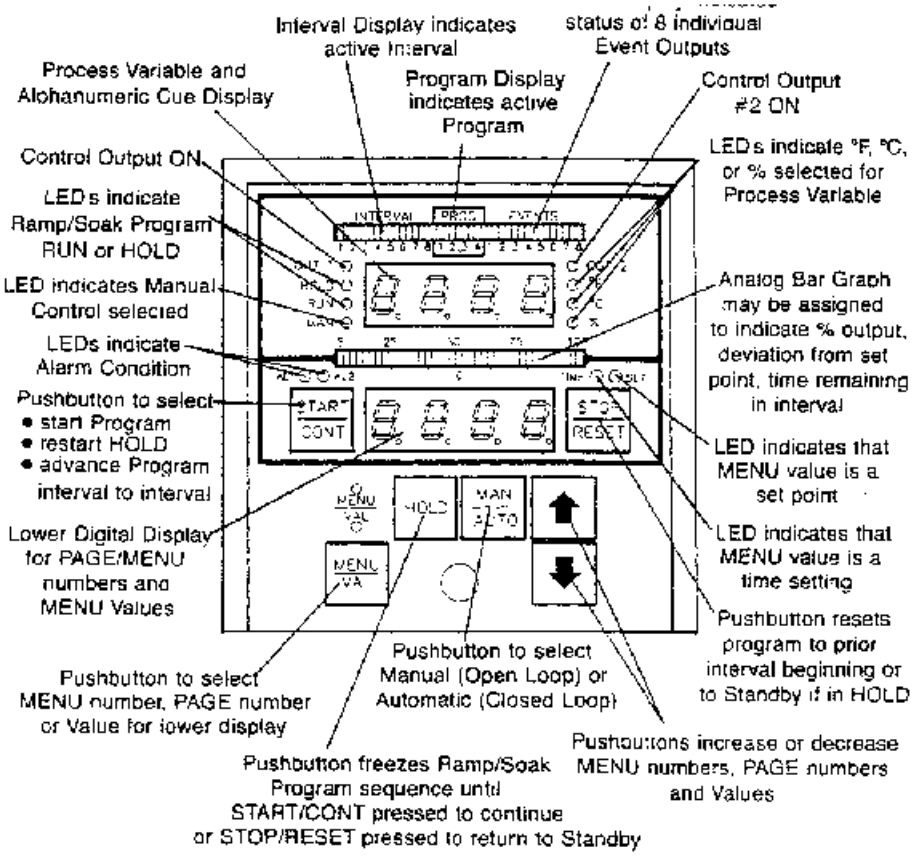


Figure 3.5
Front Panel Displays
and Pushbuttons

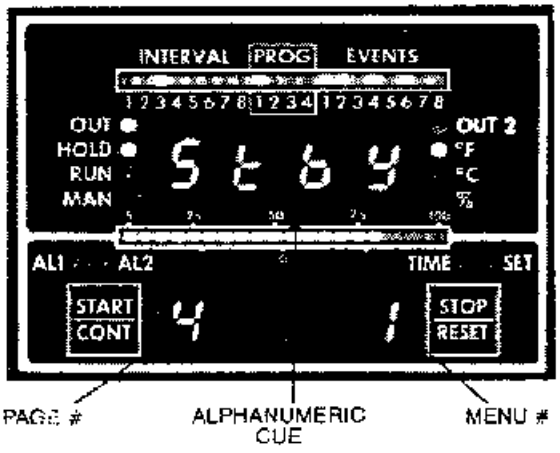


Detailed Display and Pushbutton Descriptions

Upper Digital Display - During normal operation, the upper display reflects the measured process variable. The units of this displayed value (°F, °C, %) are indicated by the LED's to the right of the digital display. Units are selected in the PAGE/MENU programming set up.

During programming, the upper digital display temporarily displays the alphanumeric command cue for the PAGE/MENU selection being adjusted. It then automatically reverts back to the process variable display. An example of an alphanumeric command cue is shown below:

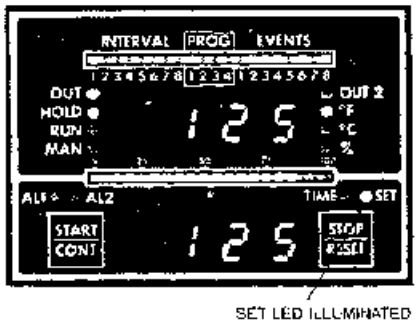
Figure 3.6
Alphanumeric Command Cue
"Standby" Set Point
PAGE 4/MENU 1



This is the cue for the selection of the Program #1 Standby Set Point.

Lower Digital Display - The lower digital display can display any one of 20 values during normal operation. During initial set up, you will select the value that you want to be displayed via PAGE 0/MENU **1**. In the example below, the process set point has been selected for the lower digital display.

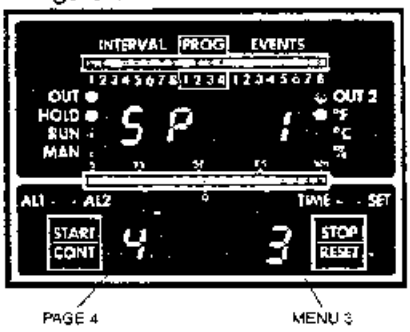
Figure 3.7
Lower Digital Display
Showing Set Point



Since the selected value is a set point, the **SET** LED to the upper right of the display is illuminated. If the value were a time value, such as rate or time left in the interval, the **TIME** LED would be illuminated.

During programming, the lower digital display performs the valuable function of indicating which PAGE/MENU numbers you are selecting, and their corresponding values. (When the controller is operating in the manual mode, the lower display will show the control output command in % of full ON.) An example of the PAGE/MENU number display is shown in Figure 3.8.

Figure 3.8
PAGE/MENU Number In
Lower Digital Display



Notice that the **MENU** LED is illuminated when the PAGE/MENU numbers are displayed.

MENU/VAL Pushbutton - This pushbutton is used to toggle the lower digital display from PAGE/MENU display to the **value** of that PAGE/MENU number. THE **VAL** LED lights when the value is being displayed.

Programming Practice

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

It is important that you take time to perform this programming practice, 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 PRACTICE.

Initial Power-Up

After the CN3220 has been properly installed and power is turned on for the first time, it will begin to operate utilizing the factory settings (as shown in the PAGE/MENU Tables). The upper digital display will contain four dashes, "----" and the lower display will contain the controller model number "CN3220".

After a short delay, during which the controller performs self-tests, the upper display will indicate the process variable (in °F) and the lower display will indicate the factory-set process set point. Since the lower display value is a set point, SET will be illuminated. Other LED's may indicate operating status, such as alarm conditions and control output.

Example Set Up

PAGE 4 of the PAGE/MENU Tables contains all of the operational and control parameters for Ramp/Soak Program #1. Your goal is to adjust the Standby Set Point, PAGE 4/MENU 1, to 100°F.

To perform the Programming Practice, you must have LEVEL C Security (or higher) entered at PAGE 1/MENU 1.

GETTING TO THE PAGE/MENU NO.

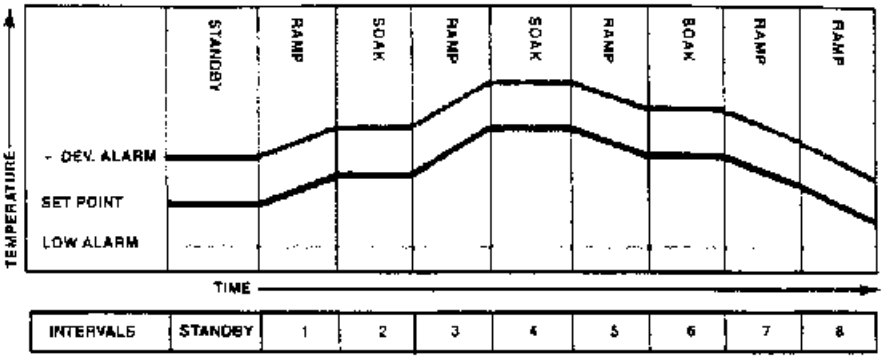
ACTION	WHAT HAPPENS	EXPLANATION
1. Press MENU/VAL to access the MENU select function.	MENU LED will light Upper Display: alphanumeric or process variable Lower Display: Current PAGE # flashes in left half, MENU # in right half	The MENU/VAL pushbutton alternately selects the MENU select function and the VALUE select function.
2. Press ▼ until the MENU digits read "0".	Upper Display: Shows the process variable	To move between the PAGE numbers, you must go to MENU 0 on any page.
3. Press MENU/VAL again.	MENU LED remains lit. Lower Display: "P 0" lights, indicating the current PAGE number is 0.	This puts you in the PAGE select function.
4. Press ▼ until "P 4" is displayed	Lower Display: "P 4"	You have moved from PAGE 0 to PAGE 4
5. Press MENU/VAL again.	Lower Display: Flashing "4 0" lights.	You are now in the MENU select function on PAGE 4 and can advance through the MENU numbers.
6. Press ▼ until MENU 1 is reached.	Lower Display: Flashing "4 1" lights. Upper Display: "Stby" the alphanumeric for PAGE 4/MENU 1, standby set point.	You are now at PAGE 4, MENU 1 and are ready to enter the new value.
ENTER THE NEW MENU VALUE:		
7. Press MENU/VAL again.	The VAL LED will light. Upper Display: Process variable Lower Display: Current MENU value (standby set point) will light.	You are now in the Value select function.
8. Press ▼ or ▼ until "100" is displayed in the lower display. NOTE: The ▼ and ▼ pushbuttons increase and decrease the display value faster as they are held pressed.	Lower Display: "100"	The new Standby set point "100" is automatically entered into memory. Adjustment is complete.
RETURN THE CONTROLLER TO THE DISPLAY MODE:		
9. Press MENU/VAL again.	Upper Display: "Stby", alphanumeric for PAGE 4/ MENU 1. Lower Display: "4 1" MENU LED will light.	You have returned to the MENU select function.
10. Press ▼ until MENU "0" is displayed in the Lower Display.	Lower Display: Flashing "4" lights.	Now that you are at MENU 0, you can enter the PAGE select function.
11. Press MENU/VAL again.	MENU LED remains lit. Lower Display "P 4" indicates you are on PAGE 4.	You are in the PAGE select function.
12. Press ▼ until you reach PAGE 0.	Lower Display "P 0"	You are now on PAGE 0 and are ready to enter the MENU select function on the PAGE.
13. Press MENU/VAL again.	Lower Display: Flashing "0 0" MENU LED lights	You are now in the MENU select function for PAGE 0.
14. Press ▼ until "0 1" is displayed in the lower display.	Upper Display: Process Variable Lower Display: Flashing "0 1"	You have selected MENU 1 on PAGE 0, which represents the Process Set Point.
15. Press MENU/VAL.	VAL LED lights Upper Display: Process Variable Lower Display: Set Point	You are now in the normal operating mode, displaying Process Variable and Set Point.

PROGRAMMING PRACTICE IS COMPLETE!

RAMP/SOAK PROGRAM OPERATION

Intervals

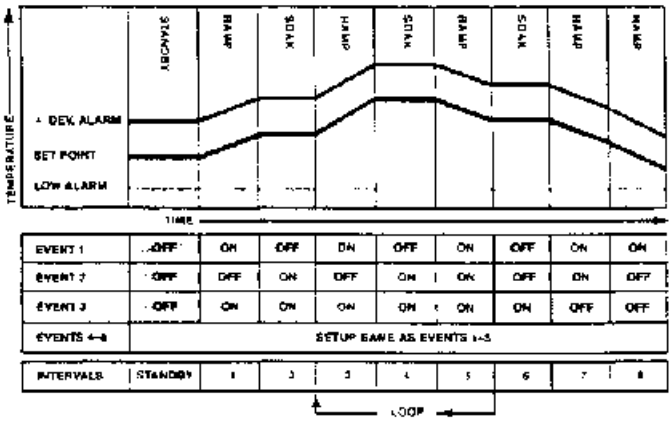
The CN3220 Ramp/Soak Controller features 4 individual Programs. Within each program there are 8 intervals plus a standby interval — the time span and set point of each of the 8 intervals being individually adjustable. These 8 intervals constitute what is referred to as the Ramp/Soak Profile. An example of a typical Ramp/Soak Profile is shown below.



Ramp/Soak Profile Graphs similar to this diagram are provided in the back of this manual to make it easier for you to graphically configure your Ramp/Soak process profiles.

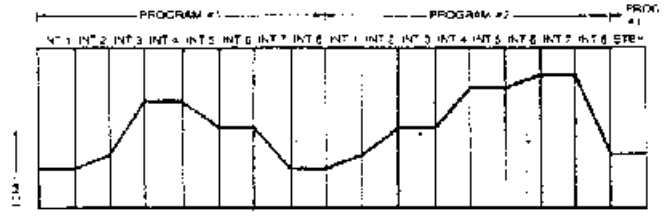
Event Outputs

Additionally, up to 8 Event Outputs (if you purchased this option) may be configured to be ON or OFF during each of the 8 intervals, as illustrated below:

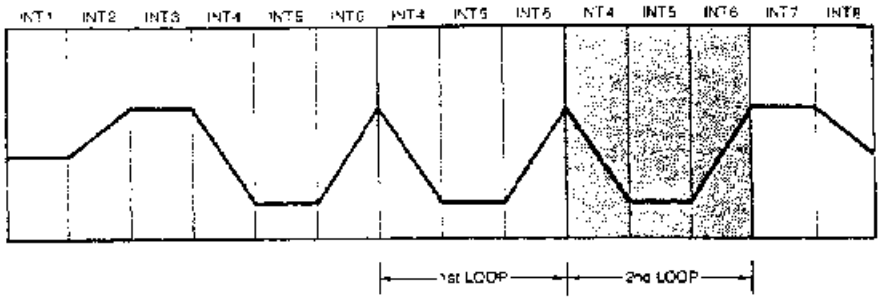


Linking and Looping

To extend the capabilities of the controller, the Programs may be linked and looped. Linking means that one Program may be "linked" to another program automatically, requiring no operator interface. For example, if Program #1 is linked to Program #2, as soon as Program #1 has completed its cycle, Program #2 will begin.



Looping means that intervals within a Program may be repeated in a looping fashion. If a loop is inserted in the Program so that Intervals 4, 5, and 6 will be repeated 2 times in addition to the single Program run of these intervals, the final process profile would look like this:



You would simply tell the controller to "loop from the end of Interval 6 to the beginning of Interval 4, 2 times" when configuring that Program.

Up to 3 loops may be established in each Program. Each of these loops has a set priority, which is discussed in detail in the "Control Theory Tutorial," Appendix I, Looping.

Programming the Ramp/Soak Programs

Each of the 4 Ramp/Soak Programs are programmed on a separate page:

Program #1 - PAGE 4
Program #2 - PAGE 5
Program #3 - PAGE 6
Program #4 - PAGE 7

The MENU numbers for each Ramp/Soak Program parameter remain the same from PAGE to PAGE, making it easier for you to learn the programming steps (for example, Program #1 Standby Set Point is PAGE 4 MENU 1, and Program #4 Standby Set Point is PAGE 7 MENU1.)

On each of the 4 Ramp/Soak Program PAGES, you will select and assign the following:

Standby Set Point
8 Time Intervals
8 Set Points
Time Units for Intervals (sec/min/hrs)
Heat and Cool Proportional Bands (#1 and #2)
Loops and Links
Event Outputs ON/OFF during each Interval
Alarms Assigned as Event Outputs
Auxiliary Ramp/Soak Set Points

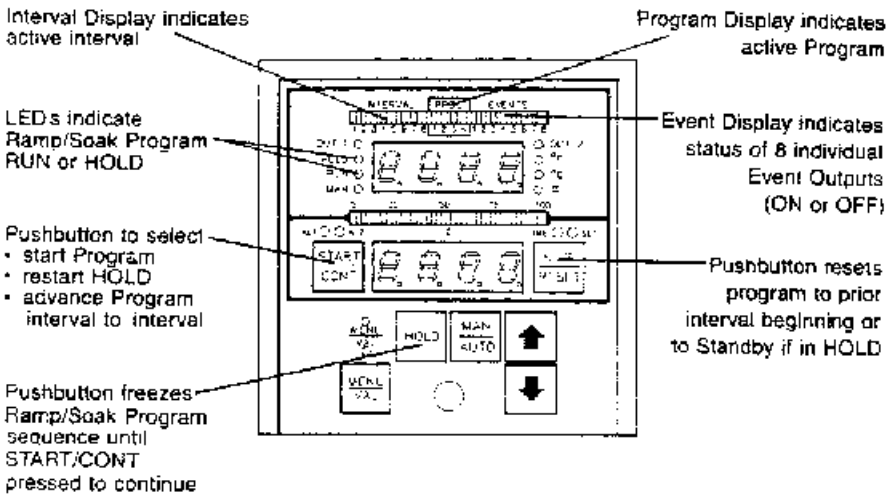
Any of the Program parameters can be changed while another Program is running without interrupting the Program in process.

Selecting and Running a Ramp/Soak Program

Once you have completed the Ramp/Soak Programming on PAGES 4-7, you are ready to select and run a Program. The Program # is selected on PAGE 1/MENU 2. Once the Program # is selected, the controller will go to Standby of the newly selected program.

The diagram below recaps the Ramp/Soak pushbutton operations and LED indications.

Figure 3.9
Ramp/Soak Pushbutton Operations and LED Indication



NOTE

If a Program is running when another Program is selected, the controller will complete the currently running Program and go to Standby of the new Program. A Program can also be selected from a remote location if your controller contains the Remote Operation Input Option (see page 38).

Starting a Program

Once the Program has been selected (PAGE 4-7/MENU 2), press START/CONT to start it. Continuing to press this pushbutton will manually advance the Program to the beginning of the next interval. At the completion of a Program, the controller will automatically go to Standby, unless the Program is linked to itself or to another Program.

Selecting Intervals

Press START/CONT to advance the Program to the beginning of the next interval. Press STOP/RESET to return the Program to the beginning of the previous interval.

Going to Standby

To interrupt the running Program and enter Standby, press HOLD, which freezes the Program. Then press STOP/RESET to go to Standby. When the controller is in Standby,

- no Interval LED's are illuminated
- the active Program # is illuminated, and
- the RUN LED is not illuminated.

Going to a New Program

While the controller is in Standby, you can switch to another Program (PAGE 1/MENU 2). Once the new Program is selected, the controller will go to the Standby set point of the newly selected Program. As stated earlier, if a Program is running when a new Program is selected, the new Program will not begin until the currently running Program is completed.

Going to HOLD

Pressing HOLD stops the Program in the current interval. The controller retains the time remaining in the interval and the set point until it is manually restarted by pressing START/CONT.

SINGLE SET POINT OPERATION

If you want to apply the controller as a single set point controller (no ramp/soak operations), you simply select "0" as the Program Selection at PAGE 1/MENU 2 and enter the process set point at PAGE 2/MENU 1. Also, select the "Controller Type" as heat or cool on PAGE 1/MENU 3.

AUTO/MANUAL OPERATION

The CN3220 controller can be switched between Automatic and Manual control by enabling Auto/Manual selection on PAGE 1/MENU 6. If this feature is disabled, the controller operates in the automatic control mode only and the MAN/AUTO pushbutton is disabled. Once this feature is enabled, the MAN/AUTO pushbutton is used to select the open loop manual mode so that the output can be manually raised and lowered with the ⬆ and ⬇ pushbuttons.* This capability is of particular importance in process applications to determine optimum control settings.

*This applies only when PID/Proportional control is selected (PAGE 2/MENU 23). The % output command cannot be adjusted beyond the output limits set in PAGE 2/MENU 15-16.

On power-up, the controller will be in the automatic mode. To enter manual operation:

1. Press MAN/AUTO
2. "MAN" LED lights
3. Ramp/Soak Program goes in HOLD
4. Output currently active will display "%" ON or "ON/OFF" in lower display
5. Adjust the output using ⬇ and ⬆.
6. Press MAN/AUTO to return to Automatic control mode
7. "MAN" LED will turn off
8. Press START/CONT to continue the Ramp/Soak Program

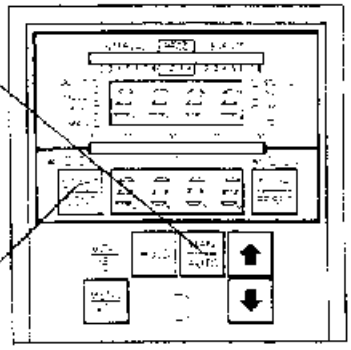


Figure 3.10
Auto/Manual Operation

When Proportional/PID control is selected for the outputs, the lower display will indicate the output % ON for both the heat and cool outputs. If ON/OFF control is selected, the ▲ and ▼ pushbuttons force the output ON and OFF, and the lower display will indicate "ON" or "OFF" for both Heat and Cool outputs. Examples of these displays are shown below.

PID CONTROL

ON/OFF CONTROL

The MEN/VAL pushbutton allows you to toggle between the two output displays (heat and cool). When first switching to manual control, the output that is currently active will be displayed in the lower display.

Bumpless Balanceless Transfer

The transfer between Automatic and Manual operation is bumpless and balanceless - when switching from automatic to manual control, the controller assumes the last output command from the automatic mode, and when returning to automatic control, the output is forced to be the last manual mode output command. This eliminates any "bumps" of disruptions to the process when switching modes.

What's Next?

You are now ready to proceed with Programming your OMEGA CN3220 Ramp/Soak Process Controller. Following are the PAGE/MENU Tables from which you can make decisions about the settings and parameters for your application. **Be sure to use the Programming Worksheets and Ramp/Soak Profile Graphs in the back of the manual to set up and record your programming.**

PAGE/MENU TABLES
SECTION 4

This section contains detailed programming information for PAGES 0-7:

PAGE 0 - Display
PAGE 1 - General Operation
PAGE 2 - Control and Alarm Parameters
PAGE 4 - Ramp/Soak Program #1
PAGE 5 - Ramp/Soak Program #2
PAGE 6 - Ramp/Soak Program #3
PAGE 7 - Ramp/Soak Program #4

PAGE 3 is a factory access PAGE and cannot be accessed in the field.

Following these tables, select the parameter values for your application, log them on the Programming Worksheets in the back of this manual, and program the CN3220 controller.

PAGE 0: DISPLAY

MENU	DISPLAY SELECTION	SECURITY LEVEL
The Display Page selects the value that will be displayed in the lower digital display. The default setting (Menu 1 selection) is suggested for display during normal operations.		
1	Process set point in units of process variable	A
2	Process variable	
3	Deviation in units of process variable	
4	Heat Output command in % full ON	
5	Cool Output command in % full ON	
6	Program #	
7	Interval #	
8	Time left in interval	
9	Remote set point in units of process variable	
10	Remote set point in % sensor input range	
11	Remote set point in mA	
12	Process out/aux. ramp/soak set point in units of process variable	
13	Process out/aux. ramp/soak set point in % sensor input range	
14	Process out/aux. ramp/soak set point in mA	
15	Proportional output Command (0 to 100%)	
16	Heat Disintegration Command (−0 to 100%)	
17	Cool Disintegration Command (− 100 to 100%)	
18	Integral command (− 100 to 100%)	
19	Rate command (− 100 to 100%)	

PAGE 1: GENERAL OPERATION

CUE	MENU	SELECTION	AVAILABLE SETTINGS	FACTORY SETTING	SECURITY LEVEL
LocK	1	Security Lock	Security Codes (0 to 9999)	458 = Level D	A
prog 0 = no 1 = P1 2 = P2 3 = P3 4 = P4 5 = rSP	2	Program Selection	0 = None (Single set point control) 1 = Program #1 2 = Program #2 3 = Program #3 4 = Program #4 5 = Remote Ramp/Soak enabled	1 = Prg1	C
	3	Controller Type	1 = Single Output Heat Control 2 = Single Output Cool Control 3 = Heat/Cool Control	3 = Heat/Cool Control	D
SEnS	4	Sensor Input Selection	1 = JT/C 2 = KT/C 3 = ET/C 4 = 100 Ohm Plt RTD 5 = 4-20 mA (1-5 Vdc) 6 = TT/C 7 = RT/C 8 = ST/C	1 = JT/C	D

PAGE 1: GENERAL OPERATION

CUE	MENU	SELECTION	AVAILABLE SETTINGS	FACTORY SETTING	SECURITY LEVEL
unit	5	Unit for Process Variable	1 = °F (Primary) 2 = °C (Secondary) 3 = 0 to 99.99% (Basic)	1 = °F	D
Auto	6	Auto/Manual Setup	0 = OFF 1 = ON	1 = ON	D
SPUL	7	Set Point Upper Limit	0.00 to 99.99% of sensor range	99.99%	E
SPLL	8	Set Point Lower Limit	0.00 to 99.99% of sensor range	0.00%	E
	9-20	See "Error Codes and Troubleshooting", Section 10 in this Manual			F

PAGE 2: CONTROL AND ALARM PARAMETERS

CUE	MENU	SELECTION	AVAILABLE SETTINGS	FACTORY SETTING	SECURITY LEVEL
SP	1	Set Point (for constant set point operation—no Ramp/Soak program selected)	Instrument sensor range	Instrument sensor range minimum	B
PID Control Parameters for Heat and Cool Outputs. See "Control Theory Tutorial," Appendix I for detailed descriptions of control parameters.					
OFSt	2	Manual Reset	– 100.0 to 100.0	0.0	B
Proportional Band #1 and #2—In MENUS 3-6 you will select two proportional band settings for Heat PID control and two proportional band settings for Cool PID Control. When making selections for each Ramp/Soak Program on PAGES 4-7, you will specify which pair of proportional band settings to use (Heat PB#1 and Cool PB#1, or Heat PB#2 and Cool PB#2).					
HPb1	3	Heat Proportional Band #1	0.1 to 999.9% span	5.0	D
HPb2	4	Heat Proportional Band #2			D
CPb1	5	Cool Proportional Band #1			D
CPb2	6	Cool Proportional Band #2			D
HrSt	7	Heat Automatic Reset	0.00 to 99.99 repeats/minute	0.00	D
CrSt	8	Cool Automatic Reset			D
HrtE	9	Heat Rate	0 to 1000 seconds		D
CrtE	10	Cool Rate			D
	11	Heat Offset (PID)	– 25.00 to 25.00% of Proportional Band	0.00	D
	12	Cool Offset (PID)			D
	13	Heat Overlap	0.0 to 1000.1% Proportional Band	0.0	D
	14	Cool Overlap			D
HtLt	15	Heat Output Limit	0.0 to 100.0% ON	100.0	D
CtLt	16	Cool Output Limit			D
HcyC	17	Heat Cycle Time*	0.1 to 65.0 seconds	1.0	D
CcyC	18	Cool Cycle Time*			D
*Cycle Time varies with the output type of your controller. Refer to Appendix I "Control Theory Tutorial" for recommended Relay, Triac, 4-20mA and Solid State Relay Drive Cycle Time settings.					
ON/OFF Control Parameters for Heat and Cool Outputs. Detailed descriptions of these parameters are given in Appendix I.					
HtoF	19	Heat Offset (ON/OFF)	– 25.00 to 25.00% of instrument sensor range	0.00	D
CtoF	20	Cool Offset (ON/OFF)			D
	21	Heat Dead band	0.01 to 25.00% of instrument sensor range	0.01	D
	22	Cool Dead band			D

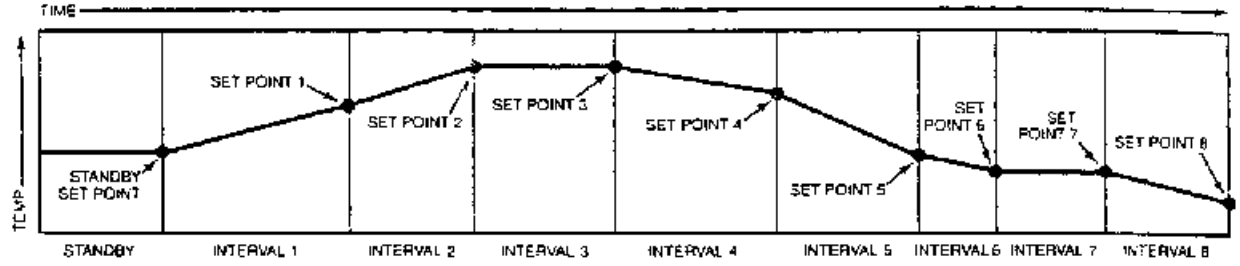
PAGE 2: CONTROL AND ALARM PARAMETERS (CONT'D)					
CUE	MENU	SELECTION	AVAILABLE SETTINGS	FACTORY SETTING	SECURITY LEVEL
Control Mode Selection					
ctrL	23	Control Mode(s)	1 = HPCP Heat PID, Cool PID 2 = HPCO Heat PID, Cool ON/OFF 3 = HOCP Heat ON/OFF, Cool PID 4 = HOCO Heat ON/OFF, Cool ON/OFF	HPCP	D
Alarm Set-Up — When using Output #2 as Alarm, you may choose to disable the OUT 2 LED. See Appendix I, topic "Output LED"					
A1 SP	24	Alarm#1 Set Point (Output #2)	Instrument sensor range	Range maximum	D
A2SP	25	Alarm #2 Set Point (Output #3)		Range minimum	D
A1 tS	26	Alarm #1 — Type (Output #2)	1 = HidE High Alarm, NDE* 2 = LOdE Low Alarm, NDE 3 = PdE Deviation, NDE 4 = -dE Deviation, NDE 5 = dE Deviation, NDE 6 = Evt Event Output 7 = HiE High Alarm, NE** 8 = LoE Low Alarm, NE 9 = PdE + Deviation, NE 10 = -dE Deviation, NE 11 = dE Deviation, NE *NDE = Normally De-Energized (Contacts closed in Alarm) **NE = Normally Energized (Contacts open in Alarm)	HidE	D
A2tY	27	Alarm #2 — Type Output #3)		2 LOdE	D
A1 db	28	Alarm #1 Dead band	0.1 to 25.00% of instrument sensor range	0.25	D
A2db	29	Alarm #2 Dead Band			
A1 on	30	Alarm #1 ON Delay	0.1 to 999.9 seconds	0.1	D
A2on	31	Alarm #2 ON Delay			
A1 oF	32	Alarm #1 OFF Delay	0.1 to 999.9 seconds	0.1	D
A2oF	33	Alarm #2 OFF Delay			
d. 5t	34	Disintegration Time (Manual to Automatic Proportional Control)	1 to 100 seconds	10	D
Inverting Outputs					
	35	Output #1	0 = Not inverted 1 = Inverted	0	D
	36	Output #2	(Inverted Example — 0% = 20mA, 100% = 4mA	0	D

NOTE When using as a Bimodal (Heat/Cool) controller, Output #3 becomes ALARM 1 or EVENT A. Reference MENU #s 24, 26, 28, 30 and 32.

PAGE 4: RAMP/SOAK PROGRAM 1 **PAGE 6: RAMP/SOAK PROGRAM 3**
PAGE 5: RAMP/SOAK PROGRAM 2 **PAGE 7: RAMP/SOAK PROGRAM 4**

CUE	MENU	SELECTION	AVAILABLE SETTINGS	FACTORY SETTING	SECURITY LEVEL

Ramp/Soak Program Sets Up: In MENUS 1-17 you will establish the times and set points for each of the 8 Intervals that make up a Ramp/Soak Program. Time units (seconds, minutes or hours) are selected in MENU 18. **Graphs and Worksheets are provided in the back of this Manual to help you in configuring and programming the Controller.**



StbY	1	Standby Set Point	Instrument Sensor Range	Instrument Range Min.	C
Int 1	2	Interval 1 Time Span	0 = Program End 1 to 9999 seconds 0.1 to 999.9 minutes 0.01 to 99.99 hours	1 second	C
SP 1	3	Set Point 1	Instrument Sensor Range	Instrument Range Min.	C
Int2	4	Interval 2 Time Span	0 = Program End 1 to 9999 seconds 0.1 to 999.9 minutes 0.01 to 99.99 hours	1 second	C
SP 2	5	Set Point 2	Instrument Sensor Range	Instrument Range Min.	C
Int3	6	Interval 3 Time Span	0 = Program End 1 to 9999 seconds 0.1 to 999.9 minutes 0.01 to 99.99 hours	1 second	C
SP 3	7	Set Point 3	Instrument Sensor Range	Instrument Range Min.	C
Int4	8	Interval 4 Time Span	0 = Program End 1 to 9999 seconds 0.1 to 999.9 minutes 0.01 to 99.99 hours	1 second	C
SP 4	9	Set Point 4	Instrument Sensor Range	Instrument Range Min.	C
Int5	10	Interval 5 Time Span	0 = Program End 1 to 9999 seconds 0.1 to 999.9 minutes 0.01 to 99.99 hours	1 second	C
SP 5	11	Set Point 5	Instrument Sensor Range	Instrument Range Min.	C
Int6	12	Interval 6 Time Span	0 = Program End 1 to 9999 seconds 0.1 to 999.9 minutes 0.01 to 99.99 hours	1 second	C
SP 6	13	Set Point 6	Instrument Sensor Range	Instrument Range Min.	C
Int 7	14	Interval 7 Time Span	0 = Program End 1 to 9999 seconds 0.1 to 999.9 minutes 0.01 to 99.99 hours	1 second	C
SP 7	15	Set Point 7	Instrument Sensor Range	Instrument Range Min.	C
Int8	16	Interval 8 Time Span	0 = Program End 1 to 9999 seconds 0.1 to 999.9 minutes 0.01 to 99.99 hours	1 second	C
SP 8	17	Set Point 8	Instrument Sensor Range	Instrument Range Min.	C
Un it	18	Time Units	1 = 1 to 999 seconds 2 = 0.1 to 999.9 minutes 3 = 0.01 to 99.99 hours	1 = seconds	C

PAGE 4: RAMP/SOAK PROGRAM 1 **PAGE 6: RAMP/SOAK PROGRAM 3**
PAGE 5: RAMP/SOAK PROGRAM 2 **PAGE 7: RAMP/SOAK PROGRAM 4**

CUE	MENU	SELECTION	AVAILABLE SETTINGS	FACTORY SETTING	SECURITY LEVEL
Select Proportional Band #1 or #2—as programmed on PAGE 2/MENU 3-6, to be used in this Program					
Pb	19	Proportional Band #1 or #2	1 = PB #1	1	D
Power Outage Recovery					
rEOP	20	Recovery Options After Power Outage	0 = Go to STDBY 1 = Resume Program at last active Interval	1 = Resume Program	D
Program Looping and Linkage Set Up: In MENUS 21-29 you may establish up to 3 separate program Loops. In MENU 30 you can link this Program to any other program, or to itself so that it runs continuously					
1Fro	21	**Loop 1 Loop from end of Interval A**	**A = 0 to 8**	**0 = Disable**	D
1 to	22	**To the beginning of Interval B**	**B = 0 to 8**	**0 = Disable**	
1 no	23	**C number of times**	**C = 0 to 9999 (0 = Continuous)**	**1**	D
2Fro	24	Loop 2 Loop from end of Interval A	A = 0 to 8	0 = Disable	D
2 to	25	To the beginning of Interval B	B = 0 to 8	0 = Disable	
2 no	26	C number of times	C = 0 to 9999 (0 = Continuous)	1	D
3Fro	27	**Loop 3 Loop from end of Interval A**	**A = 0 to 8**	**0 = Disable**	D
3 to	28	**To the beginning of Interval B**	**B = 0 to 8**	**0 = Disable**	
3 no	29	**C number of times**	**C = 0 to 9999 (0 = Continuous)**	**1**	D
LinK	30	Link the end of this Program to the beginning of Program #	0 = No Linking 1 = Program #1 2 = Program #2 3 = Program #3 4 = Program #4 5 = Continuous	0 = No Linking	D

Event Output Set Up: Detailed instructions for Event Output Set Up are given in Section 5 of this manual. Simply enter the sum of Event "ON" Codes at the MENU numbers corresponding to the intervals.

Event Output	Event ON Codes
1	1
2	2
3	4
4	8
5	16
6	32
7	64
8	128

SbEt	31	Standby Events	0 to 255 (sum of ON codes)	0	D
1 E	32	Interval 1 Events		1	D
2 E	33	Interval 2 Events		2	D
3 E	34	Interval 3 Events		4	D
4 E	35	Interval 4 Events		8	D
5 E	36	Interval 5 Events		16	D
6 E	37	Interval 6 Events		32	D
7 E	38	Interval 7 Events		64	D
8 E	39	Interval 8 Events		128	D

PAGE 4: RAMP/SOAK PROGRAM 1 **PAGE 6: RAMP/SOAK PROGRAM 3**
PAGE 5: RAMP/SOAK PROGRAM 2 **PAGE 7: RAMP/SOAK PROGRAM 4**

Optional Program Set Up — The following Options may be assigned ON in any interval by adding the ON Codes and entering that sum at the MENU number corresponding to the appropriate interval.

Options	ON Codes
Change time units from those specified in MENU 18:	
Seconds	OFF = 0 ON = 1
Minutes	OFF = 0 ON = 2
Hours	OFF = 0 ON = 4
Assign Alarm #1 as an Event Output "A"	OFF = 0 ON = 8
Assign Alarm #2 as an Event Output "B"	OFF = 0 ON = 16
Hold after interval completed (puts unit on hold at the end of the interval. All Events ON in that interval will remain ON until the Program is "Continued" and the interval is complete)	OFF = 0 ON = 64
Guaranteed Soak, assumes that the soaking time in an interval does not begin until the process reaches set point. See Appendix I for detailed description. Set the Guaranteed Soak differential in MENU 49	OFF = 0 ON = 128

*To disable OUT 2 LED, see Appendix I, topic "Output LED".

CUE	MENU	SELECTION	AVAILABLE SETTINGS	FACTORY SETTING	SECURITY LEVEL
oPSt	40	Standby Options	0, 8, 16, 24	0	D
oP.1	41	Interval 1 Options	0 to 255 (any sum of Options ON Codes)	0	
oP.2	42	Interval 2 Options			
oP.3	43	Interval 3 Options			
oP.4	44	Interval 4 Options			
oP.5	45	Interval 5 Options			
oP.6	46	Interval 6 Options			
oP.7	47	Interval 7 Options			
oP.8	48	Interval 8 Options			
GSdb	49	Guaranteed Soak Differential	0.01 to 99.9% of sensor input range	.50%	D
Auxiliary Ramp/Soak Set Point: This option allows the controller to function as a set point generator, sending a set point signal (expressed in % of output span 4-20mA or 1-5 Vdc) as assigned in each interval.					
	50	Standby Set Point	0.00 to 99.99%	0%	D
	51	Set Point 1			
	52	Set Point 2			
	53	Set Point 3			
	54	Set Point 4			
	55	Set Point 5			
	56	Set Point 6			
	57	Set Point 7			
	58	Set Point 8			

NOTE: Be sure to make MENU settings for each PAGE/PROGRAM.

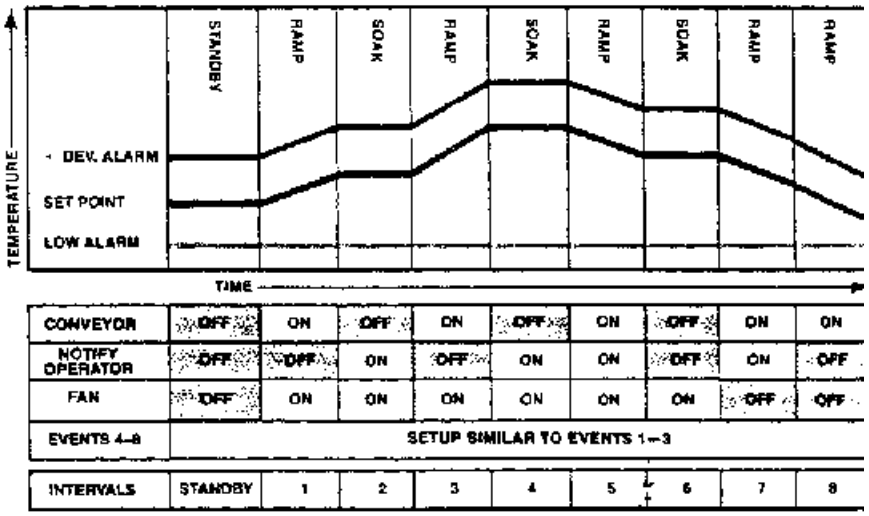
SECTION 5
EVENT OUTPUTS AND REMOTE RAMP/SOAK OPERATION INPUTS

EVENT OUTPUTS OPTION -4, 5, 6, 7, 8 or 9

One of the most versatile features of the CN3220 controller is its capability to assign 8 Event Outputs to the Ramp/Soak Program. This Event Output feature is found in CN3220 controllers ordered with option -4, 5, 6, 7, 8 or 9.

An Event Output is a simple ON or OFF signal that may turn a peripheral device ON or OFF. These events might be to turn a fan on or off, to turn on a light or annunciator, to open a solenoid valve, or switch on a conveyor belt. How these Event Outputs might be used in a process is illustrated below.

Figure 5.1
Event Outputs Applied In a Process



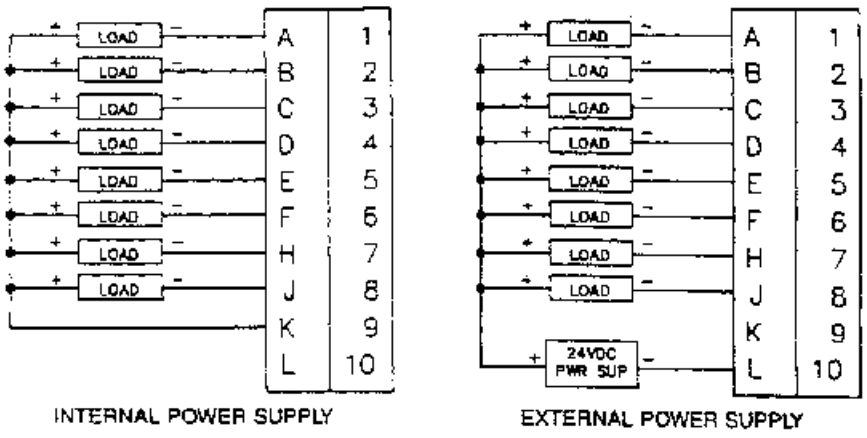
CONVEYOR	OFF	ON	OFF	ON	OFF	ON	OFF	ON	ON
NOTIFY OPERATOR	OFF	OFF	ON	OFF	ON	ON	OFF	ON	OFF
FAN	OFF	ON	ON	ON	ON	ON	ON	OFF	OFF
EVENTS 4–8	SETUP SIMILAR TO EVENTS 1–3								
INTERVALS	STANDBY	1	2	3	4	5	6	7	8

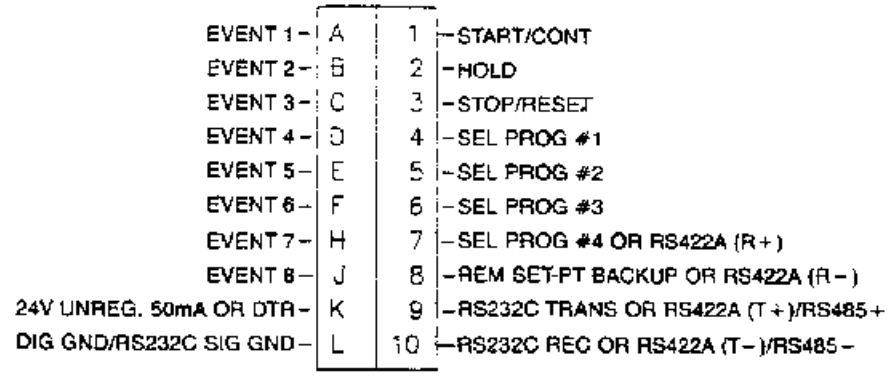
If more than 8 Event Outputs are required for a Program, Output #2 (Alarm #1) and Output #3 (Alarm #2) may be configured as Event Outputs instead of control or alarm outputs, for a total of 9 or 10 Event Outputs. This applies only if your controller is equipped with one or both of these outputs and **they are NOT 4-20 mA outputs**. Instructions for configuring these Outputs as Event Outputs are also given in the PAGE/MENU table portion of this section.

WIRING

The Event Outputs are wired to the Digital Interface Connector, terminals A-L, as shown below. These outputs drive the 24 Vdc coil of a relay or a solid state relay. An external 24 Vdc power supply is also required (OMEGA P/N V24Y101). For loads up to 50 mA, 20 Vdc unregulated, terminal K can be used as an internal power supply to drive one or two event outputs. Wiring instructions for both an Internal Power Supply connection and External Power Supply connection are given in Figure 5.2.

Figure 5.2
Field Wiring for Event Outputs





If you are using Digital Communications with the CN3220 controller, and your computer terminal requires a "Data Terminal Ready" signal, then the terminal K will not be available as a Power supply. See page 43, Digital Communications, for more details.

What's Next?

As you saw in the previous diagram, each Event can be made to turn ON or OFF at the beginning of each of the 8 intervals. This is accomplished through simple programming.

Programming the 8 Event Outputs

The Event Outputs for each Ramp/Soak Program are programmed in MENU Numbers 31 through 39 of their respective PAGES 4 through 7. This portion of the PAGE/MENU Table, presented earlier in Section 4, is repeated below:

PAGE 4: RAMP/SOAK PROGRAM 1 / PAGE 5: RAMP/SOAK PROGRAM 2 / PAGE 6: RAMP/SOAK PROGRAM 3 / PAGE 7: RAMP/SOAK PROGRAM 4					
CUE	MENU	SELECTION	AVAILABLE SETTINGS	FACTORY SETTING	SECURITY LEVEL
SbEE	31	Standby Events	0 to 255 (sum of ON codes)	0	D
.1 E	32	Interval 1 Events		1	D
.2 E	33	Interval 2 Events		2	D
.3 E	34	Interval 3 Events		4	D
.4 E	35	Interval 4 Events		8	D
.5 E	36	Interval 5 Events		16	D
.6 E	37	Interval 6 Events		32	D
.7 E	38	Interval 7 Events		64	D
.8 E	39	Interval 8 Events		128	D

Each of the Event Outputs #1 - #8 has an a different ON code, and an OFF code of "0". Simply add up the ON codes for the Events that should be ON during each interval, and enter that summed value at the appropriate MENU number.

Event Output #	ON Code
1	1
2	2
3	4
4	8
5	16
6	32
7	64
8	128

Example: Adjust Program 2, Interval 3 so that the following Events are ON

Event 1 - Indicator Light
Event 3 - Conveyor Belt
Event 4 - Vents Open
Event 7 - Notify Operator

The ON codes for each of these Events are:

Event 1 = 1
Event 3 = 4
Event 4 = 8
Event 7 = 64

TOTAL = 77

Enter the value "77" at PAGE 5/MENU 34 (for Program 2, Interval 3).

Perform this procedure for all 8 Intervals, plus the Standby Interval, for each of your Ramp/Soak Programs.

Configuring Outputs #2 and #3 (Alarms #1 and #2) as Event Outputs

If more than 8 Event Outputs are required by your process application, or your controller is not equipped with the Event Output option and you need 2 Event Outputs, you may configure Alarms #1 and #2 as Event Outputs in the programming, PAGE 4-7/MENU 40-49, and PAGE 2/MENU 26-27. The Alarm LEDS "AL1" and "AL2" will be disabled when these outputs are used as Events instead of Alarms.

REMOTE RAMP/SOAK OPERATION INPUTS

This feature, illustrated on page 3, Application #2, allows you to make the following Ramp/Soak operation selections remotely:

START/CONT
HOLD
STOP/RESET
SELECT PROGRAM #1
SELECT PROGRAM #2
SELECT PROGRAM #3
SELECT PROGRAM #4
REMOTE SET POINT INITIATION

This feature requires that you connect relay contacts or the equivalent to the Digital Interface Connector, giving you the ability to make operation selections remotely from the remote selection device.

NOTE

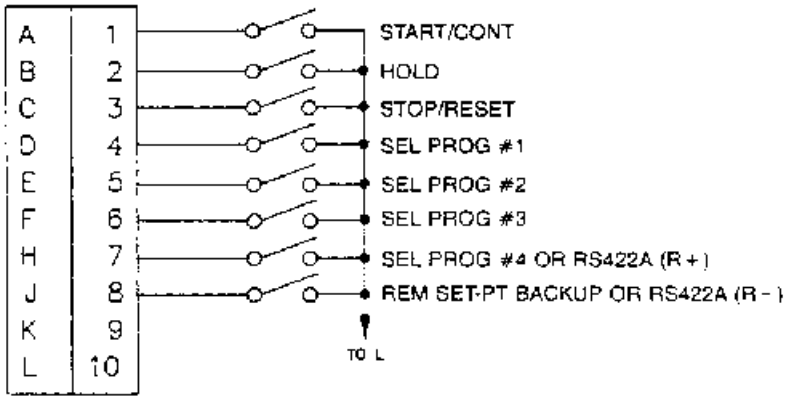
If you are using RS422A digital communications, then terminals 7 and 8 are occupied by the receive connections, and the number of remote operation selection inputs is limited to the first 6 operations listed above.

WIRING

Make the connections to the Digital Signals connector terminals 1-8 as shown in the wiring diagram Figure 5.3. These switches are 100 millisecond (minimum) momentary switches and are wired to the digital ground (terminal L) and the input.

NOTE: If a switch action is to be repeated (i.e. START/CONT must be pressed 3 times to advance from Interval #1 to Interval #4), it must be ON for 100 ms, then OFF for 100 ms before being ON again. This information applies to situations where a PLC is commanding the switching action.

Figure 5.3
Field Wiring for Remote Ramp/Soak Operation Inputs



Programming

No programming steps are required to enable the Remote Ramp/Soak Operation Input feature. Simply make the wiring connections and the remote operation capability is enabled.

SECTION 6
REMOTE SET POINT AND RAMP PROFILE ANALOG OUTPUT OPTIONS

Remote Set Point Option -1, 3 or 9

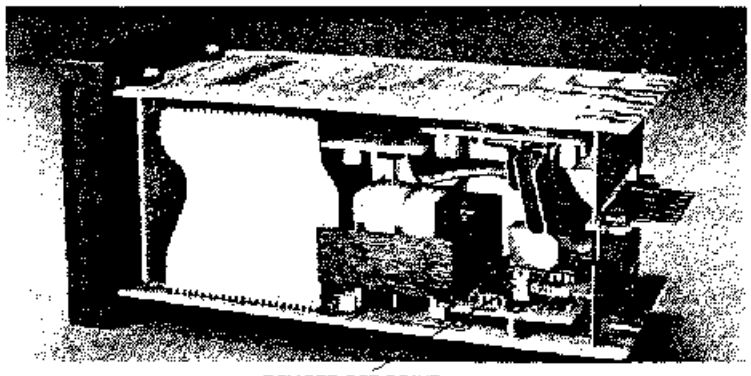
The Remote Set Point Option is found only in controllers ordered with option -1, 3 or 9.

The remote set point feature allows the control set point to be adjusted by a remote instrument or device such as a computer. The remote device must be capable of sending either a 4-20 mA or 1-5 Vdc analog set point signal to the controller.

Input Signal Selection - Either a 4-20 mA or 1-5 Vdc input signal can be selected by moving an internal jumper on the remote set point circuit card. The jumper is in the 4-20mA position when shipped from the factory. To change the unit to accept a 1-5 Vdc signal:

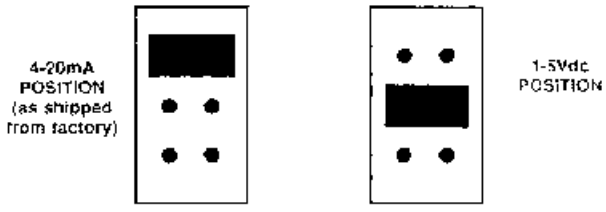
1. Remove instrument power from the controller.
2. Remove CN3220 chassis from instrument case (see page 7).
3. Locate the remote set point circuit inside the controller chassis, as shown in Figure 6.1.

Figure 6.1
Locating the Remote Set Point Circuit Card



4. Reposition the jumper as shown in diagram below.
5. Place the controller chassis back in the case and proceed to Wiring.

Figure 6.2
Jumper Positioning for Remote Set Point Input Signal Selection

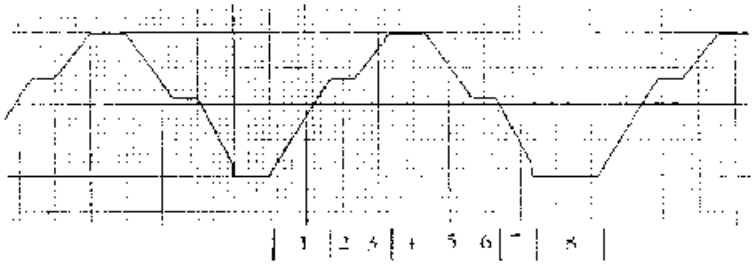


Analog Signal Output Option -2, 3, 7, 8 or 9

The Analog Signal Output Option is found only in controllers ordered with option -2, 3, 7, 8 or 9.

This option allows the process variable, process set point, auxiliary process set point, heat output command or cool output command to be transmitted to a remote recorder, computer or other device via a 4-20 mA or 1-5 Vdc analog signal. This 1-5 Vdc analog signal follows a linear curve and is factory calibrated over the entire instrument sensor range.

The following is a sample of a chart recording of the process variable, generating using the Analog Signal Output Option. Notice the 8 different intervals.

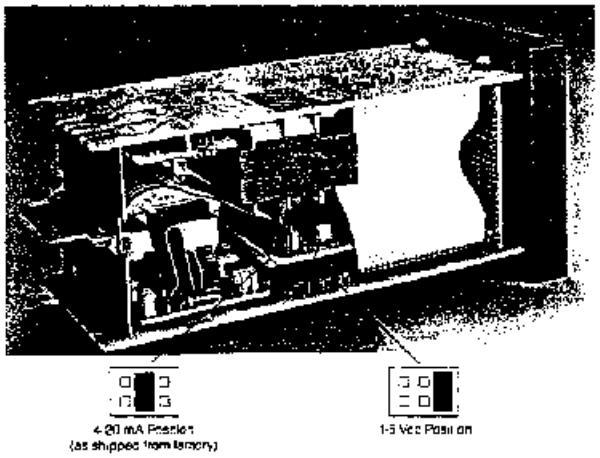


Output Signal Selection

The analog output signal jumper is in the 4-20 mA position when shipped from the factory. The 4-20 mA signal can be changed to a 1-5 Vdc output signal by moving an internal jumper on the process output circuit card. To change the analog output to a 1-5 Vdc signal:

1. Remove instrument power from the controller.
2. Remove the CN3220 chassis from the instrument case.
3. Locate the analog output signal jumper inside the controller chassis, as shown below:

Figure 6.3
Analog Output Signal Jumper



4. Reposition the jumper as shown in diagram above.
5. Place controller chassis back in case and proceed to Wiring.

WIRING

Make the wiring connections for both Remote Set Point and Analog Signal Output as shown in Figure 6.4.

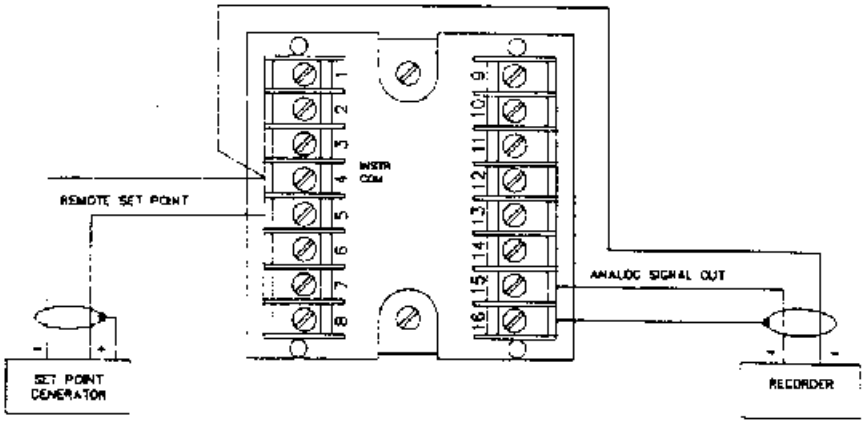


Figure 6.4
Field Wiring for Analog Signal Output and Remote Set Point Options

PROGRAMMING

Both options are enabled and defined via PAGE 10/MENU 1-2. Make the appropriate settings referring to the PAGE/MENU Table below.

MENU 1 has an optional setting (2) for Remote Set Point enabled with Back-Up for set point generator failure. In the event of a set point generator failure, the controller will operate using the last set point signal transmitted by the set point generator, and function as a fixed set point controller.

PAGE 10: REMOTE SET POINT/ANALOG OUTPUT

CUE	MENU	SELECTION	AVAILABLE SETTINGS	FACTORY SETTING	SECURITY LEVEL
REMOTE SET POINT					
rSP	1	Assignment	0 = Remote Set Point disabled 1 = Remote Set Point enabled 2 = Remote Set Point enabled with Back-up for Set Point Generator Failure	0 = Remote Set Point disabled	E
PROCESS OUT/AUXILIARY RAMP/SOAK SET POINT					
AnOt 0 = oFF 1 = P ot 2 = SPot 3 = ASPo 4 = HtCo 5 = CLCo	2	Assignment	0 = Analog Output disabled 1 = Analog Output represents Process Variable 2 = Analog Output represents Primary Ramp/Soak Set Points 3 = Analog Output represents Auxiliary Ramp/Soak Set Point (selected in PAGES 4-7/MENUS 50-58 4 = Analog Output represents Heat Output Command 5 = Analog Output represents Cool Output Command	0 = oFF	E

SECTION 7
DIGITAL COMMUNICATIONS

The Digital Communications option gives the CN3220 controller the ability to interface with computers, dumb terminals, printers and recorders. This option is found on CN3220 controllers with the option -5, 6, 8, 9, A, B, C or E.

If option code 5, 6, 8 or 9 is present, the controller may be used in the terminal or automatic data logging mode. If option code A, B, C or E is present, it may be used with OMEGA software packages or a computer developed software package. The mode that you choose is selected in the Digital Communications programming, PAGE 9.

This section of the manual presents all wiring and connection information for the Digital Communications interface. **All programming and operation information is presented in the Digital Communications Operation and Programming Supplement**, a separate document that is included with the controller, if you have purchased the Digital Communications option.

DUMB TERMINAL/COMPUTER 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 CN3220 controller, nothing more than an ASCII dumb terminal is required.

Figure 7.1 illustrates a CN3220 controller connected to a WYSE WY-60* ASCII terminal. Notice that no computer or software is required for this interface.

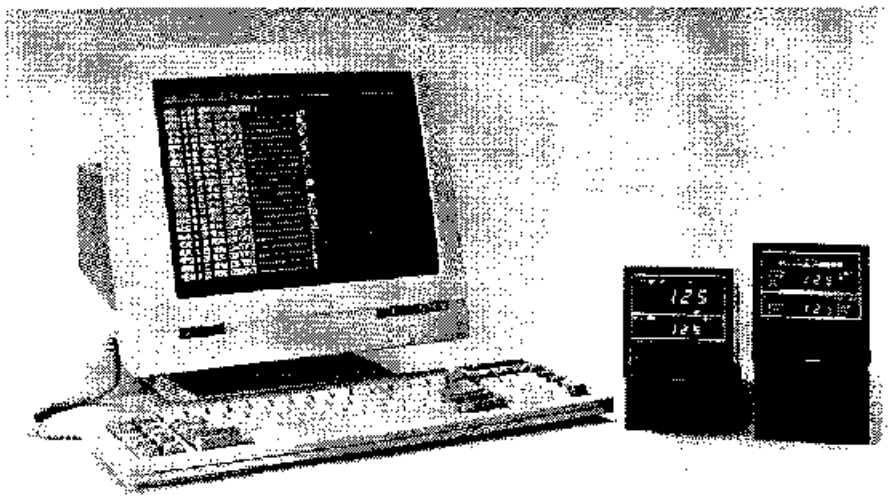


Figure 7.1
CN3220 Controller with Dumb Terminal Digital Communications Interface

*Registered trademark of WYSE Corporation.

WIRING AND TERMINAL CONNECTIONS

Wiring connections for the dumb terminal or computer interface are made on the Digital Interface Connector. Terminal designations for the Digital Interface Connector and wiring diagrams for RS232, RS422 and RS485 follow.

Figure 7.2
Digital Interface Connector Terminal Designations

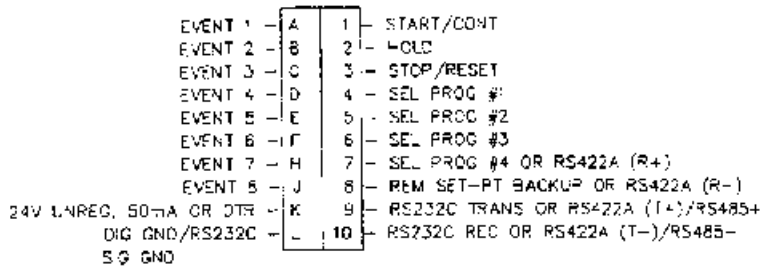


Figure 7.3
Field Wiring for RS232 Digital Communications

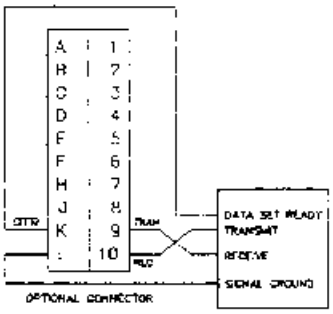


Figure 7.4
Field Wiring for RS422 Digital Communications

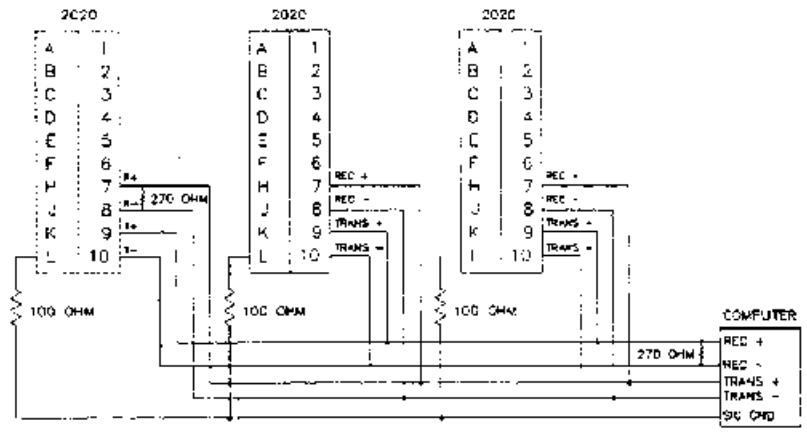
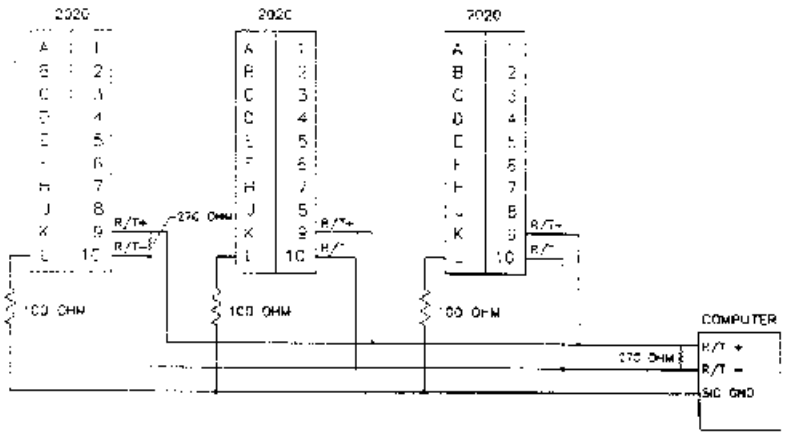


Figure 7.5
Field Wiring for RS485
Digital Communications



Since RS422A is a 4-wire connection, it requires that terminals 7 and 8 be used for receive connections and not for Remote Ramp/Soak Operation Inputs. Two jumper moves are required to complete RS422A wiring. Remove the controller chassis from its case, locate the Digital Communications circuit card (see Figure 7.6), and move the jumpers as shown below to the RS422A positions.

Figure 7.6
Digital Communications
Circuit Card

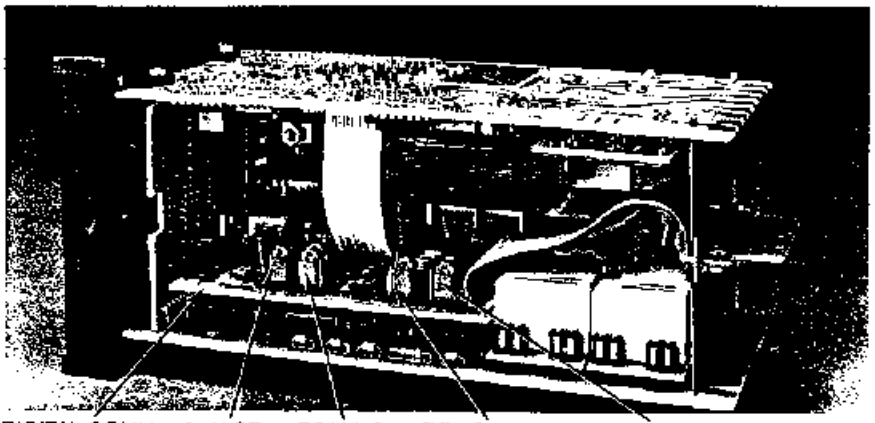
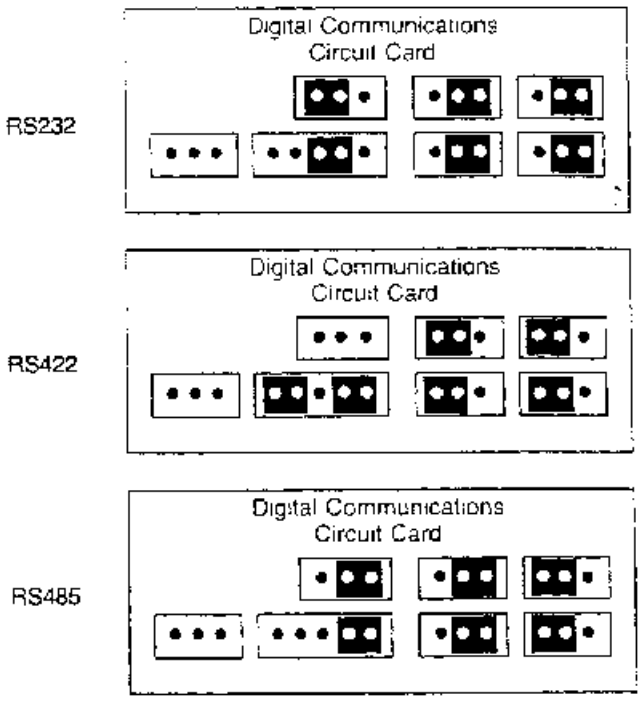


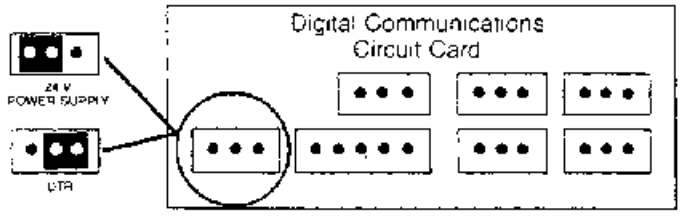
Figure 7.7
RS422A Jumper Positions



Data Terminal Ready (RS232)

Notice that terminal K is provided to supply a "Data Terminal Ready" (DTR) signal to computers that require it, and **applies only to RS232 communications.** In addition to the wiring, an internal jumper move is required to enable this function. Remove the controller chassis from its case and locate the jumper identified in Figure 7.9 below. Move the jumper to the DTR position to enable the function.

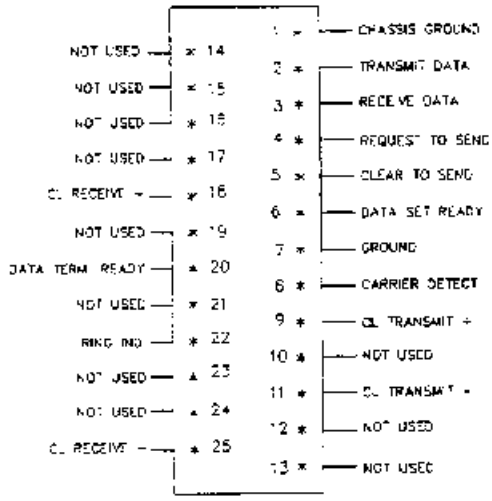
Figure 7.8
Data Terminal Ready (DTR) Jumper Position



Terminal Connections

If the terminal or computer which you are interfacing with uses a DB25 25-pin connector for its RS 232 interface , you will need a shielded serial interface cable fitted with a male 25-pin connector (DB-25) on the terminal end. Standard Connector pin assignments are given in Figure 7.9.

Figure 7.9
Standard Connector Pin Assignments



Now that the serial interface connection is complete, plug the DB-25 connector into the **MODEM** or **COMM** port on your terminal. **Be sure that the terminal is turned off before you connect the controller.**

AUTOMATIC DATA LOGGING MODE

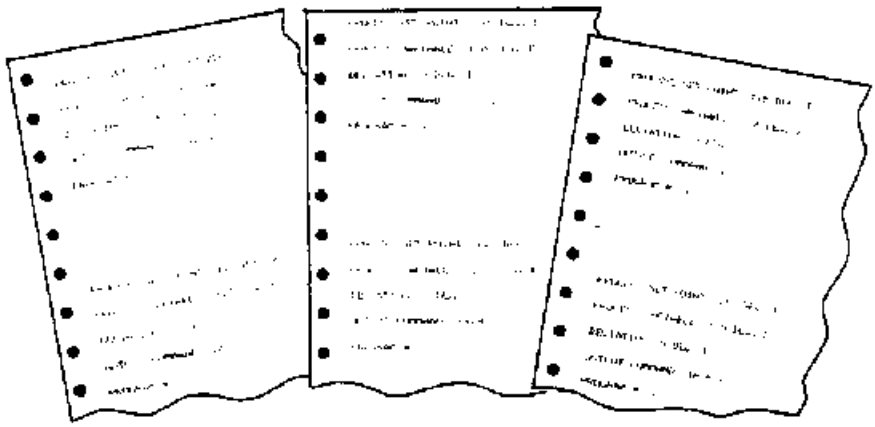
The Automatic Data Logging option is designed to provide a record or print out of selected MENU variables. The data logging function works with a simple printer or a ASCII dumb terminal.

The Automatic Data Logging print out on the following page was generated with an RS232 input printer. The MENU variables were selected from PAGE 0, with MENU 1 as the first MENU to log, and MENU 5 as the end MENU to log:

MENU 1 = Process Set Point
MENU 2 = Process Variable
MENU 3 = Deviation from Set Point
MENU 4 = Output Command in % Full On
MENU 5 = Program #

You may select as few as 1 MENU number to log, or as many as all 19 MENU numbers.

Figure 7.10
Automatic Data Logging Sample Print Out



PROGRAMMING AND OPERATION

All programming and operation information is presented in a separate document entitled Digital Communications Operation and Programming. This supplement is included in the same shipment in which you received your controller and this manual, provided you have purchased a controller with the Digital Communications option.

SECTION 8
CALIBRATION

When Is Calibration Required?

The CN3220 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:

*new input cards are installed
*all instruments in your facility are periodically calibrated to one device (metrology)
*a measurement system component fails

QUICK STEP and Manual Calibration

All calibration procedures are performed on **PAGE 11**. A simple "QUICK STEP" calibration of the full range sensor input and remote set point input is performed via MENU 1-3. MENU 4-25 are provided for manual calibration of sensor input and remote set point input in applications where the process requires extreme fine tuning over a limited range, or where an "artificial offset" from actual process temperature is desired. The Analog Process Signal Output/Ramp Profile Output must also be calibrated manually (MENU 24-25).

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 the calibration procedure is more complex. For cold junction temperature calibration on copper wire, the temperature of the connection terminal must be measured instead of the less accurate ambient temperatures. Also, 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 PAGE 11, you will need to be at LEVEL F Security. Enter Security Code "736" at PAGE 1/MENU 1.

QUICK STEP Calibration

To perform QUICK STEP calibration, you must first select the QUICK STEP calibration procedure code for your sensor type and the type of wire (T/C extension or copper) from the Calibration Procedure Code Table below. This code will "tell" the CN3220 what sensor type you are using and the calibration range.

Figure 8.1
QUICK STEP Calibration Procedure Codes

Sensor Type	Wire Type	Code
Cold Junction Comp.	Copper with variable volt. source or RTD simulator	1
J Thermocouple		2
K Thermocouple		3
E Thermocouple		4
100 ohm Platinum RTD		5
4-20 mA/1-5 Vdc		6
T Thermocouple		7
R Thermocouple		8
S Thermocouple		9
J Thermocouple	T/C Extension with T/C Simulator	10
K Thermocouple		11
E Thermocouple		12
100 ohm Platinum RTD		13
4-20 mA/1-5 Vdc		14
T Thermocouple		15
R Thermocouple		16
S Thermocouple		17
Analog Input	0 and 9.999 V, fixed volt. source	18
J/K/E Thermocouple	0.0000 and 40.0000 mV fixed volt. source	19

QUICK STEP calibration is performed via MENU numbers 1, 2 and 3, as shown in the PAGE/MENU table below.

PAGE 11: CALIBRATION					
CUE	MENU	SELECTION	AVAILABLE SETTINGS	FACTORY SETTING	SECURITY LEVEL
QUICK STEP CALIBRATION					
	1	Cold Junction Temperature	0.0 to 150.0°F	As Required	F
	2	Quick Step Calibration	Sensor and Wire Type Code	0 = None	F
	3	Procedure steps	0 = Start	See following Instructions	F
			1 = Input Minimum (zero)		F
			2 = Input Maximum (span)		F
			3 = Finished		F

Instructions for Cold Junction Compensation Calibration

1. Enter the controller terminal temperature in MENU 1.

2. Enter a "1" in MENU 2 to calibrate the cold junction compensation offset based on the temperature entered in menu #1.

3. Enter a "1" in MENU 3. The upper display will indicate "—" and then revert to the process variable. The lower display will automatically increment to "3", indicating that the cold junction compensation procedure is complete.

Instructions for Sensor Input Calibration

1. Enter the Calibration Procedure Code (obtained earlier in Figure 8.1, page 50) at MENU 2. For example, if you are using a type K thermocouple with thermocouple extension wire, the Code is "11".

2. Set the sensor simulator to the minimum range value for the sensor (sensor "zero") and wait 30 seconds for the electronics to stabilize. Sensor ranges are given in Figure 1.3 on page 3.

3. Enter "1" at MENU 3 and wait until the dashes in the upper display disappear, indicating that Step 1 of the calibration is complete.

4. Set the sensor simulator to the maximum range value for the sensor (sensor "span"). Wait 30 seconds for the electronics to stabilize.

5. Enter "2" at MENU 3 and wait until the dashes in the upper display disappear and the value in the lower display automatically increments to 3, "1, 2, 3", indicating that Step 2 of the calibration is complete.

6. **Do not change the MENU 3 value after calibration is complete or the controller will continue to calibrate. Return to the MENU mode (by pressing the MENU/VAL pushbutton) and exit the PAGE.**

MANUAL CALIBRATION

Manual calibration may be performed when your application requires calibration over a limited range or an offset from actual process input, or to calibrate the Analog Process Output/Ramp Profile Output and Remote Set Point 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 type there are 2 corresponding MENU numbers - one for zero and one 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.

The PAGE/MENU table gives the MENU numbers and sensor ranges for all sensor input types, as well as the Remote Set Point Input and Process Signal Output.

Sensor Input Manual Calibration Instructions

In these instructions, assume that a K thermocouple input is used. From the PAGE/MENU table, you can see that MENU 8 is for zero calibration and MENU 9 is for span calibration.

1. Access PAGE 11/MENU 8 and select the value to be displayed in the lower display by pressing MENU/VAL. The "VAL" LED will light.

2. Set the sensor simulator to the zero calibration value of -100 F.* Wait 30 seconds to allow the electronics to stabilize.

3. Press the ^ or V pushbutton until the upper display value equals the sensor input value.*

4. Access PAGE 11/MENU 9 and select the value to be displayed in the lower display by pressing MENU/VAL. The"VAL" LED will light.

5. Set the sensor simulator to the span calibration value of 2100 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 1-6 until **both** values equal their respective sensor input values.

*When performing manual calibration on an RTD input, the equivalent resistance value (ohms) should be used for the zero and span values.

**For voltage/current input calibration, the displayed values are expressed in 0 to 100% of span, or special values as set on PAGE 12.

Analog Output Manual Calibration Instructions

The CN3220's Analog Process Output cannot be calibrated automatically. Instructions for manual calibration follow:

1. Access PAGE 1/MENU 2 and enter the value "0". This disables ramp/soak programs and enables the use of PAGE 2/MENU 1 (single set point operation) as process set point.

2. Access PAGE 10/MENU 1 and enter the value "0". This disables the remote set point.

3. Access PAGE 10/MENU 2 and enter the value "2". This assigns the analog output to represent the primary ramp/soak set point.

4. Connect the appropriate meter (current or voltage) to measure the analog output.

5. Access PAGE 2/MENU 1 and adjust the value to its minimum possible setting for the sensor type selected on PAGE 1/MENU 4.

6. Access PAGE 11/MENU 24 and adjust the value, until the output equals 4 mA or 1 Vdc.

7. Access PAGE 2/MENU 1 and adjust the value to its maximum possible setting for the sensor selected on PAGE 1/MENU 4.

8. Access PAGE 11/MENU 25 and adjust the value until the output equals 20 mA or 5Vdc.

9. The analog output calibration is complete. Return all PAGE/MENU settings (other than those on PAGE 11) back to their original values before returning the unit to operation.

PAGE 11: CALIBRATION					
CUE	MENU	SELECTION	AVAILABLE SETTINGS	FACTORY SETTING	SECURITY LEVEL
	4	Cold Junction Zero	SEE "Sensor Input Manual Calibration Instructions" on preceding pages.		F
	5	Cold Junction Span			F
	6	J T/C Zero Calibration			F
	7	J T/C Span Calibration			F
	8	K T/C Zero Calibration			F
	9	K T/C Span Calibration			F
	10	E T/C Zero Calibration			F
	11	E T/C Span Calibration			F
	12	100 ohm Plt. Zero Calibration			F
	13	100 ohm Plt. Span Calibration			F
	14	4-20 mA Zero Calibration			F
	15	4-20 mA Span Calibration			F
	16	T T/C Zero Calibration			F
	17	T T/C Span Calibration			F
	18	R T/C Zero Calibration			F
	19	R T/C Span Calibration			F
	20	S T/C Zero Calibration			F
	21	S T/C Span Calibration			F
	22	Remote Set Point Zero Calibration			F
	23	Remote Set Point Span Calibration			F
	24	Analog Out Zero Calibration			F
	25	Analog Out Span Calibration			F

SECTION 9
SPECIFICATIONS

Control Mode (Field Selectable)	ON/OFF Proportional (P) Proportional with automatic reset/integral and/or rate/derivative (PID, PI, PD)
Auto/Manual Operation	Bumpless,balanceless transfer with Proportional Control. Disintegration Time = 1-100 seconds

RAMP/SOAK SELECTIONS

32 Intervals	4 programs, 8 intervals per program
Selectable Time Ranges	1-9999 seconds 0.1 to 999.9 minutes 0.01-99.99 hours
Linking	Programs can be linked together
Looping	3 assignable loops per program 1-9999 or continuous run for each loop
Automatic Hold	Programmable for each interval
Guaranteed Soak	Programmable for each program Deadband of 0.01 to 99.99% of instrument sensor range
Event Outputs	8 optional field assignable event outputs
Ramp/Soak Function Inputs	8 contact closures to digital ground for remote selection of START, STOP, selecting Programs 1-4, and Remote Set Point Tracking

CONTROL ADJUSTMENTS (Field Selectable)

Control Set Point	0 to 100% of span (°F,°C or %)
Set Point Limits	0.00 to 99.99% of span, adjust for minimum and maximum
Deadband	0.01 to 25.00% of span
Proportional Bands* (Gain)	0.1 to 999.9% of span, adjust for minimum and maximum
Manual Reset	-100.0 to 100.0
Automatic Reset*	0.00 to 99.99 repeats per minute
Rate*	0 to 1000 seconds

Offset*	-25.00% to 25.00% of full ON
Overlap*	0.0 to 1000.1% of full ON
Output Cycle Time*	0.1 to 65.0 seconds
Output Limit*	0.0 to 100.0%

*Indicates separate control adjustments for Heat and Cool Outputs

CONTROL OUTPUTS (Field Changeable)

Relay	Normally-open contact rated 5.0 amps at 120 Vac or 2.5 amps at 230 Vac (resistive load). Not recommended for driving unsnubbed contactors.
ac SSR	1 amp continuous, 10 amp in-rush current at 120 or 230 Vac
Current	4-20 mA into a 0-800 ohm load
dc Pulse	Transistor output of 20 Vdc nominal at 40 mA

EVENT OUTPUTS

Output Type	Open collector transistors with integral transistors tied to instrument 24Vdc unregulated power supply
Output Sink	50 mA at 2 Volts continuous

ALARM OUTPUTS

Relays	Normally open contact rated 5.0 amps at 120 Vac 2.5 amps at 230 Vac (resistive load). Normally energized or normally de-energized.
ac SSR	Rated 1 amp continuous, 10 amp in-rush current at 120 or 230 Vac
dc Pulse	Transistor output of +20Vdc nominal at 40 mA

ALARM MODES (Field Selectable)

Normally energized or de-energized:
High, range 100% of span, non-latching

Low, range 100% of span, non-latching

+ Deviation, 0 to 250°F above control set point, non-latching

-Deviation, 0 to 250°F below control set point, non-latching

+/- Deviation, 0-250°F above/below control set point, non-latching

Event Output	ON or OFF during any interval
Reset Differential	0.01 to 25.00% of span
ON Time Delay	0.1 to 999.9 seconds
OFF Time Delay	0.1 to 999.9 seconds

INPUT SELECTIONS

Thermocouple	Types J, K, E, T, R and S, non-isolated and isolated
RTD	100 ohm platinum, alpha=0.00385 DIN standard
Current/Voltage	4-20 mA/1-5 Vdc, isolated or non-isolated, field selectable range to 3 significant digits

INPUT SPECIFICATIONS

Type J Thermocouple (Iron/Constantan)	-100 to 1400°F (-73 to 760°C)
Type K Thermocouple (Chromel/Alumel)	-100 to 2100°F (-73 to 1149°C)
Type E Thermocouple (Chromel/Constantan)	-100 to 1600°F (-73 to 593°C)
Type T Thermocouple (Copper/Constantan)	-350 to 750°F (-212 to 399°C)
Type R Thermocouple (Platinum/13% Plat. 87% Rhodium)	50 to 3000°F (10 to 1649°C)
Type S Thermocouple (Platinum/10% Plat. 90% Rhodium)	50 to 3000°F (10 to 1649°C)
100 Ohm Platinum RTD	-200 to 1000°F (-128 to 538°C)
4 to 20 mA Current	0.00% to 99.99%, can be scaled to any range in field
1 to 5 Vdc	0.00% to 99.99%, can be scaled in field

INPUT SAMPLE RATE	4 samples per second

READOUT ACCURACY

Type J,K,E,T,R,S Thermocouples	+/- 2°F (1°C)
100 Ohm Platinum RTD	+/- 2°F (1°C)
Voltage/Current	+/- 0.1%
Readout Stability	Typically better than 0.15°F (J,K,E) and 0.05 F (T,R,S and RTD) per 1°F change in ambient temperature

OPEN SENSOR CONDITION

Control Output	0 to 100%, field selectable
Display Indication	"OPEN"

OUT OF RANGE CONDITION

Control Output	0 to 100%, field selectable
Display Indication	"HHHH" for over-range condition "LLLL" for under-range condition
Alarm Output Status	Alarm Action is programmable

ANALOG REMOTE SET POINT OPTION

Input Range	4-20 mA standard, conversion to 1-5 Vdc voltage by internal jumper change. Referenced to instrument common
Input Resistance	4-20 mA source, 250 ohms 1-5 Vdc source, 110k ohms

ANALOG OUTPUT OPTION

Assignable Functions	Heat or Cool Output Commands, Primary Set Point, Auxiliary Ramp/Soak Set Point or Linearized Process Signal (field selectable)
Output Signal	4-20 mA standard, conversion to 1-5 Vdc voltage by internal jumper change. 4-20 mA signal referenced to instrument common
Accuracy	0.1% of span

DIGITAL COMMUNICATIONS OPTION

RS232C/RS422A	Single drop, non-isolated or isolated
RS485	Multi-drop, isolated
Automatic Logging Interval	1 to 9999 minutes
Baud Rate	300, 600, 1200, 2400, 4800, 9600
Data String (Single Drop)	ASCII, Asynchronous, one start, one parity, seven data and one stop bit

INSTRUMENT POWER

120 or 230 Vac, -15% to +10%, 50-60 Hz. Nominal power consumption is 7 VA.

OPERATING ENVIRONMENT

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

DIMENSIONS

Panel Cutout	3.6 x 3.6 inches (52mm x 52mm), per DIN 43700
Depth Behind Panel	7.9 inches (200mm)
Front Panel Projection	0.8 inches (25mm)

INFLUENCE OF LINE VOLTAGE VARIATION

Thermocouple/RTD	+/-1 F maximum change in readout for +10%, -15% nominal line voltage
Voltage/Current	+/-0.1% maximum change in readout for +10%, -15% nominal line voltage

NOISE REJECTION

Common Mode	Less than +/- 2°F (1°C) with 230 Vac, 60 Hz applied from sensor input to instrument case (with digital filter enabled)
Series Mode	Less than +/- 2°F (1°C) with 300 mV peak to peak, 60 Hz series mode noise (with digital filter enabled)
Radio-Frequency	Typically less than 0.5% of set point span at distance of 1 m from transmitter (4W at 464 MHz)

SECTION 10
ERROR CODES AND TROUBLESHOOTING

Troubleshooting

The following Troubleshooting Guide 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.

SYMPTOM	PROBABLE CAUSE	CORRECTION
Power applied, display does not light and controller does not function	1. No power applied to controller	Check power wiring and fusing
	2. Power loss transient	Power down and re-power up
Display reads "HHHH" or "LLLL"	1. Open sensor	Check sensor wiring (PAGES 10 – 12)
		Check sensor type and selection entered on PAGE 1/MENU 4.
	2. Out of calibration	Attach sensor simulator and verify calibration.
Process does not heat up/cool down	1. No power being applied to the load	Verify output wiring (PAGES 15–17)
		Verify that load is not open—output module properly installed if changed in field.
	2. Heat output/cool output wired incorrectly.	Check control mode entered PAGE 2/ MENU 23.
Erratic Operation	1. Intermittent sensor connections.	Check sensor wiring or substitute sensor simulator.
		Power down and re-power up.
	2. Controller failure (internal)	Contact factory.
Process not in control	1. Heat/Cool output wired incorrectly	Check wiring to heat/cool outputs.
	2. Not tuned correctly	See "Tuning" in Appendix I to verify valid PID parameters entered on PAGE 2

Error Codes

The CN3220 controller is designed to perform continuous checking of internal hardware and software to insure its operating integrity.
The controller provides 7 different "Error Messages" in the upper display. The "Error Action" taken by the controller when any one of these 7 errors occurs is determined by the options you program into the controller via PAGE 1/MENU 13-20.

The Error Messages are defined below. The message will disappear from the upper display when the controller corrects the error condition (if the action programmed into the controller is sufficient to correct the problem). If the error message persists, there are manual steps suggested to correct the error.

DISPLAY	ERROR#	WHAT IT MEANS:	MANUAL CORRECTION STEPS:
Err 1	1	RAM failure on power-up self test, Outputs 1, 2, 3 off, hardware reset after 1 minute	1. Power down and up to retest RAM 2. Contact OMEGA
Err2	2	ROM failure on power-up self test, Outputs 1,2,3 off, hardware reset after 1 minute.	1. Power down and up to retest ROM 2. Contact OMEGA
Err3	3	EEPROM failure redundancy check, Outputs 1,2,3, off.	1. Power down and up to retest EEPROM 2. Reenter settings for PAGE/MENU numbers displayed in lower display, then re-power to clear
OPEn	4	Open input sensor, Outputs 1,2,3 off.	1. Check sensor wiring 2. Contact OMEGA
HHHH	5	Process over range—out of calibration, incorrect sensor or sensor incorrectly wired, Outputs 1,2,3, off.	1. Check sensor wiring 2. Check sensor type and selection on PAGE 1/MENU 4 3. Attach sensor simulator and verify calibration
LLLL	6	Process under range— same reasons as above, Outputs 1,2,3 off.	Same as above
Err7	7	Calibration error—incorrect calibration pts., sensor simulator wired incorrectly or internal electrical failure	1. Check calibration points 2. Check sensor simulator wiring 3. Contact OMEGA

Error Actions

Now that you are aware of the 7 types of error Messages, you may choose the Error Action to be taken by the controller if one of the errors occurs. The CN3220 is shipped to you configured for the Outputs to turn off in the event of an error. If you would like to change how the Outputs react to an error (turn Off or stay ON), the following Error Action Codes and the Programming Instructions will show you how.

Error Action	Code
No action	0
Display the Error Message	1
Energize Output #2—Output #2 will deenergize if this energize option is not selected	2
Energize Output #3—Output #3 will deenergize if this energize option is not selected	4
Set Output #1 to the same level and cycle time as specified for process out-of-range condition in PAGE 1/MENU 11-12*	8
Initiate software reset after 1 minute delay**	16
Initiate hardware reset after 1 minute delay***	32

*Output level and cycle time for process out-of-range: Allows the process to continue at a selected percentage of total output, rather than totally shutting down the control. For instance, a freezing process could be maintained at an acceptable, though not optimal temperature

**Initiate Software Reset: This action is similar to a computer "soft-boot". For the first minute after the error number appears and before the software reset begins, the output level and cycle time of the controller will go to the level selected via PAGE 1/MENU 11-12, giving the process a chance to re-stabilize. After one minute, the controller will re-initialize and start at the beginning of the program.

***Initiate Hardware Reset: This action resets the microprocessor with internal hardware, then causes the program to start again at the beginning.

Programming Error Actions

You may select any one or combination of the above Error Actions for each of the 7 Error Messages. Simply add up the Error Action Codes, and enter the sum of the codes in the appropriate MENU numbers listed in the following PAGE/MENU table.

For example, if you wanted the following Error Actions to take place in the event of "OPEN" - the open sensor error message:

Display Error Message	= 1
Energize Output #2	= 2
Energize Output #3	= 4
Set Out #1 to specified level	= 8
TOTAL	**15**

You would enter "15" at PAGE 1/MENU 16.

PAGE 1: GENERAL OPERATIONS—ERROR ACTIONS & TROUBLESHOOTING

MENU	SELECTION	AVAILABLE SETTINGS	FACTORY SETTING	SECURITY LEVEL
9	Initiate Software Reset	0 = Disabled 1 = Initiate Reset	0	F
10	Initiate Hardware Reset	0 = Disabled 1 = Initiate Reset	0	F
11	Output Command when Process is Out of Range	0 to 100%	0%	F
12	Output Cycle Time when Process Out of Range	1 to 60 sec.	10 sec.	F
13	Err1—RAM Error	Sum of desired Error Action Codes (from previous table)	47	F
14	Err2—ROM Error		47	F
15	Err3—EEPROM Error		15	
16	Err4—Open Sensor Response		14	F
17	Err5—Process Over Range Response		14	F
18	Err6—Process Under Range Response		14	F
19	Err7—Calibration Error Response		1	F
20	Err8—Factory Code	Will not occur in field	N/A	F

APPENDIX I
CONTROL THEORY TUTORIAL

This Tutorial contains detailed descriptions of specific control parameters, Ramp/Soak control functions and other selections made through the PAGE/MENU programming of the CN3220 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 CN3220 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.

Alarm Deadband
PAGE 2/MENU 28-29

The Alarm Deadband, expressed in % of the instrument sensor range, determines at what point the alarm will go back to its normal (energized or de-energized state) state after having gone into alarm at set point. The factory setting for Alarm Deadband is 0.25% of instrument sensor range.

Alarm OFF Delay
Page 2/MENU 32-33

This setting allows you to specify a "delay" time of 0.1 to 999.9 seconds before the Alarm "turns OFF" or resets to its normal (open or closed) state after the alarm condition no longer exists. For example, assume the low absolute alarm actuates at 200°F, and will reset at 210°F. If the OFF Delay time is set at 30.0 seconds, the alarm will not actually reset until the temperature has been at or above 210°F for 30.0 seconds. This feature will lengthen the time the unit allows for the operator to be notified of the alarm condition, and can eliminate "temporary" alarm resets due to brief process excursions to within acceptable ranges.

Alarm ON Delay
PAGE 2/MENU 30-31

This setting allows you to specify a "delay" time of 0.1 to 999.9 seconds before the Alarm will "turn ON" or actuate an alarm when an alarm condition has been reached. Assume that the high absolute alarm actuates at 1150 F. If the ON Delay time is set at 120.0 seconds, the Alarm will not actuate until the process temperature has been at or above 1150 F for 120.0 seconds. The Alarm ON Delay is used to eliminate unwanted alarm action due to momentary process excursions beyond the alarm set point.

Alarm Set Point
PAGE 2/MENU 24-25

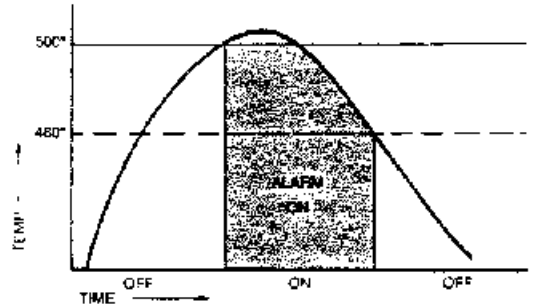
The Alarm Set Point determines at what process variable the alarm will actuate. With High and Low absolute Alarms, the Alarm Set Point is constant. For example, if the High Alarm Set Point is 500 F, the Alarm will always actuate when the process temperature reaches or exceeds 500 F.

With Deviation alarms, the Alarm Set Point determines at what point below or above the process set point the alarm will actuate, as illustrated under **Alarm Types.**

Alarm Types
PAGE 2/MENU 26-27

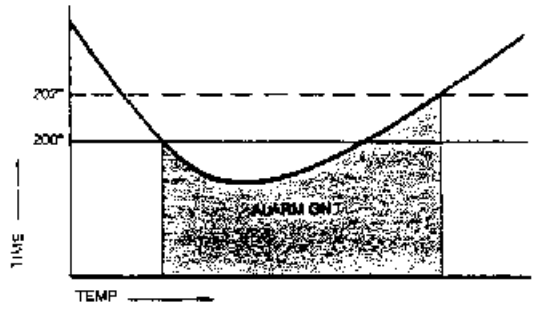
There are 5 alarm types available on the CN3220 controller.

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.**



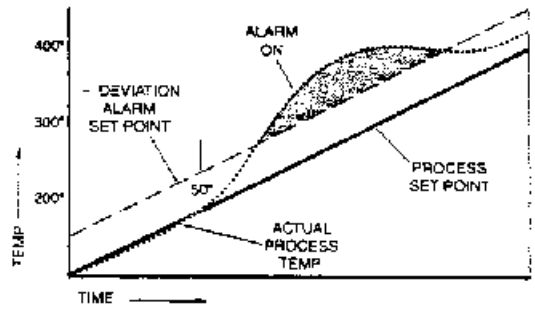
High Alarm Set Point = 500°F
Deadband = 20°F (x% span)

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



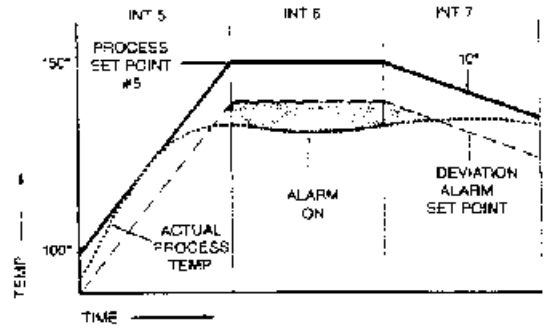
Low Alarm Set Point = 200°F
Deadband = 2°F (x% span)

+ 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.



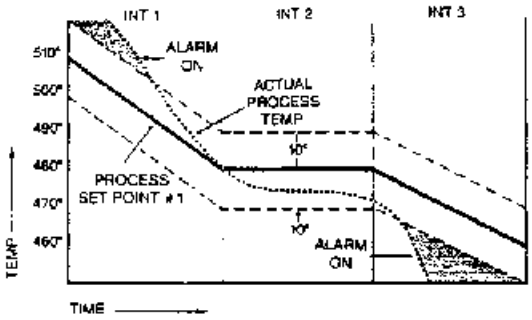
Process Set Point #1 = 200°F
Process Set Point #2 = 300°F
Process Set Point #3 = 400°F
+ Deviation Alarm Set Point = +50°F

- 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 Set Point #5 = 150°F
Process Set Point #6 = 150°F
Process Set Point #7 = 135°F
- Deviation Alarm Set Point = -10°F

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



Each of these 5 alarm types may be chosen as **normally-energized (NE)** contacts, or **normally-deenergized** (NDE) contacts. For example, a normally-deenergized High Alarm will **close** when actuated (process temperature is equal to or greater than the Alarm set point).

When an Alarm is actuated, the corresponding **AL1 or AL2 LED will light and remain illuminated until the Alarm condition no longer exists.** If Alarm #1 (Output #2) or Alarm #2 (Output #3) is being used as an Event Output, the Alarm LED's are disabled.

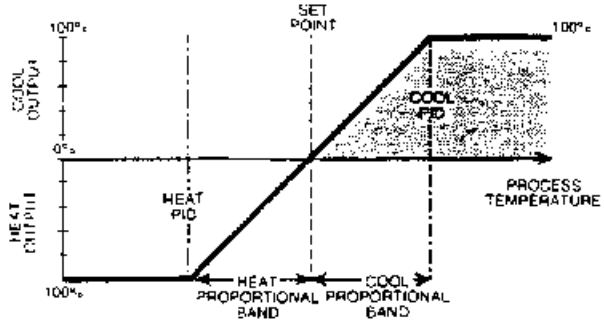
Automatic Reset PID
PAGE 2/MENU 7-8

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 2/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 CN3220 controller to minimize process overshoot by inhibiting the reset action during warm-up or cool-down.

Bimodal Control
PAGE 1/MENU 3
PAGE 2/MENU 23

A type of control with two outputs - for example, one for heating and one for cooling, each output having individually adjustable PID or ON/OFF control modes.



Cycle Time
Proportional/PID
PAGE 2/MENU 17-18

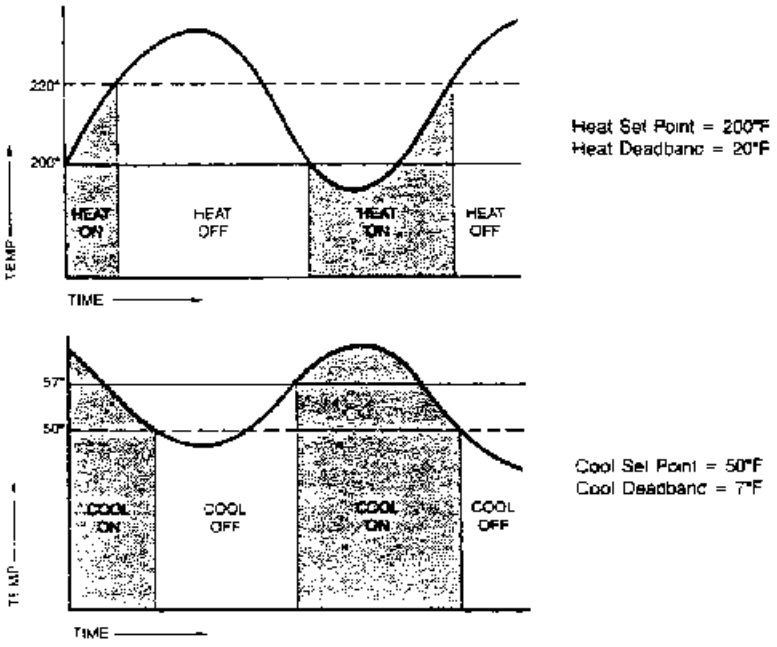
Cycle Time is the time it takes to complete a full ON to OFF to ON cycle in a time proportioning control system. For most processes, a fast cycle time (less than 5 seconds) will produce better control of loads with fast response and little time lag. You should be very careful when setting the cycle time 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, ac SSR, dc Pulse) and analog proportional outputs (4-20 mA, 1-5 Vdc). OMEGA recommends the following cycle time settings:

Relay Output - 30.0 seconds
ac SSR Output - 1.0 seconds (for direct loads), increase time if the triac drives a magnetic contactor
4-20 mA Current Output - 0.3 seconds
dc Pulse - 1.0 seconds

Deadband
ON/OFF
PAGE 2/MENU 21-22

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.

Dead band is adjustable from -25.00% to 25.00% of span, and is programmed separately for each of the two outputs, Heat and Cool, and applies only if the output is programmed as ON/OFF control on PAGE 2/MENU 23.

Disintegration Time (Proportional)
PAGE 2/MENU 34

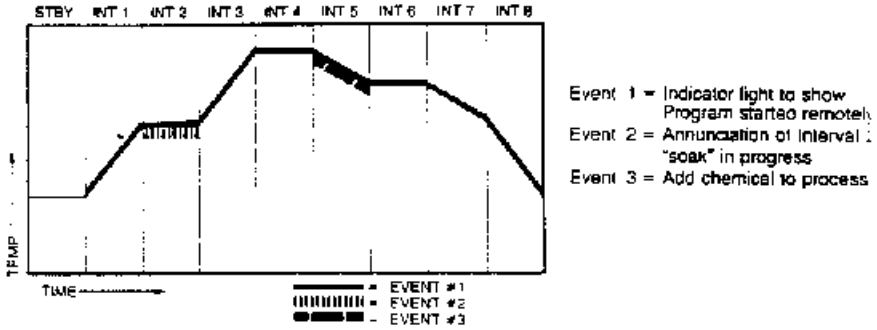
The Disintegration Time setting applies to the Auto/Manual control function if the output control mode is Proportional (Automatic Reset = 0). It is designed to allow "bumpless transfer" when going from Manual control to Automatic control. When the switch from Manual to Automatic control is made, the 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 the setting (longer time), the slower the output changes when going from Manual control to Automatic.

Event Outputs
PAGE 4-7/MENU 31-48

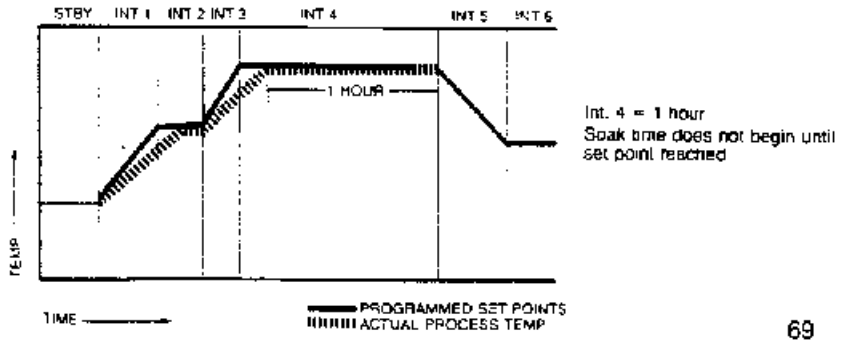
Events Outputs are merely timed outputs which are either ON or OFF during an entire Ramp/Soak Program interval. There are a total of 8 Event Outputs (if purchased) available for assignment in each Ramp/Soak Program. Additionally, Outputs #2 and #3 may be assigned as Event Outputs (PAGE 4-7/MENU 40-48).

The diagram below illustrates three Event Outputs in a Ramp/Soak Program. Notice that the Event will remain ON for the **entire interval**.



Guaranteed Soak
PAGE 4-7/MENU 31-39

This Ramp/Soak feature, when enabled, assures that the "soaking" time in an interval does not begin until the process reaches set point or is within the Guaranteed Soak Differential band. Only when the process variable is within the Guaranteed Soak Differential will the interval time begin counting down. See **Soak Interval** and **Guaranteed Soak Differential** for more information.



Guaranteed Soak Differential
PAGE 4-7/MENU 49

The Guaranteed Soak Differential establishes a symmetrical +/- band around the process set point that insures that the interval soaking time does not begin until the process is within this band.

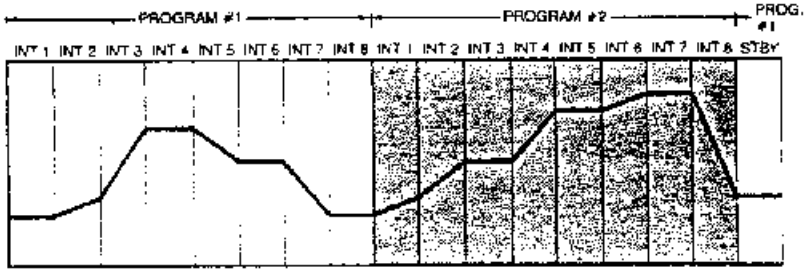
Inverting Outputs
PAGE 2/MENU 35-36

This selection allows you to invert the outputs, Heat and/or Cool, should it be necessary to drive an output requiring the opposite phase. For example, if the output is 4-20 mA, when inverted, the 20 mA signal would represent 0% ON and the 4 mA signal would represent 100% ON.

When the Output is inverted, the OUT 1 or OUT 2 LED is also inverted.

Linking Programs
PAGE 4-7/MENU 30

This Ramp/Soak feature allows you to Link the end of a Program to the beginning of another Program, as illustrated below.



In this example, Program #1 is linked to Program #2. When Program #2 is completed, the process will go to the Standby interval of Program #1, since Program #1 is the Program selected on PAGE 1/MENU 2. The Program selected dictates the Standby interval that will be in effect when the linked program(s) is/are complete.

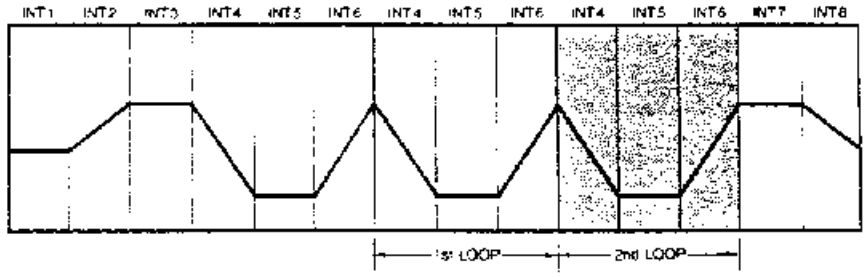
A Program can also be linked to itself, meaning that the Program would run continuously until stopped by the operator (press STOP/RESET), in which case it would then go to Standby.

Looping Intervals
PAGE 4-7/MENU 21-29

The Ramp/Soak Looping feature allows you to establish up to 3 "loops" within a Program. Looping means that an interval or series of intervals within a Program may be repeated in a looping fashion. You simple specify:

Loop the end of Interval ___ to the beginning of Interval ___ and repeat the loop ___ times.

An example of a single Loop within a Program is illustrated below:



If more than one Loop is programmed within a single Program, the Loops are prioritized, or "nested". Loop 1 has the highest priority, and Loop 3 has the lowest priority. A general rule of thumb is:

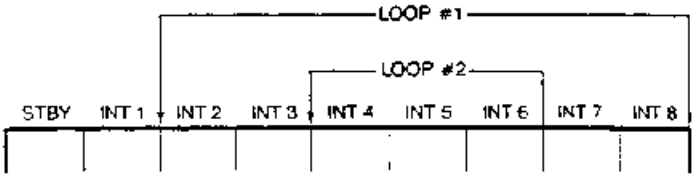
Each time Loop #1 runs, it resets all other Loop counters within Loop #1

Each time Loop #2 runs, it resets Loop #3 Loops within Loop #2, but cannot reset Loop #1

Loop #3 cannot reset any other Loop counters

Following are two different Loop configurations, illustrating this loop prioritization. The intervals and number of times each loop runs are the same, but the prioritization is different. Notice how differently the Program is executed in each example.

Looping
Example A:



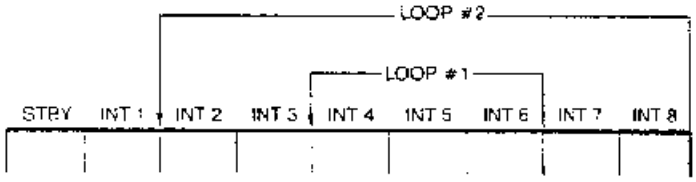
Loop #1 = Loop the end of Interval **8** to the beginning of Interval **2**, **4** times.

Loop #2 = Loop the end of Interval **6** to the beginning of Interval **4**, **2** times.

Loop #1, looped **outside** of Loop #2, has highest priority.

<u>Operation</u>
*Loop #2 will run 2 times
*Loop #1 will run 1st time, resetting Loop #2 counter to 0
*Loop #2 will run 2 times
*Loop #1 will run 2nd time, resetting Loop #2 counter to 0
*Loop #2 will run 2 times
*Loop #1 will run 3rd time, resetting Loop #2 counter to 0
*Loop #2 will run 2 times
*Loop #1 will run 4th (final) time, resetting Loop #2 counter to 0
*Loop #2 will run 2 times
***Loop #1 has counted out (4 times) and will not run again**
***Program goes to completion**

Looping
Example B:



Loop #1 = Loop the end of interval **6** to the beginning of interval **4**, **4** times.

Loop #2 = Loop the end of interval **8** to the beginning of interval **2**, **2** times.

Loop #1, looped **Inside** of Loop #2, has the highest priority.

Operation
*Loop #1 will run 4 consecutive times, counting out

*Loop #2 will run 2 consecutive times, counting out (because Loop #1 has counted out, the Loops are not reinitiated)

***Both Loops #1 and #2 counted out, so the program goes to completion.**

Manual Reset
Proportional Control
PAGE 2/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 temperature, therefore, if the process temperature is stabilizing below set point, increase the manual reset.

Offset
Proportional Control
PAGE 2/MENU 11-12
ON/OFF Control
PAGE 2/MENU 19-20

Offset should be used in applications where it is undesirable to have simultaneous operation of heat and cool outputs or energization within a specified narrow range about set point.

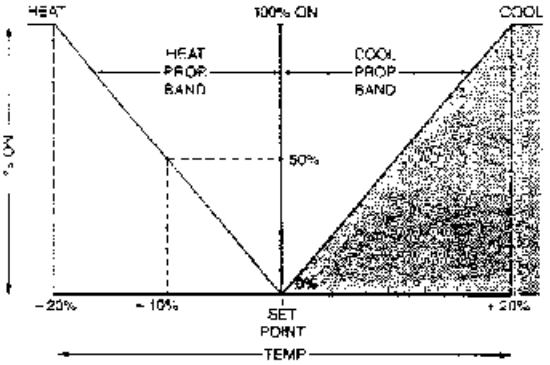
The Offset adjustment creates a dead zone between set point and the point at which the Output is active. Offset may be adjusted for both the Heat output and Cool output.

Diagrams A, B and C illustrate the effects of various offset set ups. Figure A shows both the heat and cool proportional bands originating at the set point with 0.0% Offset. With zero error signal, neither the heat nor cool outputs will be on. If the error signal deviates in either the heat or cool direction, a corresponding output will occur.

Figure B shows both the heat and cool proportional bands offset or shifted by +25.0%. This shift in effect "mirrors" both proportional bands by 5%. If the error signal deviates in either the heat or cool direction, a corresponding minimum output of 25% occurs.

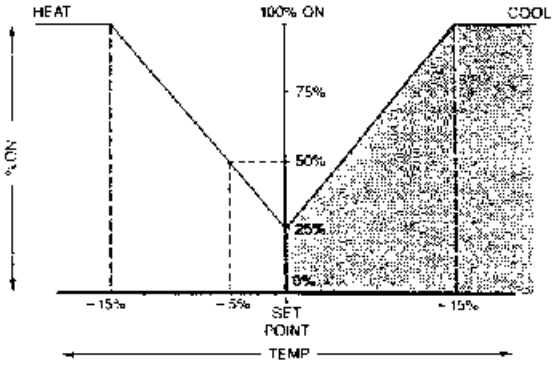
Figure C indicates the results of shifting the proportional band -25%. The proportional band remains constant at 20% for both heat and cool, but no control action occurs until the error signal has deviated 5% on either side of the setpoint.

Figure A



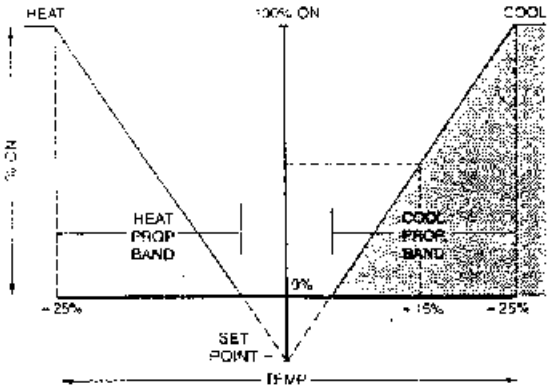
Heat Prop. Band = 20.0%
Cool Prop. Band = 20.0%
No Offset
No Overlap

Figure B



Heat Prop. Band = 20.0%
Cool Prop. Band = 20.0%
Heat Offset = +25.0%
Cool Offset = -25.0%

Figure C



Heat Prop. Band = 20.0%
Cool Prop. Band = 20.0%
Heat Offset = +25.0%
Cool Offset = -25.0%

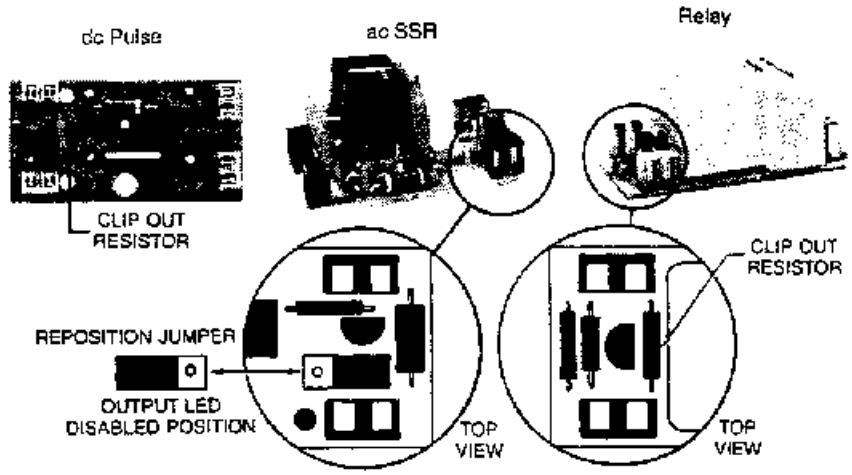
ON/OFF Control
PAGE 2/MENU 23

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. Se Hysteresis and Offset for more information on ON/OFF control.

Output LED

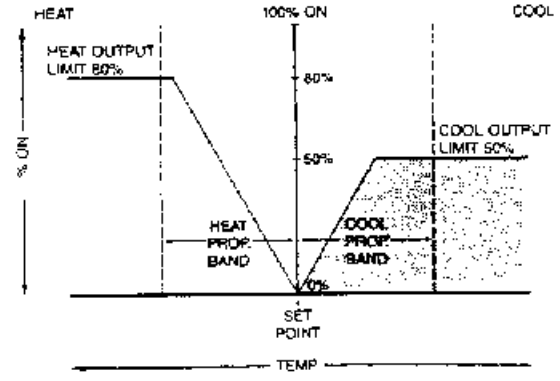
The CN3220 controller gives you the option of configuring Output #2 as an alarm or an event, instead of a control output. When this is done, it may be undesirable to have the "OUT 2" LED illuminate when the alarm or event is in an ON condition. The following hardware modification can be made to disable the OUT 2 LED.

First, you must remove the controller from its case and locate the appropriate output module, #2 or #3. This procedure is described on page 13, "Changing Output Modules." Once you have located the module, and identified whether it is an ac SSR, dc Pulse or relay output, make the necessary hardware modification as illustrated below.



Output Limits Proportional/PID
PAGE 2/MENU 15-16

The PID output for the Heat and/or Cool outputs 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 does not operate in the ON/OFF modes.



Overlap
Proportional/PID
PAGE 2/MENU 13-14

The Overlap feature allows the two outputs (heat and cool) to be on at the same time. Figure D and E define two overlap conditions. In Figure D, the heat proportional band is offset by 25% and the cool proportional band is not offset. The heat overlap is set to 100% of the heat proportional band. This causes the heat output to remain on as well as the cool output. The heat output will decrease linearly from 25% ON to 0% ON in 10% of span.

Figure D

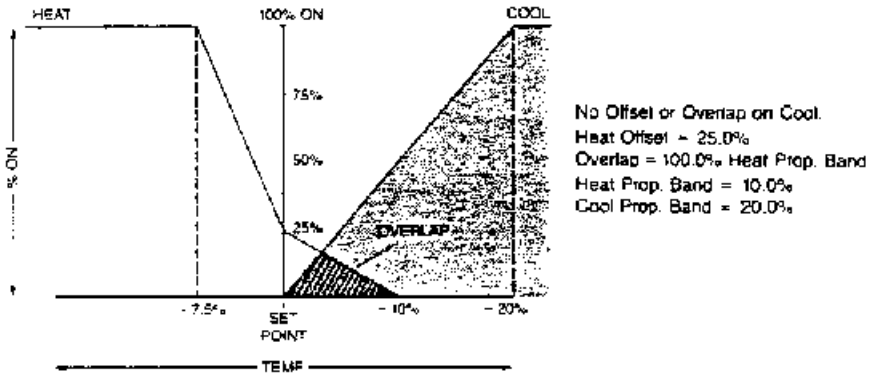
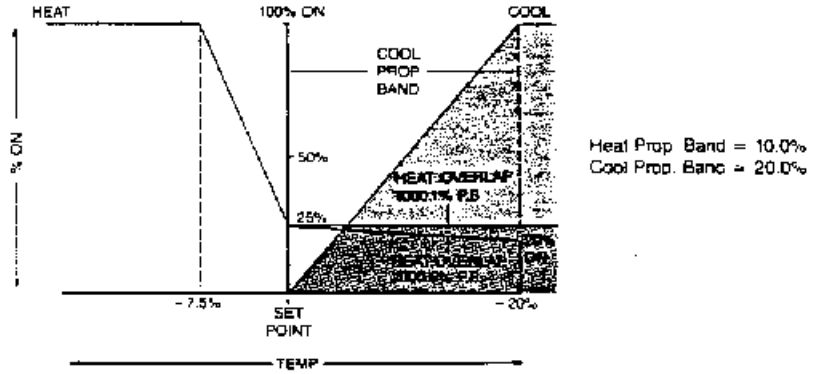


Figure E illustrates two cases. The first case is with a heat overlap setting of 1000.0% of the heat proportional band. This results in the heat output changing from 25% to 0% in a band equivalent to 10 times the heat proportional band. In the illustration, the heat output has dropped to 20% at the 100% output point in the cool proportional band (slope of decrease = 5% ON per 20% proportional band). If the overlap had been set to 1000.1% the heat would have remained 25% ON across the entire cool proportional band.

Figure E



The display on the front of the controller can represent no more than 4 digits. If a display greater than 9999 is required, the display will change from a normal base ten number system to the hexadecimal number system. Following are two examples of hexadecimal numbers that may be displayed in the overlap settings:

Base Ten Number	Hexadecimal Number
10000	2710
10001	2711

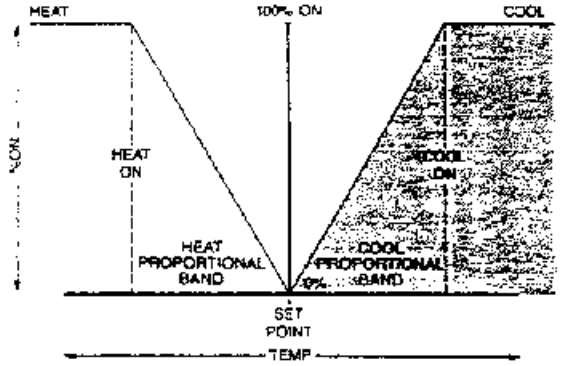
PID Control
PAGE 2/MENU 23

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.

In the CN3220 controller, both the Heat and Cool outputs can have independent PID settings, allowing for maximum flexibility of application. See PAGE 2/MENU 23 for control mode selection, and PAGE 1/MENU 3 for bimodal control selection.

Proportional Band
Proportional/PID
PAGE 2/MENU 3-6

The Proportional Band is the temperature range about set point where the proportional control action is active from 0% to 100%. Most applications require a Proportional Band setting between 1.0 and 20.0% of temperature span.



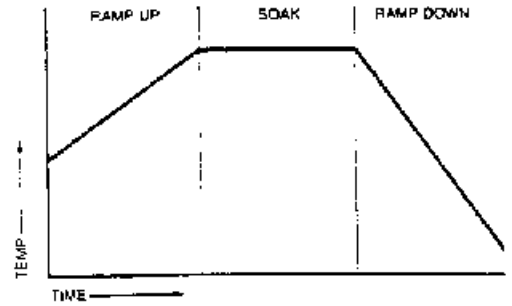
The CN3220 controller allows you to pre-establish two Proportional Band settings for each of the two outputs, Heat and Cool. This allows you to select the Proportional Band that provides the best control for different Ramp/Soak programs and processes.

Proportional Control

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

Ramp Interval

An interval within a Ramp/Soak program in which the controller action takes the process from one set point to another set point within a specified amount of time.



Rate
PID
PAGE 2/MENU 9-10

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 override 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.

Set Point Limits
PAGE 1/MENU 7-8

The Upper and Lower Set Point Limits simply allow you to pre-establish upper and lower limits for set point adjustments made on PAGE 2/MENU 1 (single set point control) or PAGE 4-7/MENU 1-17 (ramp/soak programs). This prevents dangerous over-heating or over-cooling of the process that could be caused by accidental or miscalculated set point settings.

Soak Interval

A Soak Interval is an interval in a Ramp/Soak program where the process temperature is held constant over a specified period of time. See **Guaranteed Soak** for more information on soak intervals.

Tuning Procedure
PID
PAGE 2/MENU 3-10

The following procedure gives you basic instructions for PID tuning. In applications where the CN3220 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 PAGE 2:

Proportional Band* PAGE 2/MENU 3-6
Automatic Reset (Integral) PAGE 2/MENU 7-8
Rate (Derivative) PAGE 2/MENU 9-10

PAGE 2/MENU 3-4 allow you to define two possible Proportional Band settings for heat, and MENU 5-6 allow you to define two Proportional Band settings for cool. In applications where Ramp/Soak program are not selected on PAGE 1/MENU 2 (single set point operation), Heat Proportional Band #1 and Cool Proportional Band #2 are always selected when the control output is calculated.

If a Ramp/Soak program is selected on PAGE 1/MENU2, Proportional Band #1 or #2 may be selected for the entire program. If two different proportional bands are required within a single program ramp/soak sequence, then the first program (using PB #1) should be linked to a second program (using PB #2).

Definitions

Definitions of the three PID control parameters are presented earlier in this section.

Tuning Procedure

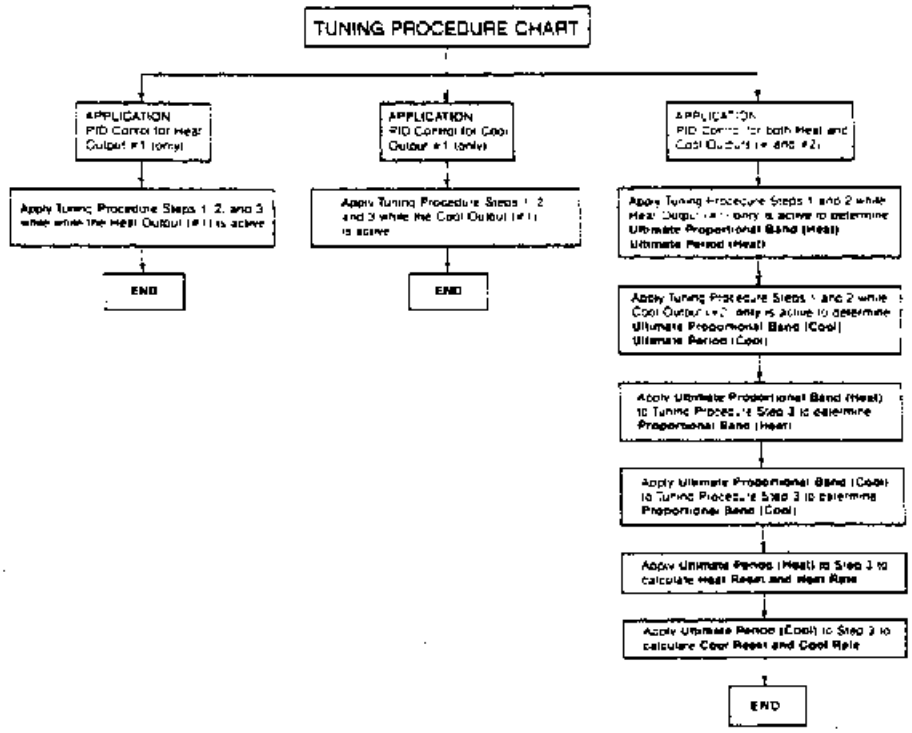
There are three applications of the CN3220 controller in which the Tuning Procedure is applied:

1. PID control is selected for Output #1 (Heat) only,
2. PID control is selected for Output #1 (Cool) only, and
3. PID control is selected for both Output #1 (Heat) and Output #2 (Cool).

The Tuning Procedure consists of three steps:

Step 1: Determining Ultimate Proportional Band
Step 2: Determining Ultimate Period
Step 3: Calculating Parameters

The following Tuning Procedure Chart will tell you how to apply these Steps, based on your application of the CN3220 controller.



Step 1: Ultimate Proportional Band

The controller should be tuned while operating in the process as a Proportional Only controller (P). It is important that Automatic Reset (PAGE 2/MENU 7-8) and Rate (PAGE 2/MENU 9-10) be set at 0.00 and 0, respectively.

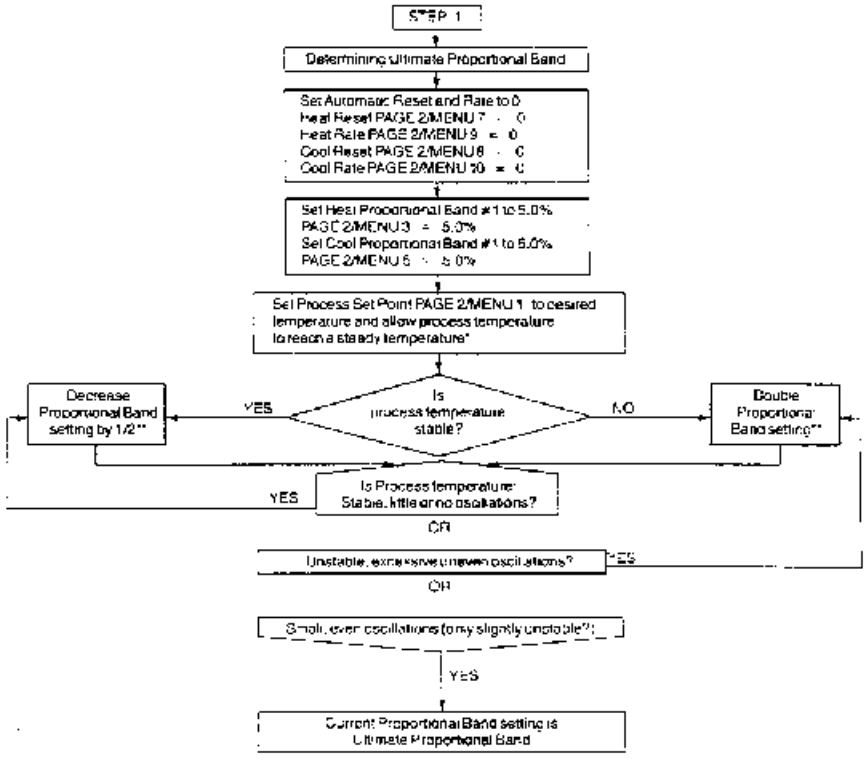
Following Step 1, below, the Proportional Band setting is gradually increased/decreased until the process temperature begins **a steady, small oscillation** that is slightly unstable. The Proportional Band setting where this steady, small oscillation occurs is referred to as the Ultimate Proportional 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 is the condition generated in this flowchart procedure that allows determination of Ultimate Proportional Band and Ultimate Period.

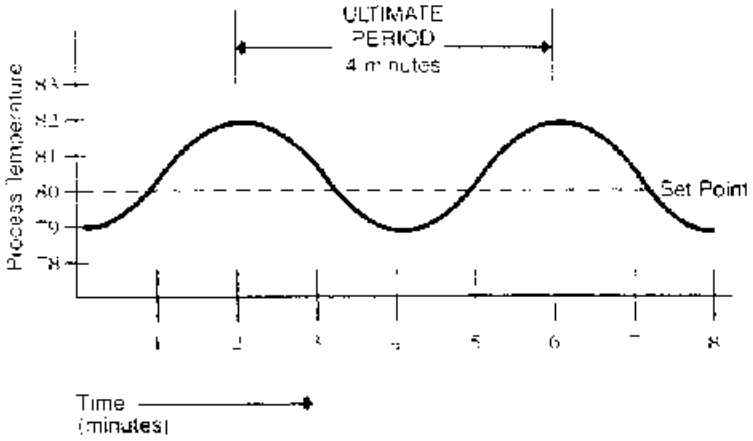


* The process temperature may become steady as much as 50°F above or below set point, which is acceptable for this initial tuning step. This offset will be corrected in later tuning steps.

** 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.

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 PID 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. Remember to use the Heat Ultimate Proportional Band and Heat Ultimate Period to calculate the Heat PID Parameters, and the Cool Ultimate Proportional Band and Cool Ultimate Period to calculate the Cool 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

PB = Ultimate Proportional Band
Period = Ultimate Period

APPENDIX II
RECONFIGURATION OF DISPLAYS AND INDICATOR LIGHTS

PAGE 8 consists of several MENU numbers that allow you to reconfigure the displays and indicator lights, thus customizing the CN3220 to special and "non-standard" applications. All of the displays are pre-configured by OMEGA prior to shipment to you, as you will see in the PAGE/MENU table "factory settings." **We recommend that you leave these MENU settings in their factory configuration unless you have special application needs.**

TIME Indicator

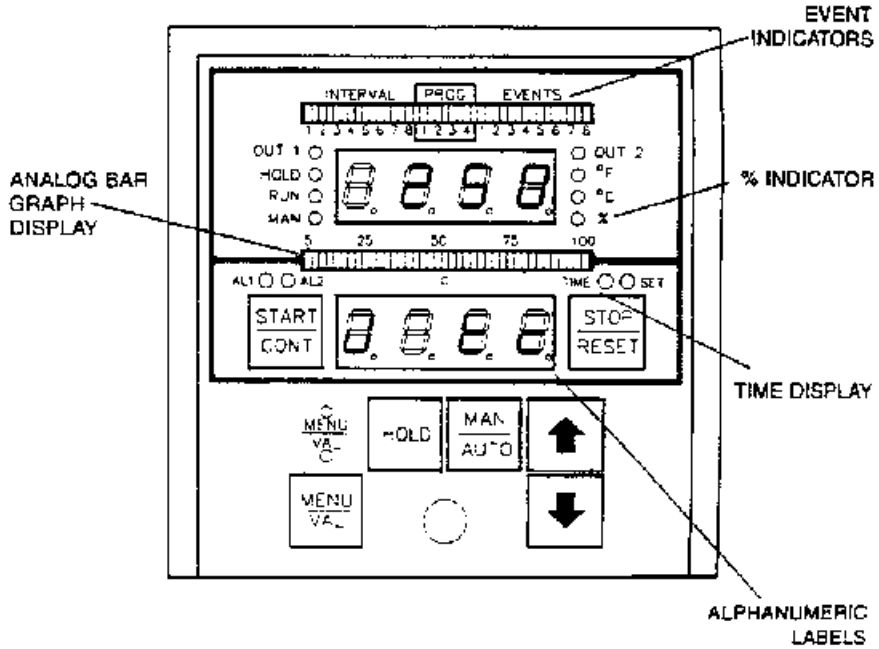
PAGE 8/MENU 1-3 are used to configure the "TIME" LED. If you choose, the TIME indicator LED may be programmed to either light or turn off on a specific PAGE/MENU number. MENU numbers 1 and 2 are used to specify the PAGE and MENU that the TIME indicator will represent, and MENU 3 is used to specify light "ON" or "OFF".

% and EVENT Indicators

PAGE 8/MENU 4-13 give you the ability to assign other actions to the "%" and "EVENT" indicators, by entering the Display Code of the action to be represented.

Alphanumeric Labels

PAGE 8/MENU 14 allows you to select alphanumeric labels for PAGES, MENUS and VALUES. The alphanumeric labels for PAGES and MENUS are shown on the PAGE/MENU tables throughout this manual. Some, but not all, of the VALUES are represented by alphanumeric labels. For example, PAGE 1/MENU 4, Sensor Select Values may be represented by numbers (1 = type J thermocouple), or an alphanumeric as drawn below.



Analog Bar Graph Display

PAGE 8/MENU 15-17 requires that you simply enter the corresponding PAGE and MENU numbers of the value to be represented by the Analog Bar Graph display. It may be turned off at all times, or can represent the value displayed in the controller's lower digital display, or can constantly represent a PAGE/MENU value which you program at PAGE 8/MENU 16-17. Normally, a parameter on PAGE 0 (Display PAGE) will be programmed.

Display Codes

There are 34 different actions/states/events that can be assigned to the "%" and "EVENT" displays. When you receive the CN3220 controller, the % Indicator is used when the PAGE 1/MENU 5 selection is %, and the Event Indicators 1-8 correspond to the Event Outputs 1-8. Each of the actions/states/events has a Display Code. These codes are shown in the following table.

Display Code	Action/Event
0	None
2	START/CONT pushbutton pressed
3	STOP/RESET pushbutton pressed
4	HOLD pushbutton pressed
5	MAN/AUTO pushbutton pressed
6	MENU/VAL pushbutton pressed
7	⊟ pushbutton pressed
8	⊞ pushbutton pressed
9	START/CONT remote input activated
10	HOLD remote input activated
11	STOP/RESET remote input activated
12	Select Program 1 remote input activated
13	Select Program 2 remote input activated
14	Select Program 3 remote input activated
15	Select Program 4 remote input activated
16	Remote Set Point Backup activated
17	Event Output 1 ON
18	Event Output 2 ON
19	Event Output 3 ON
20	Event Output 4 ON
21	Event Output 5 ON
22	Event Output 6 ON
23	Event Output 7 ON
24	Event Output 8 ON
25	Event Output A (Alarm 1 as Event Output) ON
26	Event Output B (Alarm 2 as Event Output) ON
38	Process Variable in °F
39	Process Variable in °C
40	Process Variable in basic units (0 to 99.99)
43	Alarm 1 activated
44	Alarm 2 activated
45	Output # 1 activated
46	Output # 2 activated
58	Process Variable in %

Programming

Make the appropriate entries for each display you choose to reconfigure, following the PAGE/MENU table.

Example: In your process, you have configured only 6 Event Outputs. Yo would like to use Event Output Indicators 7 and 8 to show when START/CONT is being selected remotely and when Remote Set Point Tracking is activated.

Enter Display Code 9 (START/CONT Remote Input activated) at MENU 12 (Event Output 7 Indicator), and enter Display Code 16 (Remote Set Point Tracking) at MENU 13 (Event Output 8 Indicator).

Example: You would like to enable the alphanumeric labels for PAGES, MENUS and VALUES.

PAGE = 1
MENU = 2
VALUE = 4

Total 7

Enter the value "7" at MENU 14 to enable all three labels.

PAGE 8: DISPLAY RECONFIGURATION					
CUE	MENU	SELECTION	AVAILABLE SETTINGS	FACTORY SETTING	SECURITY LEVEL
"TIME" Display Reconfiguration: Specify the PAGE # and the MENU # to be represented by the "TIME" display, and turn ON/turn OFF Action. Setting of "0" at MENU 2 maintains the normal TIME display function—the time display lights when the value represented in the lower display is a TIME function.					
	1	Reassign TIME Display to Page #	PAGE 0 through 12	0 = Display Page	F
	2	Menu #	0 through last Menu # on page	0 = Normal TIME display function	F
	3	Action	0 = Turn OFF 1 = Turn ON	1 = ON	F
"%" Display Reconfiguration: Specify the Display Code to be represented by the "%" display (Display Codes presented earlier in this section).					
	4	Reassign % Display to Display Code #	Display Codes	58 = Process Variable in %	F
	5	Action	0 = Turn OFF 1 = Turn ON	1 = Turn ON	F
"EVENT" Indicators Reconfiguration: Specify the Display Code to be represented by the 8 EVENT indicators.					
	6	Event Indicator 1	Display Codes	17 = Event 1	F
	7	Event Indicator 2		18 = Event 2	F
	8	Event Indicator 3		19 = Event 3	F
	9	Event Indicator 4		20 = Event 4	F
	10	Event Indicator 5		21 = Event 5	F
	11	Event Indicator 6		22 = Event 6	F
	12	Event Indicator 7		23 = Event 7	F
	13	Event Indicator 8		24 = Event 8	F
	14	Alphanumeric Labels	Any sum of numbers below 0 = None 1 = PAGE Labels 2 = MENU Labels 4 = VALUE Labels	7 = PAGE, MENU and VALUE Labels	F
ANALOG BAR GRAPH DISPLAY RECONFIGURATION:					
	15	Analog Bar Graph Display	0 = OFF 1 = Represent numerical value currently in lower digital display 2 = continuously represent value selected in Menu 16 and 17 below	2	F
	16	Reassign Analog Bar Graph to Page #	0 through 12	0 = Display PAGE	F
	17	Menu #	1 through last MENU # on specified PAGE	8 = Time left in interval	F

APPENDIX III
SPECIAL SENSOR SET-UPS AND CONFIGURATIONS

When using the 4-20 mA or 1-5 Vdc input, you may want to adjust the controller displays to fit your actual application. For example, the display may be adjusted so that a 4-20mA transmitter sending a pressure signal could actually represent the process variable in, say, 0 to 5000 psi.

To accommodate special applications where you may want or need to specify a non-standard sensor input range, the CN3220 provides PAGE 12 This PAGE allows you to change the span minimum and maximum values, over-range and under-range limits, and number of decimal places, as well as reassigning the three units LED's (°F, °C and %).

In the following table, you will see reference to "Primary Units", "Secondary Units" and "Basic Units." This refers back to PAGE 1/MENU 5 where you made a setting of:

1 = F (Primary Units),
2 = C (Secondary Units), or
3 = % of span (Basic Units).

Using the settings available on PAGE 12, you can virtually change each of these three settings (1,2 and 3) to mean whatever you choose.

Example

Suppose you are using a 4-20 mA input in a process, and have selected "1" on PAGE 1/MENU 5 as Primary Units. You prefer to represent the process variable in terms of "psi" and want to change the range of the input to "0.0 - 500.0 psi". You would also like to see this value represented to one decima place "250.0".

Following the PAGE/MENU table for 4-20 mA input sensor, you would make the following entries at PAGE 12:

MENU 49 = 250.0 (span maximum)
MENU 50 = 0.0 (span minimum)
MENU 56 = 0 (no LED for Primary Units)
+32 (% LED for Secondary Units)
+256 (% LED for Basic Units)
288

MENU 58= 1 (decimal point xxx.x)

Notice that you must follow the column of MENU numbers immediately below the sensor type, and that the LED selection MENU value is a summation of the values for Primary, Secondary and Basic units.

LED ON CODES

Units LEDs	Action	Code
All Units Primary, Secondary and Basic	Light None	0
Primary	Light °F	1
	Light °C	2
	Light %	4
Secondary	Light °F	8
	Light °C	16
	Light %	32
Basic	Light °F	64
	Light °C	128
	Light %	256

PAGE 12: SENSOR INPUT SET-UP PAGE

Menu# By Sensor Selection Code								Function	Available Settings	Default Settings by Sensor Selection Code								Security Level
J T/C	K T/C	E T/C	100 ohm Pt. RTD	4/20 mA (1/5 Vdc)	T T/C	R T/C	S T/C			J T/C	K T/C	E T/C	100 ohm Pt. RTD	4/20 mA (1/5 Vdc)	T T/C	R T/C	S T/C	
1	13	25	37	49	61	73	85	Primary unit (°F) Span maximum	−999 to 9999	1400	2100	1100	1000	1000	750	3000	3000	F
2	14	26	38	50	62	74	86	Primary unit (°F) Span minimum	−999 to 9999	−100	−100	−100	−200	0	−350	50	50	F
3	15	27	39	51	63	75	87	Secondary unit (°C) Span maximum	−999 to 9999	760	1149	593	538	500	399	1649	1649	F
4	16	28	40	52	64	76	88	Secondary unit (°C) Span minimum	−999 to 9999	−73	−73	−73	−129	100	−212	10	10	F
5	17	29	41	53	65	77	89	Over-range limit % span	0 to 9.99%	1.34	0.91	1.67	1.67	2.00	1.82	0.68	0.68	F
6	18	30	42	54	66	78	90	Under-range limit % span	0 to 9.99%	1.34	0.91	1.67	1.67	2.00	1.82	0.68	0.68	F
7	19	31	43	55	67	79	91	Cold junction enable/disable	0 = Disable 1 = Enable	1	1	1	0	0	1	1	1	F
8	20	32	44	56	68	80	92	Map units to units teds	0 — 511	273	273	273	273	269	273	273	273	F
9	21	33	45	57	69	81	93	Linearization	0 = Disable 1 = Enable	1	1	1	1	0	1	1	1	F
10	22	34	46	58	70	82	94	Decimal point select Primary unit	0 = None 1 = XXX.X 2 = XX.XX 3 = X.XXX	0	0	0	0	1	0	0	0	F
11	23	35	47	59	71	83	95	Decimal point select Secondary unit	0 = None 1 = XXX.X 2 = XX.XX 3 = X.XXX	0	0	0	0	2	0	0	0	F
12	24	36	48	60	72	84	96	Spare	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	F

APPENDIX IV
PAGE/MENU TABLES

This section contains the 13 PAGES of programming information, PAGES 0-12, without any of the detailed information or explanations 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: DISPLAY

MENU	DISPLAY SELECTION	SECURITY LEVEL
1	Process set point in units of process variable	A
2	Process variable	A
3	Deviation in units of process variable	A
4	Heat Output command in % full ON	A
5	Cool Output command in % full ON	A
6	Program #	A
7	Interval #	A
8	Time left in interval	A
9	Remote set point in units of process variable	A
10	Remote set point in % sensor input range	A
11	Remote set point in mA	A
12	Process out/aux. ramp/soak set point in units of process variable	A
13	Process out/aux. ramp/soak set point in % sensor input range	A
14	Process out/aux. ramp/soak set point in mA	A
15	Proportional output Command (0 to 100%)	A
16	Heat Disintegration Command (– 100 to 100%)	A
17	Cool Disintegration Command (– 100 to 100%)	A
18	Integral command (– 100 to 100%)	A
19	Rate command (– 100 to 100%)	A

PAGE 1: GENERAL OPERATION

CUE	MENU	SELECTION	AVAILABLE SETTINGS	FACTORY SETTING	SECURITY LEVEL
LocK	1	Security Lock	Security Codes (0 to 9999)	458 = Level D	C
Prog 0 = no 1 = PG1 2 = PSE 3 = PS3 4 = PG4 5 = ESEL	2	Program Selection	0 = None (Single set point control) 1 = Program #1 2 = Program #2 3 = Program #3 4 = Program #4 5 = Remote Ramp/Soak enabled	1 = PG1	C
	3	Controller Type	1 = Single Output Heat Control 2 = Single Output Cool Control 3 = Heat/Cool Control	3 = Heat/Cool Control	D
SEnS	4	Sensor Input Selection	1 = JT/C 2 = KT/C 3 = ET/C 4 = 100 Ohm Pt RTD 5 = 4-20 mA (1-5 Vdc) 6 = TT/C 7 = RT/C 8 = ST/C	1 = JT/C	D
unit	5	Unit for Process Variable	1 = °F (Primary) 2 = °C (Secondary) 3 = 0 to 99.99% (Basic)	1 = °F	D
Auto	6	Auto/Manual Setup	0 = OFF 1 = ON	1 = ON	D
SPUL	7	Set Point Upper Limit	0.00 to 99.99% of sensor range	99.99%	E
SPLL	8	Set Point Lower Limit	0.00 to 99.99% of sensor range	0.00%	E
	9-20	See "Error Codes and Troubleshooting", Section 10 in this Manual			F

PAGE 2: CONTROL AND ALARM PARAMETERS

CUE	MENU	SELECTION	AVAILABLE SETTINGS	FACTORY SETTING	SECURITY LEVEL
SP	1	Set Point (for constant set point operation—no Ramp/ Soak program selected)	Instrument sensor range	Instrument sensor range minimum	B
OFSt	2	Manual Reset	−100.0 to 100.0	0.0	B
HPb1	3	Heat Proportional Band #1	0.1 to 999.9% span	5.0	D
HPb2	4	Heat Proportional Band #2			D
CPb1	5	Cool Proportional Band #1			D
CPb2	6	Cool Proportional Band #2			D
Hr5t	7	Heat Automatic Reset	0.00 to 99.99 repeats/minute	0.00	D
Cr5t	8	Cool Automatic Reset			D
HrtE	9	Heat Rate	0 to 1000 seconds		D
CrtE	10	Cool Rate			D
	11	Heat Offset	−25.00 to 25.00% of instrument sensor range	0.00	D
	12	Cool Offset			D
	13	Heat Overlap	0.0 to 1000.1% Proportional Band	0.0	D
	14	Cool Overlap			D
HtLt	15	Heat Output Limit	0.0 to 100.0% ON	100.0	D
CtLt	16	Cool Output Limit			D
Hcyc	17	Heat Cycle Time*	0.1 to 65.0 seconds	1.0	D
Ccyc	18	Cool Cycle Time*			D
HtoF	19	Heat Offset (ON/OFF)	−25.00 to 25.00% of instrument sensor range	0.00	D
CtoF	20	Cool Offset (ON/OFF)			D
	21	Heat Dead band	0.01 to 25.00% of instrument sensor range	0.01	D
	22	Cool Dead band			D
ctrL	23	Control Mode(s)	1 = HPCP Heat PID, Cool PID 2 = HPCo Heat PID, Cool ON/OFF 3 = HoCP Heat ON/OFF, Cool PID 4 = HoCo Heat ON/OFF, Cool ON/OFF	1	D
A1SP	24	Alarm#1 Set Point (Output #2)	Instrument sensor range	Range maximum	D
A2SP	25	Alarm #2 Set Point (Output #3)		Range minimum	D
A1tY	26	Alarm #1—Type (Output #2)	1 = HAdE High Alarm, NDE* 2 = LAdE Low Alarm, NDE 3 = PAdE + Deviation, NDE 4 = nAdE − Deviation, NDE 5 = dAdE ± Deviation, NDE 6 = Ent Event Output 7 = HA E High Alarm, NE** 8 = LA E Low Alarm, NE 9 = PA E + Deviation, NE 10 = nA E − Deviation, NE 11 = dA E ± Deviation, NE *NDE = Normally De-Energized (Contacts closed in Alarm) **NE = Normally Energized (Contacts open in Alarm)	1	D
A2tY	27	Alarm #2—Type Output #3)		2	D

PAGE 2: CONTROL AND ALARM PARAMETERS (CONT'D)					
CUE	MENU	SELECTION	AVAILABLE SETTINGS	FACTORY SETTING	SECURITY LEVEL
A1 db	28	Alarm #1 Dead band	0.1 to 25.00% of instrument sensor range	0.25	D
A2db	29	Alarm #2 Dead Band			
A1 on	30	Alarm #1 ON Delay	0.1 to 999.9 seconds	0.1	D
A2on	31	Alarm #2 ON Delay			
A1 oF	32	Alarm #1 OFF Delay	0.1 to 999.9 seconds	0.1	D
A2oF	33	Alarm #2 OFF Delay			
di St	34	Disintegration Time (Manual to Automatic Proportional Control	1 to 100 seconds	10	D
	35	Output #1	0 = Not inverted 1 = Inverted	0	D
	36	Output #2	(Inverted Example— 0% = 20mA, 100% = 4mA	0	D

PAGE 4: RAMP/SOAK PROGRAM 1 PAGE 5: RAMP/SOAK PROGRAM 2			PAGE 6: RAMP/SOAK PROGRAM 3 PAGE 7: RAMP/SOAK PROGRAM 4		
CUE	MENU	SELECTION	AVAILABLE SETTINGS	FACTORY SETTING	SECURITY LEVEL
StbY	1	Standby Set Point	Instrument Sensor Range	Instrument Range Min.	C
Int 1	2	Interval 1 Time Span	0 = Program End 1 to 9999 seconds 0.1 to 999.9 minutes 0.01 to 99.99 hours	1 second	C
SP 1	3	Set Point 1	Instrument Sensor Range	Instrument Range Min.	C
Int2	4	Interval 2 Time Span	0 = Program End 1 to 9999 seconds 0.1 to 999.9 minutes 0.01 to 99.99 hours	1 second	C
SP 2	5	Set Point 2	Instrument Sensor Range	Instrument Range Min.	C
Int3	6	Interval 3 Time Span	0 = Program End 1 to 9999 seconds 0.1 to 999.9 minutes 0.01 to 99.99 hours	1 second	C
SP 3	7	Set Point 3	Instrument Sensor Range	Instrument Range Min.	C
Int4	8	Interval 4 Time Span	0 = Program End 1 to 9999 seconds 0.1 to 999.9 minutes 0.01 to 99.99 hours	1 second	C
SP 4	9	Set Point 4	Instrument Sensor Range	Instrument Range Min.	C
Int5	10	Interval 5 Time Span	0 = Program End 1 to 9999 seconds 0.1 to 999.9 minutes 0.01 to 99.99 hours	1 second	C
SP 5	11	Set Point 5	Instrument Sensor Range	Instrument Range Min.	C
Int6	12	Interval 6 Time Span	0 = Program End 1 to 9999 seconds 0.1 to 999.9 minutes 0.01 to 99.99 hours	1 second	C
SP 6	13	Set Point 6	Instrument Sensor Range	Instrument Range Min.	C
Int 7	14	Interval 7 Time Span	0 = Program End 1 to 9999 seconds 0.1 to 999.9 minutes 0.01 to 99.99 hours	1 second	C
SP 7	15	Set Point 7	Instrument Sensor Range	Instrument Range Min.	C
Int8	16	Interval 8 Time Span	0 = Program End 1 to 9999 seconds 0.1 to 999.9 minutes 0.01 to 99.99 hours	1 second	C
SP 8	17	Set Point 8	Instrument Sensor Range	Instrument Range Min.	C

PAGE 4: RAMP/SOAK PROGRAM 1 PAGE 5: RAMP/SOAK PROGRAM 2			PAGE 6: RAMP/SOAK PROGRAM 3 PAGE 7: RAMP/SOAK PROGRAM 4		
CUE	MENU	SELECTION	AVAILABLE SETTINGS	FACTORY SETTING	SECURITY LEVEL
un IE	18	Time Units	1 = 1 to 999 seconds 2 = 0.1 to 999.9 minutes 3 = 0.01 to 99.99 hours	1 = seconds	C
Pb	19	Proportional Band #1 or #2	1 = PB #1	1	D
rEOP	20	Recovery Options After Power Outage	0 = Go to STDBY 1 = Resume Program at last active Interval	1 = Resume Program	D
1Fro	21	Loop 1 Loop from end of Interval A	A = 0 to 8	0 = Disable	D
1 to	22	To the beginning of Interval B	B = 0 to 8	0 = Disable	
1 no	23	C number of times	C = 0 to 9999 (0 = Continuous)	1	D
2Fro	24	Loop 2 Loop from end of Interval A	A = 0 to 8	0 = Disable	D
2 to	25	To the beginning of Interval B	B = 0 to 8	0 = Disable	
2 no	26	C number of times	C = 0 to 9999 (0 = Continuous)	1	D
3Fro	27	Loop 3 Loop from end of Interval A	A = 0 to 8	0 = Disable	D
3 to	28	To the beginning of Interval B	B = 0 to 8	0 = Disable	
3 no	29	C number of times	C = 0 to 9999 (0 = Continuous)	1	D
LinK	30	Link the end of this Program to the beginning of Program #	0 = No Linking 1 = Program #1 2 = Program #2 3 = Program #3 4 = Program #4 5 = Continuous	0 = No Linking	D
SbEE	31	Standby Events	0 to 255 (sum of ON codes)	0	D
1 E	32	Interval 1 Events		1	D
2 E	33	Interval 2 Events		2	D
3 E	34	Interval 3 Events		4	D
4 E	35	Interval 4 Events		8	D
5 E	36	Interval 5 Events		16	D
6 E	37	Interval 6 Events		32	D
7 E	38	Interval 7 Events		64	D
8 E	39	Interval 8 Events		128	D
oPSt	40	Standby Options	0, 8, 16, 24	0	D
oP 1	41	Interval 1 Options	0 to 255 (any sum of Options On Codes)	0	D
oP 2	42	Interval 2 Options			D
oP 3	43	Interval 3 Options			D
oP 4	44	Interval 4 Options			D
oP 5	45	Interval 5 Options			D
oP 6	46	Interval 6 Options			D
oP 7	47	Interval 7 Options			D
oP 8	48	Interval 8 Options			D
GSdb	49	Guaranteed Soak Differential	0.01 to 99.9% of sensor input range	50%	D
	50	Auxiliary Standby Set Point	0.00 to 99.99%	0%	D
	51	Auxiliary Set Point 1			D
	52	Auxiliary Set Point 2			D
	53	Auxiliary Set Point 3			D
	54	Auxiliary Set Point 4			D
	55	Auxiliary Set Point 5			D
	56	Auxiliary Set Point 6			D
	57	Auxiliary Set Point 7			D
	58	Auxiliary Set Point 8			D

PAGE 8: DISPLAY RECONFIGURATION					
CUE	MENU	SELECTION	AVAILABLE SETTINGS	FACTORY SETTING	SECURITY LEVEL
	1	Reassign TIME Display to Page #	PAGE 0 through 12	0 = Display Page	F
	2	Menu #	0 through last Menu # on page	0 = Normal TIME display function	F
	3	Action	0 = Turn OFF 1 = Turn ON	1 = ON	F
	4	Reassign % Display to Display Code #	Display Codes	58 = Process Variable in %	F
	5	Action	0 = Turn OFF 1 = Turn ON	1 = Turn ON	F
	6	Event Indicator 1	Display Codes	17 = Event 1	F
	7	Event Indicator 2		18 = Event 2	F
	8	Event Indicator 3		19 = Event 3	F
	9	Event Indicator 4		20 = Event 4	F
	10	Event Indicator 5		21 = Event 5	F
	11	Event Indicator 6		22 = Event 6	F
	12	Event Indicator 7		23 = Event 7	F
	13	Event Indicator 8		24 = Event 8	F
	14	Alphanumeric Labels	Any sum of numbers below 0 = None 1 = PAGE Labels 2 = MENU Labels 4 = VALUE Labels	7 = PAGE, MENU and VALUE Labels	F
	15	Analog Bar Graph Display	0 = OFF 1 = Represent numerical value currently in lower digital display 2 = continuously represent value selected in Menu 16 and 17 below	2	F
	16	Reassign Analog Bar Graph to Page #	0 through 12	0 = Display PAGE	F
	17	Menu #	1 through last MENU # on specified PAGE	8 = Time left in interval	F

PAGE 9: DIGITAL COMMUNICATIONS					
CUE	MENU	SELECTION	AVAILABLE SETTINGS	FACTORY SETTING	SECURITY LEVEL
Fnct	1	Operation Mode	0=Disabled 3=Computer Interface 1=Terminal Interface 4=ASC II Line modem 2=Automatic Data Logging (IEEE 488)	0=Disabled	E
LOG i	2	Automatic Logging Interval	1–9999 Minutes	1 Minute	E
LOGF	3	First Display PAGE 0/ MENU # to Log	1–19	1	E
LOGL	4	Last Display PAGE 0/ MENU # to Log	1–19	1	E
	5	Home Character Code	0 to 255	30	E
	6	Clear Screen Character Code	0 to 255	26	E
	7	Interface Select	0=RS232C 1=RS422A 2=RS485	0=RS232C	E
bAUd	8	Baud Rate	0= 300 3=2400 6=19.2K 1= 600 4=4800 7=38.4K 2=1200 5=9600	5=9600	E
PArt	9	Parity	0=No Parity 1=Odd Parity 2=Even Parity	0=No Parity	E
rcon	10	Reconfigure Baud Rate and Parity	0=Finish 1=Request Configuration	0	E
	11	Address	0–255	0	E

PAGE 10: REMOTE SET POINT/ANALOG OUTPUT

CUE	MENU	SELECTION	AVAILABLE SETTINGS	FACTORY SETTING	SECURITY LEVEL
r SP	1	Assignment	0 = Remote Set Point disabled	0 = Remote Set Point disabled	E
			1 = Remote Set Point enabled		E
			2 = Remote Set Point enabled with Back-up for Set Point Generator Failure		E
AnOt	2	Assignment	0 = Analog Output disabled	0 = oFF	E
0 = oFF			1 = Analog Output represents Process Variable		E
1 = P SE			2 = Analog Output represents Primary Ramp/Soak Set Points		E
2 = SPot			3 = Analog Output represents Auxiliary Ramp/Soak Set Point (selected in PAGES 4-7/MENUS 50-58)		E
3 = RSPo			4 = Analog Output represents Heat Output Command		E
4 = HtCd			5 = Analog Output represents Cool Output Command		E
5 = CtCd					

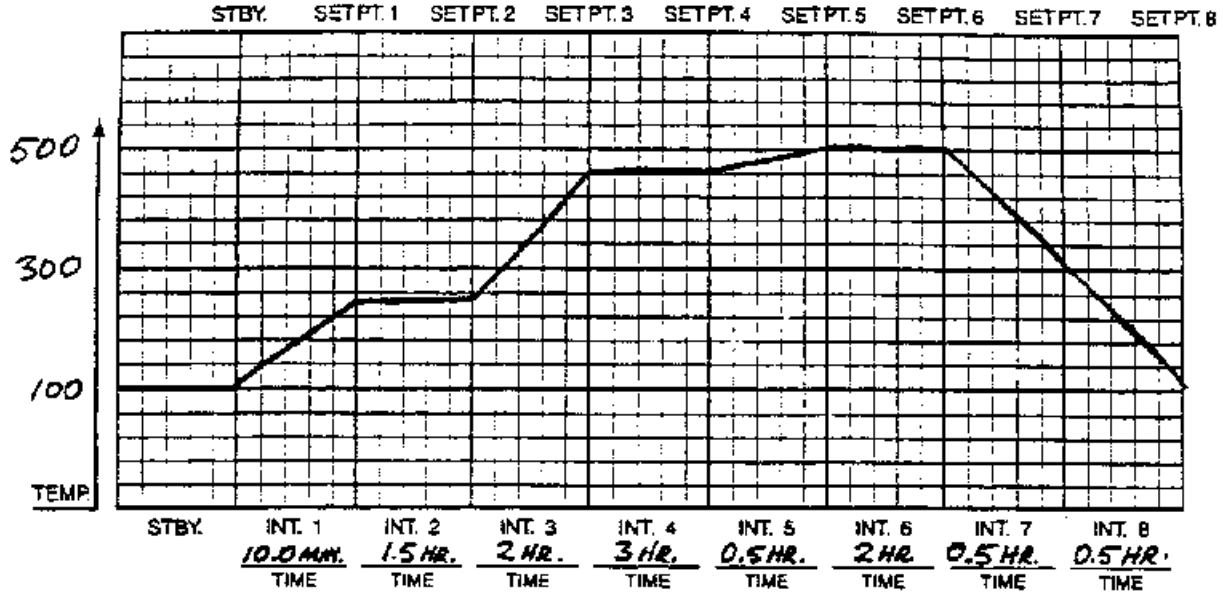
PAGE 11: CALIBRATION

CUE	MENU	SELECTION	AVAILABLE SETTINGS	FACTORY SETTING	SECURITY LEVEL
	1	Cold Junction Temperature	0.0 to 150.0°F	As Required	F
	2	Quick Step Calibration	Sensor and Wire Type Code	0 = None	F
	3	Procedure steps	0 = Start		F
			1 = Input Minimum (zero)	See following Instructions	F
			2 = Input Maximum (span)		F
			3 = Finished		F
	4	Cold Junction Zero	See "Sensor Input Manual Calibration Instructions" Page 47		F
	5	Cold Junction Span			F
	6	JT/C Zero Calibration			F
	7	JT/C Span Calibration			F
	8	KT/C Zero Calibration			F
	9	KT/C Span Calibration			F
	10	ET/C Zero Calibration			F
	11	ET/C Span Calibration			F
	12	100 ohm Plt. Zero Calibration			F
	13	100 ohm Plt. Span Calibration			F
	14	4-20 mA Zero Calibration			F
	15	4-20 mA Span Calibration			F
	16	TT/C Zero Calibration			F
	17	TT/C Span Calibration			F
	18	RT/C Zero Calibration			F
	19	RT/C Span Calibration			F
	20	ST/C Zero Calibration			F
	21	ST/C Span Calibration			F
	22	Remote Set Point Zero Calibration			F
	23	Remote Set Point Span Calibration			F
	24	Analog Out Zero Calibration			F
	25	Analog Out Span Calibration			F

PAGE 12: SENSOR INPUT SET-UP PAGE

Menu# By Sensor Selection Code								Function	Available Settings	Default Settings by Sensor Selection Code								Security Level
J T/C	K T/C	E T/C	100 ohm Plt. RTD	4/20 mA (1/5 Vdc)	T T/C	R T/C	S T/C			J T/C	K T/C	E T/C	100 ohm Plt. RTD	4/20 mA (1/5 Vdc)	T T/C	R T/C	S T/C	
1	13	25	37	49	61	73	85	Primary unit (°F) Span maximum	−999 to 9999	1400	2100	1100	1000	1000	750	3000	3000	F
2	14	26	38	50	62	74	86	Primary unit (°F) Span minimum	−999 to 9999	−100	−100	−100	−200	0	−350	50	50	F
3	15	27	39	51	63	75	87	Secondary unit (°C) Span maximum	−999 to 9999	760	1149	593	538	500	399	1649	1649	F
4	16	28	40	52	64	76	88	Secondary unit (°C) Span minimum	−999 to 9999	−73	−73	−73	−129	100	−212	10	10	F
5	17	29	41	53	65	77	89	Over-range limit % span	0 to 9.99%	1.34	0.91	1.67	1.67	2.00	1.82	0.68	0.68	F
6	18	30	42	54	66	78	90	Under-range limit % span	0 to 9.99%	1.34	0.91	1.67	1.67	2.00	1.82	0.68	0.68	F
7	19	31	43	55	67	79	91	Cold junction enable/disable	0 = Disable 1 = Enable	1	1	1	0	0	1	1	1	F
8	20	32	44	56	68	80	92	Map units to units leds	0 — 511	273	273	273	273	269	273	273	273	F
9	21	33	45	57	69	81	93	Linearization	0 = Disable 1 = Enable	1	1	1	1	0	1	1	1	F
10	22	34	46	58	70	82	94	Decimal point select Primary unit	0 = None 1 = XXX.X 2 = XX.XX 3 = X.XXX	0	0	0	0	1	0	0	0	F
11	23	35	47	59	71	83	95	Decimal point select Secondary unit	0 = None 1 = XXX.X 2 = XX.XX 3 = X.XXX	0	0	0	0	2	0	0	0	F
12	24	36	48	60	72	84	96	Spare	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	F

RAMP/SOAK PROFILE GRAPH



	STBY.	INT. 1	INT. 2	INT. 3	INT. 4	INT. 5	INT. 6	INT. 7	INT. 8	Event ON Codes
EVENT 1 (INDICATOR)	ON									1
EVENT 2 (FAN ON)								ON	ON	2
EVENT 3 (PROGRAM RUN)		ON	ON	ON	ON	ON	ON	ON	ON	4
EVENT 4 END OF PROGRAM									ON	8
EVENT 5 (ADD CHEM. #1)		ON								16
EVENT 6										32
EVENT 7										64
EVENT 8										128
Total Event ON Codes	1	20	4	4	4	4	4	6	14	

	STBY.	INT. 1	INT. 2	INT. 3	INT. 4	INT. 5	INT. 6	INT. 7	INT. 8	Options ON Codes
SECONDS										1
MINUTES		ON								2
HOURS										4
ALARM 1 AS EVENT										8
ALARM 2 AS EVENT										16
HOLD AT INT. END									ON	64
GUARANTEE SOAK					ON					128
Total Option ON Codes		2			128				64	

LOOP #1

Loop from end of Interval: 7
to beginning of Interval: 3
How many times? 3

LOOP #2

Loop from end of Interval: ___
to beginning of Interval: ___
How many times? ___

LOOP #3

Loop from end of Interval: ___
to beginning of Interval: ___
How many times? ___

LINK

Link end of this Program to
beginning of Program # 2

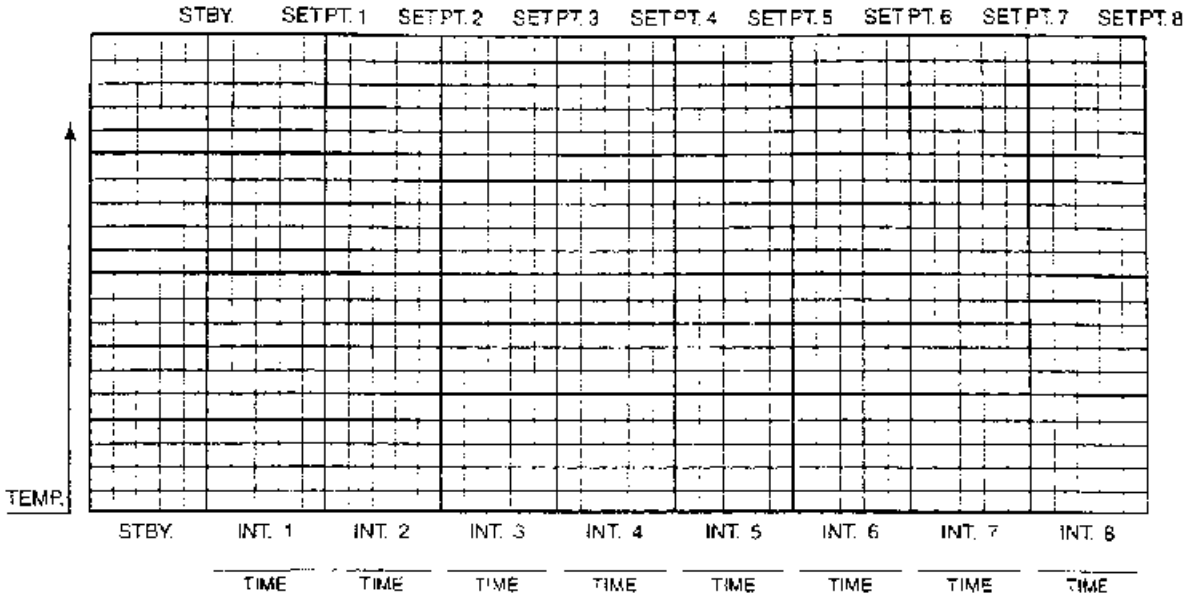
PROGRAMMING WORKSHEET

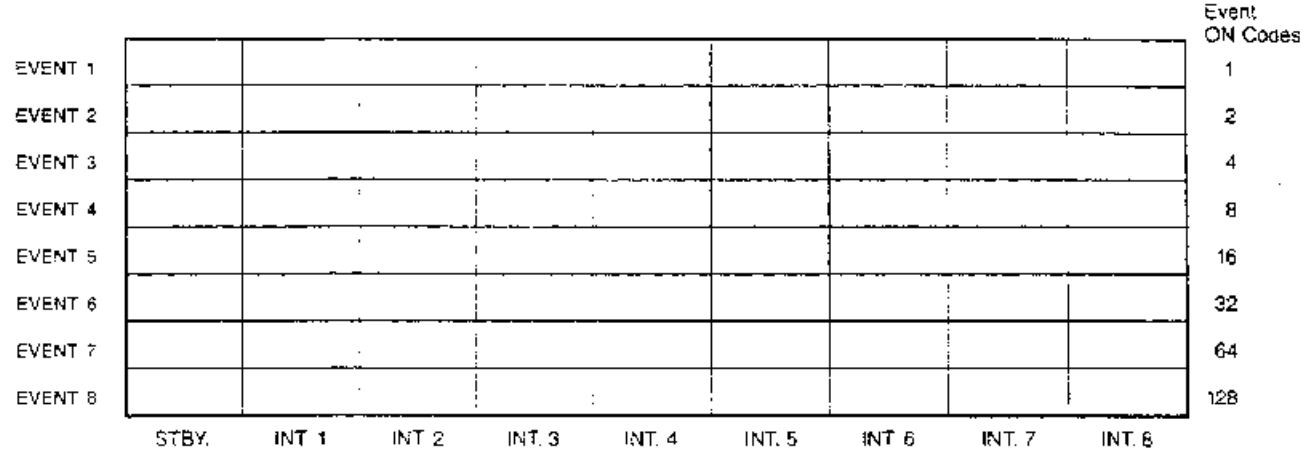
PROGRAM# 1 PAGE 4

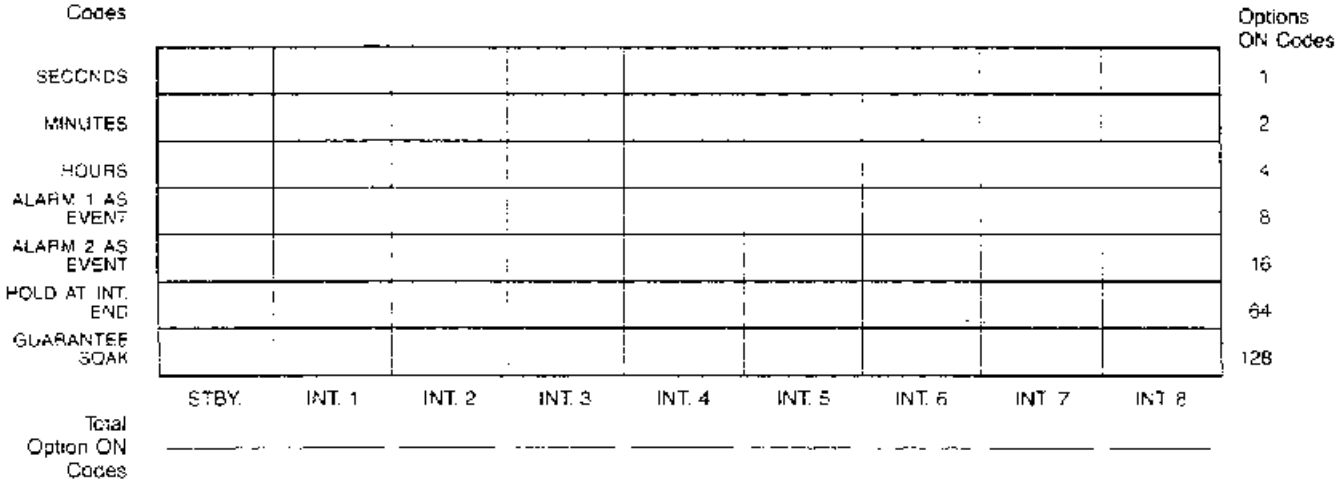
PROGRAM#1 = PAGE 4 PROGRAM#2 = PAGE 5
PROGRAM#3 = PAGE 6 PROGRAM#4 = PAGE 7

CUE	MENU	SELECTION	YOUR SETTINGS:		
			Date: 3/12	Date:	Date:
StbY	1	Standby Set Point	100		
Int 1	2	Interval 1 Time Span	10.0 MIN.		
SP 1	3	Set Point 1	240		
Int2	4	Interval 2 Time Span	1.50 HR.		
SP 2	5	Set Point 2	240		
Int3	6	Interval 3 Time Span	2.00 HR.		
SP 3	7	Set Point 3	465		
Int4	8	Interval 4 Time Span	3.00		
SP 4	9	Set Point 4	465		
Int5	10	Interval 5 Time Span	0.50		
SP 5	11	Set Point 5	500		
Int6	12	Interval 6 Time Span	2.00		
SP 6	13	Set Point 6	500		
Int 7	14	Interval 7 Time Span	0.50		
SP 7	15	Set Point 7	300		
Int8	16	Interval 8 Time Span	0.50		
SP 8	17	Set Point 8	100		
un it	18	Time Units	3 (HRS.)		
Pb	19	Select Proportional Band #1 or #2	1		
rEOP	20	Recovery Options after Power Outage	1		
1Fro	21	LOOP 1 from end of Interval #	7		
1 to	22	to the beginning of Interval #	3		
1 no.	23	# of times	3		
2Fro	24	LOOP 2 from end of Interval #	0		
2 to	25	to the beginning of Interval #	0		
2 no.	26	# of times	0		
3Fro	27	LOOP 3 from end of Interval #	0		
3 to	28	to the beginning of Interval #	0		
3 no.	29	# of times	0		
LinK	30	LINK end of this Program to Program #	2		
SbEt	31	Standby Interval—Event Outputs	1		
.1 E	32	Interval 1—Event Outputs	20		
.2 E	33	Interval 2—Event Outputs	4		
.3 E	34	Interval 3—Event Outputs	4		
.4 E	35	Interval 4—Event Outputs	4		
.5 E	36	Interval 5—Event Outputs	4		
.6 E	37	Interval 6—Event Outputs	4		
.7 E	38	Interval 7—Event Outputs	6		
.8 E	39	Interval 8—Event Outputs	14		
oPSt	40	Standby Interval—Options	0		
oP.1	41	Interval 1—Options	2		
oP.2	42	Interval 2—Options	0		
oP.3	43	Interval 3—Options	0		
oP.4	44	Interval 4—Options	128		
oP.5	45	Interval 5—Options	0		
oP.6	46	Interval 6—Options	0		
oP.7	47	Interval 7—Options	0		
oP.8	48	Interval 8—Options	64		
GSdb	49	Guaranteed Soak Differential	.01		

RAMP/SOAK PROFILE GRAPH







LOOP #1

Loop from end of Interval ____

to beginning of Interva ____

How many times? ____

LOOP #2

Loop from end of Interval ____

to beginning of Interval ____

How many times?

LOOP #3

Loop from end of Interval ____

to beginning of Interval ____

How many times? ____

LINK

Link end of this Program to

beginning of Program # ____

PROGRAMMING WORKSHEET

PROGRAM# _____ PAGE _____

PROGRAM#1 = PAGE 4 PROGRAM#2 = PAGE 5
PROGRAM#3 = PAGE 6 PROGRAM#4 = PAGE 7

CUE	MENU	SELECTION	YOUR SETTINGS:		
			Date:	Date:	Date:
SEbS	1	Standby Set Point			
int 1	2	Interval 1 Time Span			
SP 1	3	Set Point 1			
int2	4	Interval 2 Time Span			
SP 2	5	Set Point 2			
int3	6	Interval 3 Time Span			
SP 3	7	Set Point 3			
int4	8	Interval 4 Time Span			
SP 4	9	Set Point 4			
int5	10	Interval 5 Time Span			
SP 5	11	Set Point 5			
int6	12	Interval 6 Time Span			
SP 6	13	Set Point 6			
int7	14	Interval 7 Time Span			
SP 7	15	Set Point 7			
int8	16	Interval 8 Time Span			
SP 8	17	Set Point 8			
unit	18	Time Units			
Pb	19	Select Proportional Band #1 or #2			
rEOP	20	Recovery Options after Power Outage			
1Fro	21	LOOP 1 from end of Interval #			
1 to	22	to the beginning of Interval #			
1 no	23	# of times			
2Fro	24	LOOP 2 from end of Interval #			
2 to	25	to the beginning of Interval #			
2 no	26	# of times			
3Fro	27	LOOP 3 from end of Interval #			
3 to	28	to the beginning of Interval #			
3 no	29	# of times			
LinK	30	LINK end of this Program to Program #			
SbEt	31	Standby Interval—Event Outputs			
.1 E	32	Interval 1—Event Outputs			
.2 E	33	Interval 2—Event Outputs			
.3 E	34	Interval 3—Event Outputs			
.4 E	35	Interval 4—Event Outputs			
.5 E	36	Interval 5—Event Outputs			
.6 E	37	Interval 6—Event Outputs			
.7 E	38	Interval 7—Event Outputs			
.8 E	39	Interval 8—Event Outputs			
oPSt	40	Standby Interval—Options			
oP.1	41	Interval 1—Options			
oP.2	42	Interval 2—Options			
oP.3	43	Interval 3—Options			
oP.4	44	Interval 4—Options			
oP.5	45	Interval 5—Options			
oP.6	46	Interval 6—Options			
oP.7	47	Interval 7—Options			
oP.8	48	Interval 8—Options			
GSdb	49	Guaranteed Soak Differential			

WARRANTY

OMEGA warrants this unit to be free of defects in materials and workmanship and to give satisfactory service for a period of **13 months** from date of purchase. OMEGA Warranty adds an additional one (1) month grace period to the normal **one (1) year product warranty** to cover handling and shipping time. This ensures that our customers receive maximum coverage on each product. If the unit should malfunction, it must be returned to the factory for evaluation. Our 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.

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Direct all warranty and repair requests/inquiries to the OMEGA ENGINEERING Customer Service Department. Call toll free in the USA and Canada: 1-800-622-2378, FAX: 203-359-7811; International: 203-359-1660, FAX: 203-359-7807.

BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, YOU MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OUR 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 you are having with the product.

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

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

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