CN6081 & CN6082

Ramp and Soak Temperature Controllers

OMEGA®
An OMEGA Technologies Company

Operator's Manual

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

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

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SECTION 1 INTRODUCTION

1.1 GENERAL DESCRIPTION

The OMEGA® CN6081/6082 Controllers provide auto tune capability, optional communications capability, and Ramp and Soak profile control. Up to eight ramp or soak segments can be programmed for a time of 0-999 minutes each. A guaranteed soak feature stops the clock if the temperature drops below a preset value, then continues the timing when temperature returns within limits. The profile can be set to repeat up to 254 times or continuously.

1.2 AVAILABLE MODELS

Model No.	Description
CN6081-(*)	Single Output with Ramp & Soak
CN6082-(*)	Dual Output (single setpoint) with Ramp & Soak
6070-C1	Plug-in RS-232C Board
6070-C2	Plug-in RS-485 Board
6070-C3	Plug-in 20 mA Board

**Insert Input Code: J, K, T, R, S, P1 or P2.*

Input Code	Input Type	Range	Res.
J	Iron-Constantan	0 to 1400°F 0 to 760°C	1°F 1°C
K	Chromega® Alomega®	0 to 2000°F 0 to 1093°C	1°F 1°C
T	Copper-Constantan	– 200 to 600°F – 129 to 315°C	1°F 1°C
R	Platinum-Pt 13% Rhodium	0 to 3200°F 0 to 1745°C	1°F 1°C
S	Platinum-Pt 10% Rhodium	0 to 3200°F 0 to 1745°C	1°F 1°C
P1	100 ΩPt RTD	– 200 to 1200°F – 128 to 648°C	1°F 1°C
P2*	100 ΩPt RTD	– 199.9 to 199.9°F – 128.8 to 93.3°C	0.1°F 0.1°C

Units switchable from J and K, or from P1 and P2
** Unit does not auto-tune on this range.*

Alarm Options High/low Process/Deviation

Ordering Suffix	Description
-AL1	Single Alarm
-AL2	Dual Alarms

Note: Relays are 1A SSR, user selectable for high/low and process/deviation action.

Output Options

Output Type	Heating First Output	Cooling 2nd Output (6082 Only)
1A SSR	T1	T2
4-20 mA	F1	F2
Pulse 20Vdc	DC1	DC2

NOTE: Standard Output(s) is 7 A Mechanical Relay (7 A at 120 Vac, 5A at 240 Vac)

SECTION 2 INSTALLATION

2.1 UNPACKING

Remove the packing list and verify that all equipment has been received. If there are any questions about the shipment, please call OMEGA Customer Service Department .

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

NOTE

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

2.2 LOCATION

Select a location for the controller where it will not be subject to excessive shock, vibration, dirt, moisture, or oil. The ambient temperature of the area should be between 32° and 131°F.

2.3 MOUNTING

Mount the controller into a 3-5/8" (92 mm) square cutout. See Figure 2-1 for the cutout and case dimensions. The plug-in controller does not have to be removed from its housing for mounting. Remove the two screws that hold the mounting slides and then remove the slides. Insert case from front panel and re-install the two slides and two screws. Do not overtighten screws. The length of the slides must be reduced if the controller is to be mounted in an extra thick panel. If the controller has been unplugged from its housing, the top of the housing can be determined because it features the serial tag. The unit can be removed from its housing by pulling firmly on the black front bezel. If a communication port is connected, remove it first.

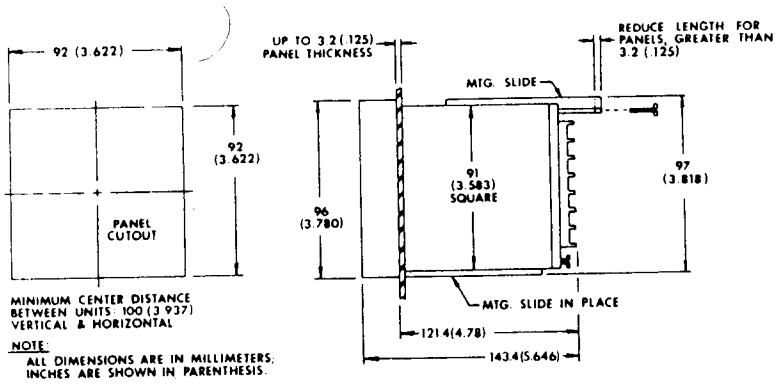


Figure 2-1. Case Dimensions

SECTION 3 OUTPUT MODULES

The CN6081/6082 offers field-interchangeable output modules, which make it possible to fill output requirements for a variety of applications with a single controller model.

MECHANICAL RELAY: The standard output for the CN6081/6082 is a mechanical relay rated for 7A/5A (at 120/240 VAC) which is used for driving resistive heaters.

NOTE

Do not use this output with mechanical contactors because they generate an excessive EMI field which can interfere with the CN6081/6082 microprocessor. Instead, use "T" output modules for this application.

MODULE TYPE F: This 4-20 mA output module can deliver full output to loads having an input impedance of 500 ohms or less. The cycle time setting must be ZERO for smooth current output.

MODULE TYPE DC: Similar to F, but pulsed 20 VDC output for driving solid state relays. Up to 6 (input series connected) solid state relays can be used. Cycle time can be set to optimize the load response time requirements.

F and DC MODULE NOTE

A push-on terminal is utilized as a return for ground currents of the milliamp source. It is connected internally by the mating lug on the circuit board. To avoid ground loops, drive floating (ungrounded) loads.

MODULE TYPE T: This solid-state relay is capable of 1 Amp at 120/240 VAC. It is zero voltage switched and optically isolated from the drive signal. With it, resistive loads up to 120 watts at 120 VAC and 240 watts at 240 VAC may be controlled directly. Using direct control there is no lower limit on the cycle time setting (down to 200 milliseconds).

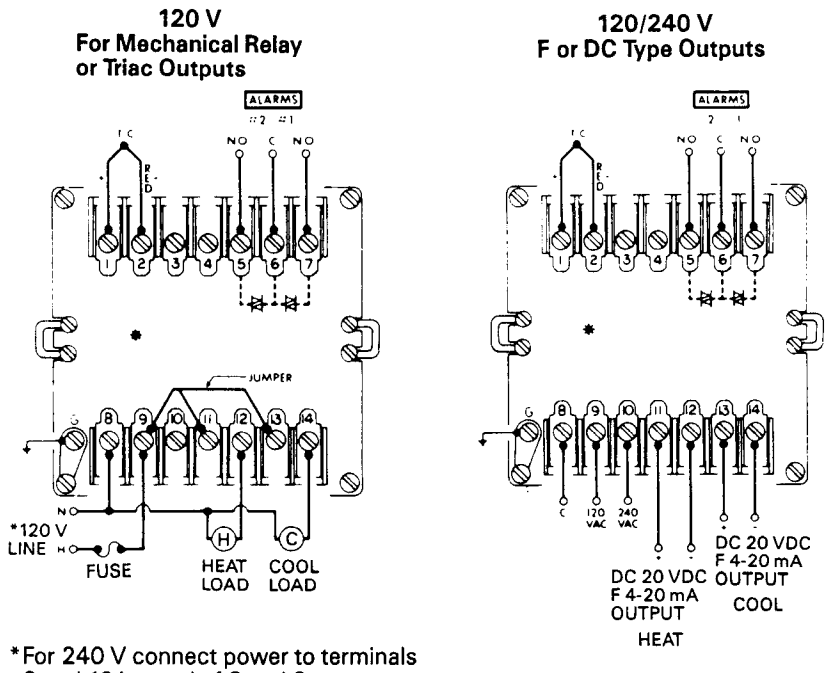
Larger loads may be controlled using an external contactor. In this case, it is advisable to use cycle settings of ten seconds or greater to minimize contactor wear. **External suppression of the contactor is mandatory.** See Section 4.4 on electrical noise.

SECTION 4 BASIC WIRING

4.1 THERMOCOUPLE OR RTD PLACEMENT

Proper thermocouple placement can eliminate many problems in the system. The probe should be placed so that it can detect any temperature change with minimal thermal lag. In a process that requires fairly constant heat output, the probe should be placed close to the heater. In processes where heat demand is variable, the probe should be close to the work area. Some experimenting with probe location may be necessary to find the optimum location.

Figures 4-1 and 4-2 show typical wiring examples.



*For 240 V connect power to terminals 8 and 10 instead of 8 and 9.

Figure 4-1. Typical Wiring Examples

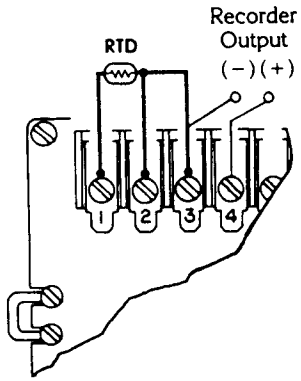


Figure 4-2. Typical RTD Wiring

4.2 WIRING THERMOCOUPLE CIRCUITS

Before wiring, check thermocouple and extension wire to make sure that they conform to the appropriate thermocouple type. In thermometry, the negative lead is color-coded red. Extension wires must be of the same alloy and polarity as the thermocouple. The thermocouple lead resistance should not exceed 100 ohms for rated accuracy. Slight inaccuracies may result if resistance is higher.

Do not run thermocouple leads in the same conduit as the power lines. If shielded thermocouple wire is used, terminate the shield only at the controller end using the corner screw provided for that purpose.

4.3 WIRING RTD CIRCUITS

CN6081/6082 P1 and P2 units are designed for 100 ohm Platinum RTDs. 2-wire RTDs are connected to terminals 1 and 2 with a jumper connecting 2 to 3. Keep leads short and use heavy gauge copper extension wires if necessary, to minimize lead resistance. For long runs, 3-wire RTD should be used and wire gauge should be sufficient that resistance does not exceed 10 ohms. An error of 0.2°F will result for each additional 10 ohms per lead.

CAUTION

DO NOT RUN RTD LEADS IN THE SAME CONDUIT AS POWER LINES.

If shielded RTD wire is used, terminate the shield only at the controller end, using the corner screw provided for that purpose. RTDs tend to be shock-sensitive and require extra care in handling and installation.

4.4 ELECTRICAL NOISE

Microprocessors can be randomly interfered with by large electrical spikes, even with elaborate watchdog circuits and filtering built into the unit. Contacts and coils must be suppressed. One very effective filter is a .1ufd/600V capacitor in series with a 100 ohm, 1/2 watt (min.) resistor. This RC network must be put on all contacts, especially across hard contacts with switching coils and across the coils themselves. The filter should be placed as close to the noise source as possible, i.e. right on a coil.

Other recommended practices include:

- Run sensor wires separately, shield if possible, and ground only one end of the shield.

- Install .01 ufd/100V or greater capacitors from each sensor terminal to case ground (the green screw).

- Connect each unit's ground (green case screw) directly to the machine (ground). Do not connect it to the panel. Paint and corrosion can cause poor signal transfer. Do not connect ground wires in series from unit to unit. Ground wires must be connected from each unit directly to a common ground.

Figure 4-3 is an example of noise suppression circuits.

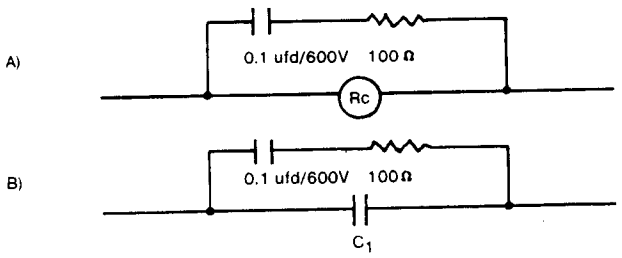
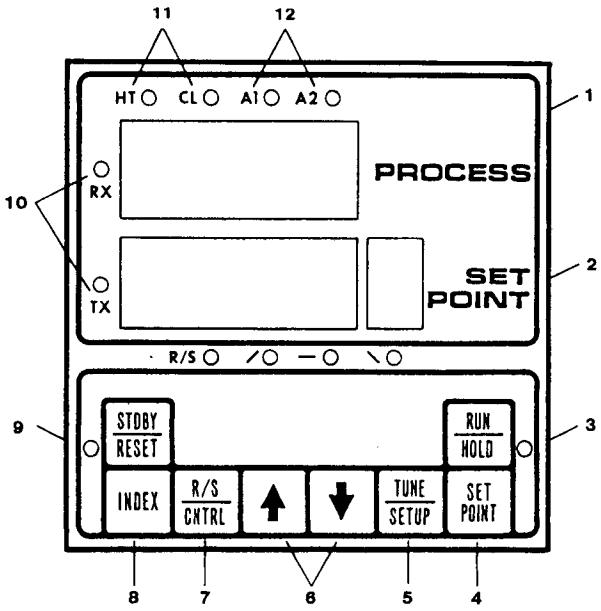


Figure 4-3. Noise Suppression Circuit

SECTION 5 OPERATION

5.1 FRONT PANEL FEATURES



1. Process Temperature or Parameter Code display

2. Set Point or Parameter Setting display
   (Degrees F and C are also displayed).

3. RUN/HOLD key initiates or pauses Ramp/Soak routine.
   LED lights in HOLD mode.

4. SET POINT key allows user to return to set point.

5. TUNE/SETUP key initiates Auto-Tuning when used in the proper sequence. Also allows access to Ramp/Soak routine settings.

6. Up/Down keys raise and lower settings, respectively.
   2-Step Scan Rate: Slow and faster (after 5 seconds).

7. R/S-CNTRL (Ramp/Soak Controller), selects controller mode.

8. INDEX key selects parameters to be addressed.

9. STDBY/RESET key disables outputs. Unit is put in idle mode. LED lights in STANDBY mode. STANDBY is also used as the position from which AUTO-TUNE is accessed. If the key is pressed during Auto-Tuning, the unit will cancel the Auto-Tuning procedure and return to the STANDBY mode. When pressed during a Ramp/Soak routine, the unit returns to SP = 0 and is put in STANDBY.

10. RX (Receive) and TX (Transmit) Lights indicate a signal is present at the communication port. They light only momentarily. These are functional only on units with communications options.

Front Panel (cont'd)

11. HT (Heat) and CL (Cool) Output Lights light when output drive signal is present.

12. Alarm (A1 and A2) lights light when unit is in alarm. (Programmable High, Low, process or deviation).

5.2 BASIC SET-UP

1. The controller has dual-input ranges which allow selection of one of two ranges and T/C types, by simply moving the position of the internal jumper. To set the unit to proper range, remove unit from case and position jumper on top board. Front position is range A, rear position is range B.

J/K	R/S	P1/P2	T
A = J	A = S	A = .1 degree	A=T
B = K	B = R	B = 1 degree	

The controller is shipped with the following factory settings:

SP = 100	CG = 30	Id = 01
A1 = 105	CC = 05 (F=00)	bd = 02
A2 = 95	cd = 08	cL = Range dependent
rt = 00	AT = 00	CH = Range dependent
HG = 30	cF = 08 (05 for °C ranges)	
HC = 05 (F=00)	ct = 00	

2. Range of Adjustments (Parameters)

All parameters are accessed by pressing the INDEX key. They are listed in the order they are displayed when the INDEX key is pressed.

The front panel of the unit contains a lower display of 5 digits, which displays the set point temperature, other parameter values, and degrees F or C. The upper display consists of 4 digits, which display the process value or the parameter abbreviations. (For example, A1 = Alarm 1).

As the INDEX key is pressed, the second column abbreviations appear in the upper display. To the right of the TUNE/SETUP key is an EXIT key labelled "SET POINT" which allows the user to exit parameters 2 through 16, back to parameter #1 (set point).

After changing a value, the SET POINT or INDEX key must be pressed. This enters the new value in memory. If it is not pressed and power is removed, the last value entered for that parameter will be retained for that parameter.

NO.	DISPLAY CODE	PARAMETER	RANGE
0	-	Process Temperature	Zero to span of unit (°F or °C)
1	-	Set Point	Zero to span of unit (°F or °C)
-	RS	Setup	Set Point (SP) 0 to 8, time (t) 1 to 8 0 to 9999 minutes Guaranteed Soak (GS) 0 to 100°F, or equivalent (0-56°C)
2	A1	Alarm 1	Zero to span of unit
3	A2	Alarm 2	Zero to span of unit
4	rt	Rate/Reset (1:6 ratio)	0 to 255 seconds
5	HG	Heat Gain	1 to 400
6	HC	Heat Cycle Time	0 to 120 seconds
7	CG	Cool Gain	0 to 400
8	CC	Cool Cycle Time	0 to 120 seconds
9	cd	Access Code	0 to 255

NO.	DISPLAY CODE	PARAMETER	RANGE
10	At	Auto-tune Damping	0 = Low, 1 = normal, 2 = High
11	cF	Configuration	0 to 15
12*	ct	Cooling Type	0 = Oil or none 1 = Air 2 = Water
13	Id	Unit ID Code	0 to 99
14	bd	Baud Rates	300 (0) 600 (1) 1200 (2) 2400 (3)
15	cL	Calibration, Low (Zero)	± 3% Span (°F/°C)
16	cH	Calibration, High (Span)	± 3% Span (°F/°C)

*Not on RTD units.

3. When setting up the unit for the first time, use the STANDBY key (LED is on), and the unit will be placed into an idle condition. Outputs and alarms will be off. Upon completion of initial setup, push the STANDBY key again (LED off) for normal operation.

4. Press the INDEX key until parameter #9 (cd) appears in the process display area.

   Set 14 in the lower display to gain access to configuration code, by pressing the up or down arrow.

5. Press the INDEX key until parameter #11 (cF) appears in the process display area. Refer to the configuration code chart and select a number that represents the desired configuration of the alarms and display units. For example, #06 = °F, Deviation Alarms, Alarm 1 = Low Acting, Alarm 2 = High Acting. Set this number into the lower display.

NOTE

Changing temperature scale requires re-setting of all control points.

CONFIGURATION CODE CHART

0	F	P	H1	H2
1	C	P	H1	H2
2	F	D	H1	H2
3	C	D	H1	H2
4	F	P	L1	H2
5	C	P	L1	H2
6	F	D	L1	H2
7	C	D	L1	H2
8	F	P	H1	L2
9	C	P	H1	L2
10	F	D	H1	L2
11	C	D	H1	L2
12	F	P	L1	L2
13	C	P	L1	L2
14	F	D	L1	L2
15	C	D	L1	L2

CODE ABBREVIATIONS

F - Fahrenheit
C - Celsius
H1 - High Alarm
H2 - High Alarm
P - Process Alarms
D - Deviation Alarms
L1 - Low Alarm
L2 - Low Alarm

6. If the unit will interface with a computer:

   Press the INDEX key until parameter #13 (Id) identification code appears in the upper display area. If a digital communication option module is installed, select a value between 00 and 99 and set into the lower display. This is the unit's address.

7. Baud rate: Index to position #14 (bd) and enter the code for the proper baud rate, e.g. 00 = 300, 01 = 600, 02 = 1200, 03 - 2400 baud.

8. Press SET POINT and set in the desired temperature value on the lower display. If you have pressed the INDEX key, the unit will advance to the High and Low Calibration positions, but INDEX no further until the SET POINT key is pressed.

CAUTION

DO NOT CHANGE THE CALIBRATION LOW OR HIGH ADJUSTMENT UNLESS YOU ARE QUALIFIED AND HAVE A CALIBRATION TEST SET-UP CONNECTED.

When you have finished entering all parameters, return to "cd" using the INDEX key. Select the level of security desired and enter the appropriate value into memory.

#01 - Allows changes to Set Point only.
#08 - Allows changes to first nine parameters only.
#14 - Allows changes to 9 parameters and calibration constants.

NOTE: Any other value only allows changes to Access Code (cd).

Setup Reference Notes

1. Parameters #10 through #16 are accessed from the front panel only, and cannot be set from a remote terminal.

2. The gain value (HG and CG) is a multiplier used to increase the sensitivity of the controller according to the formula: Output = Gain (E+I+D) where E = Error, I = Integral, D = Derivative. Its relationship to proportional band is as follows:

$$\text{PROP BAND} = \frac{\text{Unit Span}}{\text{Heat Gain (HG) or Cool Gain (CG)}}$$

   Note that proportional band is an inverse function of gain. The range of adjustment is 0 to 400 for Heat, 0 to 400 for Cool.

   For units utilizing only Heating output, the Cooling gain should be set by the user to the equivalent heat gain. The inverse is also true. Setting CG to 0 initiates an on/off (narrow deadband) output for cooling, which is recommended for cooling-only applications. Setting HG to 0 disables the Heat output.

3. The Access code is a number stored in ROM that allows user access to change parameters when it is entered in location "cd". Depending upon the code entered, the user may then alter calibration and configuration of the controller. When this is accomplished, the code may be changed to prevent tampering with critical values. When the number is "1", only the set point can be changed. When the number is "8", changes are allowed to the first nine parameters. When the number is "14", all settings can be altered. When neither 1, 8, or 14 are entered, only the access code can be altered.

4. The Configuration code allows the user to configure the alarms for process/deviation, high or low energizing. This code also selects °F or °C operation of the unit. See the Configuration Code Chart.

5. "Id" is the unit identification code. It is variable from 00 through 99 and is used with the communications interface to allow a remote device to identify which controller it is communicating with.

6. Setting "RT" to 0 disables rate and reset action for proportional only control. This may cause an offset between set point and process temperature.

7. Set the Heat Cycle (HC) and Cool Cycle (CC) according to the power controlling device being used: 0 for 4-20 mAdc outputs, 5-20 for contactors and solenoids. Setting HC or CC to 0 initiates 200 millisecond timebase for fast cycling of the respective output. Use with external solid state relays (DC modules), or SCR power controllers (F modules).

5.3 RAMP/SOAK OPERATION

5.3.1 Introduction

1. The CN6081/6082 can perform a recipe with up to 8 ramp or soak segments. Refer to Section 5.3.2 for the procedure.

2. RS/CNTRL: The unit can be operated as a temperature controller (with one set point) or as a ramp/soak unit (with a temperature set point recipe). To select the mode of operation, press the RS/CNTRL key. In the Ramp/Soak mode, the R/S LED will light.

3. RUN/HOLD: To start the Ramp/Soak, press the RUN/HOLD key. To stop the timer at any point in the recipe, press the RUN/HOLD key (LED will light). To continue, press the key again.

4. STDBY/RESET: To return the unit to the beginning of the recipe, press the RESET key. The unit will be put into stand-by mode. The last set point will continue to be displayed and the Standby LED will light.

During operation, the display will periodically flash the segment of the recipe currently running (SEG 2) and the number of repeats remaining (4r) in the lower display. The front panel features three Ramp/Soak status lights that indicate if a recipe is currently in a Ramp Up (/), Soak(-), or Ramp Down (\) segment.

Recipes can be loaded from a computer. The routine can also be started via the communication port. See Section 6, Communications, for additional details.

5.3.2 Programming Ramp/Soak

1. Ramp/Soak menus are programmed by entering a series of alternating set points (SP-0 through SP-8) and time intervals (t-1 through 8). Two consecutive set points of the same temperature will produce a soak segment at the specified temperature for the duration of the time interval programmed between the set points. When consecutive set points are programmed for different values, the result will be a ramp (up or down) from the first set point to the second in the specified time interval.

2. To enter a Ramp/Soak menu, first press the INDEX key until parameter #9 (cd) appears in the process display area. Set 14 in the lower display by pressing the up or down arrows, then press the SET POINT key.

3. Press the INDEX key and SETUP will appear in the lower display, and "rs" (ramp/soak) in the upper display.

4. To access the Ramp/Soak menu, press the SETUP key. "SP-0" will then be displayed. This is the starting set point.

5. To enter your profile, use the up and down arrows to set the value for SP-0, then press the INDEX key and "t1" will appear in the upper display. This is the first time interval and is set in minutes (0-9999) using the arrow keys. Setting any time interval to zero will end the profile after completion of the previous segment.

6. Press the INDEX key after entering "t1" and the display will advance to the next set point. Continue this sequence (alternating set points and times) until the entire profile is entered (8 time segments maximum). If less than eight segments are desired, setting the first time interval after the recipe to zero will cause the recipe to end at that point.

7. At the end of the Ramp/Soak menu (after SP-8), there are two positions, rC (Repeat Cycle), and GS (Guaranteed Soak).

   rC: Adjustable number of times the recipe is repeated; can be set from 0 to 254 or continuous (by setting to 255).

GS: Adjustable deviation HOLD, settable for 1 to 100°F or equivalent °C below the main set point. If the setting is exceeded, the clock stops until the temperature rises above the setting. A setting of 0 disables this function.

8. To exit the Ramp/Soak setup menu, press the INDEX key until GS is displayed. Press the SET POINT key once to enter the basic Setup Menu, or twice to return to the normal operating display.

Example: 5 SEGMENTS		
Initial	SPO =	80 F
Ramp	t1 =	15 min
	SP1 =	180 F
Soak	t2 =	30 min
	SP2 =	180 F
Ramp	t3 =	30 min
	SP3 =	400 F
Soak	t4 =	180 min
	SP4 =	400 F
Ramp	t5 =	60 min
	SP5 =	80 F
Shut Off	t6 =	00
	SP6 =	XX
	t7 =	XX
	SP7 =	XX
	t8 =	XX
	SP8 =	XX
Repeats	r0 =	YY
Guar. Soak	GS =	ZZ

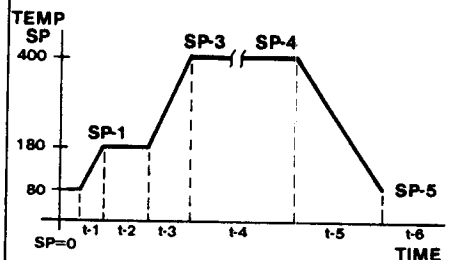


Figure 5-2. Example of Ramp/Soak Settings

5.3.3 Running a Ramp/Soak Profile

After entering a Ramp/Soak profile (following the instructions in Section 5.3.2), it can be executed using the following procedure.

1. While in the normal mode of operation, place the controller in Standby by pressing the STDBY-RESET key. The Standby LED will illuminate and both control outputs will turn off.

2. Select the Ramp/Soak mode by pressing the R/S-CNTRL key. The R/S LED will illuminate.

3. To start the profile, press the RUN/HOLD key. The Standby LED will go out and the appropriate segment indicator LED (Ramp-up, Soak, or Ramp-down) will illuminate.

5.4 TUNING THE CONTROLLER

5.4.1 Introduction

The user has the option of automatically selecting the controller's PID settings or manually setting the unit as desired. Tuning a 3-mode controller involves three major adjustments: Proportional Band (Gain), Rate (Derivative), and Reset (Integral) action. In the CN6081/6082, the Rate and Reset settings are incorporated into one adjustment, RT, which is displayed in seconds of Rate time. The Reset time is automatically set at six (6) times the displayed Rate values.

5.4.2 Automatic PID Tuning Procedure

1. Set point must be a minimum of 100°F above the starting or ambient temperature when tuning is initiated for accurate tuning. Less than 100°F may not yield effective tuning settings.

2. Multi-zone applications require Auto-Tune units on each zone and simultaneous warm-up.

3. Loss of power or a turn-off during the Auto-Tune cycle requires a re-start from ambient (or at least 100°F rise to set point) for reliable PID values.

4. Change of state processes, i.e. solid to liquid, or liquid to gas, may introduce erroneous tuning parameters during process warm-up. Tuning should be done after the change has occurred.

5.4.2.1 Damping Settings

Heat Damping Choices (At, position #10)

To allow the controller to provide automatic tuning for a wide variety of processes that may exhibit varying heating characteristics and/or varying heating capabilities, the controller offers three damping choices:

00 Low Damping - For processes that: (any combination of the following)
- are adequately powered with excellent coupling between heater and probe.
- require quick response and the tightest possible temperature control is desired.

01 Normal Damping - For processes that (any combination of the following)
- have heaters that are properly sized.
- have good coupling between heater and probe.
- are considered standard with moderate lags and response time.

02 High Damping - For processes that (any combination of the following)
- are overpowered.
- have multiple lags.
- are poorly coupled between the heater and probe.

Cool (Ct, position #12) (Not on RTD units)

When using the controller on heating and cooling applications, such as extruders, the "ct" number allows setting of the controller for the type of controller used:

00 - Oil cooling (use this setting if no cooling is used)
01 - Air cooling (Forced air)
02 - Water cooling (above 212°F set point)

5.4.2.2 Starting the Automatic Tuning Procedure

1. Energize the unit and proceed immediately to Step 2.

2. Place the unit on Standby by pushing the STANDBY key. LED will light. Auto-tune can only be accessed from STANDBY position.

3. INDEX down and enter access code, position 9, then press SET POINT.

4. INDEX down and enter all settings per Section 5.2., for example, set point, A1, A2, HC, CC, AT, cF, ct, ld, bd, and press SET POINT. RT, HG, and CG will be set by controller during auto-tuning.

5. INDEX down to "At".

6. When ready to start auto-tuning calculation of PID settings, press the "TUNE" key. The displays will return to process and Set Point is displayed. The F/C digit will blink while tuning is in process. Upon completion of tuning, the digit will stop blinking. To stop auto-tuning, press STANDBY/RESET.

NOTE: The CN6081/6082 P input will not auto-tune when the decimal point range is used. If tenth degree range is desired, either auto tune on the other range and then move the range jumper, or use manual tuning methods.

5.4.2.3 Overriding Auto Tune Parameters

It is possible to set or fine tune the three mode parameters manually. To manually enter parameters:

1. Press INDEX key until Rt (Rate), HG (Heat Gain), or CG (Cool Gain) are displayed.

2. Enter new parameter setting desired, using the Up/Down keys.

The new parameters will now take control of the process.

5.4.3 Manual Tuning Procedure (Ziegler-Nichols PID Tuning Method)

The following procedure can be used for fine tuning after or instead of auto-tuning.

The Ziegler-Nichols PID Tuning Method has long been an accepted method of tuning PID (3-mode) controllers, using a minimum of time and set-up to reach effective tuning parameters. Before proceeding, make sure the basic unit setup is done as discussed in Section 5.2.

NOTE

If Cooling is not used, enter Heat Gain value in Cool Gain also.

1. Apply power and immediately press the STANDBY key. The STANDBY light will come on.

2. Adjust desired set point. If oscillations and overheating will damage equipment, a lower set point should be used for initial tuning.

3. Set Heat Gain (HG) and Cool Gain (CG) to 400 (even if no cooling is to be used, the cooling gain should be set the same as the heat gain). Disconnect the cooling apparatus.

4. Press STANDBY again and temperature will begin to rise. When the process rises to the desired set point, it wil probably oscillate. Periodically decrease the Gain (lower the HG number) until a small constant oscillation is obtained. Reducing the Gain by steps of 1/2 the previous HG setting is an acceptable method to obtain the desired small oscillation. Note time between oscillations in sections. (See "T" marked on Figure 5.3).

5. Decrease the Heat Gain to 60% of the value obtained in the previous step. The Gain is now tuned. Enter the same number in the Cool Gain.

6. The best rate time (RT) setting is 1/8 the time in seconds of one cycle (see cycle time "T" in Figure 5-3). This will give a conservatively tuned system. If faster response and/or faster rise to set point is desired, 1/12 of "T" may be used. Note that faster settings may yield instability and temperature overshoots on start-up. Remember that the Reset automatically tracks the rate (rt) adjustment.

7. Connect cooling apparatus. Observe control stability.

8. If oscillation occurs, lower the Cool Gain number. If cooling is sluggish, raise the Cooling Gain number.

In order to observe changes in process temperature, especially as they relate to time, it is helpful to use a temperature recorder in conjunction with all tuning and parameter setting procedures.

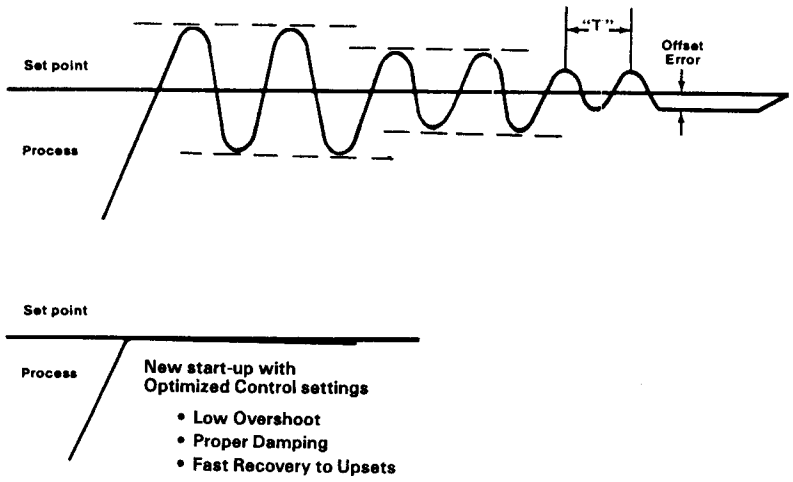


Figure 5-3. Ziegler-Nichols Tuning Method

TUNING HINTS:

1. Once the optimum "rt" and HG have been set into the unit, cold start tests of the process should be tried. Remember that start-up and running parameters will usually be different, and it is desirable to adjust both gain (HG) and Rate/reset (rt) ±25% to strike a balance between good start-up and running settings.

   Generally, higher settings of "rt" will give more controlled start-ups with less overshoot; lower values will give faster recovery from process upsets. Higher gain settings will give tighter control of the running process, but may give more overshoot on start-up.

2. If difficulty is encountered in tuning the cooling control:

a. Be sure that cool cycle is optimized (faster settings give less "ripple" and better control, but must be weighed against shortened solenoid life, motor starter wear, etc.).

b. Cooling mechanisms may have excessive lag (time delay). If possible, improve the dynamics of the cooling transfer; otherwise, use a higher (2X) rt value.

c. Optimize cooling gain. If temperature continues to climb, begin doubling the value of cooling gain (CG). Allow sufficient time for the process to stabilize between adjustment. If the process begins to oscillate on cooling, reduce the Cool Gain (CG) setting. Optimum setting of the Cooling Gain will minimize temperature excursions without causing oscillation.

d. Since heat rate has been compromised, reduce heat gain to 1/2 previous value.

3. On/Off Cooling. Setting the Cool Gain (CG) to 00 produces On/Off action for cooling. The deadband is 1 degree.

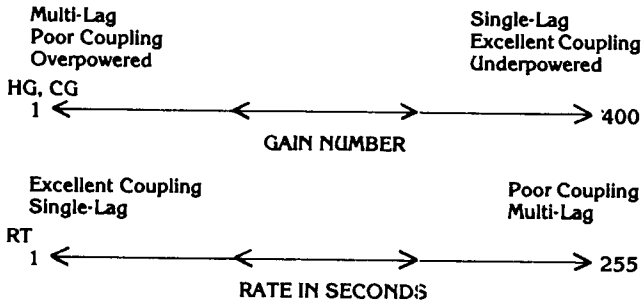


Figure 5-4. Characteristics vs. Settings

SECTION 6 COMMUNICATIONS

6.1 COMMUNICATIONS MODULES

Optional plug-in modules are availab e for the controller to allow interfacing to the most common indu:try standards. A brief description of each type follows.

6.1.1 RS-485

RS-485 is a specification standard foı balanced voltage digital interface circuits published by the EIA.

It was published in 1983 as an upgrac e of RS-422A electrical specifications, with emphasis given to the application of multipoint systems. The interface circuits used i n the controller meet the electrical characteristics of the RS-485 standarcl.

The RS-485 multipoint capability allow s up to 32 units to be connected together in a half-duplex network. Mo e can be added with the user of repeaters, such as the OMEGA MODEL A1300 Repeater.

This module allows bi-directional data transfer over a shielded twisted pair. The twisted pair is a transmissio n line with drops to communicating devices. Since it is a t ansmission line, terminating resistors are required at the most distant ends of the line to minimize reflections (typically, 60 ohms from eac h line to signal ground). The RS-485 module is fully optically isolate d, eliminating group loop problems. Parallel drops from the tran smission line should be kept as short as possible. Alternately, the line could be daisy-chained at each DB-9 connector.

Note that the polarity of the line is important and each device will specify an "A" and "B" connection. On the RS-485 module, A is pin 8 and 4; B is pin 7 and 3, and communications ground is available on pins 1, 2, and 6. Frame ground is pin 5 and 9.

6.1.2 RS-232C

The RS-232C is a standard that was published in 1968 by the EIA. RS is an acronym for Recommended Standard, 232 is the identification number for that standard, and C designates the last revision made to the RS-232 standard. The purpose of this standard is to define the electrical characteristics for the interfacing of Data Terminal Equipment and Data Communications Equipment. The standard provides voltage ranges for data and control signals to provide proper transmission.

This module allows bi-directional data transfer via a three-conductor cable consisting of Signal Ground (pin 7), Receive (Input, pin 2), and Transmit (Output pin 3). It is recommended for less that 50 feet between computer/terminal and instrument. Note that multiple instruments cannot be tied to the same port. The module is optically isolated to eliminate ground loop problems. Note that in a typical installation, "Data Out" of the computer/terminal connects to "Receive Data" of the CN6081/6082, and "Receive Data" of the computer/terminal connects to "Data Out" of the CN6081/6082. If shielded cable is used, it should be connected to frame ground at one end only. Signal ground is connected at both ends. The RS-232 module is configured for active operation.

6.2 INSTALLING THE COMMUNICATIONS MODULES

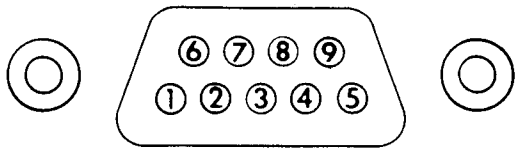
1. Plug the 11-point receptacle on the module into the header on processor module (vertical board behind display). Be sure the connector is properly centered on the header connector.

2. Slide the notch on the PC board into the slot on the stand-off.

3. RS-485 and RS-232 Modules: Plug the three-pin connector into the mating header on the power supply (lower board). Be sure leads are free of other components.

NOTE

To the left of the upper display is an LED indicator for the Receive function. This LED will illuminate briefly when a transmission is present on the communications bus. To the left of the lower display is an LED indicator for the Transmit function. This LED will illuminate briefly when the CN6081/6082 that has been addressed transmits information onto the communications bus.



PIN #	RS485	RS232
1	SIGNAL GROUND	SIGNAL GROUND
2	SIGNAL GROUND	RECEIVE (INPUT)
3	"B"	TRANSMIT (OUTPUT)
4	"A"	NC
5	FRAME GROUND	FRAME GROUND
6	SIGNAL GROUND	SIGNAL GROUND
7	"B"	SIGNAL GROUND
8	"A"	NC
9	FRAME GROUND	FRAME GROUND

Figure 6-1. Communications Connector Pinout

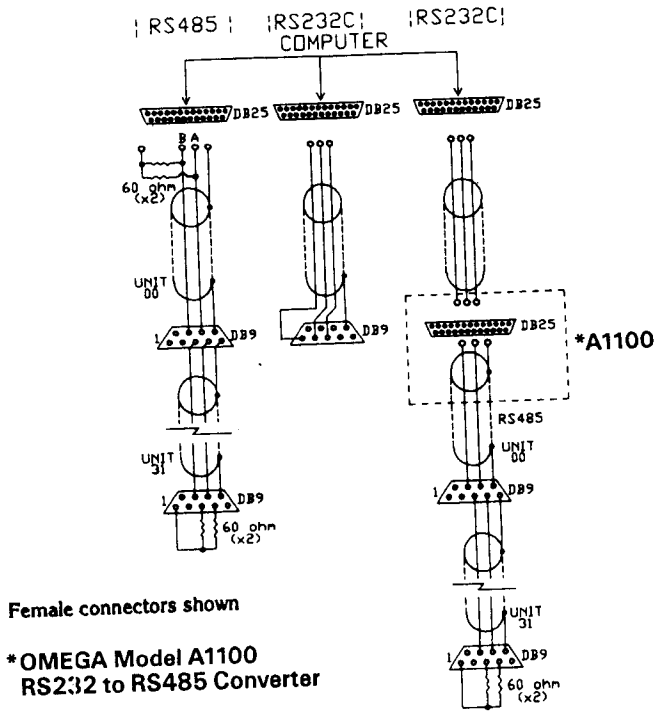


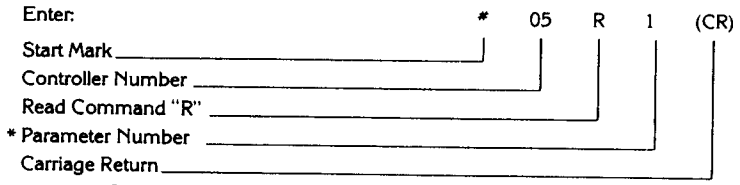
Figure 6-2. Typical Wiring for Communications Options

6.3 INTERFACE EXAMPLES

The CN6081/6082 is designed to respond to data transmitted in ASCII 7 bit code with one start bit, one stop bit and odd parity from any terminal or computer. Baud rate is selectable at 300, 600, 1200 or 2400 baud.

6.3.1 To Read a Parameter

6.3.1.1 For All Parameters Except Ramp/Soak Recipe



Controller Response:

(LF) #05R1 0123F (CR) (LF)

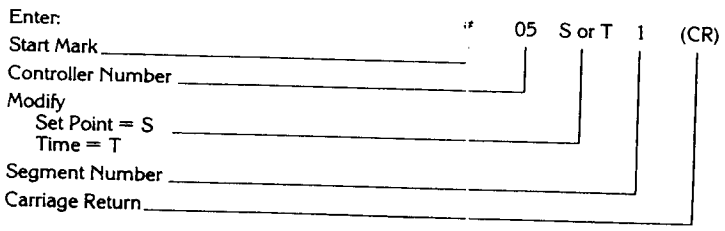
Parameter #1 (Set Point) on controller 05 is presently 123 F.

CR = Carriage Return

LF = Line Feed

*Parameter Numbers 0-9 can be accessed via interface

6.3.1.2 Reading Parameters in Ramp/Soak Recipes



Controller Response:

For Set Point: (LF)*05S1 0080F(CR)(LF)

Set Point *1 (SP-1) on controller number 05 is 80° F

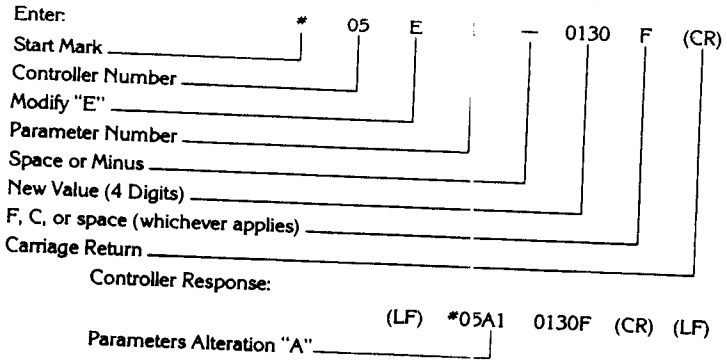
For Time: (LF)*05T1 0010(CR)

Time Segment *1 (-tI-) on controller number 05 is 10 minutes

NOTE: T9 = Repeat Cycles setting (rC)
S9 = Guaranteed Soak setting (GS)

6.3.2 To Modify and Store in Non-Volatile Memory

6.3.2.1 For All Parameters Except Ramp/Soak Recipe



The set point (Parameter 1) for controller 05 has now been changed to 130°F and entered in non-volatile memory.

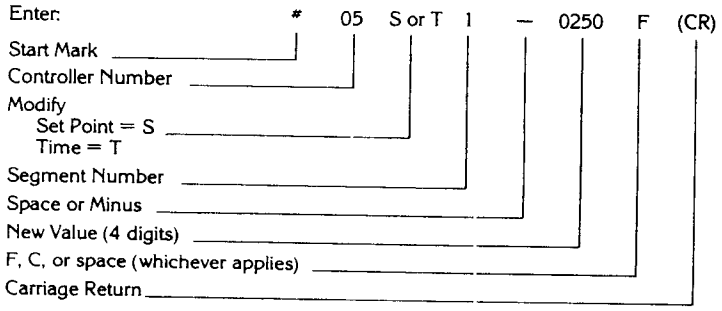
NOTE: For the RTD Series an extra character must be added to accommodate the decimal point feature.

Example:

ENTER: #05M1-0130__F (CR) For range 26C
ENTER: #05M1-130. 0 F (CR) For range 22F
ENTER: #05M4-0130___ (CR) For Parameters

Space

6.3.2.2 To Modify and Store Ramp/Soak Recipes



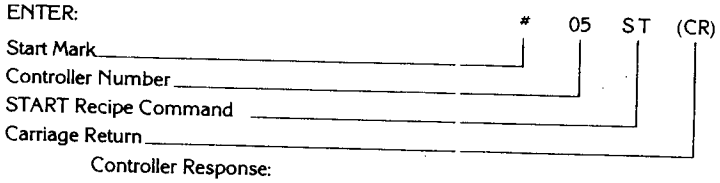
Controller Response:

For Set Point: (LF)#05S1 0250F(CR)
Set Point #1 on controller number 05 has been changed to 250° F and this setting was also entered into non-volatile memory.

For Time: (LF)#05T1 0250(CR)
Time segment # 1 on controller 05 has been changed to 250 minutes and this setting was also entered into non-volatile memory.

NOTE: T9 = Repeat Cycles (rC) setting
S9 = Guaranteed Soak (GS) setting

6.3.3 To Start a Profile



Controller Response:

(LF)#05ST START CR)

Controller number 05 has just started its Ramp/Soak routine. This command overrides all else regardless of the mode the controller is in.

SECTION 7 CALIBRATION

WARNING
These adjustments are factory set and should only be changed by a qualified person using calibrated equipment. Adjustment is not necessary during the life of these controllers.

7.1 ZERO (cL) AND SPAN (cH) CALIBRATION

1. Unlock access to the calibration constants by entering the Unlock number (14) into location #9 (cd).
2. Use a temperature calibrator with a range appropriate for the unit to be calibrated. Set in the value for low scale calibration, e.g. 3% of range.
3. Step to cL (calibrate low [ZERO]) using the INDEX key on the CN6081/6082.
4. Press the Up/Down arrow keys on the controller until both instruments agree.
5. Set in a value on the calibrator equivalent to the high end capability of the unit under test, e.g. 95% of range.
6. Step to cH (calibrate high [SPAN]) using the INDEX key.

7. Press the Up/Down arrow keys on the controller until both instruments agree.

8. Repeat steps 2 through 7 until readings agree. Some interaction between ZERO (cL) and SPAN (cH) calibration usually occurs.

9. Lock out configuration access, if desired, and return to set point by pressing SET POINT key.

NOTE

Pressing INDEX continuously selects cH or cL (Span and Zero) in the calibrate mode to facilitate testing. Exit this mode by pressing the SET POINT key.

SECTION 8 TROUBLESHOOTING

8.1 TROUBLESHOOTING - GENERAL

Symptom	Probable Cause and Corrective Action
Display does not light up.	No power, blown fuse.
Process display shows (---) or HHHH	Open thermocouple circuit. Shorting terminals 1 and 2 should indicate temperature at back of case. Repair or replace thermocouple.
Process display show LLLL or counts down scale when temperature is rising.	Check for reversed thermocouple.
Approx. 30% error	Wrong thermocouple type connected or internal range jumper in wrong position. Check serial tag for sensor type and then check probe. Check jumper location.
No heat	Incorrect heater wiring, wrong output module. Check for cause and correct the components.

Symptom	Probable Cause and Corrective Action
Display blinks; entered values change.	Electromagnetic interference (EMI). To eliminate high voltage spikes, separate sensor and controller wiring from "dirty" power lines. Ground heated devices. Suppress all coils and contacts. See Section 4.4 on Electrical Noise.
Heat stays on.	Welded relay contacts or shorted output module. Check components.

8.2 TROUBLESHOOTING - COMMUNICATIONS

If problems are encountered, it is recommended that all connections and adjustments be reviewed carefully. The following are suggested checks.

1. Connect wiring per drawings, make sure to double check all connections.
2. Check that unit ID code is correct.
3. Select baud rate on controller and make sure that it agrees with host system.

4. Select ODD parity and confirm that ASCII 7-bit code with one start and one stop bit is selected.

5. Apply power and address controller, making note of the Receive (RX) light, which will light if there is a signal occurring on the lines connected to the unit.

6. Try "READ" command sequence. No response usually indicates a problem with the baud rate, parity or host terminal software. Recheck all settings if problems are experienced.

7. It may be necessary to reverse the A and B lines to the host system if the polarity is unknown on RS-485 interface. If the Receive (RX) light on the RS-485 is lit, but the Transmit light (TX) is not, the signal polarity is probably backwards.

8. If inconsistent or random responses are experienced, electrical noise is probably the cause. Add terminating resistors, shielded cable, and suppress source if it can be identified.

9. Garbled response may indicate open or intermittent wiring or connectors.

10. If units with RS-485 are being addressed through a conversion box by an RS-232C port on the computer, and the RS and TX lights are lighting but the computer is not getting data back from the controllers, check the RTS line. It may be missing or may not be getting toggled.

SECTION 9 SPECIFICATIONS

RAMP/SOAK SEGMENTS:	Eight ramp or soak segments, plus a starting set point temperature.
COMMUNICATIONS	
DIGITAL FORMAT:	Isolated 7-bit ASCII, asynchronous with 1 start and 1 stop bit, odd parity, selectable baud rate (300, 600, 1200, 2400)
LINE VOLTAGE:	120/240 VAC ±10%, 50-60 Hz
POWER CONSUMPTION:	Less than 6 VA (instrument)
SENSOR BREAK PROTECTION:	Upscale standard
ACCURACY:	±0.2% of full scale, ±1 digit
TEMPERATURE STABILITY:	5 μV/°C maximum, 3 μV/°C typical
T/C COLD END TRACKING:	0.05°C/°C ambient
OPERATING AMBIENT:	32 to 131°F (0 to 55°C)
SERIES MODE NOISE REJECTION:	80 dB

COMMON MODE NOISE REJECTION:	120 dB
DUAL DISPLAY:	Process temperature or parameter code is shown on upper display; set point or parameter value can be selected on lower display; 4-digits process and parameters; °C and °F indicator
UPDATE RATE:	2.5 times per second; digitally filtered to eliminate noise fluctuation
°F/°C:	Front panel selectable
ALARMS:	1 and 2, auxiliary on/off, adjustable for high or low temperature triggering; LED displays alarm status; process/deviation mode selectable; optically isolated solid-state relays, rated 1 A at 120/240 VAC (on/off)
RELAY (TIME PROPORTIONAL):	SPST relay, 7 Amps resistive at 120 VAC, 5 Amps resistive at 240 VAC, 50 VA inductive
"F" CURRENT PROPORTIONAL:	4-20 mADC into 500 ohm maximum

SPECIFICATIONS (Cont'd)

"DC" PULSED VOLTAGE:	20 Vdc pulsed time proportional signal for driving SSRs
"T" TRIAC (TIME PROPORTIONAL):	Plug-in relay output zero voltage switched; rates 1A holding and 10A inrush
CONNECTIONS:	Inputs and outputs via barrier strips with UL listed locking terminals; communication via 9-pin sub-miniature "D" connector
DIMENSIONS:	Depth behind panel: 4.78" (121.4mm); Panel Cut-out: 3.622" square (92mm)
MOUNTING:	Channel slides and screws
WEIGHT:	2 lbs. (0.9 kg)

NOTES

MADE IN THE USA

WARRANTY

OMEGA warrants this unit to be free of defects in materials and workmanship and to give satisfactory service for a period of **13 months** from date of purchase. OMEGA Warranty adds an additional one (1) month grace period to the normal **one (1) year product warranty** to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product. If the unit should malfunction, it must be returned to the factory for evaluation. OMEGA's Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective it will be repaired or replaced at no charge. However, this WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of being damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components which wear or which are damaged by misuse are not warranted. These include contact points, fuses, and triacs.

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

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