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OMEGA ENGINEERING, INC.

SERIES 6000
Microprocessor-Based Temperature Controller

Operator's Manual

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 current, heat, moisture, vibration, or misuse. Components which wear or which are damaged by misuse are not warranted. These include contact points, fuses, and triacs.

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Return Requests/Inquiries

Direct all warranty and repair requests/inquiries to OMEGA Customer Service Department, telephone number (203) 359-1660. Before returning any instrument, please contact the OMEGA Customer Service Department to obtain an authorized return (AR) number. The designated AR number should then be marked on the outside of the return package.

To avoid processing delays, also please be sure to include:

1. Returnee's name, address, and phone number.
2. Model and Serial numbers.
3. Repair instructions.

M150/016

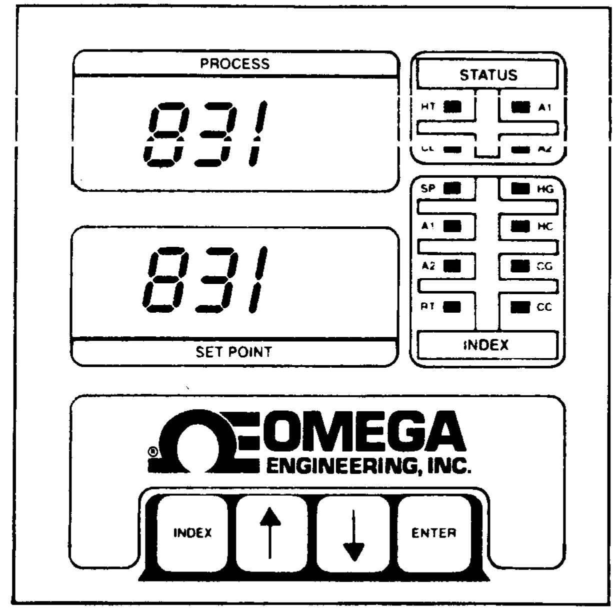


TABLE OF CONTENTS
MODEL 6000 MICROPROCESSOR-BASED TEMPERATURE CONTROLLER

SECTION 1 INTRODUCTION

1.1 GENERAL DESCRIPTION

The OMEGA® Model 6000 Microprocessor-Based Temperature Controller provides the latest in heating and cooling control. A large dual 4 digit display shows process and set point temperature at a glance.

Three mode PID (proportional, integral and derivative) action eliminates offset as cooling and heating requirements change in the process, provides fast output response to rate of change, and reduces temperature overshoot and undershoot. Heating and cooling outputs can be either relay, 4-20 mA, triac or 20 V dc pulsed, in combination.

The touch-key operation of the Model 6000 Controller eliminates all external knobs and protruding switches. Parameters are entered easily and can be locked in to prevent unauthorized tampering.

The Model 6000 Controller also incorporates: software linearization and stabilized sensor input; °F to °C conversion; alarms that can be energized by temperature rise or fall and be selectable as process or deviation type; and a program restart circuit that eliminates program lockup due to transient voltage spikes or line voltage "brownout." Program automatically restarts within 20 milliseconds after condition passes. The Model 6000 Controller is available with thermocouple types J, K, T, or RTD inputs. RTD inputs are available in two models: P1 for 1° resolution and P2 for 0.1° resolution. RTD models also feature, as standard, a recorder output: P1 has 1 mV/°F output (1.8 mV/°C); P2 has 10 mV/°F output (18 mV/°C).

1.2 FEATURES

- Dual 4 digit display
- Heating and cooling outputs
- Microprocessor-based
- Dual process or deviation alarms
- Easy touch-key setup
- Compact ¼ DIN case
- Only 3⅝'' deep

SECTION 2 INSTALLATION

2.1 UNPACKING

Remove the Packing List and check off actual equipment received. If there are any questions about the shipment, please call OMEGA Customer Service Department at (203) 359-1660.

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

NOTE

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

2.2 CONTROLLER LOCATION

Select a location for the controller where it will not be subject to excessive shock, vibration, dirt, moisture or oil. The ambient temperature should be between 32° and 122°F (0° and 50°C).

2.3 OUTPUT CONTROL MODULES

The 6000 Series Controllers offer field interchangeable output modules. This unique feature makes it possible to fill output requirements for a variety of applications with a single controller model. Heating and cooling outputs may be selected independently. Before installation, be sure that the controller has been configured with the output control modules that are appropriate for the process involved.

2.3.1 Output Module R (Relay-Time Proportional)

This 7A/5A relay (at 120/240 V ac) is used for driving resistive heaters and loads directly. A range of cycle times from 10 to 120 seconds is recommended for best relay life, set with consideration to the needs of the process to provide lowest ripple. Cycle times less than ten seconds will drastically shorten relay life and in no case should the cycle time be set to zero (60 millisecond time base). Normally open contacts are provided for both heating or cooling use.

NOTE

Do not use this output module with mechanical contactors because they generate an excessive EMI field which can interfere with other controllers. Instead T output modules are recommended for this application.

2.3.2 Output Module MA (Current Proportional)

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.

A push-on terminal is utilized as a return for ground currents of the milliamp source. It is connected internally to the mating lug on the heat-sink. To avoid ground loops, drive floating (ungrounded) loads or use isolated sensors.

2.3.3 Output Module T (Triac-Time Proportional)

This solid state relay is capable of 1 amp at 120/240 V ac. It is zero voltage switched and optically isolated from the drive signal. With it, resistive loads up to 120 watts at 120 V ac and 240 watts at 240 V ac may be controlled directly. Using direct control there is no lower limit on the cycle time setting (down to 60 milliseconds).

Larger loads may be controlled utilizing 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 advisable if EMI becomes a problem.

2.3.4 Output Module DC (Pulsed Voltage)

Similar to MA, but pulsed 20 V/20 mA dc output for driving solid state relays. Up to six (series input connected) solid state relays can be used. Cycling time (HC) can be set to optimize the load response time requirements without sacrificing relay life.

2.4 MOUNTING

Mount the controller into a 3⅝" (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. (If necessary, it can be withdrawn with a firm straight pull on front sides. On some units, remove a back center holding screw). Remove two screws that hold the mounting slides; then remove the slides. Insert case at the front panel and reinstall the two slides and two 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 by the serial tag.

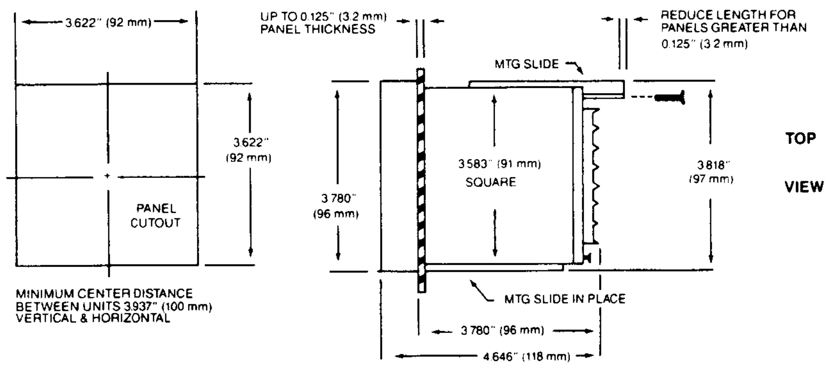


Figure 2-1. Cutout and Mounting Dimensions

2.5 WIRING THERMOCOUPLE SENSOR

Use thermocouple and extension wire that conforms to the appropriate thermocouple type specified on the serial number tag. In thermocouple circuits, the negative lead is red. Extension wires must be of the same alloy and polarity as the thermocouple. The thermocouple circuit resistance should not exceed 100 ohms. Refer to the resistance tables for various gage thermocouple wires in the *OMEGA Temperature Measurement Handbook*.

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

2.6 WIRING RTD SENSOR

The Model 6000 RTD Controllers are designed for use with 100 ohm platinum elements and probe assemblies, alpha = .00385 (DIN standard 43760).

For high accuracy, particularly where long lead wire runs are involved, a three wire RTD is recommended. The three lead wires should be copper and all legs essentially the same length. If any of the leads have an appreciably greater resistance than the others, they should be wired to Terminal 1. The size of the wire should be sufficently large so the resistance per leg does not exceed 10 ohms. Table 2-1 will assist in the selection of the appropriate copper wire gage.

TABLE 2-1

COPPER WIRE GAGE CHART

Gage	Ohms/1000ft
20	10.2
22	16.1
24	25.7
26	40.8

Two wire RTD's are connected to Terminals 1 and 2 with a jumper connected between Terminals 2 and 3. Keep leads short and use heavy gage copper lead wire, if necessary, to minimize lead resistance.

2.7 SENSOR PLACEMENT

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

NOTE

Some RTD's are shock sensitive and require care in handling and installation.

In a bath process, the addition of a stirrer will help to eliminate lags. Since the sensor is basically a point measuring device, putting more than one sensor in parallel will provide an average temperature reading and produce better results in air heated processes.

CAUTION

If controllers with MA or DC output control modules are to drive loads with grounded or hot input terminals (not floating), an ungrounded (isolated) thermocouple or RTD must be used. Severe ground loop currents will cause errors or permanent damage if both input and output are grounded.

Standard thermocouple limits of error for J and K calibrations are ±4°F or 0.75% and type T, ±2°F or 0.75% (half that for special limits of error) plus drift caused by improper protection or over-temperature. This is far worse than controller error, but cannot be corrected at the sensor except by selection and replacement. In extreme cases, total system requirements can be met by calibrating the controller to match outside errors.

The RTD elements conform to alpha = .00385 ohms/ohm/°C. The calibration of these RTD elements meet 0.1% DIN standard tolerance and conforms to the DIN 43760 standard.

2.8 CONNECTION TERMINALS

Refer to Table 2-2 for the functions of the controller connection terminals. Some typical wiring examples are shown in Figure 2-2.

TABLE 2-2
CONNECTION TERMINALS

TERMINAL		FUNCTION
1	Thermocouple +	RTD
2	Thermocouple −	RTD
3		RTD
3	Recorder Output −	(For RTD Models only)
4	Recorder Output +	(For RTD Models only)
5	Alarm 2 contact, closes on alarm	
6	Alarm 1 and 2 common	
7	Alarm 1 contact, closes on alarm	
8	Controller power, line neutral	
9	Controller power, 120 V line	
10	Controller power, 240 V line	
11	R or T Power in for heat function MA or DC + Output	
12	R or T Power out to heater or contactor MA or DC − Output	
13	R or T Power in for cool function MA or DC + Output	
14	R or T Power out to cooling fan, valve, etc. MA or DC − Output	

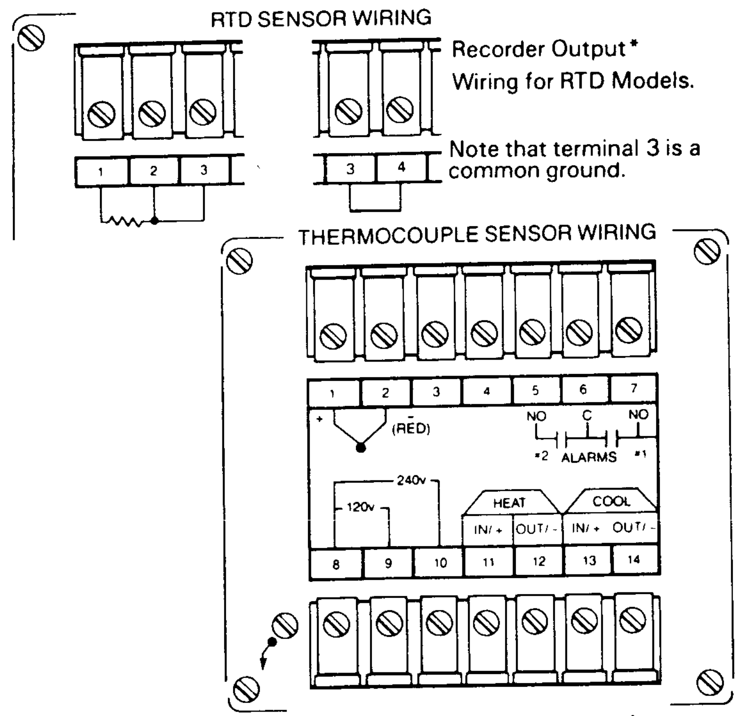


Figure 2-2. Typical Wiring Connection

*CAUTION: Ground loop may occur if recorder unit is grounded. For safety, make sure recorder is **not** grounded.

SECTION 3 OPERATION

3.1 TOUCH KEY OPERATION

All controls, parameters, and function selections are entered with touch keys. External knobs and switches have been eliminated. The completely digital controls can be indexed by touching one button, values can be adjusted at another touch, and another touch enters the value. Once values are entered, they can be locked in with an internal switch to prevent unauthorized tampering. The control panel touch keys are further described in Figure 3-1.

1. Continuous display of process variable.
2. LEDs indicate output STATUS.
3. Function selected indicated by LED (advanced by index button, 7).
4. Enters the selected value to nonvolatile memory.
5. Lowers (decreases) the selected variable.
6. Raises (increases) the selected variable.
7. The index button advances the FUNCTION group.
8. Continuous display of set point or selected parameter.

3.2 STARTUP PRECAUTIONS

Before line voltage is applied, double check all items connected to the controller:

a. The sensor must be connected to the terminals (see Figure 2-2).

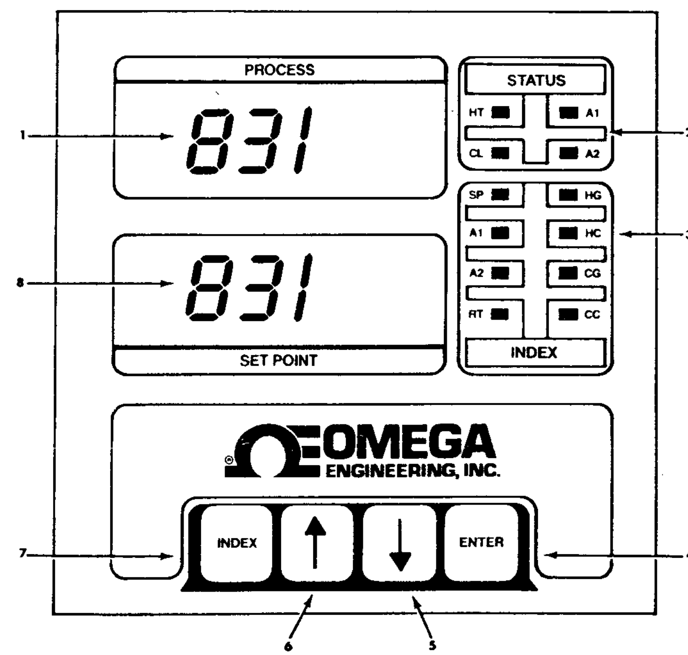


Figure 3-1. Control Panel

b. Line voltage must be connected to terminals:
 8-9 for 120 V 8-10 for 240 V
c. There must be no exposed (bare) wires nor frayed insulation.
d. All external apparatus must be in proper working condition.
e. The °C/°F selector switch must be set for process.

Switch Position Number One (bottom) of the four pole switch configures the unit for degrees Fahrenheit when depressed. It is shipped from the factory in this position. To change to degrees Celsius, push the switch to the other position.

3.3 PARAMETER ENTRY

a. Apply power. The process display should indicate the sensor temperature at the process. The SET POINT display should indicate the set point temperature. The INDEX indicator should illuminate set point (SP). The STATUS or output indicator should show output status corresponding to differences between actual and set (desired) temperatures.

b. To set control temperature (INDEX at SP), depress UP or DOWN touch keys until the desired set point is reached. For permanent retention, depress the ENTER key to lock in nonvolatile memory. The display should blink.

c. Depress INDEX key until the INDEX indicator shows A1. Now set alarm 1 (A1) trip point using up or down keys as before. Enter by depressing ENTER key. If configured as a tracking alarm, the set display will automatically show deviation from control temperature.

d. Depress the INDEX key again and advance to alarm 2 (A2). Set as for alarm 1 in step C.

e. Depress the INDEX key and advance to rate (RT). This is the rate (differential or anticipating) action adjustment calibrated in seconds. It is software connected to automatic reset (integral or droop correcting) action, which automatically tracks the rate. This wide range, high resolution, single button entry greatly simplifies tuning the control to the process. Temporarily run it down to zero (proportional only). Enter by depressing ENTER key.

f. Heat gain (HG), the next INDEX position, sets controller gain for heating control. It is the inverse of proportional band (PB) which can be calculated as °PB = Full-Scale °/Gain. At HG = 0, heating is off. Temporarily set HG to 400 or about 4° proportional band.

g. Heat cycling (HC), the next INDEX position should be preset to the longest possible cycling time in seconds, depending on the mass of the process for increased life expectancy of relays (15 to 30 seconds for massive loads, 10 to 15 for fast loads when relay driven). Module T output solid state relays are directly connected to small heaters, 0-5 seconds, but not faster than 10 seconds when driving mechanical contactors. Module DC solid state contactor drivers can be used for 0-10 seconds; Module MA output units must be set to HC = 0, less than 1 second.

h. The next INDEX position (CG) is for cooling gain. If no cooling is used, set it to 100 and depress ENTER to enter. If cooling is employed, start at CG = 400.

i. The final index position (CC) is used to set cooling cycling time. For module MA output units, CC = 0. Other outputs are dictated by the type of cooling method employed. Mechanical compressors may require 2 minutes, liquid pumps 30 seconds, solenoid valves 5-15 seconds, small fans 5 seconds, large ones 30. Decide, set, and enter (E) to lock in value. Index back to SP.

j. Connect power to heater and observe temperature rise. Run set point down to meet process. Heat output will start proportioning within a few degrees of process temperature. Cool will proportion once SP is below process.

k. Alarms can be checked out in similar fashion.

3.4 KEY PAD SECURITY LOCK

Switch B1 disables operator access to all parameters (except set point). Pressing the INDEX key does not advance the LED cursor in the index window. Changes to set point may still be effected and entered into nonvolatile memory in the usual manner. (See Figure 3-2.)

3.5 REDUCED RATE ACTION

For processes with noticeable transit dead time (heated upstream, measured downstream) or with inherent fluctuations such as air or fluid flow processes, an internal switch "B" (see Figure 3-2) enables reduced rate (derivative) gain. Depress the right side of switch B2 for this function change.

Instruments are shipped from the factory in the normal rate gain mode.

SWITCH "B"			
FUNCTION	ON ←	→ OFF	
RATE GAIN	NORMAL	REDUCED	2
*SECURITY LOCK	LOCKED	UNLOCKED	1

*ACCESS TO SET POINT MAINTAINED IN LOCKED MODE. ALL OTHER PARAMETER CHANGES INHIBITED

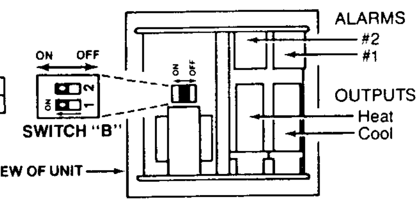


Figure 3-2. Rate Gain Selector, Security Lock for Parameters (Except Set Point)

3.6 RATE (RT) AND RESET SETTING

Set rate (RT) to 01 second for fast systems, 05 for slow, and 10 for massive systems. Observe that oscillations build up and note time of peak-to-peak excursions. Double the rate time and note oscillation. Repeat until oscillation stops. Enter the rate value by depressing ENTER.

NOTE

Setting of 0 disables rate and reset action for proportional only control.

The optimum rate and reset times for the frequency response of the process are now set. If time permits, finer adjustment can be made. For faster startup (with some overshoot), reduce rate time 10-20%. For more anticipation (giving undershoot), increase rate slightly. Experiment with HG; refer to the following examples:

EXAMPLES:

Slow, 2 lag process, matched power, 200°F set point.

HG	RT	TEMPERATURE	REMARKS
400	00	197°-199°F	2° oscillation, 2° av. droop
200	00	196°F	Gain O.K., 4° droop
200	05	194°-206°F	8° slow oscillation, reset hunting
200	10	199°-201°F	Almost
200	20	200°F	Good
200	40	198°-202°F	4° faster (rate) hunting Back up

Fast, 3 lag, overpowered process, 400°F set point.

HG	RT	TEMPERATURE	REMARKS
400	00	389°-435°F	Wild, skip to much less gain
25	00	375°-391°F	16° oscillation, 17° droop
12	00	364°F	Gain O.K., 36° droop
12	01	371°-435°F	Need more rate time
12	02	396°-404°F	Getting close
12	03	400°F ±	Good
12	04	400°F	Optimum

Low gain requirement indicates poor thermal coupling or overpower. Special problems can be caused by very "noisy" turbulent flow processes or by systems having a pure dead time between heat application and temperature measurement. In both cases, rate is likely to continuously over-react. Unplug unit and switch to reduced rate gain. (See Figure 3-2.)

3.7 HEAT GAIN (HG) SETTING

Adjust set point (SP) to desired temperature. (If overshoots cannot be tolerated during setup, use 20—30% lower temperature.) Set heat gain (HG) at 400. Note time between peak-to-peak temperature oscillations. Reduce gain to one/half (200). Note oscillations.

Repeat halving until temperature is stable. Depress ENTER key. This compensates for heater power and number of lags, but a droop between set and actual still exists.

3.8 COOL GAIN (CG) SETTING

If cooling is to be controlled, first optimize the heat adjustments. Start the heat generating mechanism (chemical reaction, mechanical, sub-ambient set point, etc.) that will require cooling action.

Set cool gain to 400 (maximum). If stable, enter. It is more likely that temperature will oscillate. Note the values.

Reduce gain to 200. Observe temperature oscillations. If oscillation reduces, keep reducing the gain until the process is stable. If temperature oscillation peaks get bigger, cool cycling (CC) may be too long, or the cooling mechanism has too much lag or time delay. If possible, improve dynamics of cool transfer; if not, go to rate (RT) and double the rate time. Now optimize cooling gain. Since the heating rate will not be too long, compensate by decreasing the heat gain.

3.9 USING RATE OF TEMPERATURE RISE TO DETERMINE RATE TIME

Process must be cold to start tuning. Temperature must rise a minimum of 100°F before proportioning begins.

(1) Set rate gain switch to normal.

(2) Remove heating module to disable heat.

(3) Enter desired set point.

(4) Set RT to zero and enter.

(5) Set and enter cycle time to that which is appropriate for the process.

(6) Set HG and CG to 20.

(7) Replace heating module.

(8) Start process heating and time the temperature rate of rise in °F/Min. for a minimum of 100°F and before proportioning cycle begins. Proportioning is indicated by cycling of the heat L.E.D. Do not include dead time on start. See Figure 3-3.

(9) To determine rate time, use the following formula:

$$RT = \frac{1680}{^\circ F \text{ Minute Rise}}$$

Do not enter the RT number at this time.

(10) Adjust heat gain until the process oscillates in temperature, then reduce the gain (lower the HG number) until the oscillation just stops. Multiply this number by 0.6 and enter in memory. Also enter in CG.

(11) Enter the RT number found in step 9.

(12) The controller is now conservatively tuned. For faster response you may wish to lower the RT and increase the HG and CG.

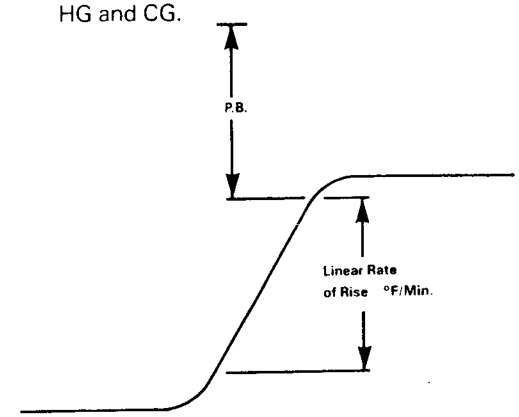


Figure 3-3. Temperature Rate of Rise in °F/Min.

3.10 SPAN AND ZERO ADJUSTMENTS (Internal)

On the inside right side of the instrument are two multi-turn potentiometers. These are span (left) and zero (right). Use zero for low temperature trimming and span for the high temperature end.

These are factory set and do not normally require adjustment, except when a range change kit is installed. If adjustment is needed, refer to Section 4 (Calibration).

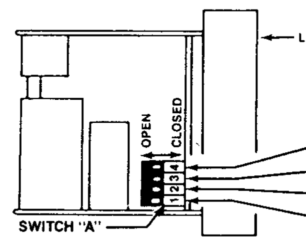
3.11 ALARMS

If the controller is equipped with either one or two alarms (1 or 2), they can be configured as deviation or process alarms utilizing the four position A switch inside the unit (see Figure 3-4).

Switch Position Number Four changes both alarms from deviation to process when depressed.

Switch Position Number Three changes alarm 1 from low to high when depressed (energizes on temperature rise).

Switch Position Number Two changes alarm 2 from low to high when depressed (energizes on temperature rise). Instruments are shipped from the factory with the alarms in the process configuration with alarm 1 high and alarm 2 low. When the alarms are configured as process alarms, the alarm will trip when the process is greater than the alarm set point, if it has been configured for high alarm. The alarm will trip when the process is less than the alarm set point if it has been configured for low alarm. When the alarms are configured as deviation alarms, the alarm set point value, when added to the process set point (in the case of high alarms) or subtracted from the process (in the case of low alarms), serves as the trip point for the alarm relay.



	SWITCH "A"	
	OPEN ←	→ CLOSED
4	DEVIATION	PROCESS
3	ALARM "1" LOW	ALARM "1" HIGH
2	ALARM "2" LOW	ALARM "2" HIGH
1	°C	°F

NOTES: In deviation mode, low alarm positions imply minus number in display.

Figure 3-4. Internal Switches For Alarms and °C or °F Display

SECTION 4 CALIBRATION

4.1 CALIBRATION FOR THERMOCOUPLE MODELS

4.1.1 Equipment Needed

A. Frequency counter with period capability (Leader LDC-822 or equivalent)

B. Digital Thermometer

C. Millivolt Source, 0-100 mV

D. Small screwdriver and sealer for pots.

4.1.2 Calibration Procedure

1. Ensure unit has warmed up thoroughly. Connect counter ground to heat sink. Connect counter probe to test pin "A".

2. Set counter to period measurement. Adjust square blue pot on processor module for 203 milliseconds.
3. Set in zero calibration value (see Table 4-1) on digital thermometer; adjust zero pot for agreement.
4. Set in span calibration value (see Table 4-1) on digital thermometer; adjust span pot for agreement.
5. Repeat steps 3 and 4 above.
6. Check center value (see Table 4-1) to see if accuracy specification is met.
7. Apply sealer to zero and span pots.
8 If necessary touch up period adjustment pot.

TABLE 4-1
THERMOCOUPLE CALIBRATION VALUES

Range	Zero Calibration Value	Span Calibration Value	Center Value	Maximum Allowable Error at Center Value
0° to 1400°F Type J	10°F	1350°F	700°F	±3°
0° to 2000°F Type K	10°F	1950°F	1000°F	±4°
0° to 2500°F Type K	10°F	2350°F	1250°F	±5°
−200° to +600°F Type T	−190°F	550°F	200°F	±2°

NOTES

Steps 1 and 2 must be performed if microprocessor chip has been changed, or as routine check.

SETTINGS ON LDC-822
Multiplier - X10
Sensitivity - 2V
Period Mode

An additional 500 K ohm is required in series with the signal lead of the counter for accurate readings.

4.2 CALIBRATION FOR RTD MODELS

4.2.1 Equipment Needed

A. Frequency counter with period capability (Leader LDC-822 or equivalent)
B. Decade Resistance Box
C. Small Screwdriver and Sealer for Pots

4.2.2 Calibration Procedure

1. Ensure unit has warmed up thoroughly. Connect counter ground to heat sink. Connect counter probe to test pin "A".
2. Set counter to period measurement. Adjust square blue pot on processor module for 203 milliseconds.

3. Set in zero calibration value (see Table 4-2) on resistance box; adjust zero pot for agreement.
4. Set in span calibration value (see Table 4-2) on resistance box; adjust span pot for agreement.
5. Repeat steps 3 and 4 above.
6. Check center value (see Table 4-2) to see if accuracy specification is met.
7. Apply sealer to zero and span pots.
8 If necessary touch up period adjustment pot.
9 Apply sealer to period adjustment pot.

TABLE 4-2
RTD CALIBRATION VALUES

Range	Zero Calibration		Span Calibration		Center Value		Maximum Allowable Error at Center Value
	Temp.	Resis. (Ω)	Temp.	Resis. (Ω)	Temp.	Resis. (Ω)	
−328° to 1112°F	−320°F	20.33	+1100°F	311.50	400°F	177.48	±1°
−99.9° to 199.9°F	−90.0°F	73.18	+190°F	133.86	+50.0°F	103.90	±0.7°

NOTES

Steps 1 and 2 must be performed if microprocessor chip has been changed, or as routine check.

SETTINGS ON LDC-822
Multiplier - X10
Sensitivity - 2V
Period Mode

An additional 500 K ohm is required in series with the signal lead of the counter for accurate readings.

SECTION 5 TROUBLESHOOTING

The troubleshooting information is included to serve as a guide to enable equipment repair. Table 5-1 is a guide only and cannot cover all possible contingencies that may occur.

TABLE 5-1
TROUBLESHOOTING CHART

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
1. Front does not light up	No power	Repair or replace power source.
	Burned-out transformer	Replace transformer.

TABLE 5-1 (continued)

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
2. Process display shows CCCC	Open sensor or lead wires	Check sensor. Replace sensor or repair lead wire.
3. Process shows about half or twice expected reading	°C/°F selector in wrong position	Set selector to correct position for process range.
4. Heating does not turn on	Wrong output module	Install correct module. (Refer to paragraphs 2.3.1–2.3.4)
	Blown fuse	Check fuses, replace as necessary.
	Heater wiring	Repair heater as necessary.
5. Heating does not go off	Welded relay contacts	Correct cause of overload. Replace relay.

SECTION 6 SPECIFICATIONS

INPUTS

LINE VOLTAGE:	120/240 V ac +10 -15%, 50 to 60 Hz
SENSOR:	J, K or T thermocouple, 100Ω platinum RTD
POWER CONSUMPTION:	Less than 6 VA (Instrument only)
RANGES:	J; 0° to 1400°F (0° to 760°C), 1° resolution K; 0° to 2500°F (0° to 1370°C), 1° resolution T; −200° to 600°F (−129° to 316°C), 1° resolution RTD 1; −328° to −1112°F (−200° to 600°C), 1° resolution (Model P1); 0 mV to 1440 mV RTD 2; −99.9° to 199.9°F (−73.3° to 93.3°C), 0.1° resolution (Model P2); 0 mV to 2998 mV
ACCURACY:	±0.2% of full-scale
TEMPERATURE STABILITY:	5 μV/°C Max 3 μV/°C typ.
COLD END TRACKING:	0.05°C/°C ambient
RECORDER OUTPUT FOR RTD MODELS:	P1; 1 mV/°F (1.8 mV/°C) P2; 10 mV/°F (18 mV/°C)

OPERATING AMBIENT FOR RATED ACCURACY:	0 to 55°C
MAXIMUM THERMOCOUPLE LEAD RESISTANCE FOR RATED ACCURACY:	1000 ohms
SERIES MODE NOISE REJECTION:	80 dB
COMMON MODE NOISE REJECTION:	120 dB
SENSOR BREAK PROTECTION:	Upscale standard
DUAL DISPLAY:	Process temperature displayed continuously; set point or other parameters updated on lower display
DISPLAY UPDATE RATE AND FILTERING:	Greater than 5 times per second. Analog and digital filtering techniques increase stability of process and display.
°F/°C:	Internal switch selection—process, set point and alarms affected
ALARM 1 & 2:	Adjustable over full range of control. LED displays alarm status. 3 amp relay at 120 V ac normally open contact. Reverse acting relay by switch selecting for low alarms. Process/deviation mode selectable (internal switch)

OUTPUTS (SINGLE OR DUAL SET POINT)

R—RELAY (TIME PROPORTIONING):	SPST relay 7 amps resistive at 120 V ac, 5 amp resistive at 240 V ac, 50 VA inductive
MA—CURRENT PROPORTIONAL:	4-20 mA dc into 500 ohm max
DC—PULSED VOLTAGE:	0-20 V dc pulsed time proportioning signal for driving solid state relays
T—TRIAC (TIME PROPORTIONAL):	Solid state plug-in triac output. Rated 1 amp holding and 10 amp inrush
A1 & A2—AUXILIARY ALARM RELAYS (ON/OFF):	SPST relays, rated 3 amps at 120 V ac
FILTERED LED DISPLAY:	4 digits for process, 4 digits for parameters
LINEARIZATION:	Continuously calculated and updated using ROM based algorithm
CONNECTIONS:	Inputs and outputs via barrier strips with U.L. approved locking terminals
DIMENSIONS:	H: 3.78'' (96 mm) x W: 3.78'' (96 mm) x D: 4.65'' (118 mm) Depth behind panel: 3.78'' (96 mm)
WEIGHT:	2 lbs (0.91 Kg)

6.1 PARTS LIST 6000 SERIES

PART NUMBER	DESCRIPTION
A-60G2-6	Mechanical Main Relay R
A-60G2-2	Solid State Relay T
A60G2-3	Output Module 4-20 mA dc MA
A60G2-4	Output Module Time Prop. DC
RC1V-3	Alarm Relay
7407N	Output Driver-Hex Buffer
PC-5-1670	Transformer
W02M	Bridge Rectifier
T1542	Cold End Compensator
MC1403U	Precision Reference
A-6000-1J	Microprocessor J Couple
A-6000-2K	Microprocessor K Couple
A-6000-6T	Microprocessor T Couple
A-6000-1P	Microprocessor Pt RTD
N-231	Front Overlay
CD4051 BE	Multiplexer
NCR7033PC	Memory