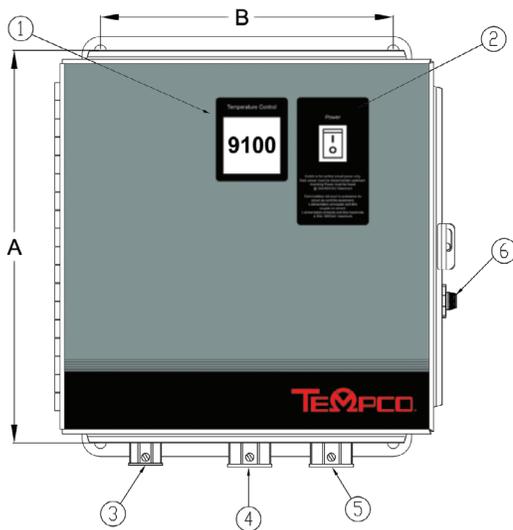


Instructions for Tempco Control Enclosure PCM10005 through PCM10008

Part Number	Input voltage	Max. Amperage	Required Heater Fusing	Max. Wattage 1ph	Max. Wattage 3ph	Mounting Dimensions
PCM10005	240VAC	24	30 Amps	5760W	9,970W	10.75"H x 8"W
PCM10006	480VAC	24	30 Amps	11,520W	19,930W	14.75"H x 10"W
PCM10007	240VAC	48	60 Amps	11,520W	19,930W	14.75"H x 10"W
PCM10008	480VAC	48	60 Amps	23,000W	39,900W	14.75"H x 10"W

Component Identification



- 1: TEC-9100 Controller
- 2: On-Off Rocker Switch
- 3: 1/2" EMT Conn. For Sensor
- 4: 3/4" EMT Conn. For Heater Power - For PCM10005 Only
1" EMT Conn. For Heater Power - For PCM10006-08
- 5: 3/4" EMT Conn. For Incoming Power - For PCM10005 Only
1" EMT Conn. For Incoming Power - For PCM10006-08
- 6: 2 Fuse Holders, see spare parts for fuse replacement on next page

**There is no disconnect or heater fusing in this enclosure.
Heater fusing and disconnect must be supplied by the installer.**

It is strongly recommended that the process should incorporate a **LIMIT CONTROL** such as the **TEC-910** which will shut down the equipment at a preset process condition in order to preclude possible damage to products or system.

1. Dangerous voltage capable of causing injury or death is present within this enclosure. Power to all equipment must be disconnected before installation or beginning any troubleshooting procedures. All wiring and component replacement must be made by qualified personnel only.
2. To minimize the possibility of fire or shock, do not expose this console to rain or excessive moisture.
3. Do not use this enclosure in areas where hazardous conditions exist such as excessive shock, vibration, dirt, corrosive gases, oil or where explosive gases or vapors are present.

WIRING (for safety, disconnect all power sources prior to wiring, refer to the appropriate wiring diagram at the end of this manual)

1. Attach the leads from your sensor to the sensor terminal block, terminals 7, 8 & 9. For a thermocouple, most commonly the red lead is negative (-) negative, attach that to terminal 9. The positive lead of the thermocouple should be connected to terminal 8. The TEC-9100 controller is preprogrammed to accept a type J thermocouple. If another sensor is used, the "INPT" setting has to be revised.
2. **Make sure your service power has been disconnected and locked out.**
Please note the enclosed wiring diagram.
Wire your single phase supply to terminals 1 & 2. If you are using three phase power, wire to terminals 1, 2 & 3.
Connect your heater load to terminals 4 & 5 if using single phase, 4, 5 & 6 if using three phase. Follow all local and national codes.
Add disconnect and fusing as required.
Before applying power, check tightness of all terminals.
3. An optional NO-NC alarm can be connected to terminals 1, 2 & 3 of the TEC-9100 controller. This relay is rated at 2 amps, 240 volts. See Alarm Wiring Diagrams on page 7.

Note Wire Drawing on Pages: PCM10005 - Pg. 16
PCM10006 - Pg. 17
PCM10007 - Pg. 18
PCM10008 - Pg. 19

OPERATION

1. Refer to the instruction manual provided for complete operation and auto-tuning instructions for the TEC-9100 temperature controller.
2. Close and secure the door. Switch on the enclosure. Using the up & down pushbuttons on the TEC-9100 controller, start out with the temperature set low to test your system performance.
If the set point temperature is being maintained, set your desired temperature setpoint.
If your setpoint temperature is **not** being maintained, please refer to the auto-tuning procedure in the attached manual.
If auto-tuning does not produce the required results, manual tuning may be necessary.

Note: The signal of the output circuit is wired through output 2 of the TEC-9100 which can be used as a cut-out in the event of an over-setpoint temperature condition. This is a deviation contact set to 30° F above the setpoint.

In the event of an over-setpoint temperature condition, output 2 will open, cutting the control signal to the output relay.

This deviation setpoint can be changed by accessing "SP2" in the TEC-9100 (note following). This is not meant to be a redundant safety controller.

Refer to our TEC-910 for a safety controller.

SPARE/REPLACEMENT PARTS

Part Number	Description
EHD-124-276	(2) TEC Control fuses rated 1 amp, 250VAC, 1/4" x 1-1/4", Bussmann ABC-1 or equal (PCM10005/PCM10007)
EHD-124-253	(2) TEC Control fuses rated 3/10 amp, 600VAC class CC. Littelfuse KLDR-3/10 or equal (PCM10006/PCM10008)

1-3 Programming Port

The TEC99011 cable and TEC99003 network adapter can be used to connect the programming port to a PC for automatic configuration.

The programming port is used for off-line automatic setup and testing procedures only. Don't attempt to make any connection to these pins when the unit is used for a normal control purpose.

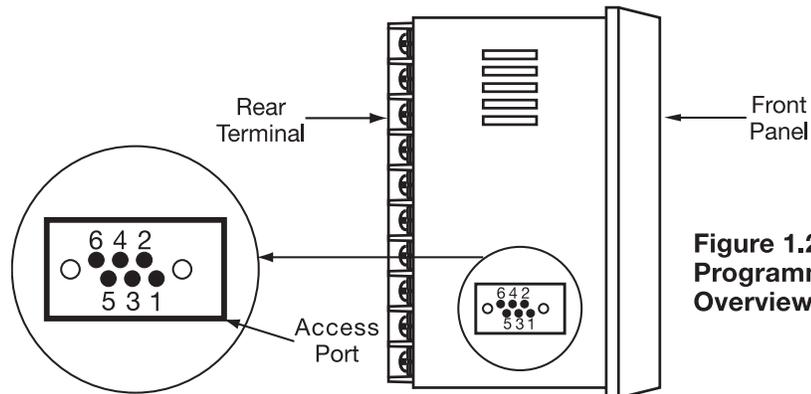


Figure 1.2
Programming Port Overview

1-4 Keys and Displays

KEYPAD OPERATION

SCROLL KEY:

This key is used to select a parameter to be viewed or adjusted.

UP KEY:

This key is used to increase the value of the selected parameter.

DOWN KEY:

This key is used to decrease the value of the selected parameter.

RESET KEY:

This key is used to:

1. Revert the display to show the process value.
2. Reset the latching alarm, once the alarm condition is removed.
3. Stop the manual control mode, auto-tuning mode, and calibration mode.
4. Clear the message of communication error and auto-tuning error.
5. Restart the dwell timer when the dwell timer has timed out.
6. Enter the manual control menu when in failure mode.

ENTER KEY: Press

Press

1. Enter setup menu. The display shows
2. Enter manual control mode—when manual control mode
3. Enter auto-tuning mode—when auto-tuning mode
4. Perform calibration to a selected parameter during the calibration procedure.
 - Press
 - Press
 - Press

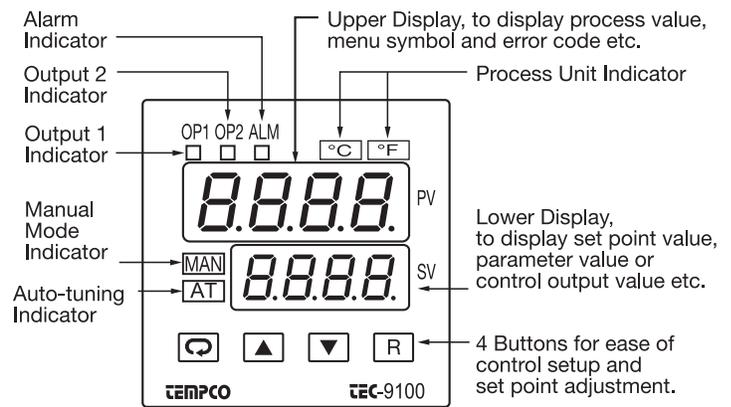


Figure 1.3 Front Panel Description

Table 1.1 Display Form of Characters

A	<i>A</i>	E	<i>E</i>	I	,	N	<i>n</i>	S	<i>S</i>	X	
B	<i>b</i>	F	<i>F</i>	J	<i>J</i>	O	<i>o</i>	T	<i>t</i>	Y	<i>Y</i>
C	<i>C</i>	G	<i>G</i>	K	<i>K</i>	P	<i>P</i>	U	<i>u</i>	Z	
c	<i>c</i>	H	<i>H</i>	L	<i>L</i>	Q		V	<i>v</i>	?	<i>?</i>
D	<i>d</i>	h	<i>h</i>	M	<i>m</i>	R	<i>r</i>	W		=	<i>=</i>

▴ Indicates Abstract Characters

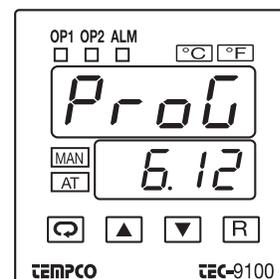
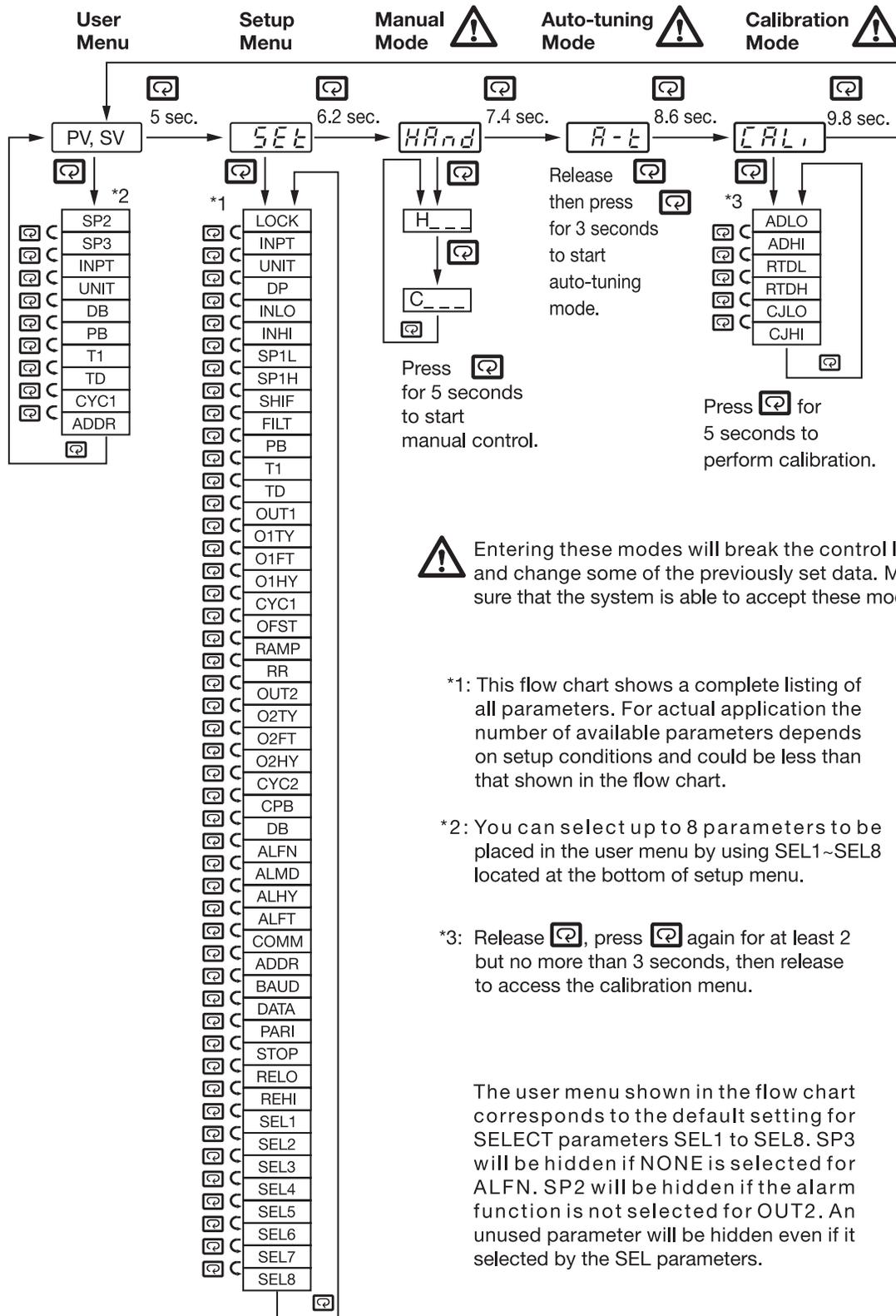


Figure 1.4
Display during Power Up

Display program code of the product for 2.5 seconds.

The left diagram shows program number 6 for TEC-9100 with version 12.

1-5 Menu Overview



! Entering these modes will break the control loop and change some of the previously set data. Make sure that the system is able to accept these modes.

- *1: This flow chart shows a complete listing of all parameters. For actual application the number of available parameters depends on setup conditions and could be less than that shown in the flow chart.
- *2: You can select up to 8 parameters to be placed in the user menu by using SEL1~SEL8 located at the bottom of setup menu.
- *3: Release , press  again for at least 2 but no more than 3 seconds, then release to access the calibration menu.

The user menu shown in the flow chart corresponds to the default setting for SELECT parameters SEL1 to SEL8. SP3 will be hidden if NONE is selected for ALFN. SP2 will be hidden if the alarm function is not selected for OUT2. An unused parameter will be hidden even if it selected by the SEL parameters.

1-6 Parameter Descriptions (page 1 of 2)

Parameter Notation	Parameter Description (Refer to Page:)	Range	Default Value
<i>SP1</i> SP1	Set point for output 1	Low: SP1L High: SP1H	77.0°F
<i>SP2</i> SP2	Set point for output 2 when output 2 performs alarm function	Low: -19999 High: 45536	30.0°F
* <i>SP3</i> SP3	Set point for alarm or dwell timer output	Low: -19999 High: 45536	18.0°F
<i>LoLk</i> LOCK	Select parameters to be locked out (Page 8)	0) <i>nonE</i> : No parameters are locked 1) <i>SEt</i> : Setup data is locked 2) <i>uSEr</i> : Setup data and User data except Set point are locked 3) <i>ALL</i> : All data are locked	0
<i>inPt</i> INPT	Input sensor selection (Page 8)	0) <i>J-tC</i> : J type thermocouple 1) <i>K-tC</i> : K type thermocouple 2) <i>T-tC</i> : T type thermocouple 3) <i>E-tC</i> : E type thermocouple 4) <i>B-tC</i> : B type thermocouple 5) <i>R-tC</i> : R type thermocouple 6) <i>S-tC</i> : S type thermocouple 7) <i>N-tC</i> : N type thermocouple 8) <i>L-tC</i> : L type thermocouple 9) <i>Pt.dn</i> : PT 100 ohms DIN curve 10) <i>Pt.J5</i> : PT 100 ohms JIS curve 11) <i>4-20</i> : 4-20 mA linear current input 12) <i>0-20</i> : 0-20 mA linear current input 13) <i>0-60</i> : 0-60 mV linear millivolt input 14) <i>0-1V</i> : 0-1V linear voltage input 15) <i>0-5V</i> : 0-5V linear voltage input 16) <i>1-5V</i> : 1-5V linear voltage input 17) <i>0-10</i> : 0-10V linear voltage input	0
<i>unit</i> UNIT	Input unit selection (Page 8)	0) <i>C</i> : Degree C unit 1) <i>F</i> : Degree F unit 2) <i>Pu</i> : Process unit	1
<i>dP</i> DP	Decimal point selection (Page 8)	0) <i>noDP</i> : No decimal point 1) <i>1-dP</i> : 1 decimal digit 2) <i>2-dP</i> : 2 decimal digits 3) <i>3-dP</i> : 3 decimal digits	0
* <i>inLo</i> INLO	Input low scale value	Low: -19999 High: 45486	0°F (-17.8°C)
* <i>inHi</i> INHI	Input high scale value	Low: INLO+50 High: 45536	1000°F (538°C)
<i>SP1L</i> SP1L	Low limit of set point	Low: -19999 High: 45536	0°F (-17.8°C)
<i>SP1H</i> SP1H	High limit of set point value	Low: SP1L High: 45536	1000°F (538°C)
<i>SHiF</i> SHIF	PV shift (offset) value (Page 12)	Low: -360.0°F (-200.0°C) High: 360.0°F (200.0°C)	0.0
<i>FILt</i> FILT	Filter damping time constant of PV (Page 12)	0) <i>0</i> : 0 second time constant 1) <i>0.2</i> : 0.2 second time constant 2) <i>0.5</i> : 0.5 second time constant 3) <i>1</i> : 1 second time constant 4) <i>2</i> : 2 seconds time constant 5) <i>5</i> : 5 seconds time constant 6) <i>10</i> : 10 seconds time constant 7) <i>20</i> : 20 seconds time constant 8) <i>30</i> : 30 seconds time constant 9) <i>60</i> : 60 seconds time constant	2

Parameter Notation	Parameter Description (Refer to Page:)	Range	Default Value
<i>Pb</i> PB	Proportional band value (Page 13)	Low: 0 High: 900.0°F (500.0°C)	18.0°F
<i>tI</i> TI	Integral time value (Page 13)	Low: 0 High: 1000 sec	100
<i>tD</i> TD	Derivative time value (Page 13)	Low: 0 High: 360.0 sec	25.0
<i>out1</i> OUT1	Output 1 function (Page 8)	0) <i>REv</i> : Reverse (heating) control action 1) <i>dir</i> : Direct (cooling) control action	0
<i>o1tY</i> O1TY	Output 1 signal type	0) <i>RELY</i> : Relay output 1) <i>SSrd</i> : Solid state relay drive output 2) <i>SSr</i> : Solid state relay output 3) <i>4-20</i> : 4-20 mA DC 4) <i>0-20</i> : 0 - 20 mA DC 5) <i>0-1V</i> : 0 - 1V DC 6) <i>0-5V</i> : 0 - 5V DC 7) <i>1-5V</i> : 1 - 5V DC 8) <i>0-10</i> : 0 - 10V DC	0
<i>o1ft</i> O1FT	Output 1 failure transfer mode	Select BPLS (bumpless transfer) or 0.0 - 100.0% to continue output 1 control function as the unit fails, or select OFF (0) or ON (1) for ON-OFF control.	0
<i>o1HY</i> O1HY	Output 1 ON-OFF hysteresis	Low: 0.1 High: 50.0°C (90°F)	0.2°F (0.1°C)
<i>CYC1</i> CYC1	Output 1 cycle time	Low: 0.1 High: 90.0 sec.	18.0
<i>oFSt</i> OFST	Offset value for P control	Low: 0 High: 100.0%	25.0
<i>rRnP</i> RAMP	Ramp function selection (Page 11)	0) <i>nonE</i> : No ramp function 1) <i>ni nr</i> : Use unit/minute as Ramp Rate 2) <i>Hrr</i> : Use unit/hour as Ramp Rate	0
<i>rr</i> RR	Ramp rate (Page 11)	Low: 0 High: 500.0°C (900.0°F)	0.0
<i>out2</i> OUT2	Output 2 function	0) <i>nonE</i> : Output 2 No Function 2) <i>dEH</i> : Deviation High 3) <i>dEL</i> : Deviation Low 6) <i>PuH</i> : Process High 7) <i>PuL</i> : Process Low 8) <i>Cool</i> : Cooling PID Function	3
<i>o2tY</i> O2TY	Output 2 signal type	0) <i>RELY</i> : Relay output 1) <i>SSrd</i> : Solid state relay drive output 2) <i>SSr</i> : Solid state relay output 3) <i>4-20</i> : 4-20 mA DC 4) <i>0-20</i> : 0 - 20 mA DC 5) <i>0-1V</i> : 0 - 1V DC 6) <i>0-5V</i> : 0 - 5V DC 7) <i>1-5V</i> : 1 - 5V DC 8) <i>0-10</i> : 0 - 10V DC	0
<i>o2ft</i> O2FT	Output 2 failure transfer mode	Select BPLS (bumpless transfer) or 0.0 - 100.0% to continue output 2 control function as the unit fails, or select OFF (0) or ON (1) for alarm function.	0

* Indicates Controller Parameter Settings That Are Not Applicable

Parameter Descriptions (page 2 of 2)

Parameter Notation	Parameter Description (Refer to Page:)	Range	Default Value
<i>o2HY</i> O2HY	Output 2 hysteresis value when output 2 performs alarm function	Low: 0.1 High: 90.0°F (50.0°C)	0.2°F (0.1°C)
* <i>CYC2</i> CYC2	Output 2 cycle time	Low: 0.1 High: 90.0 sec.	18.0
* <i>CPb</i> CPB	Cooling proportional band value	Low: 50 High: 300%	100
* <i>db</i> DB	Heating-cooling deadband (negative value=overlap)	Low: -36.0 High: 36.0%	0
<i>ALFN</i> ALFN	Alarm function for alarm output (Page 10)	0) <i>nonE</i> : No alarm function 1) <i>t, nr</i> : Dwell timer action 2) <i>dEH</i> : Deviation high alarm 3) <i>dELo</i> : Deviation low alarm 4) <i>dbH</i> : Deviation band out of band alarm 5) <i>dbLo</i> : Deviation band in band alarm 6) <i>PuH</i> : Process value high alarm 7) <i>PuLo</i> : Process value low alarm	0
<i>ALMD</i> ALMD	Alarm operation mode (Page 10)	0) <i>nor</i> : Normal alarm action 1) <i>Ltch</i> : Latching alarm action 2) <i>Hold</i> : Hold alarm action 3) <i>LtHo</i> : Latching & Hold action	0
<i>ALHY</i> ALHY	Hysteresis control of alarm	Low: 0.1 High: 90.0°F (50.0°C)	0.2°F (0.1°C)
<i>ALFT</i> ALFT	Alarm failure transfer mode	0) <i>on</i> : Alarm output ON as unit fails 1) <i>off</i> : Alarm output OFF as unit fails	0
* <i>Co</i> COMM	Communication function	0) <i>nonE</i> : No communication 1) <i>rEv</i> : Modbus RTU mode protocol 2) 4-20 : 4 - 20 mA retransmission output 3) 0-20 : 0 - 20 mA retransmission output 4) 0-5V : 0 - 5 V retransmission output 5) 1-5V : 1 - 5 V retransmission output 6) 0-10 : 0 - 10 V retransmission output	0
* <i>Addr</i> ADDR	Address assignment for digital communication	Low: 1 High: 255	—
* <i>baud</i> BAUD	Baud rate of digital communication	0) 24 : 2.4 Kbits/s baud rate 1) 48 : 4.8 Kbits/s baud rate 2) 96 : 9.6 Kbits/s baud rate 3) 144 : 14.4 Kbits/s baud rate 4) 192 : 19.2 Kbits/s baud rate 5) 288 : 28.8 Kbits/s baud rate 6) 384 : 38.4 Kbits/s baud rate	2

Parameter Notation	Parameter Description (Refer to Page:)	Range	Default Value
* <i>dAtA</i> DATA	Data bit count of digital communication	0) <i>7b, t</i> : 7 data bits 1) <i>8b, t</i> : 8 data bits	1
* <i>PAr</i> PARI	Parity bit of digital communication	0) <i>EVEN</i> : Even parity 1) <i>odd</i> : Odd parity 2) <i>nonE</i> : No parity bit	0
* <i>StoP</i> STOP	Stop bit count of digital communication	0) <i>1b, t</i> : One stop bit 1) <i>2b, t</i> : Two stop bits	0
* <i>rELo</i> RELO	Retransmission low scale value	Low: -19999 High: 45536	0°F (-17.8°C)
* <i>rEH</i> REHI	Retransmission high scale value	Low: -19999 High: 45536	1000°F (538°C)
<i>SEL1</i> SEL1	Select 1st parameter for user menu	0) <i>nonE</i> : No parameter selected 1) <i>LoCk</i> : LOCK is put ahead 2) <i>iNPT</i> : INPT is put ahead 3) <i>uNiT</i> : UNIT is put ahead 4) <i>dP</i> : DP is put ahead 5) <i>SHiF</i> : SHIF is put ahead 6) <i>Pb</i> : PB is put ahead 7) <i>tI</i> : TI is put ahead 8) <i>tD</i> : TD is put ahead 9) <i>o1HY</i> : O1HY is put ahead 10) <i>CYC1</i> : CYC1 is put ahead 11) <i>oFSt</i> : OFST is put ahead 12) <i>rR</i> : RR is put ahead 13) <i>o2HY</i> : O2HY is put ahead 14) <i>CYC2</i> : CYC2 is put ahead 15) <i>CPb</i> : CPB is put ahead 16) <i>db</i> : DB is put ahead 17) <i>AdDr</i> : ADDR is put ahead 18) <i>ALHY</i> : ALHY is put ahead	2
<i>SEL2</i> SEL2	Select 2nd parameter for user menu	Same as SEL1	3
<i>SEL3</i> SEL3	Select 3rd parameter for user menu	Same as SEL1	4
<i>SEL4</i> SEL4	Select 4th parameter for user menu	Same as SEL1	6
<i>SEL5</i> SEL5	Select 5th parameter for user menu	Same as SEL1	7
<i>SEL6</i> SEL6	Select 6th parameter for user menu	Same as SEL1	8
<i>SEL7</i> SEL7	Select 7th parameter for user menu	Same as SEL1	10
<i>SEL8</i> SEL8	Select 8th parameter for user menu	Same as SEL1	17

* Indicates Controller Parameter Settings That Are Not Applicable

Alarm Wiring

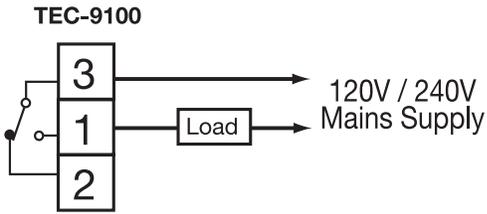


Figure 2.19 Alarm Output to Drive Load

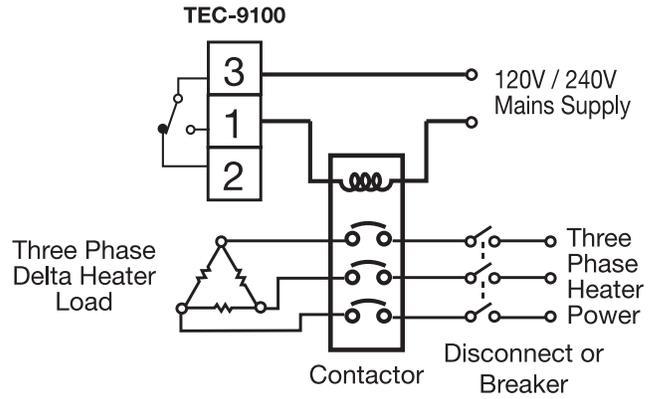


Figure 2.20 Alarm Output to Drive Contactor

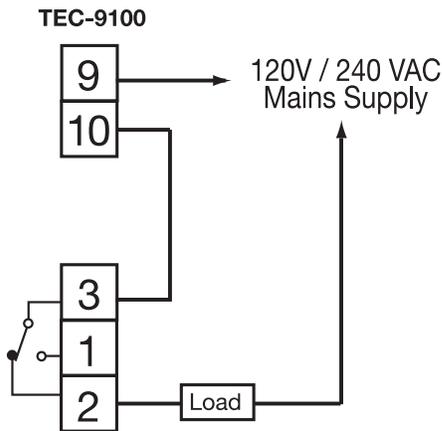


Figure 2.20.1 Dwell Timer Function

Chapter 3 Programming

Press  for 5 seconds and release to enter the setup menu. Press  to select the desired parameter. The upper display indicates the parameter symbol, and the lower display indicates the selected value of the parameter.

3-1 Lockout

There are four security levels that can be selected using the LOCK parameter.

If **NONE** is selected for LOCK, then no parameter is locked.

If **SET** is selected for LOCK, then all setup data are locked.

If **USER** is selected for LOCK, then all setup data as well as user data (refer to section 1-5) except the set point are locked to prevent them from being changed.

If **ALL** is selected for LOCK, then all parameters are locked to prevent them from being changed.

3-2 Signal Input

INPT: Selects the sensor type or signal type for signal input.

Range: (thermocouple) J-TC, K-TC, T-TC, E-TC, B-TC, R-TC, S-TC, N-TC, L-TC (RTD) PT.DN, PT.JS

UNIT: Selects the process unit

Range: °C, °F

DP: Selects the resolution of process value.

Range: (For T/C and RTD) NO.DP, 1-DP

3-3 Control Outputs

There are four kinds of control modes that can be configured as shown in table 3.1.

Table 3.1 Heat-Cool Control Setup Value

Control Modes	OUT1	OUT2	O1HY	O2HY	CPB	DB
Heat only	REVR	×	☆	×	×	×
Cool only	DIRT	×	☆	×	×	×
Heat: PID Cool: ON-OFF	REVR	DE.HI	×	○	×	×
Heat: PID Cool: PID	REVR	COOL	×	×	○	○

× : Does not apply

○ : Adjust to meet process requirements

☆ : Required if ON-OFF control is configured

OUT1:
Output 1 Type

OUT2:
Output 2 Type

O1HY:
Output 1 Hysteresis

O2HY:
Output 2 Hysteresis

CPB:
Cooling Proportional Band

DB:
Heating Cooling Dead Band

Control Outputs, continued...

Heat only ON-OFF control: Select REVR for OUT1. Set PB (proportional band) to 0. O1HY is used to adjust dead band for ON-OFF control. The output 1 hysteresis (O1HY) is enabled in case PB=0. The heat only on-off control function is shown in the following diagram:

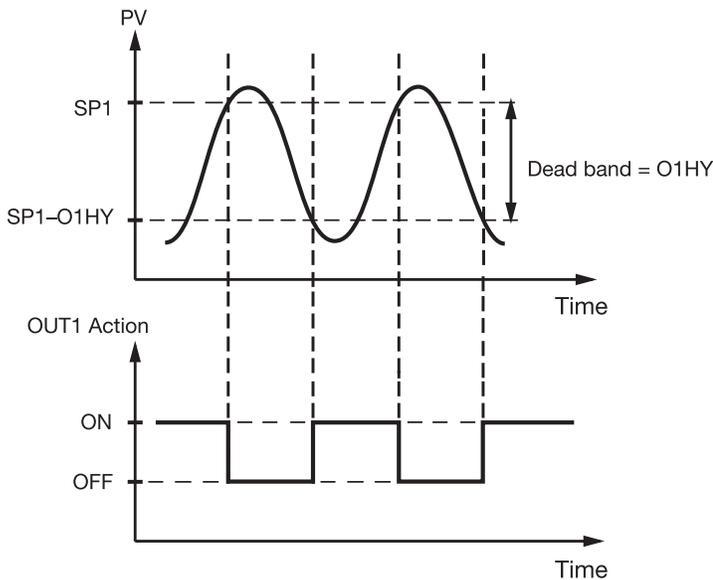


Figure 3.2 Heat Only ON-OFF Control

The ON-OFF control may introduce excessive process oscillation even if hysteresis is minimized. If ON-OFF control is set (i.e., PB=0), TI, TD, CYC1, OFST, CYC2, CPB, and DB will be hidden and have no function in the system. The auto-tuning and bumpless transfer functions will be disabled as well.

Heat only P (or PD) control: Select REVR for OUT1, set TI to 0. OFST is used to adjust the control offset (manual reset). **O1HY is hidden** if PB is not equal to 0. **OFST function:** OFST is measured by % with a range of 0–100.0%. In the steady state (i.e., process has been stabilized), if the process value is lower than the set point by a definite value, say 5°C, while 20°C is used for PB, that is lower by 25%, then increase OFST 25%, and vice-versa. After adjusting OFST value, the process value will be varied and eventually coincide with set point.

Refer to section 3-12 “manual tuning” for the adjustment of PB and TD. Manual reset (adjust OFST) is not practical because the load may change from time to time and OFST may need to be adjusted repeatedly. PID control can avoid this situation.

Heat only PID control: If REVR is selected for OUT1, PB and TI should not be zero. Perform auto-tuning for the new process, or set PB, TI, and TD with historical values. See section 3-11 for auto-tuning operation. If the control result is still unsatisfactory, then use manual tuning to improve control. See section 3-12 for manual tuning. The unit contains a very advanced PID and Fuzzy Logic algorithm to create a very small overshoot and very quick response to the process if it is properly tuned.

Cool only control: ON-OFF control, P (PD) control, and PID control can be used for cool control. Set OUT1 to DIRT (direct action). The other functions for cool only ON-OFF control, cool only P (PD) control, and cool only PID control are the same as for heat only control except that the output variable (and action) for cool control is inverse to heat control.

NOTE: ON-OFF control may result in excessive overshoot and undershoot problems in the process. P (or PD) control will result in a deviation of process value from the set point. It is recommended to use PID control for heat-cool control to produce a stable and zero offset process value.

Other setup required: O1TY, CYC1, O2TY, CYC2, O1FT and O2FT are set in accordance with the types of OUT1 and OUT2 installed. CYC1 and CYC2 are selected according to the output 1 type (O1TY) and output 2 type (O2TY). Generally, select 0.5~2 seconds for CYC1 if SSRD or SSR is used for O1TY; 10~20 seconds if relay is used for O1TY. CYC1 is ignored if a linear output is used. Similar conditions are applied for CYC2 selection.

You can use the auto-tuning program for the new process or directly set the appropriate values for PB, TI, and TD according to historical records for the repeated systems. If the control behavior is still inadequate, use manual tuning to improve the control. See section 3-12 for manual tuning.

3.3 & 3.4 Alarm Figures, next page...

3.3 & 3.4 Alarm Figures

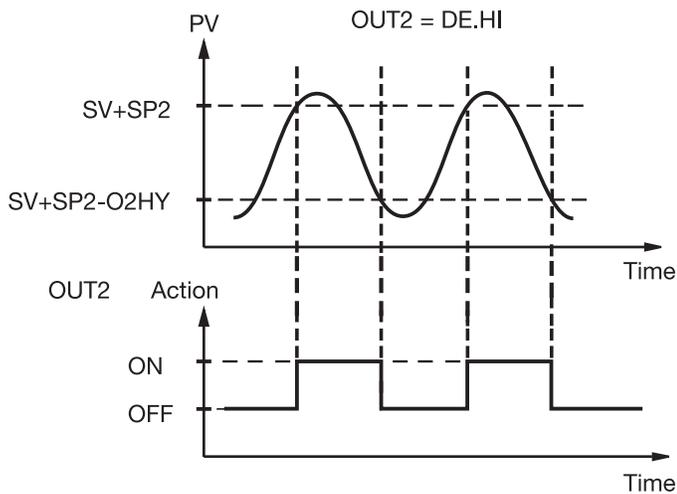


Figure 3.3 Output 2 Deviation High Alarm

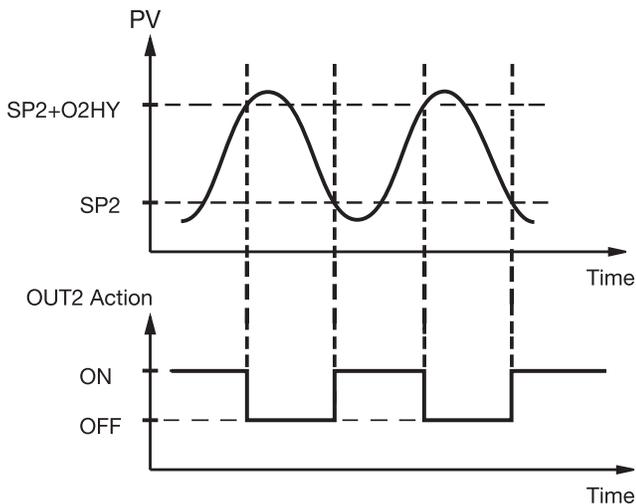


Figure 3.4 Output 2 Process Low Alarm

3-4 Alarm

The controller has one alarm output. There are six types of alarm functions and one dwell timer that can be selected, and four kinds of alarm modes (ALMD) are available for each alarm function (ALFN). Output 2 can be configured as another alarm in addition to the alarm output. But output 2 only provides four kinds of alarm functions and only normal alarm mode is available for this alarm. When output 2 is used as an alarm, SP2 sets the trigger point. SP3 sets the trigger point for Alarm.

A **process alarm** sets absolute trigger levels. When the process is higher than SP3, a process high alarm (PV.HI) occurs, and the alarm is off when the process is lower than SP3-ALHY. When the process is lower than SP3, a process low alarm (PV.LO) occurs, and the alarm is off when the process is higher than SP3+ALHY. A process alarm is independent of the set point.

A **deviation alarm** alerts the user when the process deviates from the set point. When the process is higher than SV+SP3, a deviation high alarm (DE.HI) occurs, and the alarm is off when the process is lower than SV+SP3-ALHY. When the process is lower than SV+SP3, a deviation low alarm (DE.LO) occurs, and the alarm is off when the process is higher than SV+SP3+ALHY. The trigger level of the deviation alarm moves with the set point.

A **deviation band alarm** presets two trigger levels relative to the set point. The two trigger levels are SV+SP3 and SV-SP3 for alarm. When the process is higher than (SV+SP3) or lower than (SV-SP3), a deviation band high alarm (DB.HI) occurs. When the process is within the trigger levels, a deviation band low alarm (DB.LO) occurs.

There are four types of alarm modes available for each alarm function. These are: normal alarm, latching alarm, holding alarm and latching/holding alarm. They are described as follows:

Normal alarm: ALMD=NORM

When a normal alarm is selected, the alarm output is de-energized in the non-alarm condition and energized in an alarm condition.

Latching alarm: ALMD=LTCH

If a latching alarm is selected, once the alarm output is energized, it will remain unchanged even if the alarm condition is cleared. The latching alarm is reset when the RESET key is pressed after the alarm condition is removed.

Holding alarm: ALMD=HOLD

A holding alarm prevents an alarm when the control is powering up. The alarm is enabled only when the process reaches the set point value. Afterwards, the alarm performs the same function as a normal alarm.

Latching/holding alarm: ALMD=LT.HO

A latching/holding alarm performs both holding and latching functions. The latching alarm is reset when the RESET key is pressed after the alarm condition is removed.

Alarm failure transfer is activated as the unit enters failure mode. The alarm will go on if ALFT is set for ON and go off if ALFT is set for OFF. The unit will enter failure mode when a sensor break occurs or if the A-D converter of the unit fails.

3-5 Configuring User Menu

Most conventional controllers are designed with a fixed order in which the parameters scroll. The x100 series have the flexibility to allow you to select those parameters which are most significant to you and put these parameters at the front of the display sequence.

SEL1~SEL8: Selects the parameter for view and change in the user menu.

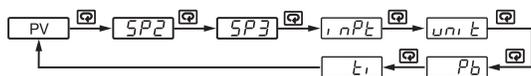
Range: LOCK, INPT, UNIT, DP, SHIF, PB, TI, TD, O1HY, CYC1, OFST, RR, O2HY, CYC2, CPB, DB, ADDR, ALHY

When using the up and down keys to select the parameters, you may not see all of the above parameters. The number of visible parameters is dependent on the setup condition. The hidden parameters for the specific application are also blocked from the SEL selection.

Example:

OUT2 set for DE.LO PB= 100.0 SEL1 set for INPT
 SEL2 set for UNIT SEL3 set for PB SEL4 set for TI
 SEL5~SEL8 set for NONE

Now, the upper display scrolling becomes:



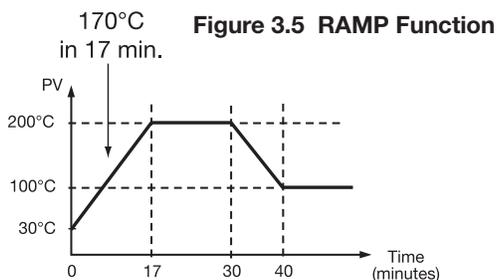
3-6 Ramp

Ramp

The ramping function is performed during power up as well as any time the set point is changed. If MINR or HRR is chosen for RAMP, the unit will perform the ramping function. The ramp rate is programmed by adjusting RR. The ramping function is disabled as soon as failure mode, manual control mode, auto-tuning mode or calibration mode is entered.

Example without dwell timer

Select MINR for RAMP, select °C for UNIT, select 1-DP for DP, set RR=10.0. SV is set to 200°C initially, and changed to 100°C 30 minutes after power-up. The starting temperature is 30°C. After power-up, the process runs like the curve shown below:



Note: When the ramp function is used, the lower display will show the current ramping value. The ramping value is an artificially determined setpoint created and updated by the control to match the ramp rate set by the user. However, it will revert to show the set point value as soon as the up or down key is touched for adjustment. The ramping value is initiated to process value either on power-up or when RR and/or the set point are changed. Setting RR to zero means no ramp function.

3-7 Dwell Timer

The alarm output can be configured as a dwell timer by selecting TIMR for ALFN (alarm function). As the dwell timer is configured, the parameter SP3 is used for dwell time adjustment. The dwell time is measured in minutes ranging from 0.1 to 4553 minutes. Once the process reaches the set point the dwell timer starts to count down to zero (time out). The timer relay will remain unchanged until time out. For the dwell timer to control the heater, the heater circuit (or contactor) must be wired in series with the alarm relay. Note the following diagram located below and also Figure 2.20.1 on page 11. When the dwell timer times out, the heater will be turned off. The dwell timer operation is shown in the following diagram.

After time out, the dwell timer can be restarted by pressing the RESET key.

The timer stops counting during manual control mode, failure mode, the calibration period and the auto-tuning period.

If the alarm is configured as a dwell timer, ALHY and ALMD are hidden.

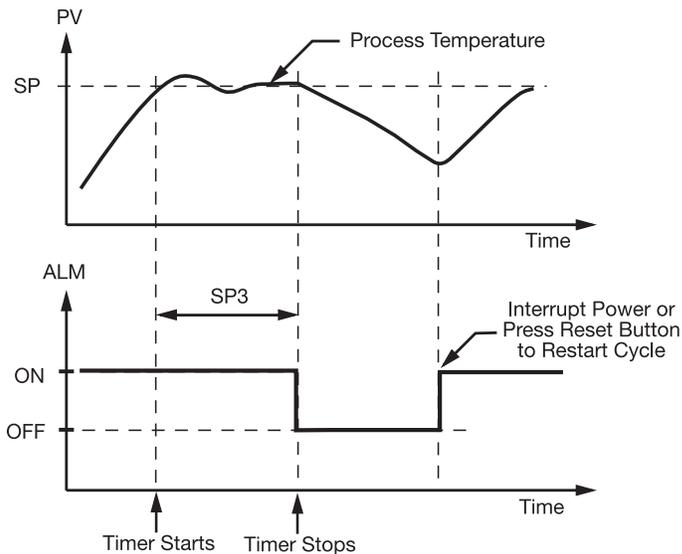
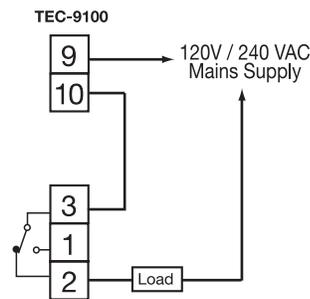


Figure 3.6 Dwell Timer Function



Dwell Timer Function Wiring Diagram

3-8 PV Shift

In certain applications it is desirable to shift the controller display value (PV) from its actual value. This can easily be accomplished by using the PV shift function.

The SHIF function will alter PV only.

Example: A process is equipped with a heater, a sensor, and a subject to be warmed up. Due to the design and position of the components in the system, the sensor could not be placed any closer to the part. Thermal gradient (differing temperatures) is common and necessary to an extent in any thermal system for heat to be transferred from one point to another. If the difference between the sensor and the subject is 35°C, and the desired temperature at the subject to be heated is 200°C, the temperature at the sensor should be 235°C. You should enter -35°C to subtract 35°C from the actual process display. This in turn will cause the controller to energize the load and bring the process display up to the set point value.

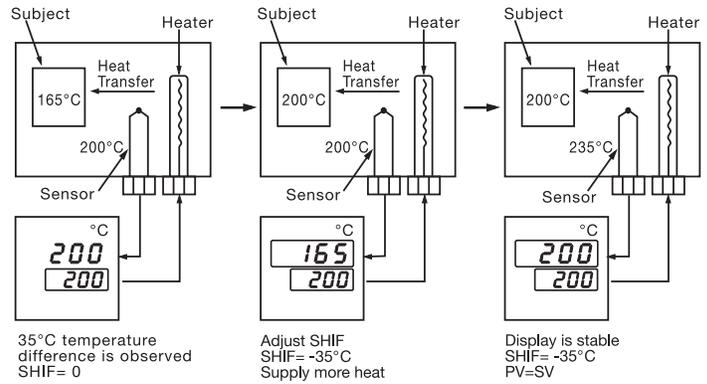


Figure 3.7 PV Shift Application

3-9 Digital Filter

In certain applications, the process value is too unstable to be read due possibly to electrical noise. A programmable low-pass filter incorporated in the controller is used to improve this. It is a first-order filter with the time constant specified by the FILT parameter. The default value of FILT is set at 0.5 seconds before shipping. Adjust FILT to change the time constant from 0 to 60 seconds. 0 seconds means no filter is applied to the input signal. The filter is characterized by the following diagram:

Note

The filter is available only for PV, and is performed for the displayed value only. The controller is designed to use unfiltered signal for control even if the filter is applied. A lagged (filtered) signal, if used for control, may produce an unstable process.

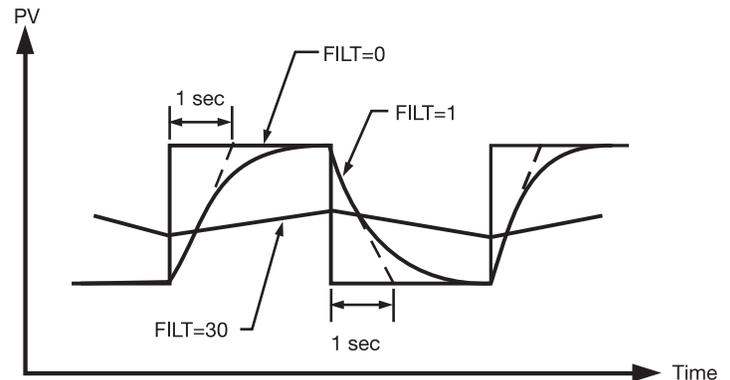


Figure 3.8 Filter Characteristics

3-10 Failure Transfer

The controller will enter failure mode if one of the following conditions occurs:

1. **SBER** occurs due to input sensor break or input current below 1mA if 4-20 mA is selected or input voltage below 0.25V if 1-5V is selected.
2. **ADER** occurs due to the A-D converter of the controller failing.

Output 1 and output 2 will perform the failure transfer function as the controller enters failure mode.

Output 1 failure transfer, if activated, will perform:

1. If output 1 is configured as proportional control (PB≠0), and BPLS is selected for O1FT, then output 1 will perform bumpless transfer. Thereafter, the

previous averaging value of MV1 will be used for controlling output 1.

2. If output 1 is configured as proportional control (PB≠0), and a value of 0 to 100.0% is set for O1FT, then output 1 will perform failure transfer. Thereafter, the value of O1FT will be used for controlling output 1.
3. If output 1 is configured as ON-OFF control (PB=0), then output 1 will be driven OFF if OFF is set for O1FT and will be driven ON if ON is set for O1FT.

Output 2 failure transfer, if activated, will perform:

1. If OUT2 is configured as COOL, and BPLS is selected for O1FT, then output 2 will perform bumpless transfer.

Thereafter, the previous averaging value of MV2 will be used for controlling output 2.

2. If OUT2 is configured as COOL, and a value of 0 to 100.0% is set for O2FT, then output 2 will perform failure transfer. Thereafter, the value of O1FT will be used for controlling output 2.
3. If OUT2 is configured as alarm function, and O2FT is set to OFF, then output 2 will go off. Otherwise, output 2 will go on if O2FT is set to ON.

Alarm failure transfer is activated as the controller enters failure mode. Thereafter, the alarm will transfer to the ON or OFF state preset by ALFT.

3-11 Auto-tuning

⚠ The auto-tuning process is performed near the set point. The process will oscillate around the set point during the tuning process. Set the set point at a lower value if overshooting beyond the normal process value is likely to cause damage.

Auto-tuning is applied in cases of:

- Initial setup for a new process
- The set point is changed substantially from the previous auto-tuning value
- The control result is unsatisfactory

Operation:

1. The system has been installed normally.
2. Set the correct values for the setup menu of the unit, but don't set a zero value for PB and TI, or the auto-tuning program will be disabled. The LOCK parameter should be set at NONE.
3. Set the set point to a normal operating value, or a lower value if overshooting beyond the normal process value is likely to cause damage.
4. Press **☐** and hold until **A.T** appears on the display.
5. Then press **☐** again for at least 5 seconds. The AT indicator will begin to flash and the auto-tuning procedure begins.

NOTE: The ramping function, if used, will be disabled when auto-tuning is taking place.

Auto-tuning mode is disabled as soon as either failure mode or manual control mode is entered.

Procedures:

Auto-tuning can be applied either as the process is warming up (cold start), or when the process has been in a steady state (warm start). After the auto-tuning procedures are completed, the AT indicator will cease to flash and the unit will revert to PID control using its new PID values. The PID values obtained are stored in the nonvolatile memory.

ATER Auto-Tuning Error

If auto-tuning fails an ATER message will appear on the upper display in the following cases:

- If PB exceeds 9000 (9000 PU, 900.0°F or 500.0°C),
- if TI exceeds 1000 seconds,
- if the set point is changed during the auto-tuning procedure.

Solutions to **ATER**

1. Try auto-tuning once again.
2. Don't change the set point value during the auto-tuning procedure.
3. Don't set a zero value for PB and TI.
4. Use manual tuning instead of auto-tuning (see section 3-12).
5. Touch RESET key to reset **ATER** message.

3-12 Manual Tuning

In certain applications auto-tuning may be inadequate for the control requirements. You can try manual tuning for these applications.

If the control performance using auto-tuning is still unsatisfactory, the following rules can be applied for further adjustment of PID values:

ADJUSTMENT SEQUENCE	SYMPTOM	SOLUTION
(1) Proportional Band (PB)	Slow Response	Decrease PB
	High overshoot or Oscillations	Increase PB
(2) Integral Time (TI)	Slow Response	Decrease TI
	Instability or Oscillations	Increase TI
(3) Derivative Time (TD)	Slow Response or Oscillations	Decrease TD
	High Overshoot	Increase TD

Table 3.2 PID Adjustment Guide

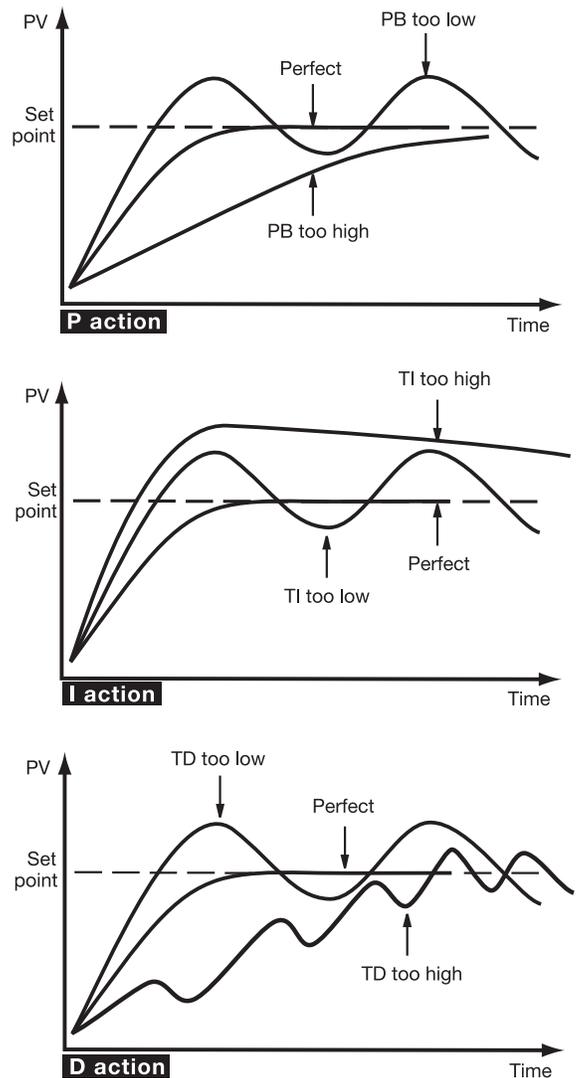


Figure 3.9 Effects of PID Adjustment

Figure 3.9 shows the effects of PID adjustment on process response.

3-13 Manual Control

Operation

To enable manual control, the LOCK parameter should be set to NONE, then press  for 6.2 seconds;   (hand control) will appear on the display. Press  for 5 seconds, then the MAN indicator will begin to flash and the lower display will show . The controller is now in manual control mode.  indicates output control variable for output 1, and  indicates control variable for output 2. Now you can use the up and down keys to adjust the percentage values for the heating or cooling output.

The controller performs open loop control as long as it stays in manual control mode.

Exit Manual Control

Pressing the  key will cause the controller to revert to its normal display mode.

Table A.1 Error Codes and Corrective Actions

Error Code	Display Symbol	Error Description	Corrective Action
4	<i>Er 04</i>	Illegal setup values being used: Before COOL is used for OUT2, DIRT (cooling action) has already been used for OUT1, or PID mode is not used for OUT1 (that is, PB=0 and/or TI=0)	Check and correct setup values of OUT2, PB, TI and OUT1. If OUT2 is required for cooling control, the control should use PID mode (PB≠0, TI≠0) and OUT1 should use reverse mode (heating action). Otherwise, don't use OUT2 for cooling control.
10	<i>Er 10</i>	Communication error: bad function code	Correct the communication software to meet the protocol requirements.
11	<i>Er 11</i>	Communication error: register address out of range	Don't issue an over-range register address to the slave.
14	<i>Er 14</i>	Communication error: attempt to write a read-only data or a protected data	Don't write a read-only data or a protected data to the slave.
15	<i>Er 15</i>	Communication error: write a value which is out of range to a register	Don't write an over-range data to the slave register.
26	<i>AtEr</i>	Fail to perform auto-tuning function	<ol style="list-style-type: none"> 1. The PID values obtained after auto-tuning procedure are out of range. Retry auto-tuning. 2. Don't change set point value during auto-tuning procedure. 3. Use manual tuning instead of auto-tuning. 4. Don't set a zero value for PB. 5. Don't set a zero value for TI. 6. Press RESET key
29	<i>EEPE</i>	EEPROM can't be written correctly	Return to factory for repair.
30	<i>CJEr</i>	Cold junction compensation for thermocouple malfunction	Return to factory for repair.
39	<i>SbEr</i>	Input sensor break, or input current below 1 mA if 4-20 mA is selected, or input voltage below 0.25V if 1-5V is selected	Replace input sensor.
40	<i>AdEr</i>	A to D converter or related component(s) malfunction	Return to factory for repair.

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MTW, COPPER, BLACK

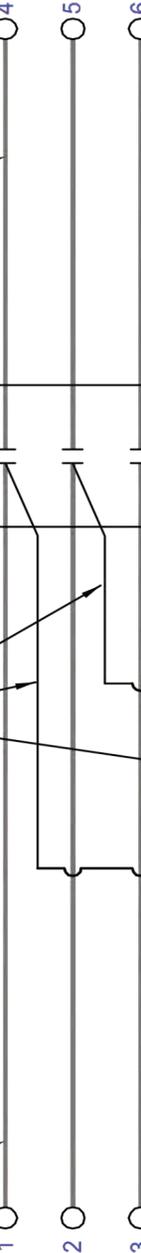
CONTROL POWER WIRES:
#14AWG, 90°C WIRE,
THHN, COPPER, BLACK

CONTROL CONTACTOR:
600V, 32A RESISTIVE,
3-POLE, 240V COIL

CUSTOMER HEATER CONNECTION

CUSTOMER SUPPLY

240 V, 24A NOMINAL
5760 WATTS 1-PHASE OR
9970 WATTS 3-PHASE



MIN. #10AWG, COPPER
90°C THHN CONDUCTOR
OR BETTER EXPECTED

PHASE **TERMINALS**
1 1 AND 2
3 1, 2, AND 3

GROUND WIRING:
#10 AWG, 90°C WIRE,
MTW, COPPER, GREEN
OR GREEN/YELLOW

NOTE: TEC-9100 SETTINGS
SP2=30
out2=dELo

SENSOR WIRE:
3 COND., #24AWG, TEFLON WIRE,
WHITE, WHITE, RED, COPPER,
WHITE TEFLON COVER

CUSTOMER TEMP. SENSOR CONNECTION
TYPE J, K OR RTD

NOTE: HEATER FUSING AND DISCONNECT IS THE RESPONSIBILITY OF THE INSTALLER. USE 30 AMP 600V, JKS CLASS J

HERMOCOUPLES: RED LEAD IS NEGATIVE (-)

RTDs: 2-WIRE - TO TERM. 7 AND 8, NON-POLARIZED,
WITH JUMPER BETWEEN TERM. 8 AND 9
3-WIRE - UNIQUE WIRE COLOR TO TERM. 7 AND
THE 2 SAME COLOR WIRES TO TERM. 8 AND 9

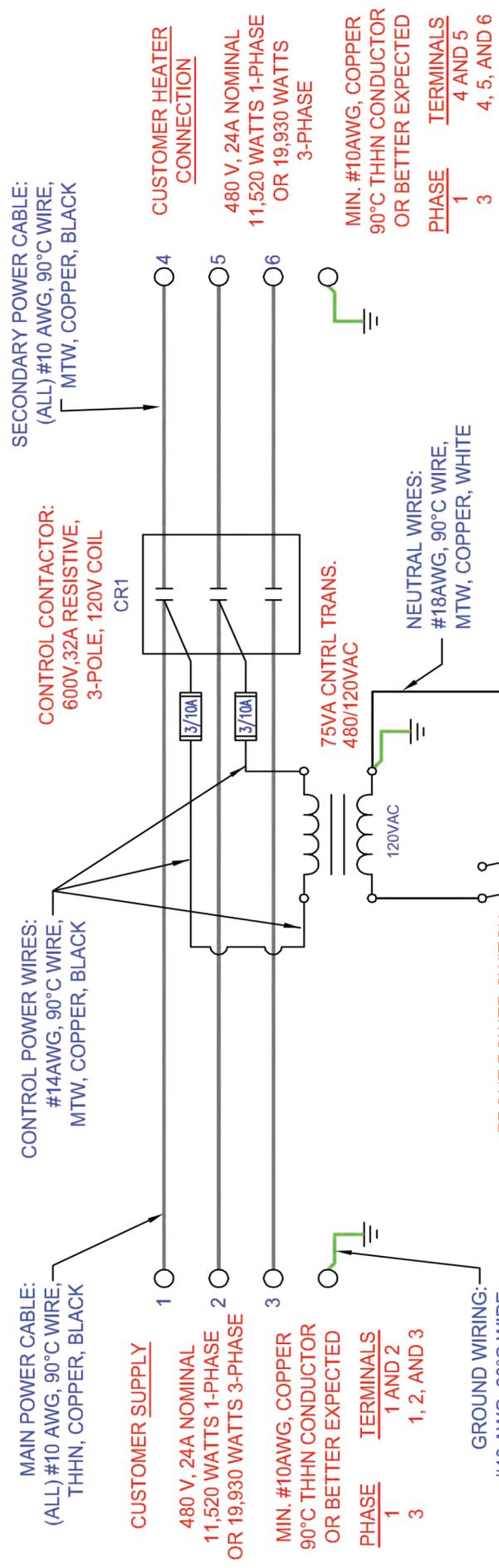
TOLERANCES UNLESS OTHERWISE SPECIFIED	
FRACTIONS	±1/64
DECIMALS	±0.01
ANGLES	±0.005
SURFACE FINISH	±1°
CUSTOMER:	-

TITLE: INTERNAL WIRING DIAGRAM FOR PCM10005	
SCALE: N/A	DATE: 3-17-10
APPROVED: JT	DRAWN BY: DZ
REV. SHEET	9 1 OF 1
THIRD ANGLE PROJECTION	

TEPCO
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607 N. Central Ave.
Wood Dale, IL 60191-1462 U.S.A.
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DRAWING NUMBER: PCM10005-WD

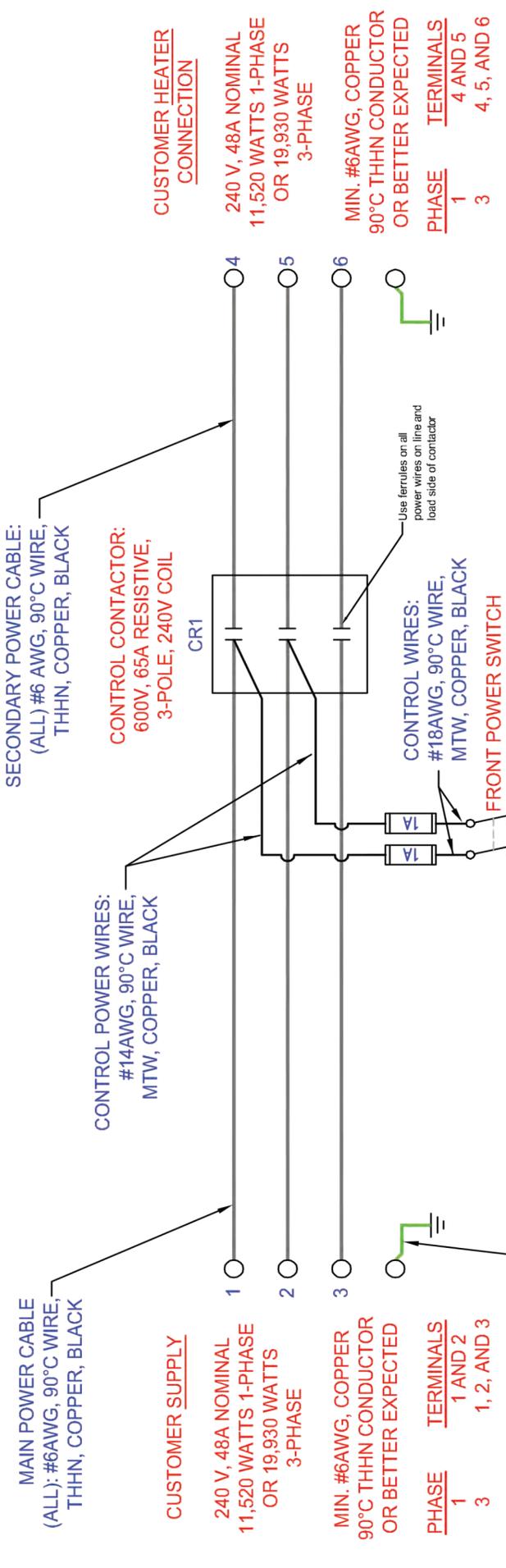
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NOTE: TEC-9100 SETTINGS
SP2=30
out2=dELO

TOLERANCES UNLESS OTHERWISE SPECIFIED FRACTIONS ±1/64 DECIMALS .XX ±0.01 .XXX ±0.005 ANGLES ±1° SURFACE FINISH -	TITLE: INTERNAL WIRING DIAGRAM FOR PCM10006 24A, 480VAC		
	SCALE: -:-	DATE: 3/17/10	DRAWN BY: DZ
CUSTOMER: TEMPCO	THIRD ANGLE PROJECTION	REV. 8	SHEET 1 OF 1
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MTW, COPPER, BLACK

CONTROL CONTACTOR:
600V, 65A RESISTIVE,
3-POLE, 240V COIL

CUSTOMER SUPPLY
240 V, 48A NOMINAL
11,520 WATTS 1-PHASE
OR 19,930 WATTS
3-PHASE

**MIN. #6AWG, COPPER
90°C THHN CONDUCTOR
OR BETTER EXPECTED**

PHASE	TERMINALS
1	1 AND 2
3	1, 2, AND 3

GROUND WIRING:
#6 AWG, 90°C WIRE,
MTW, COPPER, GREEN
OR GREEN/YELLOW

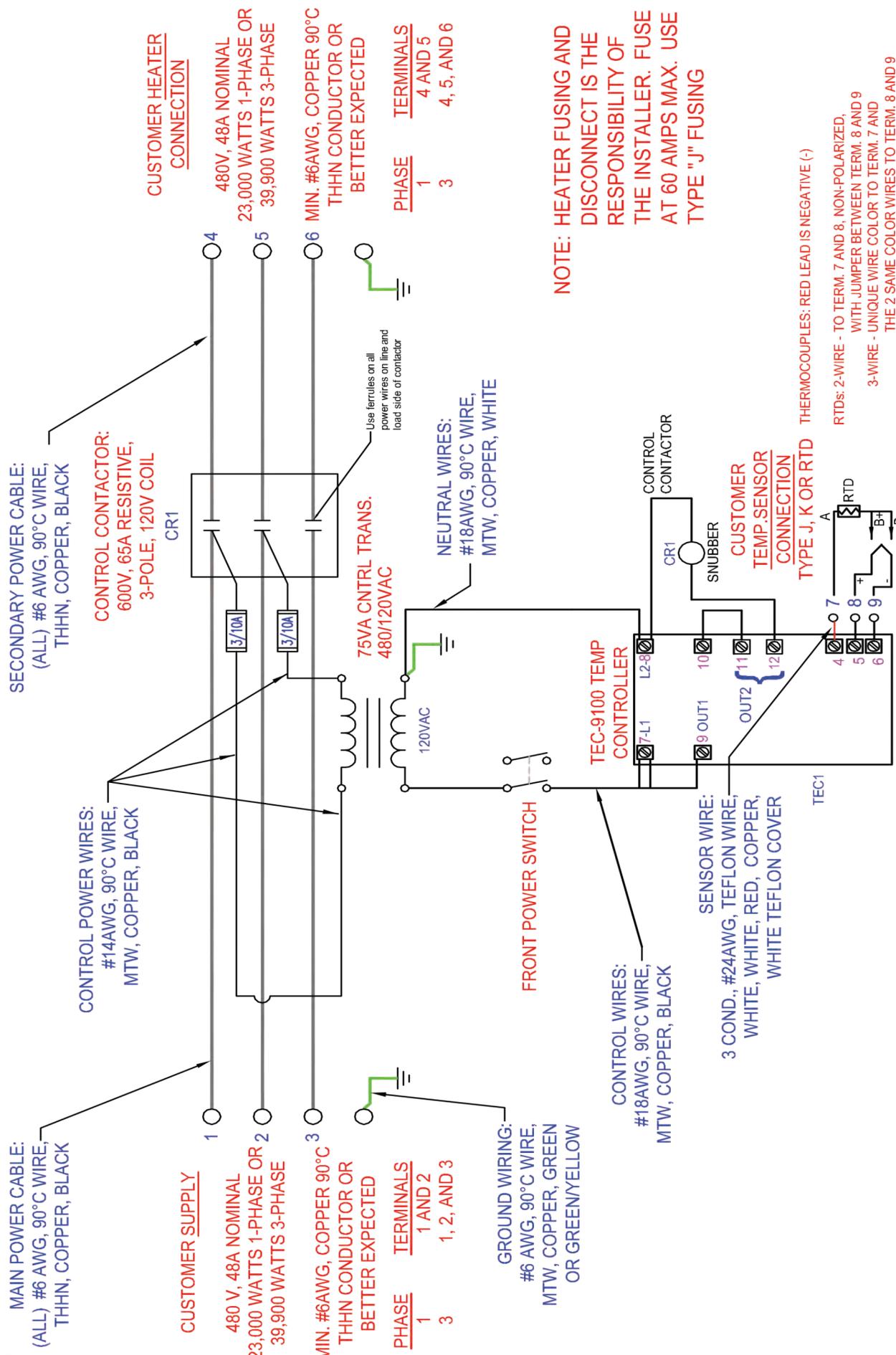
SENSOR WIRE:
3 COND., #24AWG, TEFLON WIRE,
WHITE, WHITE, RED, COPPER,
WHITE TEFLON COVER

NOTE: TEC-9100 SETTINGS
SP2=30
out2=dEllo

**NOTE: HEATER FUSING AND
DISCONNECT IS THE
RESPONSIBILITY OF
THE INSTALLER. FUSE
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TECHNICAL NOTES:
THERMOCOUPLES: RED LEAD IS NEGATIVE (-)
RTDs: 2-WIRE - TO TERM. 7 AND 8, NON-POLARIZED,
WITH JUMPER BETWEEN TERM. 8 AND 9
3-WIRE - UNIQUE WIRE COLOR TO TERM. 7 AND
THE 2 SAME COLOR WIRES TO TERM. 8 AND 9

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CUSTOMER: TEMPCO	DRAWING NUMBER: PCM10007-WD



NOTE: TEC-9100 SETTINGS
SP2=30
out2=dElo

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TITLE: WIRING DIAGRAM FOR PCM10008 CONTROL CONSOLE 480V, 48A	
TOLERANCES UNLESS OTHERWISE SPECIFIED FRACTIONS ±1/64 DECIMALS .XX ±0.01 ANGLES .XXX ±0.009 SURFACE FINISH - ±1"	SCALE: -:- DATE: 3/17/10 THIRD ANGLE PROJECTION
CUSTOMER: TEMPCO	APPROVED: JP REV. SHEET: 6 1 OF 1 DRAWING NUMBER: PCM10008-WD

NOTES

RETURNS

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TECHNICAL SUPPORT

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