TEMPERATURE CONTROLLERS

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The Trusted Source for Innovative Control Solutions

QUICK Specs

Temperature Controllers

	CONTROL	INDICATION	CONTROL	
	CUB5RT/TC	**PAXLRT/TC**	**PAXLT**	**DP5T**
				
Description	RTD/Thermocouple Meter With Output Option Card Capability	1/8 DIN RTD/Thermocouple Indicator	RTD and Thermocouple Meter With Setpoint Capability	1/8 DIN RTD and Thermocouple Temperature Indicator
Dimensions (Height) x (Width)	39 mm (H) x 75 mm (W)	50 mm (H) x 97 mm (W)	50 mm (H) x 97mm (W)	50 mm (H) x 97mm (W)
Display	5 Digit, .48" (12mm) Reflective and Red Backlight LCD	4 Digit, .56" (14mm) Red LED	5 Digit, .56" (14mm) Red LED	4 1/2 Digit, .56" (14mm) Red LED
Input Ranges	RTD (CUB5RT) Pt385, Pt392, Ni672, and Cu427 Thermocouple (CUB5TC) T, E, J, K, R, S, B, N, and mV	RTD (PAXLRT) Pt385 and Pt392 Thermocouple (PAXLTC) T, E, J, K, R, S, B, N, and mV	RTD Pt385, Pt392, Ni672, and Cu427 Thermocouple T, E, J, K, R, S, B, N, and mV	Thermocouple T, E, J, K, R, S, B, N, and C RTD Pt385, Pt392, Ni672, and Cu427 Direct 10 Ohm, 100 Ohm, and mV
Control	Yes	No	Yes	No
Outputs	Single Form C Relay Dual Sinking	No	Dual Form C	No
Communications	RS232 RS485	No	No	No
Other Features/ Options	User Input Min/Max Memory Custom Units Indicato	Programmable Offset, Peak/Valley Memory, Custom Units Overlay	User Input Min/Max Memory, Custom Units Overlay	Min/Max Memory, Integrator/Totalizer, Custom Units Overlay
Power Source	9 to 28 VDC	85 to 250 VAC	50 to 250 VAC 21.6 to 250 VDC	85 to 250 VAC 11 to 36 VDC 24 VAC
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*See website for product information.

† Field Installable Option Card

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QUICK Specs

Temperature Controllers

	CONTROL		PID CONTROL	
	PAXT	**PAX2A**	**T16**	**T48**
				
Description	1/8 DIN RTD and Thermocouple Temperature Indicator	1/8 DIN Dual Line RTD and Thermocouple Temperature Meter With Output Option Card Capability	1/16 DIN Temperature Controller	1/16 DIN Temperature Controller
Dimensions (Height) x (Width)	50 mm (H) x 97mm (W)	50 mm (H) x 97mm (W)	48 mm (H) x 48mm (W)	48 mm (H) x 48mm (W)
Display	4 1/2 Digit, .56" (14mm) Standard Green or Sunlight Readable Red LED, Adjustable Intensity	Top Line: 6 Digit, .71" (18mm) Tri-color Backlight Bottom Line: 9 Digit, .35" (9mm) Green Backlight	2 x 4 Digit, Main Display .3" (7mm) Red Sec. Display .2" (5mm) Green LED	2 x 4 Digit, Main Display .4" (10mm) Red Sec. Display .3" (7mm) Green LED
Input Ranges	Thermocouple T, E, J, K, R, S, B, N, C, and mV RTD 2 or 3 Wire 100 Ohm (ALPHA = .00385, .00391 and .00672)	Thermocouple T, E, J, K, R, S, B, N, C, and mV RTD Pt385, Pt392, Ni672, and Cu427 Direct 10 Ohm, 100 Ohm, and mV	Thermocouple T, E, J, K, R, S, B, N, and mV RTD 2 or 3 Wire 100 Ohm (ALPHA = .00385 and .00391)	Thermocouple T, E, J, K, R, S, B, N, and mV RTD 2, 3, or 4 Wire 100 Ohm (ALPHA = .00385 and .00391)
Control	On/Off	On/Off	On/Off, PID	On/Off, PID
Outputs	Dual Form C Quad Form A Quad Sinking Quad Sourcing	Dual Form C Quad Form A Quad Sinking Quad Sourcing	Main Control (Heat/Cool), Cooling Output, Dual Alarms (Relay, SSR Drive)	Main Control (Heat/Cool), Cooling Output, Dual Alarms (Relay, SSR Drive, Triac) Field Replaceable
Communications	RS232 RS485 Modbus DeviceNet Profibus Ethernet w/ICM8	RS232 RS485 Modbus DeviceNet Profibus	No	RS485
Other Features/ Options	Analog Output*, Min/Max Memory, Integrator/Totalizer, Linearizer, Custom Units Overlay	Analog Output*, Min/Max Memory, Integrator/Totalizer, Linearizer, Custom Units Display	Analog Output	Heater Current Monitor, Analog Output, Remote Setpoint
Power Source	85 to 250 VAC 18 to 36 VDC 24 VAC	50 to 250 VAC 21.6 to 250 VDC	85 to 250 VAC 18 to 36 VDC 24 VAC	85 to 250 VAC 18 to 36 VDC 24 VAC
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*See website for product information.

† Field Installable Option Card

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QUICK Specs

Temperature Controllers

PID CONTROL

	PAX2C	TCU	TSC	P16
				
Description	1/8 DIN Dual Line Temperature/Process Controller With Output Option Card Capability	1/8 DIN Temperature Controller	1/8 DIN Temperature Setpoint Controller	1/16 DIN Process Controller
Dimensions (Height) x (Width)	50 mm (H) x 97mm (W)	96 mm (H) x 48mm (W)	96 mm (H) x 48mm (W)	48 mm (H) x 48mm (W)
Display	Dual Line 4 Digit Tri-color Backlight Vertical: Line 1- .51" (13mm); Line 2- .44" (11.2mm) Horiz.: Line 1- .62" (15.7mm); Line 2- .47" (12.0mm)	2 x 4 Digit, Main Display .4" (10mm) Red Sec. Display .3" (7mm) Green LED	2 x 4 Digit, Main Display .4" (10mm) Red Sec. Display .3" (7mm) Green LED	2 x 4 Digit, Main Display .3" (7mm) Red Sec. Display .2" (5mm) Green LED
Input Ranges	Thermocouple T, E, J, K, R, S, B, N, C, and mV RTD Pt385, Pt392, Ni672, and Cu427 Direct: 10 or 100 Ohm, and mV Process Current: 250µADC - 2ADC Voltage: 250mVDC - 200VDC	Thermocouple T, E, J, K, R, S, B, N, and mV RTD 2, 3, or 4 Wire 100 Ohm (ALPHA = .00385 and .00391)	Thermocouple T, E, J, K, R, S, B, N, and mV RTD 2, or 3 Wire 100 Ohm (ALPHA = .00385 and .00391)	Process Input 0 to 10 VDC or 0 to 20 mA
Control	On/Off, PID	On/Off, PID	On/Off, PID	On/Off, PID
Outputs	Main Control (Heat/Cool) Cooling Output Alarms	Main Control (Heat/Cool), Cooling Output, Dual Alarms (Relay, SSR Drive, Triac) Field Replaceable	Main Control (Heat/Cool), Cooling Output, Dual Alarms (Relay, SSR Drive, Triac) Field Replaceable	Main Control (Direct/Reverse), Secondary Output, Dual Alarms
Communications	RS232 or RS485 Modbus DeviceNet Profibus	RS485	RS485	No
Other Features/ Options	Analog Output	Heater Current Monitor, Analog Output, Remote Setpoint	Analog Output	Analog Output
Power Source	50 to 250 VAC 21.6 to 250 VDC	115/230 VAC	115/230 VAC	85 to 250 VAC 18 to 36 VDC 24 VAC
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*See website for product information.

† Field Installable Option Card

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QUICK Specs

Temperature Controllers

	PID CONTROL			CONTROL
	P48	**PCU**	**PSC**	**TLA**
				
Description	1/16 DIN Process Controller	1/8 DIN Process Controller	1/8 DIN Process Setpoint Controller	1/16 DIN Temperature Limit Alarm
Dimensions (Height) x (Width)	48 mm (H) x 48mm (W)	96 mm (H) x 48mm (W)	96 mm (H) x 48mm (W)	48 mm (H) x 48mm (W)
Display	2 x 4 Digit, Main Display .4" (10mm) Red Sec. Display .3" (7mm) Green LED	2 x 4 Digit, Main Display .4" (10mm) Red Sec. Display .3" (7mm) Green LED	2 x 4 Digit, Main Display .4" (10mm) Red Sec. Display .3" (7mm) Green LED	2 x 4 Digit, Main Display .4" (10mm) Red Sec. Display .3" (7mm) Green LED
Input Ranges	Process Input 0 to 10 VDC or 0 to 20 mA	Process Input 0 to 10 VDC or 0 to 20 mA	Process Input 0 to 10 VDC or 0 to 20 mA	
Control	On/Off, PID	On/Off, PID	On/Off, PID	On/Off
Outputs	Main Control (Direct/Reverse), Secondary Output, Dual Alarms (Relay Only)	Main Control (Direct/Reverse), Secondary Output, Dual Alarms (Relay, SSR Drive, Triac) Field Replaceable	Main Control (Direct/Reverse), Secondary Output, Dual Alarms (Relay, SSR Drive, Triac) Field Replaceable	Limit Alarm Relay Alarm Output Single or Dual Relay
Communications	RS485	RS485	RS485	No
Other Features/ Options	Dual Setpoint, Remote Setpoint, Analog Output	Motorized Valve Positioner, Analog Output, Remote Setpoint	Analog Output	No
Power Source	85 to 250 VAC 18 to 36 VDC 24 VAC	115/230 VAC	115/230 VAC	85 to 250 VAC 18 to 36 VDC 24 VAC
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*See website for product information.

† Field Installable Option Card

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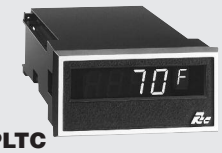
REPLACEMENT Guide

WHAT YOU'RE USING NOW		CURRENT PRODUCT	
MODEL NUMBER	**FEATURES**	**MODEL NUMBER**	**FEATURES**
 **APLTC**	■ Display: 4 Digit, .56" (14 mm) Red LED ■ Construction: Metal Front Bezel ■ Power Source: 115/230 VAC ■ Measurement: Thermocouple	 **PAXLTC**	■ Display: 4 Digit, .56" (14 mm) Red LED ■ Power Source: 85 to 250 VAC ■ Measurement: Thermocouple
 **IMR**	■ Display: 4 Digit, .56" (14 mm) Red LED ■ Construction: Metal Front Bezel ■ Power Source: 115/230 VAC ■ Measurement: RTD	 **PAXT**	■ Display: 6 Digit, .56" (14 mm) Red LED ■ Power Source: 85 to 250 VAC ■ Measurement: RTD ■ Requires Appropriate Option Card
 **IMT**	■ Display: 4 Digit, .56" (14 mm) Red LED ■ Construction: Metal Front Bezel ■ Power Source: 115/230 VAC ■ Measurement: Thermocouple	 **PAXT**	■ Display: 6 Digit, .56" (14 mm) Red LED ■ Power Source: 85 to 250 VAC ■ Measurement: Thermocouple ■ Requires Appropriate Option Card
 **CUB4TC**	■ Display: 5 Digit, .48" (12 mm) Reflective and Red Backlight LCD ■ Power Source: 9 to 26 VDC ■ Measurement: Thermocouple	 **CUB5TC**	■ Display: 5 Digit, .48" (12 mm) Reflective, Green and Red Backlight LCD ■ Power Source: 9 to 28 VDC ■ Measurement: Thermocouple
 **CUB4RT**	■ Display: 5 Digit, .48" (12 mm) Reflective and Red Backlight LCD ■ Power Source: 9 to 26 VDC ■ Measurement: RTD	 **CUB5RT**	■ Display: 5 Digit, .48" (12 mm) Reflective, Green and Red Backlight LCD ■ Power Source: 9 to 28 VDC ■ Measurement: RTD

Note: Refer to the current product literature, as some differences may exist.

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MODEL CUB5TC - MINIATURE ELECTRONIC 5-DIGIT THERMOCOUPLE METER

- *THERMOCOUPLE INPUTS*
  Thermocouple types T, E, J, K, R, S, B, N, or mV
- *PROGRAMMABLE TEMPERATURE OFFSET*
- *SELECTABLE °F or °C WITH 1 or 0.1 DEGREE RESOLUTION*
- *°F OR °C DISPLAY ANNUNCIATORS*
- *CONFORMS TO ITS-90 TEMPERATURE STANDARD*
- *COLD JUNCTION COMPENSATION (Enable/Disable)*
- *MINIMUM AND MAXIMUM DISPLAY CAPTURE*
- *LCD, REFLECTIVE OR GREEN/RED LED BACKLIGHTING*
- *0.48" (12.2 mm) HIGH DIGITS*
- *OPTIONAL SETPOINT OUTPUT CARD*
- *OPTIONAL SERIAL COMMUNICATION CARD (RS232 or RS485)*
- *OPTIONAL USB PROGRAMMING CARD*
- *OPERATES FROM 9 TO 28 VDC POWER SOURCE*
- *FRONT PANEL OR CRIMSON PROGRAMMABLE*
- *DISPLAY COLOR CHANGE CAPABILITY AT SETPOINT OUTPUT*
- *NEMA 4X/IP65 SEALED FRONT BEZEL*

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GENERAL DESCRIPTION

The CUB5 provides the user the ultimate in flexibility, from its complete user programming to the optional setpoint control and communication capability. The CUB5TC accepts a thermocouple input and provides a temperature display in Celcius or Farenheit. The meter also features minimum and maximum display capture, display offset, °F or °C indicator, and programmable user input. The display can be toggled either manually or automatically between the selected displays.

The CUB5 display has 0.48" (12.2 mm) high digits. The LCD is available in two versions, reflective and red/green backlight. The backlight version is user selectable for the desired color and also has variable display intensity.

The capability of the CUB5 can be easily expanded with the addition of option cards. Setpoint capability is field installable with the addition of the setpoint output cards. Serial communications capability for RS232 or RS485 is added with a serial option card.

The CUB5 can be powered from an optional Red Lion Micro-Line/Sensor Power Supply (MLPS), which attaches directly to the back of a CUB5. The MLPS is powered from 85 to 250 VAC and provides up to 400 mA to drive the unit and sensors.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in this literature or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Do not use this meter to directly command motors, valves, or other actuators not equipped with safeguards. To do so can be potentially harmful to persons or equipment in the event of a fault to the meter.

CAUTION: Risk of Danger.
Read complete instructions prior to installationand operation of the unit.

CAUTION: Risk of electric shock.

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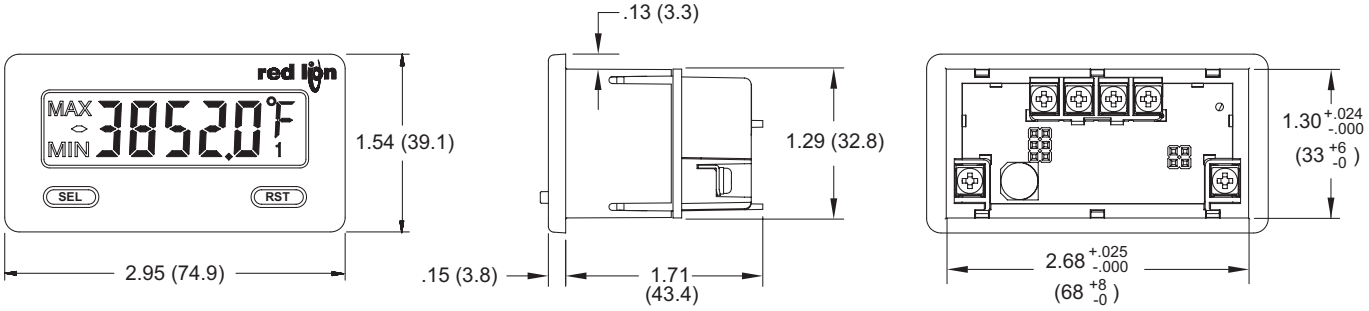
DIMENSIONS In inches (mm)

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 2.15" (54.6) H x 3.00" (76.2) W.



Ordering Information

TYPE	MODEL NO.	DESCRIPTION	PART NUMBER
CUB5	CUB5TC	Thermocouple Meter with Reflective Display	CUB5TCR0
		Thermocouple Meter with Backlight Display	CUB5TCB0
Optional Plug-in Cards	CUB5RLY	Single Relay Option Card	CUB5RLY0
	CUB5SNK	Dual Sinking Open Collector Output card	CUB5SNK0
	CUB5COM	RS485 Serial Communications Card	CUB5COM1
		RS232 Serial Communications Card	CUB5COM2
	CUB5USB	USB Programming Card	CUB5USB0
Accessories	MLPS	+12 VDC Micro-Line Power Supply, 85 to 250 VAC source, 400 mA max out	MLPS1000
		+24 VDC Micro-Line Power Supply, 85 to 250 VAC source, 200 mA max out	MLPS2000
	CBLPROG	Programming Cable RS232 (RJ11-DB9)	CBLPROG0
	CBPRO	Programming Cable RS485 (RJ11-DB9)	CBPRO007
	SFCRD	Crimson PC Configuration Software for Windows 98, ME, 2000, XP [1]	SFCRD200
	CBLUSB	USB Programming Cable	CBLUSB00

[1] Crimson software is a free download from http://www.redlion.net

General Meter Specifications

1. **DISPLAY**: 5 digit LCD 0.48" (12.2 mm) high digits
   CUB5TCR0: Reflective LCD with full viewing angle
   CUB5TCB0: Transmissive LCD with selectable red or green LED backlight, viewing angle optimized. Display color change capability with output state when using an output module.
2. **POWER**: Input voltage range is +9 to +28 VDC with short circuit and input polarity protection. Must use an RLC model MLPS or an NEC Class 2 or Limited Power Source (LPS) rated power supply.

MODEL NO.	DISPLAY COLOR	INPUT CURRENT @ 9 VDC WITHOUT CUB5RLY0	INPUT CURRENT @ 9 VDC WITH CUB5RLY0
CUB5TCR0	---	10 mA	40 mA
CUB5TCB0	Red (max intensity)	85 mA	115 mA
CUB5TCB0	Green (max intensity)	95 mA	125 mA

3. **READOUT**:
   Resolution: 1 or 0.1 degrees
   Scale: °F or °C
   Offset Range: -999 to 9999 display units
4. **THERMOCOUPLE INPUTS**:
   Isolation: TC+ and TC- terminals are not electrically isolated from the power supply or optional comms cards.
   Open Sensor Display: OPEN
   Overrange/Underrange Input: OLOL/ULUL
   Overrange/Underrange Display : "....."/"-....."
   Maximum Input Voltage: 30 VDC, TC+ to TC-
   Maximum Input Voltage TC-: 3 VDC max. with respect to common

TC TYPE	RANGE	ACCURACY @ 23°C ±°C	ACCURACY @ -35 to 75°C ±°C	WIRE COLOR	
				ANSI	BS 1843
T	-200 to 400°C -328 to 752°F	2.3	5.8	(+) blue (-) red	(+) white (-) blue
E	-200 to 871°C -328 to 1600°F	2.7	4.9	(+) purple (-) red	(+) brown (-) blue
J	-200 to 760°C -328 to 1400°F	1.9	4.3	(+) white (-) red	(+) yellow (-) blue
K	-200 to 1372°C -328 to 2502°F	2.3	5.8	(+) yellow (-) red	(+) brown (-) blue
R	-50 to 1768°C -58 to 3214°F	4.5	15.0	no standard	(+) white (-) blue
S	-50 to 1768°C -58 to 3214°F	4.5	15.0	no standard	(+) white (-) blue
B	200 to 1820°C 392 to 3308°F	9.1<540°C 4.5>540°C	42.6<540°C 15.0>540°C	no standard	no standard
N	-200 to 1300°C -328 to 2372°F	2.8	8.1	(+) orange (-) red	(+) orange (-) blue
mV	-10.00 to 65.00	0.02 mV	0.08 mV	no standard	no standard

*After 20 min. warm-up. Accuracy is specified in two ways: Accuracy at 23°C and 15 to 75% RH environment; and Accuracy over a -35 to 75°C and 0 to 85% RH (non condensing) environment. Accuracy specified over the -35 to 75°C operating range includes meter tempco and cold junction tracking effects. The specification includes the A/D conversion errors, linearization conformity, and thermocouple cold junction compensation. Total system accuracy is the sum of meter and probe errors. Accuracy may be improved by field calibrating the meter readout at the temperature of interest.

5. **RESPONSE TIME:**
   Display: 500 msec min.
   Output: 800 msec max (with input filter setting of 0)
6. **USER INPUT (USR):** Programmable input. Connect terminal to common (USR COMM) to activate function. Internal 10KΩ pull-up resistor to +9 to 28 VDC.
   Threshold Levels: V_{IL} = 0.7 V max; V_{IH} = 2.4 V min; V_{MAX} = 28 VDC
   Response Time: 5 msec typ.; 50 msec debounce (activation and release)
7. **CERTIFICATIONS AND COMPLIANCES**:
   CE Approved
   EN 61326-1 Immunity to Industrial Locations
   Emission CISPR 11 Class A
   IEC/EN 61010-1
   RoHS Compliant
   UL Recognized Component: File #E179259
   UL Listed: File #E137808
   Type 4X Outdoor Enclosure rating (Face only)
   IP65 Enclosure rating (Face only)
   IP20 Enclosure rating (Rear of unit)
   Refer to EMC Installation Guidelines for additional information.
8. **MEMORY**: Nonvolatile E^2PROM memory retains all programming parameters and max/min values when power is removed.
9. **CONNECTIONS**: Wire clamping screw terminals
   Wire Strip Length: 0.3" (7.5 mm)
   Wire Gage: 30-14 AWG copper wire
   Torque: 5 inch-lbs (0.565 N-m) max.
10. **ENVIRONMENTAL CONDITIONS**:
    Operating Temperature Range for CUB5TCR0: -35 to 75°C
    Operating Temperature Range for CUB5TCB0 depends on display color and intensity level as per below:

	INTENSITY LEVEL	TEMPERATURE
Red Display	1 & 2	-35 to 75°C
	3	-35 to 70°C
	4	-35 to 60°C
	5	-35 to 50°C
Green Display	1 & 2	-35 to 75°C
	3	-35 to 65°C
	4	-35 to 50°C
	5	-35 to 35°C

    Storage Temperature: -35 to 85°C
    Operating and Storage Humidity: 0 to 85% max. relative humidity (non-condensing)
    Vibration to IEC 68-2-6: Operational 5-500 Hz, 5 g
    Shock to IEC 68-2-27: Operational 30 g
    Altitude: Up to 2000 meters
11. **CONSTRUCTION**: This unit is rated for NEMA 4X/IP65 requirements for outdoor use. Installation Category I, Pollution Degree 2. High impact plastic case with clear viewing window. Panel gasket and mounting clip included.
12. **WEIGHT**: 3.2 oz (100 g)

Optional Plug-in Cards

ADDING OPTION CARDS

The CUB5 meters can be fitted with optional output cards and/or serial communications cards. The details for the plug-in cards can be reviewed in the specification section below. The plug-in cards, that are sold separately, can be installed initially or at a later date.

WARNING: Disconnect all power to the unit before installing Plug-in card.

SINGLE RELAY CARD

Type: Single FORM-C relay
Isolation To Sensor & User Input Commons: 1400 Vrms for 1 min.
Working Voltage: 150 Vrms
Contact Rating: 1 amp @ 30 VDC resistive; 0.3 amp @ 125 VAC resistive
Life Expectancy: 100,000 minimum operations

DUAL SINKING OUTPUT CARD

Type: Non-isolated switched DC, N Channel open drain MOSFET
Current Rating: 100 mA max.
$V_{DS\ ON}$: 0.7 V @ 100 mA
$V_{DS\ MAX}$: 30 VDC
Offstate Leakage Current: 0.5 mA max.

RS485 SERIAL COMMUNICATIONS CARD

Type: RS485 multi-point balanced interface (non-isolated)
Note: *Non-grounded (isolated) thermocouple probes must be used when multiple units are connected in an RS485 network, or measurement errors will occur.*
Baud Rate: 300 to 38.4k
Data Format: 7/8 bits; odd, even, or no parity
Bus Address: 0 to 99; max 32 meters per line
Transmit Delay: Selectable (refer to CUB5COM bulletin)

RS232 SERIAL COMMUNICATIONS CARD

Type: RS232 half duplex (non-isolated)
Baud Rate: 300 to 38.4k
Data Format: 7/8 bits; odd, even, or no parity

USB PROGRAMMING CARD

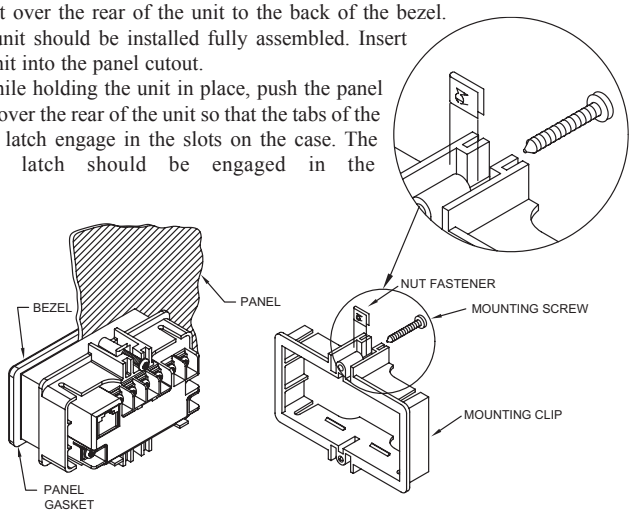
Type: USB virtual comms port
Connection: Type B
Baud Rate: 300 to 38.4k
Unit Address: 0 to 99

1.0 Installing the Meter

INSTALLATION

The meter meets NEMA 4X/IP65 requirements when properly installed. The unit is intended to be mounted into an enclosed panel. Prepare the panel cutout to the dimensions shown. Remove the panel latch from the unit. Slide the panel gasket over the rear of the unit to the back of the bezel. The unit should be installed fully assembled. Insert the unit into the panel cutout.

While holding the unit in place, push the panel latch over the rear of the unit so that the tabs of the panel latch engage in the slots on the case. The panel latch should be engaged in the farthest forward slot possible. To achieve a proper seal, tighten the latch screws evenly until the unit is snug in the panel (Torque to approx. 28 to 36 in-oz [0.202 to 0.26 N-m]). Do not over-tighten the screws.

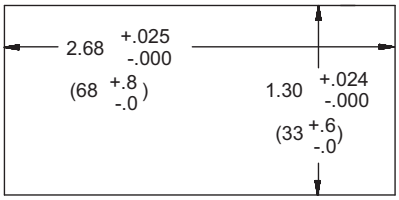


INSTALLATION ENVIRONMENT

The unit should be installed in a location that does not exceed the operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.

The bezel should only be cleaned with a soft cloth and neutral soap product. Do NOT use solvents. Continuous exposure to direct sunlight may accelerate the aging process of the bezel.

Do not use tools of any kind (screwdrivers, pens, pencils, etc.) to operate the keypad of the unit.



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2.0 Installing Plug-In Cards

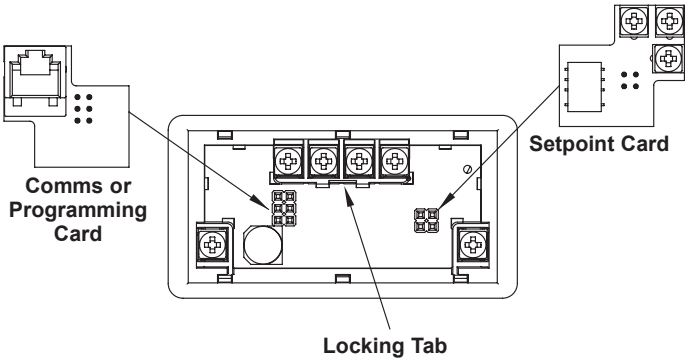
WARNING: Exposed line voltage exists on the circuit boards. Remove all power to the meter and load circuits before accessing inside of the meter.

CAUTION: The Plug-in cards and main circuit board contain static sensitive components. Before handling the cards, discharge static charges from your body by touching a grounded bare metal object. Ideally, handle the cards at a static controlled clean workstation. Also, only handle the cards by the edges. Dirt, oil or other contaminants that may contact the cards can adversely affect circuit operation.

REMOVING THE REAR COVER

To remove the rear cover, locate the cover locking tab below the 2nd and 3rd input terminals. To release the tab, insert a small, flat blade screwdriver between the tab and the plastic wall below the terminals. Inserting the screwdriver will provide enough pressure to release the tab locks. To replace the cover, align the cover with the input terminals and press down until the cover snaps into place.

The Plug-in cards are separately purchased option cards that perform specific functions. The cards plug into the main circuit board of the meter.



3.0 Wiring the Meter

WIRING OVERVIEW

Electrical connections are made via screw-clamp terminals located on the back of the meter. All conductors should conform to the meter's voltage and current ratings. All cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that the power supplied to the meter (DC or AC) be protected by a fuse or circuit breaker.

Strip the wire, leaving approximately 0.3" (7.5 mm) bare lead exposed (stranded wires should be tinned with solder.) Insert the lead under the correct screw-clamp terminal and tighten until the wire is secure. (Pull wire to verify tightness.) Each terminal can accept up to one #14 AWG (2.55 mm) wire, two #18 AWG (1.02 mm), or four #20 AWG (0.61 mm).

EMC INSTALLATION GUIDELINES

Although Red Lion Controls Products are designed with a high degree of immunity to Electromagnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, source or coupling method into a unit may be different for various installations. Cable length, routing, and shield termination are very important and can mean the difference between a successful or troublesome installation. Listed are some EMI guidelines for a successful installation in an industrial environment.

1. A unit should be mounted in a metal enclosure, which is properly connected to protective earth.
2. Use shielded cables for all Signal and Control inputs. The shield connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield to earth ground (protective earth) at one end where the unit is mounted.
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is over 1 MHz.
3. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors, feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be run through metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter. Also, Signal or Control cables within an enclosure should be routed as far away as possible from contactors, control relays, transformers, and other noisy components.
4. Long cable runs are more susceptible to EMI pickup than short cable runs.
5. In extremely high EMI environments, the use of external EMI suppression devices such as Ferrite Suppression Cores for signal and control cables is effective. The following EMI suppression devices (or equivalent) are recommended:
   Fair-Rite part number 0443167251 (RLC part number FCOR0000)
   Line Filters for input power cables:
   Schaffner # FN2010-1/07 (RLC part number LFIL0000)
6. To protect relay contacts that control inductive loads and to minimize radiated and conducted noise (EMI), some type of contact protection network is normally installed across the load, the contacts or both. The most effective location is across the load.
   a. Using a snubber, which is a resistor-capacitor (RC) network or metal oxide varistor (MOV) across an AC inductive load is very effective at reducing EMI and increasing relay contact life.
   b. If a DC inductive load (such as a DC relay coil) is controlled by a transistor switch, care must be taken not to exceed the breakdown voltage of the transistor when the load is switched. One of the most effective ways is to place a diode across the inductive load. Most RLC products with solid state outputs have internal zener diode protection. However external diode protection at the load is always a good design practice to limit EMI. Although the use of a snubber or varistor could be used.
   RLC part numbers: Snubber: SNUB0000
   Varistor: ILS11500 or ILS23000
7. Care should be taken when connecting input and output devices to the instrument. When a separate input and output common is provided, they should not be mixed. Therefore a sensor common should NOT be connected to an output common. This would cause EMI on the sensitive input common, which could affect the instrument's operation.

Visit RLC's web site at http://www.redlion.net/Support/InstallationConsiderations.html for more information on EMI guidelines, Safety and CE issues as they relate to Red Lion Controls products.

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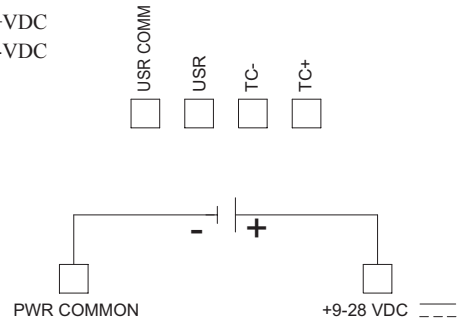
3.1 POWER WIRING

DC Power

+9 to +28 VDC: +VDC
Power Common: -VDC

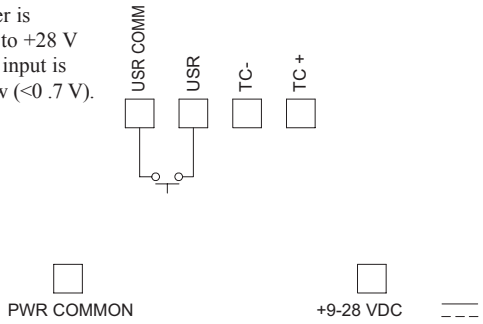


3.2 USER INPUT WIRING

Sinking Logic

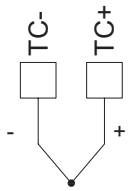
USR COMM } Connect external switching device between the
USR } User Input terminal and User Input Common.

The user input of the meter is internally pulled up to +9 to +28 V with 10 K resistance. The input is active when it is pulled low (<0 .7 V).



3.3 INPUT WIRING

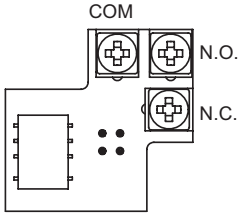
Thermocouple



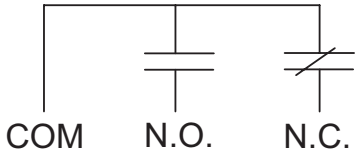
***CAUTION**: Power input common and sensor input common are NOT isolated from user input common. In order to preserve the safety of the meter application, the power input common and the sensor input common must be suitably isolated from hazardous live earth referenced voltages; or input common must be at protective earth ground potential. If not, hazardous live voltage may be present at the User Inputs and User Input Common terminals. Appropriate considerations must then be given to the potential of the user input common with respect to earth common; and the common of the isolated plug-in cards with respect to input common.*

3.4 SETPOINT (OUTPUT) WIRING

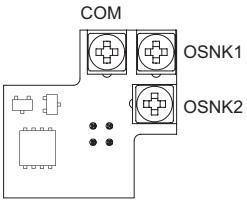
SINGLE SETPOINT RELAY PLUG-IN CARD



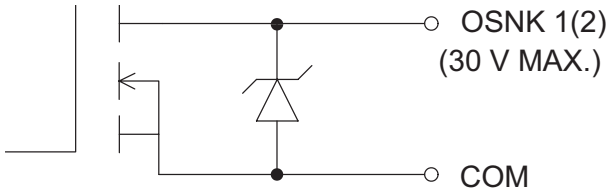
ELECTRICAL CONNECTIONS



DUAL SETPOINT N-FET OPEN DRAIN PLUG-IN CARD



ELECTRICAL CONNECTIONS



Output Common is not isolated from DC Power Common. Load must be wired between OSNK terminal and V+ of the load supply.

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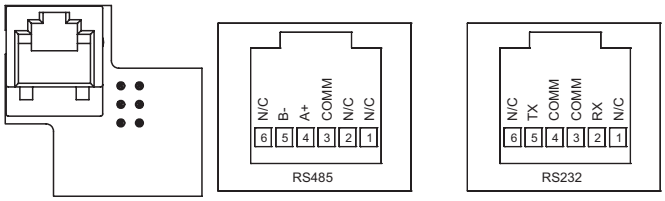
3.5 SERIAL COMMUNICATION WIRING

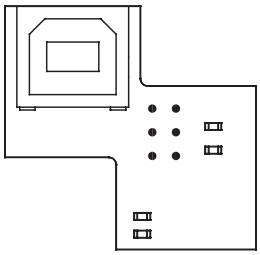
SERIAL COMMUNICATIONS PLUG-IN CARD



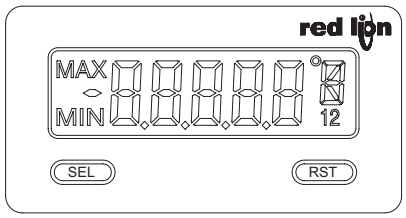
RJ11 CONNECTOR PIN OUTS

3.6 USB PROGRAMMING

USB PROGRAMING PLUG-IN CARD



4.0 Reviewing the Front Buttons and Display



BUTTON	DISPLAY MODE OPERATION	ENTERING PROGRAM MODE	PROGRAMMING MODE OPERATION
SEL	Index display through enabled values	Press and hold for 2 seconds to activate	Store selected parameter and index to next parameter
RST	Resets values (MIN / MAX) or outputs		Advances through the program menu Increments selected parameter value or selection

OPERATING MODE DISPLAY DESIGNATORS

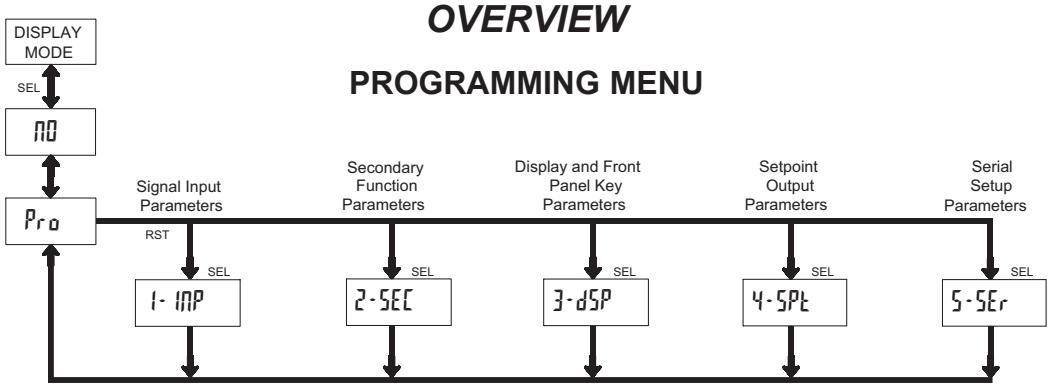
MAX - Maximum display capture value
MIN - Minimum display capture value
"1" - To the right of the display indicates setpoint 1 output activated.
"2" - To the right of the display indicates setpoint 2 output activated.

Pressing the **SEL** button toggles the meter through the selected displays. If display scroll is enabled, the display will toggle automatically every four seconds between the enabled display values.

5.0 Programming the Meter

OVERVIEW

PROGRAMMING MENU



PROGRAMMING MODE ENTRY (SEL BUTTON)

It is recommended that all programming changes be made off line, or before installation. The meter normally operates in the Display Mode. No parameters can be programmed in this mode. The Programming Mode is entered by pressing and holding the **SEL** button. If it is not accessible then it is locked by either a security code, or a hardware lock.

MODULE ENTRY (SEL & RST BUTTONS)

The Programming Menu is organized into separate modules. These modules group together parameters that are related in function. The display will alternate between Pro and the present module. The **RST** button is used to select the desired module. The displayed module is entered by pressing the **SEL** button.

MODULE MENU (SEL BUTTON)

Each module has a separate module menu (which is shown at the start of each module discussion). The **SEL** button is pressed to advance to a particular parameter to be changed, without changing the programming of preceding parameters. After completing a module, the display will return to Pro nO. Programming may continue by accessing additional modules.

SELECTION / VALUE ENTRY

For each parameter, the display alternates between the present parameter and the selections/value for that parameter. The **RST** button is used to move through the selections/values for that parameter. Pressing the **SEL** button, stores and activates the displayed selection/value. This also advances the meter to the next parameter.

For numeric values, press the **RST** button to access the value. The right hand most digit will begin to flash. Pressing the **RST** button again increments the digit by one or the user can hold the **RST** button and the digit will automatically scroll. The **SEL** button will advance to the next digit. Pressing and holding the **SEL** button will enter the value and move to the next parameter.

PROGRAMMING MODE EXIT (SEL BUTTON)

The Programming Mode is exited by pressing the **SEL** button with Pro nO displayed. This will commit any stored parameter changes to memory and return the meter to the Display Mode. (If power loss occurs before returning to the Display Mode, verify recent parameter changes.)

PROGRAMMING TIPS

It is recommended to start with Module 1 and proceed through each module in sequence. When programming is complete, it is recommended to record the parameter programming and lock out parameter programming with the user input or programming security code.

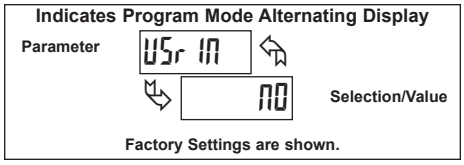
FACTORY SETTINGS

Factory Settings may be completely restored in Module 2. This is useful when encountering programming problems.

Pressing both the **SEL** and the **RST** button on power-up will also load the factory settings and display rESEt. This allows operation in the event of a memory failure or corrupted data.

ALTERNATING SELECTION DISPLAY

In the explanation of the modules, the following dual display with arrows will appear. This is used to illustrate the display alternating between the parameter on top and the parameter's Factory Setting on the bottom. In most cases, selections and values for the parameter will be listed on the right.



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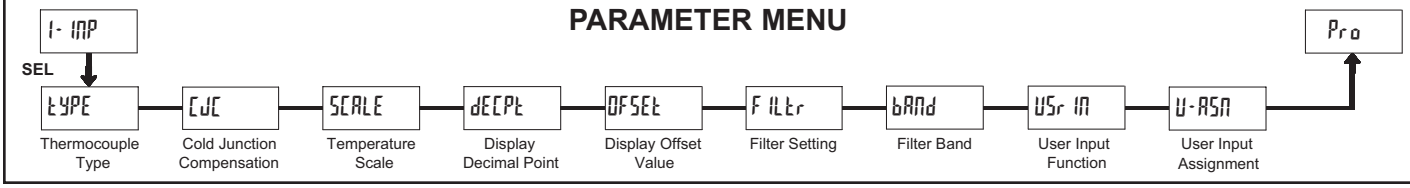
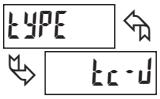
5.1 MODULE 1 - SIGNAL INPUT PARAMETERS (1-INP)

PARAMETER MENU



THERMOCOUPLE TYPE

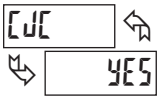


SELECTION	TC TYPE	SELECTION	TC TYPE
tc-t	T	tc-S	S
tc-E	E	tc-b	B
tc-J	J	tc-n	N
tc-K	K	VOLt	
tc-r	R		

Select the thermocouple type used for the application. The appropriate curve will be automatically loaded for the selected type.

Selecting VOLt displays the millivolt input signal with 10 µV resolution.

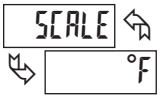
COLD JUNCTION COMPENSATION



YES NO

This parameter enables or disables internal cold junction compensation. For most applications, cold junction compensation should be enabled (YES). This parameter does not appear if tYPE = VOLt.

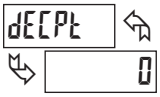
TEMPERATURE SCALE



°F °C

Select the temperature scale. This selection applies for the Input, MAX and MIN displays. This parameter does not appear if tYPE = VOLt.

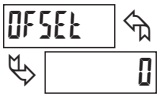
DISPLAY DECIMAL POINT



0 0.0

Select the decimal point location for the desired display resolution. This selection applies for the Input, MAX and MIN displays. This parameter does not appear if tYPE = VOLt or for types R, S or B thermocouples which have a fixed 1 degree resolution.

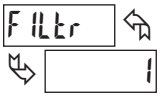
DISPLAY OFFSET VALUE



-999 to 9999

The temperature display can be corrected with an offset value. This can be used to compensate for probe errors, errors due to variances in probe placement or adjusting the readout to a reference thermometer.

FILTER SETTING

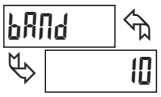


0 1 2 3

If the displayed temperature is difficult to read due to small process variations or noise, increased levels of filtering will help to stabilize the display. Software filtering effectively combines a fraction of the current input reading with a fraction of the previous displayed reading to generate the new display.

Filter values represent no filtering (0), up to heavy filtering (3). A value of 1 for the filter uses 1/4 of the new input and 3/4 of the previous display to generate the new display. A filter value of 2 uses 1/8 new and 7/8 previous. A filter value of 3 uses 1/16 new and 15/16 previous.

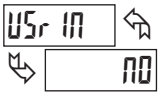
FILTER BAND



00 to 199 display units

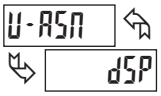
The filter will adapt to variations in the input signal. When the variation exceeds the input filter band value, the filter disengages. When the variation becomes less than the band value, the filter engages again. This allows for a stable readout, but permits the display to settle rapidly after a large process change. The value of the band is in display units, independent of the Display Decimal Point position. A band setting of '0' keeps the filter permanently engaged at the filter level selected above.

USER INPUT FUNCTION



DISPLAY	MODE	DESCRIPTION
NO	No Function	User Input disabled.
P-Loc	Program Mode Lock-out	See Programming Mode Access chart (Module 3).
rESEt	Reset (Edge triggered)	Resets the assigned value(s) to the current input value.
d-HLd	Display Hold	Holds the assigned display, but all other meter functions continue as long as activated (maintained action).
d-SEL	Display Select (Edge Triggered)	Advance once for each activation.
d-LEU	Display Intensity Level (Edge Triggered)	Increase intensity one level for each activation (backlight version only).
COLOr	Backlight Color (Edge Triggered)	Change backlight color with each activation (backlight version only).
Print	Print Request	Serial transmit of the active parameters selected in the Print Options menu (Module 5).
P-rSt	Print and Reset	Same as Print Request followed by a momentary reset of the assigned value(s).
rSt-1	Setpoint 1 Reset	Resets setpoint 1 output.
rSt-2	Setpoint 2 Reset	Resets setpoint 2 output.
rSt 12	Setpoint 1 and 2 Reset	Reset both setpoint 1 and 2 outputs.

USER INPUT ASSIGNMENT



HI HI-LO

LO dSP

Select the value(s) to which the User Input Function is assigned. The User Input Assignment only applies if a selection of reset, display hold, or print and reset is selected in the User Input Function menu.

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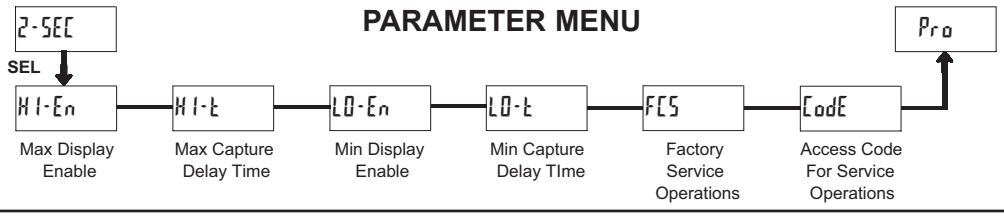
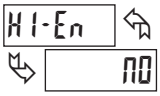
5.2 MODULE 2 - SECONDARY FUNCTION PARAMETERS (2-SEC)



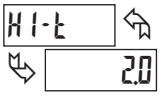
MAX DISPLAY ENABLE



NO YES

Enables the Maximum Display Capture capability.

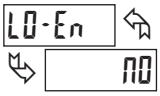
MAX CAPTURE DELAY TIME



0.0 to 9999 seconds

When the Input Display is above the present MAX value for the entered delay time, the meter will capture that display value as the new MAX reading. A delay time helps to avoid false captures of sudden short spikes.

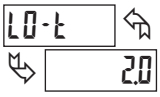
MIN DISPLAY ENABLE



NO YES

Enables the Minimum Display Capture capability.

MIN CAPTURE DELAY TIME



0.0 to 9999 seconds

When the Input Display is below the present MIN value for the entered delay time, the meter will capture that display value as the new MIN reading. A delay time helps to avoid false captures of sudden short spikes.

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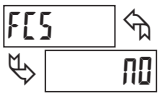
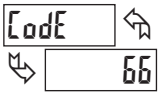
FACTORY SERVICE OPERATIONS



NO YES

Select YES to perform either of the Factory Service Operations shown below.

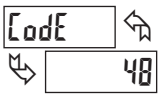
RESTORE FACTORY DEFAULT SETTINGS



Entering Code 66 will overwrite all user settings with the factory settings. The meter will display rESEt and then return to CodE 00. Press **SEL** button to exit the module.

Pressing both the **SEL** and the **RST** button on power-up will also load the factory settings and display rESEt. This allows operation in the event of a memory failure or corruted data.

CALIBRATION



The CUB5TC uses stored voltage calibration and cold junction temperature values to provide accurate temperature and voltage measurements. Over time, the electrical characteristics of the components inside the meter could slowly change. The result is that the stored calibration values may no longer accurately define the input circuit. For most applications, recalibration every 1 to 2 years should be sufficient.

Calibration of the CUB5TC involves a voltage calibration and a cold junction calibration. It is recommended that both calibrations be performed. The voltage calibration MUST precede the cold junction calibration. Allow 30 minute warm up before performing any calibration related procedure. The following procedures should be performed at an ambient temperature of 15 to 35 °C (59 to 95 °F).

Calibration should only be performed by individuals experienced in calibrating electronic equipment.

***CAUTION**: The accuracy of the calibration equipment will directly affect the accuracy of the CUB5TC.*

Input Voltage Calibration

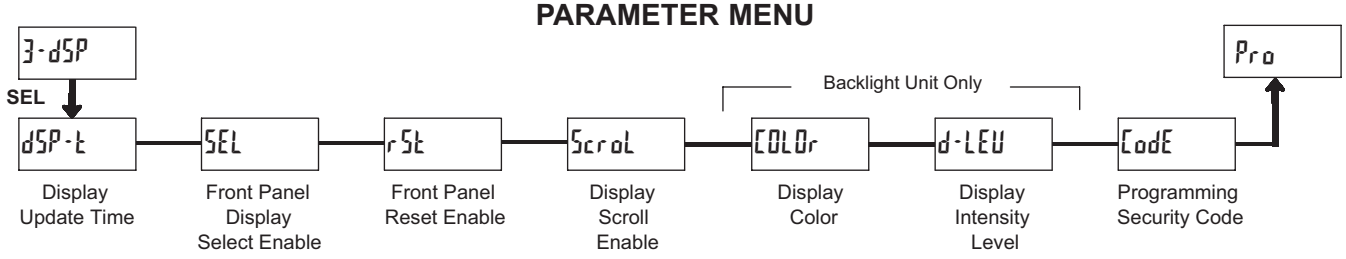
1. Connect a precision DC voltage source with an accuracy of 0.01% or better to the TC+ (positive) and the TC- (negative) terminals of the CUB5TC. Set the output of the voltage source to zero.
2. With the display at CodE 48, press and hold the SEL button for 2 seconds. Unit will display CAL AD.
3. Press the RST button to select InP.
4. Press the SEL button. Display reads 0.0u.
5. With the voltage source set to zero, press SEL. Display reads CALC for about eight seconds.
6. When display reads 60.0u, apply 60.000 mV input signal. Press SEL. Display reads CALC for about eight seconds.
7. When display reads CAL AD, press SEL twice to exit Module 2 and return to the normal display mode.
8. Proceed to Cold Junction Calibration.

Cold Junction Calibration

1. **Install all option cards needed for your application and the rear cover, or invalid results will occur.**
2. The ambient temperature must be within 20°C to 30°C.
3. Connect a thermocouple (types T, E, J, K, or N only) with an accuracy of 1°C or better to the meter.
4. Enter programming mode and verify the following settings in Module 1:
   tYPE = thermocouple type connected to the unit
   CJC = YES; SCALE = °C; dECPt = 0.0; OFSEt = 0
5. Place the thermocouple in close thermal contact to a reference thermometer probe. (Use a reference thermometer with an accuracy of 0.25°C or better.) The two probes should be shielded from air movement and allowed sufficient time to equalize in temperature. (A calibration bath of known temperature could be used in place of the thermometer.)
6. Compare the unit display with the reference temperature indicator (or calibration bath). If a difference of more than ±1.0 °C exists, note the difference (CJ error) and continue with cold junction calibration.
   CJ Error = Reference Temperature - Unit Display.
7. Enter programming mode. Step through Module 2 to the Service Access Code parameter and select CodE 48. Press and hold the SEL button until the unit displays CAL AD. Press the RST button to select CJC.
8. Press SEL. Display reads CJC followed by the current cold junction value. Calculate a new cold junction value as follows:
   New cold junction = Current cold junction + CJ Error (noted above)
9. Press RST and set the display to the new cold junction value. Press and hold SEL. Display reads CALC for about four seconds and then returns to CAL AD.
10. Press SEL twice to exit calibration and return to the normal display mode. Verify the input reading is correct. If not, repeat steps 6 through 10.

5.3 MODULE 3 - DISPLAY AND FRONT PANEL BUTTON PARAMETERS (3-dSP)

PARAMETER MENU



DISPLAY UPDATE TIME

dSP-t → 1 | 0.5 | 1 | 2 | seconds

This parameter sets the display update time in seconds.

FRONT PANEL DISPLAY SELECT ENABLE (SEL)

SEL → YES | YES | NO

The YES selection allows the **SEL** button to toggle through the enabled displays.

FRONT PANEL RESET ENABLE (RST)

rSt → dSP | NO | LO | dSP | HI | HI-LO

This selection allows the **RST** button to reset the selected value(s).

DISPLAY SCROLL ENABLE

ScroL → NO | YES | NO

The YES selection allows the display to automatically scroll through the enabled displays. The scroll rate is every 4 seconds.

DISPLAY COLOR (BACKLIGHT UNIT ONLY)

COLOr → rEd | rEd | Grn

Enter the desired display color, red or green. This parameter is active for backlight units only.

DISPLAY INTENSITY LEVEL (BACKLIGHT UNIT ONLY)

d-LEU → 5 | 1 to 5

Enter the desired Display Intensity Level (1-5). The display will actively dim or brighten as levels are changed. This parameter is active for backlight units only.

PROGRAMMING SECURITY CODE

CodE → 000 | 000 to 999

The Security Code determines the programming mode and the accessibility of programming parameters. This code can be used along with the Program Mode Lock-out (P-Loc) in the User Input Function parameter (Module 1).

Two programming modes are available. Full Programming mode allows all parameters to be viewed and modified. Quick Programming mode permits only the Setpoint values to be modified, but allows direct access to these values without having to enter Full Programming mode.

Programming a Security Code other than 0, requires this code to be entered at the CodE prompt in order to access Full Programming mode. Depending on the code value, Quick Programming may be accessible before the CodE prompt appears (see chart).

USER INPUT FUNCTION	USER INPUT STATE	SECURITY CODE	MODE WHEN "SEL" BUTTON IS PRESSED	FULL PROGRAMMING MODE ACCESS
not P-Loc	_____	0	Full Programming	Immediate Access
		1-99	Quick Programming	After Quick Programming with correct code entry at CodE prompt *
		100-999	CodE prompt	With correct code entry at CodE prompt *
P-Loc	Active	0	Programming Lock	No Access
		1-99	Quick Programming	No Access
		100-999	CodE prompt	With correct code entry at CodE prompt *
	Not Active	0-999	Full Programming	Immediate Access

** Entering Code 222 allows access regardless of security code.*

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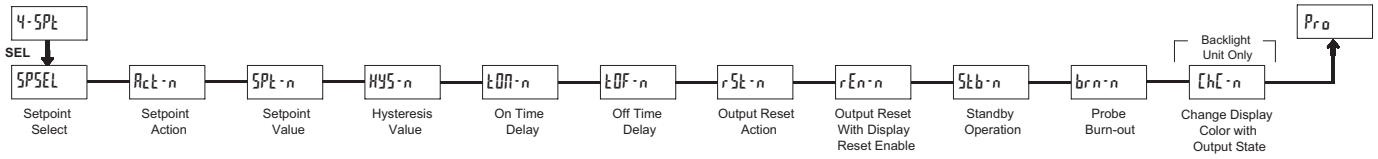
5.4 MODULE 4 - SETPOINT OUTPUT PARAMETERS (4-SPt)

PARAMETER MENU



The Setpoint Output Parameters are only active when an optional output module is installed in the meter.

SETPOINT SELECT

SPSEL NO SP-1 SP-2

NO

Enter the setpoint (output) to be programmed. The n in the following parameters will reflect the chosen setpoint number. After the chosen setpoint is completely programmed, the display will return to SPSEL. Repeat steps for each setpoint to be programmed. Select NO to exit the module. The number of setpoints available is setpoint output card dependent.

SETPOINT 2 ENABLE

Enb-2 YES NO

NO

Select YES to enable Setpoint 2 and access the setup parameters. If NO is selected, the unit returns to SPSEL and setpoint 2 is disabled.

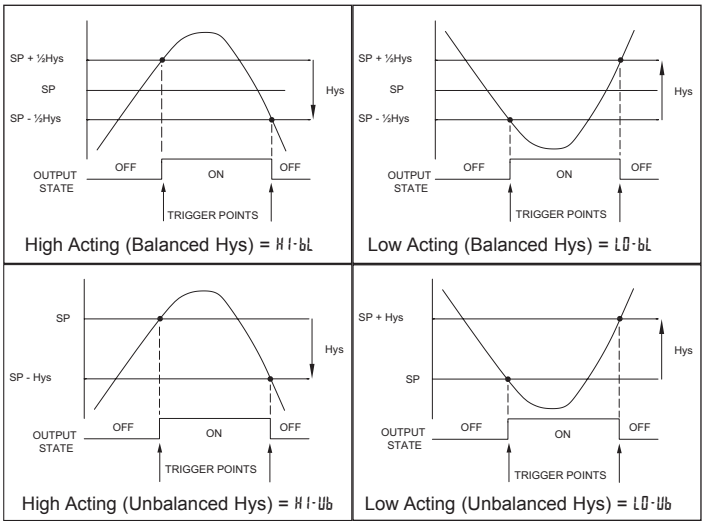
SETPOINT ACTION

Act-n HI-bL LO-bL HI-Ub LO-Ub

HI-Ub

Enter the action for the selected setpoint (output). See Setpoint Output Figures for a visual detail of each action.

HI-bL = High Acting, with balanced hysteresis
LO-bL = Low Acting, with balanced hysteresis
HI-Ub = High Acting, with unbalanced hysteresis
LO-Ub = Low Acting, with unbalanced hysteresis



SETPOINT VALUE

SPt-n -9999 to 99999

100

Enter the desired setpoint value. The decimal point position for the setpoint and hysteresis values follow the selection set in Module 1.

HYSTERESIS VALUE

HYS-n 1 to 59999

2

Enter desired hysteresis value. See Setpoint Output Figures for visual explanation of how setpoint output actions (balanced and unbalanced) are affected by the hysteresis. When the setpoint is a control output, usually balanced hysteresis is used. For alarm applications, usually unbalanced hysteresis is used. For unbalanced hysteresis modes, the hysteresis functions on the low side for high acting setpoints and functions on the high side for low acting setpoints.

Note: Hysteresis eliminates output chatter at the switch point, while time delay can be used to prevent false triggering during process transient events.

ON TIME DELAY

tON-n 0.0 to 599.9 seconds

0.0

Enter the time value in seconds that the output is delayed from turning on after the trigger point is reached. A value of 0.0 allows the meter to update the output status per the response time listed in the Specifications.

OFF TIME DELAY

tOF-n 0.0 to 599.9 seconds

0.0

Enter the time value in seconds that the output is delayed from turning off after the trigger point is reached. A value of 0.0 allows the meter to update the output status per the response time listed in the Specifications.

OUTPUT RESET ACTION

rSt-n Auto LAtCH L-dLY

Auto

Enter the reset action of the output. See figure for details.

Auto = Automatic action; This action allows the output to automatically reset off at the trigger points per the Setpoint Action shown in Setpoint Output Figures. The "on" output may be manually reset (off) immediately by the front panel **RST** button or user input.The output remains off until the trigger point is crossed again.

LAtCH = Latch with immediate reset action; This action latches the output on at the trigger point per the Setpoint Action shown in Setpoint Output Figures. Latch means that the output can only be turned off by the front panel **RST** button or user input manual reset, serial reset command or meter power cycle.

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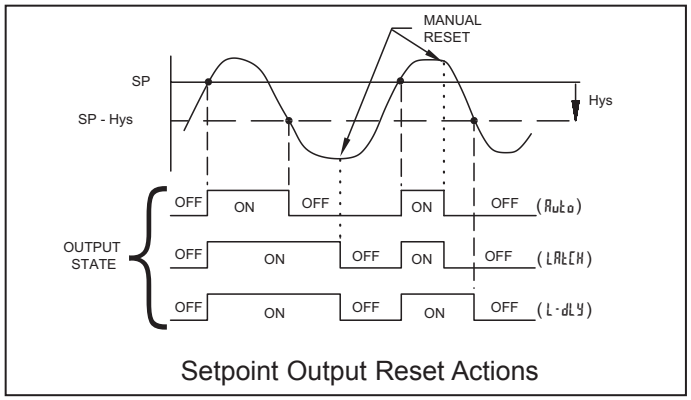
When the user input or **RST** button is activated (momentary action), the corresponding "on" output is reset immediately and remains off until the trigger point is crossed again. (Previously latched alarms will be off if power up Display Value is lower than setpoint value.)

L-dLY = Latch with delay reset action; This action latches the output on at the trigger point per the Setpoint Action shown in Setpoint Output Figures. Latch means that the output can only be turned off by the front panel **RST** button or user input manual reset, serial reset command or meter power cycle. When the user input or **RST** button is activated (momentary action), the meter delays the event until the corresponding "on" output crosses the trigger off point. (Previously latched outputs are off if power up Display Value is lower than setpoint value. During a power cycle, the meter erases a previous L-dLY reset if it is not activated at power up.)



Setpoint Output Reset Actions

OUTPUT RESET WITH DISPLAY RESET

rEn-n NO YES

YES

This parameter enables the **RST** button or user input to reset the output when the display is reset.

Note: For this parameter to operate, the **RST** button or User Input being used must be set to dSP and the Input value must be displayed. If these conditions are not met, the output will not reset.

STANDBY OPERATION

Stb-n NO YES

NO

When YES, the output is disabled (after a power up) until the trigger point is crossed. Once the output is on, the output operates normally per the Setpoint Action and OutputReset Action.

PROBE BURN-OUT ACTION

brn-n OFF ON

OFF

Enter the probe burn-out action. In the event of a temperature probe failure (open), the output can be programmed to be on or off.

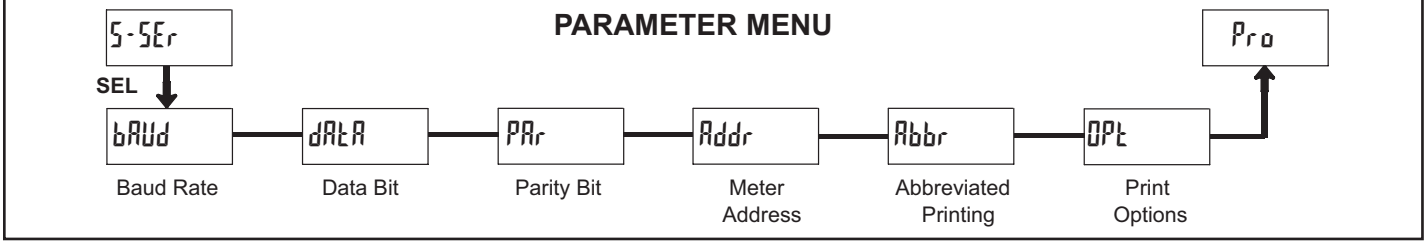
CHANGE DISPLAY COLOR w/OUTPUT STATE

ChC-n NO YES

NO

This parameter enables the backlight CUB5 to switch the backlight color when the output state changes. This parameter is only active for the backlight version.

5.5 MODULE 5 - SERIAL SETUP PARAMETERS (5-SEr)



The Serial Setup Parameters are only active when one of the optional serial communications/programming cards is installed in the meter.
Refer to the CUB5COM bulletin for details and setup for the CUB5 RS232 or RS485 serial communications.
Refer to the CUB5USB bulletin for details on the CUB5 USB programming and programming requirements.

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MODEL CUB5RT - MINIATURE ELECTRONIC 5-DIGIT RTD METER

- *MINIMUM AND MAXIMUM DISPLAY CAPTURE*
- *LCD, REFLECTIVE OR GREEN/RED LED BACKLIGHTING*
- *0.48" (12.2 mm) HIGH DIGITS*
- *OPTIONAL SETPOINT OUTPUT CARD*
- *OPTIONAL SERIAL COMMUNICATION CARD (RS232 or RS485)*
- *OPTIONAL USB PROGRAMMING CARD*
- *OPERATES FROM 9 TO 28 VDC POWER SOURCE*
- *FRONT PANEL OR CRIMSON PROGRAMMABLE*
- *DISPLAY COLOR CHANGE CAPABILITY AT SETPOINT OUTPUT*
- *NEMA 4X/IP65 SEALED FRONT BEZEL*

- *RTD INPUTS*
  RTD types Pt385, Pt392, Ni672, Cu427
- *PROGRAMMABLE TEMPERATURE OFFSET*
- *SELECTABLE °F or °C WITH 1 or 0.1 DEGREE RESOLUTION*
- *°F OR °C DISPLAY ANNUNCIATORS*

c UL US LISTED
IND. CONT. EQ.
51EB

GENERAL DESCRIPTION

The CUB5 provides the user the ultimate in flexibility, from its complete user programming to the optional setpoint control and communication capability. The CUB5RT accepts an RTD input and provides a temperature display in Celcius or Farenheit. The meter also features minimum and maximum display capture, display offset, °F or °C indicator, and programmable user input. The display can be toggled either manually or automatically between the selected displays.

The CUB5 display has 0.48" (12.2 mm) high digits. The LCD is available in two versions, reflective and red/green backlight. The backlight version is user selectable for the desired color and also has variable display intensity.

The capability of the CUB5 can be easily expanded with the addition of option cards. Setpoint capability is field installable with the addition of the setpoint output cards. Serial communications capability for RS232 or RS485 is added with a serial option card.

The CUB5 can be powered from an optional Red Lion Micro-Line/Sensor Power Supply (MLPS), which attaches directly to the back of a CUB5. The MLPS is powered from 85 to 250 VAC and provides up to 400 mA to drive the unit and sensors.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in this literature or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Do not use this meter to directly command motors, valves, or other actuators not equipped with safeguards. To do so can be potentially harmful to persons or equipment in the event of a fault to the meter.

CAUTION: Risk of Danger.
Read complete instructions prior to installationand operation of the unit.

CAUTION: Risk of electric shock.

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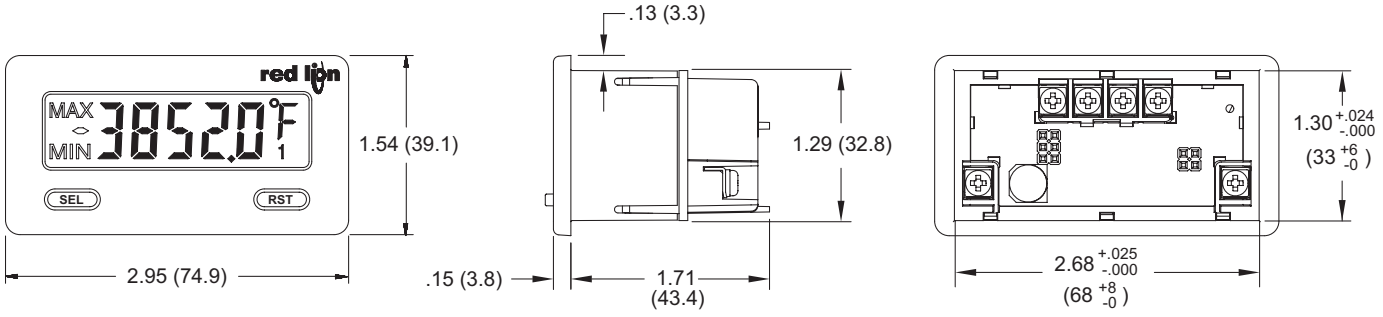
DIMENSIONS In inches (mm)

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 2.15" (54.6) H x 3.00" (76.2) W.



Ordering Information

TYPE	MODEL NO.	DESCRIPTION	PART NUMBER
CUB5	CUB5RT	RTD Meter with Reflective Display	CUB5RTR0
		RTD Meter with Backlight Display	CUB5RTB0
Optional Plug-in Cards	CUB5RLY	Single Relay Output Card	CUB5RLY0
	CUB5SNK	Dual Sinking Output Card	CUB5SNK0
	CUB5COM	RS485 Serial Communications Card	CUB5COM1
		RS232 Serial Communications Card	CUB5COM2
	CUB5USB	USB Programming Card	CUB5USB0
Accessories	MLPS	+12 VDC Micro-Line Power Supply, 85 to 250 VAC source, 400 mA max out	MLPS1000
		+24 VDC Micro-Line Power Supply, 85 to 250 VAC source, 200 mA max out	MLPS2000
	CBLPROG	RS232 Programming Cable (DB9-RJ11)	CBLPROG0
	CBPRO	Crimson PC Configuration Software for Windows 98, ME, 2000, XP [1]	SFCRD200
	CBLUSB	USB Programming Cable	CBLUSB00

[1] Crimson software is a free download from http://www.redlion.net/

General Meter Specifications

1. **DISPLAY**: 5 digit LCD 0.48" (12.2 mm) high digits
   CUB5RTR0: Reflective LCD with full viewing angle
   CUB5RTB0: Transmissive LCD with selectable red or green LED backlight, viewing angle optimized. Display color change capability with output state when using an output module.
2. **POWER**: Input voltage range is +9 to +28 VDC with short circuit and input polarity protection. Must use an RLC model MLPS or a NEC Class 2 or Limited Power Source (LPS) rated power supply.

MODEL NO.	DISPLAY COLOR	INPUT CURRENT @ 9 VDC WITHOUT CUB5RLY0	INPUT CURRENT @ 9 VDC WITH CUB5RLY0
CUB5RTR0	---	10 mA	40 mA
CUB5RTB0	Red (max intensity)	85 mA	115 mA
CUB5RTB0	Green (max intensity)	95 mA	125 mA

3. **READOUT**:
   Resolution: 1 or 0.1 degrees
   Scale: °F or °C
   Offset Range: -19999 to 19999 display units
4. **RTD INPUTS**:
   Isolation: Input and EXC terminals are not electrically isolated from the power supply or optional comms cards.
   Failed Sensor Display: OPEN or Short
   Overrange/Underrange Input: OLOL/ULUL
   Overrange/Underrange Display : "....."/"-....."
   Maximum Input Voltage: 30 VDC
   Type: 2, 3 or 4 wire
   Excitation current: 100 ohm range: 165 µA
   10 ohm range: 2.5 mA
   Lead resistance: 100 ohm range: 10 ohm/lead max.
   10 ohm range: 3 ohms/lead max.
   Balanced Lead Resistance: Automatically compensated up to max per lead.
   Unbalanced Lead Resistance: Uncompensated.

INPUT TYPE	RANGE	ACCURACY* (18 to 28°C)	ACCURACY* (0 to 50°C)	STANDARD
100 ohm Pt alpha = .00385	-200 to 850°C	0.4°C	1.6°C	IEC 751
100 ohm Pt alpha = .00392	-200 to 850°C	0.4°C	1.6°C	no official standard
120 ohm Nickel alpha = .00672	-80 to 260°C	0.2°C	0.5°C	no official standard
10 ohm Copper alpha = .00427	-100 to 260°C	0.4°C	0.9°C	no official standard

*After 20 min. warm-up. Accuracy is specified in two ways: Accuracy at 23°C and 15 to 75% RH environment; and Accuracy over a -35 to 75°C and 0 to 85% RH (non condensing) environment. Accuracy specified over the -35 to 75°C operating range includes meter tempco effects. The specification includes the A/D conversion errors and linearization conformity. Total system accuracy is the sum of meter and probe errors. Accuracy may be improved by field calibrating the meter readout at the temperature of interest.

5. **RESPONSE TIME**:
   Display: 500 msec min.
   Output: 1.25 sec max (with input filter setting of 0)
6. **USER INPUT (USR):** Programmable input. Connect terminal to common (USR COMM) to activate function. Internal 10KΩ pull-up resistor to +9 to 28 VDC.
   Threshold Levels: V_{IL} = 0.7 V max; V_{IH} = 2.4 V min; V_{MAX} = 28 VDC
   Response Time: 5 msec typ.; 50 msec debounce (activation and release)
7. **CERTIFICATIONS AND COMPLIANCES**:
   CE Approved
   EN 61326-1 Immunity to Industrial Locations
   Emission CISPR 11 Class A
   IEC/EN 61010-1
   RoHS Compliant
   UL Recognized Component: File #E179259
   UL Listed: File #E137808
   Type 4X Outdoor Enclosure rating (Face only)
   IP65 Enclosure rating (Face only)
   IP20 Enclosure rating (Rear of unit)
   Refer to EMC Installation Guidelines for additional information.
8. **MEMORY**: Nonvolatile E^2PROM memory retains all programming parameters and max/min values when power is removed.
9. **CONNECTIONS**: Wire clamping screw terminals
   Wire Strip Length: 0.3" (7.5 mm)
   Wire Gage: 30-14 AWG copper wire
   Torque: 5 inch-lbs (0.565 N-m) max.
10. **ENVIRONMENTAL CONDITIONS**:
    Operating Temperature Range for CUB5RTR0: -35 to 75 °C
    Operating Temperature Range for CUB5RTB0 depends on display color and intensity level as per below:

	INTENSITY LEVEL	TEMPERATURE
Red Display	1 & 2	-35 to 75°C
	3	-35 to 70°C
	4	-35 to 60°C
	5	-35 to 50°C
Green Display	1 & 2	-35 to 75°C
	3	-35 to 65°C
	4	-35 to 50°C
	5	-35 to 35°C

    Storage Temperature: -35 to 85 °C
    Operating and Storage Humidity: 0 to 85% max. relative humidity (non-condensing)
    Vibration to IEC 68-2-6: Operational 5-500 Hz, 5 g
    Shock to IEC 68-2-27: Operational 30 g
    Altitude: Up to 2000 meters
11. **CONSTRUCTION**: This unit is rated for NEMA 4X/IP65 requirements for outdoor use. Installation Category I, Pollution Degree 2. High impact plastic case with clear viewing window. Panel gasket and mounting clip included.
12. **WEIGHT**: 3.2 oz (100 g)

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Optional Plug-in Cards

ADDING OPTION CARDS

The CUB5 meters can be fitted with optional output cards and/or serial communications cards. The details for the plug-in cards can be reviewed in the specification section below. The plug-in cards, that are sold separately, can be installed initially or at a later date.

WARNING: Disconnect all power to the unit before installing Plug-in card.

SINGLE RELAY CARD

Type: Single FORM-C relay
Isolation To Sensor & User Input Commons: 1400 Vrms for 1 min.
Working Voltage: 150 Vrms
Contact Rating: 1 amp @ 30 VDC resistive; 0.3 amp @ 125 VAC resistive
Life Expectancy: 100,000 minimum operations

DUAL SINKING OUTPUT CARD

Type: Non-isolated switched DC, N Channel open drain MOSFET
Current Rating: 100 mA max.
$V_{DS\ ON}$: 0.7 V @ 100 mA
$V_{DS\ MAX}$: 30 VDC
Offstate Leakage Current: 0.5 mA max.

RS485 SERIAL COMMUNICATIONS CARD

Type: RS485 multi-point balanced interface (non-isolated)
Note: *Non-grounded (isolated) RTD probes must be used when multiple units are connected in an RS485 network, or measurement errors will occur.*
Baud Rate: 300 to 38.4k
Data Format: 7/8 bits; odd, even, or no parity
Bus Address: 0 to 99; max 32 meters per line
Transmit Delay: Selectable (refer to CUB5COM bulletin)

RS232 SERIAL COMMUNICATIONS CARD

Type: RS232 half duplex (non-isolated)
Baud Rate: 300 to 38.4k
Data Format: 7/8 bits; odd, even, or no parity

USB PROGRAMMING CARD

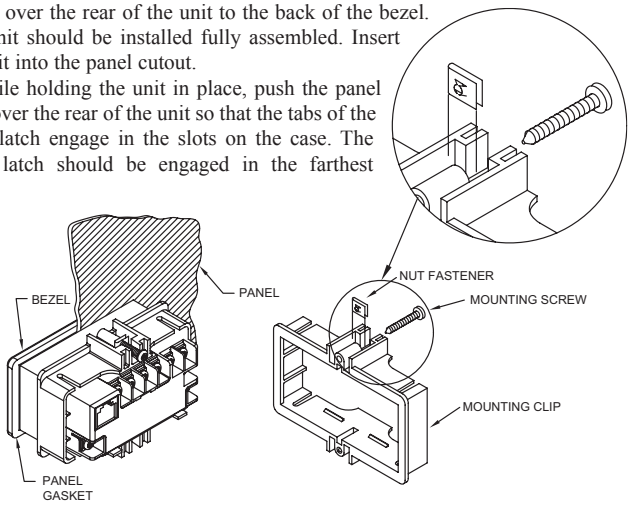
Type: USB virtual comms port
Connection: Type B
Baud Rate: 300 to 38.4k
Unit Address: 0 to 99

1.0 Installing the Meter

INSTALLATION

The meter meets NEMA 4X/IP65 requirements when properly installed. The unit is intended to be mounted into an enclosed panel. Prepare the panel cutout to the dimensions shown. Remove the panel latch from the unit. Slide the panel gasket over the rear of the unit to the back of the bezel. The unit should be installed fully assembled. Insert the unit into the panel cutout.

While holding the unit in place, push the panel latch over the rear of the unit so that the tabs of the panel latch engage in the slots on the case. The panel latch should be engaged in the farthest forward slot possible. To achieve a proper seal, tighten the latch screws evenly until the unit is snug in the panel (Torque to approx. 28 to 36 in-oz [0.202 to 0.26 N-m]). Do not over-tighten the screws.

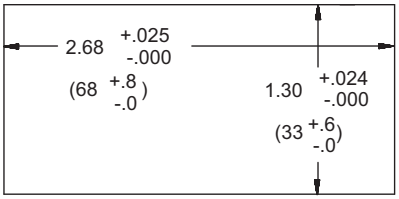


INSTALLATION ENVIRONMENT

The unit should be installed in a location that does not exceed the operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.

The bezel should only be cleaned with a soft cloth and neutral soap product. Do NOT use solvents. Continuous exposure to direct sunlight may accelerate the aging process of the bezel.

Do not use tools of any kind (screwdrivers, pens, pencils, etc.) to operate the keypad of the unit.



2.0 Setting the Jumpers

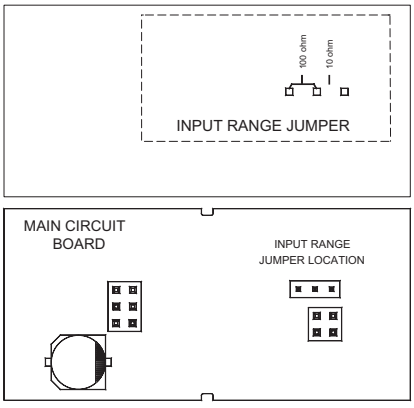
INPUT RANGE JUMPER

This jumper is used to select the proper input range. The input range selected in programming must match the jumper setting. Select a range that is high enough to accommodate the maximum input signal to avoid overloads. To access the jumper, remove the rear cover of the meter.

Warning: Exposed line voltage exists on the circuit boards. Remove all power to the meter and load circuits before accessing inside of the meter.

REMOVING THE REAR COVER

To remove the rear cover, locate the cover locking tab below the 2nd and 3rd input terminals. To release the tab, insert a small, flat blade screwdriver between the tab and the plastic wall below the terminals. Inserting the screwdriver will provide enough pressure to release the tab locks. To replace the cover, align the cover with the input terminals and press down until the cover snaps into place.



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3.0 Installing Plug-In Cards

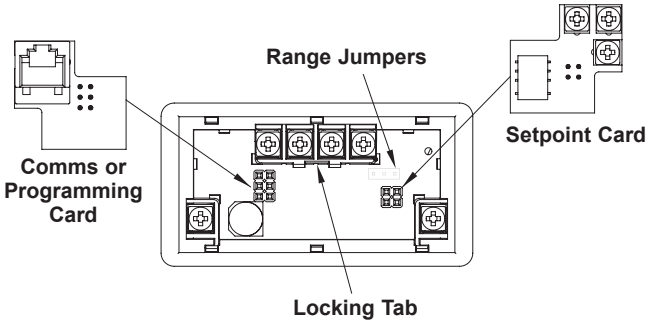
WARNING: Exposed line voltage exists on the circuit boards. Remove all power to the meter and load circuits before accessing inside of the meter.

CAUTION: The Plug-in cards and main circuit board contain static sensitive components. Before handling the cards, discharge static charges from your body by touching a grounded bare metal object. Ideally, handle the cards at a static controlled clean workstation. Also, only handle the cards by the edges. Dirt, oil or other contaminants that may contact the cards can adversely affect circuit operation.

REMOVING THE REAR COVER

To remove the rear cover, locate the cover locking tab below the 2nd and 3rd input terminals. To release the tab, insert a small, flat blade screwdriver between the tab and the plastic wall below the terminals. Inserting the screwdriver will provide enough pressure to release the tab locks. To replace the cover, align the cover with the input terminals and press down until the cover snaps into place.

The Plug-in cards are separately purchased option cards that perform specific functions. The cards plug in to the main circuit board of the meter.



4.0 Wiring the Meter

WIRING OVERVIEW

Electrical connections are made via screw-clamp terminals located on the back of the meter. All conductors should conform to the meter's voltage and current ratings. All cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that the power supplied to the meter (DC or AC) be protected by a fuse or circuit breaker.

Strip the wire, leaving approximately 0.3" (7.5 mm) bare lead exposed (stranded wires should be tinned with solder.) Insert the lead under the correct screw-clamp terminal and tighten until the wire is secure. (Pull wire to verify tightness.) Each terminal can accept up to one #14 AWG (2.55 mm) wire, two #18 AWG (1.02 mm), or four #20 AWG (0.61 mm).

EMC INSTALLATION GUIDELINES

Although Red Lion Controls Products are designed with a high degree of immunity to Electromagnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, source or coupling method into a unit may be different for various installations. Cable length, routing, and shield termination are very important and can mean the difference between a successful or troublesome installation. Listed are some EMI guidelines for a successful installation in an industrial environment.

1. A unit should be mounted in a metal enclosure, which is properly connected to protective earth.
2. Use shielded cables for all Signal and Control inputs. The shield connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield to earth ground (protective earth) at one end where the unit is mounted.
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is over 1 MHz.
3. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors, feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be run through metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter. Also, Signal or Control cables within an enclosure should be routed as far away as possible from contactors, control relays, transformers, and other noisy components.
4. Long cable runs are more susceptible to EMI pickup than short cable runs.
5. In extremely high EMI environments, the use of external EMI suppression devices such as Ferrite Suppression Cores for signal and control cables is effective. The following EMI suppression devices (or equivalent) are recommended:
   Fair-Rite part number 0443167251 (RLC part number FCOR0000)
   Line Filters for input power cables:
   Schaffner # FN2010-1/07 (Red Lion Controls # LFIL0000)
6. To protect relay contacts that control inductive loads and to minimize radiated and conducted noise (EMI), some type of contact protection network is normally installed across the load, the contacts or both. The most effective location is across the load.
   a. Using a snubber, which is a resistor-capacitor (RC) network or metal oxide varistor (MOV) across an AC inductive load is very effective at reducing EMI and increasing relay contact life.
   b. If a DC inductive load (such as a DC relay coil) is controlled by a transistor switch, care must be taken not to exceed the breakdown voltage of the transistor when the load is switched. One of the most effective ways is to place a diode across the inductive load. Most RLC products with solid state outputs have internal zener diode protection. However external diode protection at the load is always a good design practice to limit EMI. Although the use of a snubber or varistor could be used.
   RLC part numbers: Snubber: SNUB0000
   Varistor: ILS11500 or ILS23000
7. Care should be taken when connecting input and output devices to the instrument. When a separate input and output common is provided, they should not be mixed. Therefore a sensor common should NOT be connected to an output common. This would cause EMI on the sensitive input common, which could affect the instrument's operation.

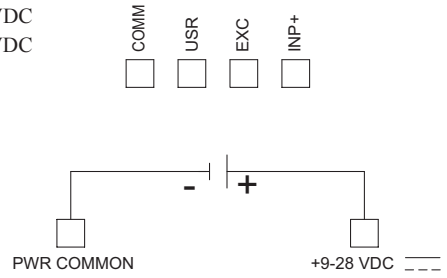
Visit RLC's web site at http://www.redlion.net/Support/InstallationConsiderations.html for more information on EMI guidelines, Safety and CE issues as they relate to Red Lion Controls products.

F

4.1 POWER WIRING

DC Power

+9 to +28 VDC: +VDC
Power Common: -VDC

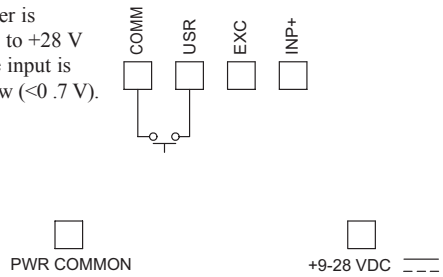


4.2 USER INPUT WIRING

Sinking Logic

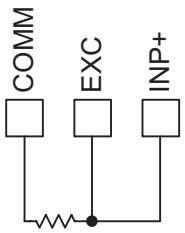
USR COMM } Connect external switching device between the
USR } User Input terminal and User Input Common.

The user input of the meter is internally pulled up to +9 to +28 V with 10 K resistance. The input is active when it is pulled low (<0 .7 V).

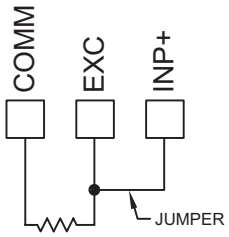


4.3 INPUT WIRING

3-WIRE RTD



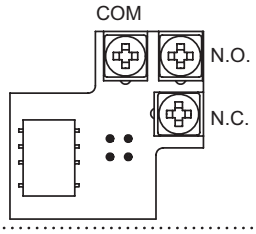
2-WIRE RTD



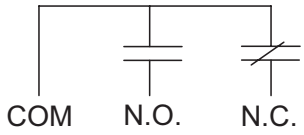
***CAUTION**: Power input common and sensor input common are NOT isolated from user input common. In order to preserve the safety of the meter application, the power input common and the sensor input common must be suitably isolated from hazardous live earth referenced voltages; or input common must be at protective earth ground potential. If not, hazardous live voltage may be present at the User Inputs and User Input Common terminals. Appropriate considerations must then be given to the potential of the user input common with respect to earth common; and the common of the isolated plug-in cards with respect to input common.*

4.4 SETPOINT (OUTPUT) WIRING

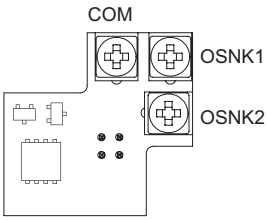
SINGLE SETPOINT RELAY PLUG-IN CARD



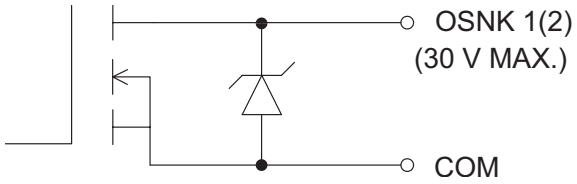
ELECTRICAL CONNECTIONS



DUAL SETPOINT N-FET OPEN DRAIN PLUG-IN CARD



ELECTRICAL CONNECTIONS



Output Common is not isolated from DC Power Common. Load must be wired between OSNK terminal and V+ of the load supply.

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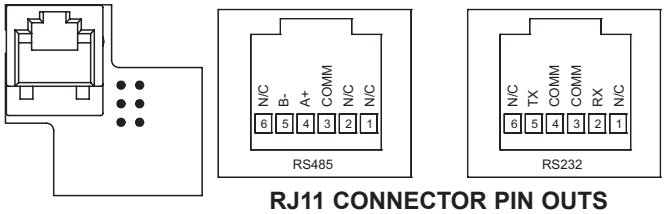
4.5 SERIAL COMMUNICATION WIRING

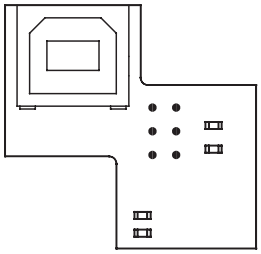
SERIAL COMMUNICATIONS PLUG-IN CARD



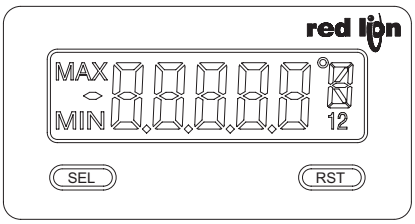
RJ11 CONNECTOR PIN OUTS

4.6 USB PROGRAMMING

USB PROGRAMING PLUG-IN CARD



5.0 Reviewing the Front Buttons and Display



BUTTON	DISPLAY MODE OPERATION	ENTERING PROGRAM MODE	PROGRAMMING MODE OPERATION
SEL	Index display through enabled values	Press and hold for 2 seconds to activate	Store selected parameter and index to next parameter
RST	Resets values (MIN / MAX) or outputs		Advances through the program menu Increments selected parameter value or selection

OPERATING MODE DISPLAY DESIGNATORS

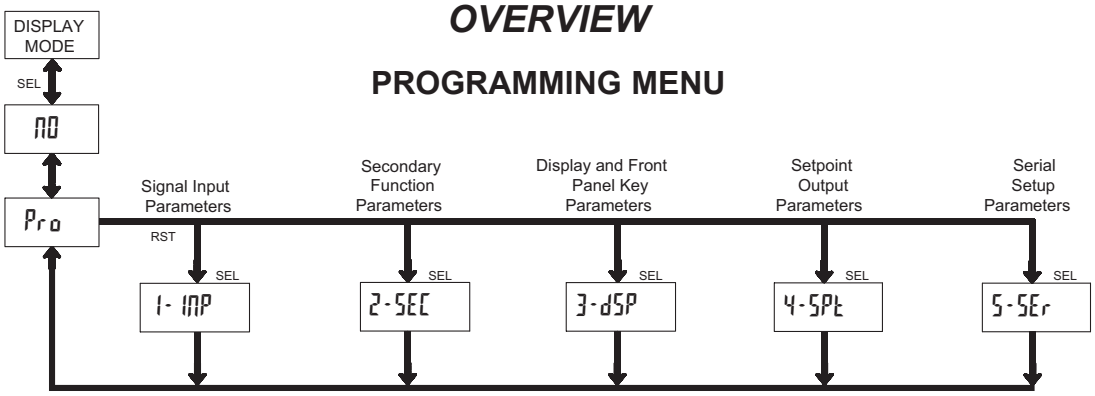
MAX - Maximum display capture value
MIN - Minimum display capture value
"1" - To the right of the display indicates setpoint 1 output activated.
"2" - To the right of the display indicates setpoint 2 output activated.

Pressing the **SEL** button toggles the meter through the selected displays. If display scroll is enabled, the display will toggle automatically every four seconds between the enabled display values.

6.0 Programming the Meter

OVERVIEW

PROGRAMMING MENU



PROGRAMMING MODE ENTRY (SEL BUTTON)

It is recommended that all programming changes be made off line, or before installation. The meter normally operates in the Display Mode. No parameters can be programmed in this mode. The Programming Mode is entered by pressing and holding the **SEL** button. If it is not accessible then it is locked by either a security code, or a hardware lock.

MODULE ENTRY (SEL & RST BUTTONS)

The Programming Menu is organized into separate modules. These modules group together parameters that are related in function. The display will alternate between Pro and the present module. The **RST** button is used to select the desired module. The displayed module is entered by pressing the **SEL** button.

MODULE MENU (SEL BUTTON)

Each module has a separate module menu (which is shown at the start of each module discussion). The **SEL** button is pressed to advance to a particular parameter to be changed, without changing the programming of preceding parameters. After completing a module, the display will return to Pro no. Programming may continue by accessing additional modules.

SELECTION / VALUE ENTRY

For each parameter, the display alternates between the present parameter and the selections/value for that parameter. The **RST** button is used to move through the selections/values for that parameter. Pressing the **SEL** button, stores and activates the displayed selection/value. This also advances the meter to the next parameter.

For numeric values, press the **RST** button to access the value. The right hand most digit will begin to flash. Pressing the **RST** button again increments the digit by one or the user can hold the **RST** button and the digit will automatically scroll. The **SEL** button will advance to the next digit. Pressing and holding the **SEL** button will enter the value and move to the next parameter.

PROGRAMMING MODE EXIT (SEL BUTTON)

The Programming Mode is exited by pressing the **SEL** button with Pro no displayed. This will commit any stored parameter changes to memory and return the meter to the Display Mode. (If power loss occurs before returning to the Display Mode, verify recent parameter changes.)

PROGRAMMING TIPS

It is recommended to start with Module 1 and proceed through each module in sequence. When programming is complete, it is recommended to record the parameter programming and lock out parameter programming with the user input or programming security code.

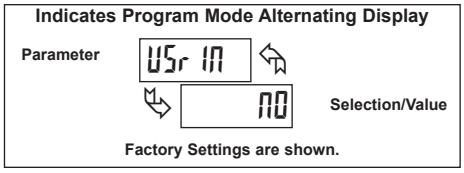
FACTORY SETTINGS

Factory Settings may be completely restored in Module 2. This is useful when encountering programming problems.

Pressing both the **SEL** and the **RST** button on power-up will also load the factory settings and display rESEt. This allows operation in the event of a memory failure or corrupted data.

ALTERNATING SELECTION DISPLAY

In the explanation of the modules, the following dual display with arrows will appear. This is used to illustrate the display alternating between the parameter on top and the parameter's Factory Setting on the bottom. In most cases, selections and values for the parameter will be listed on the right.



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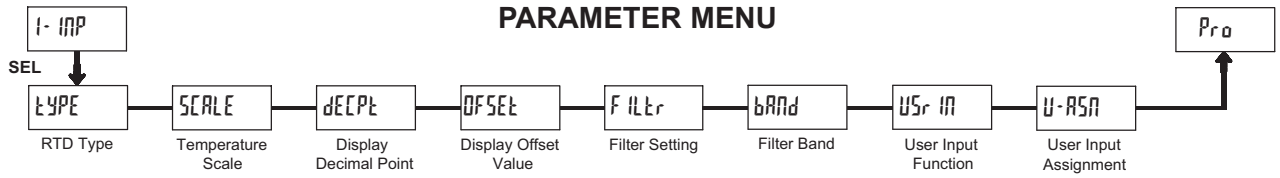
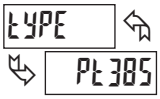
6.1 MODULE 1 - SIGNAL INPUT PARAMETERS (1-INP)

PARAMETER MENU



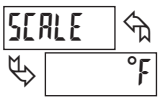
RTD TYPE



SELECTION	TYPE	RANGE JUMPERS
Pt385	RTD Platinum 385	100 ohm
Pt392	RTD Platinum 392	100 ohm
Ni672	RTD Nickel 672	100 ohm
Cu427	RTD Copper 10 Ω	10 ohm

Select the RTD type used for the application. The appropriate curve will be automatically loaded for the selected type. The position of the Input Range Jumper must match the RTD type selected.

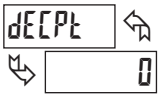
TEMPERATURE SCALE



°F °C

Select the temperature scale. This selection applies for the Input, MAX and MIN displays.

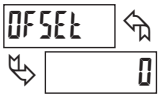
DISPLAY DECIMAL POINT



0 0.0

Select the decimal point location for the desired display resolution. This selection applies for the Input, MAX and MIN displays.

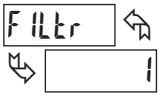
DISPLAY OFFSET VALUE



-19999 to 19999

The temperature display can be corrected with an offset value. This can be used to compensate for probe errors, errors due to variances in probe placement or adjusting the readout to a reference thermometer.

FILTER SETTING

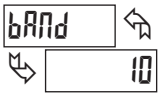


0 1 2 3

If the displayed temperature is difficult to read due to small process variations or noise, increased levels of filtering will help to stabilize the display. Software filtering effectively combines a fraction of the current input reading with a fraction of the previous displayed reading to generate the new display.

Filter values represent no filtering (0), up to heavy filtering (3). A value of 1 for the filter uses 1/4 of the new input and 3/4 of the previous display to generate the new display. A filter value of 2 uses 1/8 new and 7/8 previous. A filter value of 3 uses 1/16 new and 15/16 previous.

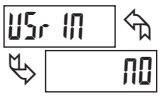
FILTER BAND



00 to 199 display units

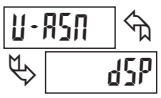
The filter will adapt to variations in the input signal. When the variation exceeds the input filter band value, the filter disengages. When the variation becomes less than the band value, the filter engages again. This allows for a stable readout, but permits the display to settle rapidly after a large process change. The value of the band is in display units, independent of the Display Decimal Point position. A band setting of '0' keeps the filter permanently engaged at the filter level selected in the previous parameter.

USER INPUT FUNCTION



DISPLAY	MODE	DESCRIPTION
no	No Function	User Input disabled.
P-Loc	Program Mode Lock-out	See Programming Mode Access chart (Module 3).
rESEt	Reset (Edge triggered)	Resets the assigned value(s) to the current input value.
d-Hld	Display Hold	Holds the assigned display, but all other meter functions continue as long as activated (maintained action).
d-SEL	Display Select (Edge Triggered)	Advance once for each activation.
d-LEU	Display Intensity Level (Edge Triggered)	Increase intensity one level for each activation (backlight version only).
COLOr	Backlight Color (Edge Triggered)	Change backlight color with each activation (backlight version only).
Print	Print Request	Serial transmit of the active parameters selected in the Print Options menu (Module 5).
P-rSt	Print and Reset	Same as Print Request followed by a momentary reset of the assigned value(s).
rSt-1	Setpoint 1 Reset	Resets setpoint 1 output.
rSt-2	Setpoint 2 Reset	Resets setpoint 2 output.
rSt12	Setpoint 1 and 2 Reset	Reset both setpoint 1 and 2 outputs.

USER INPUT ASSIGNMENT



HI HI-LO

LO dSP

Select the value(s) to which the User Input Function is assigned. The User Input Assignment only applies if a selection of reset, display hold, or print and reset is selected in the User Input Function menu.

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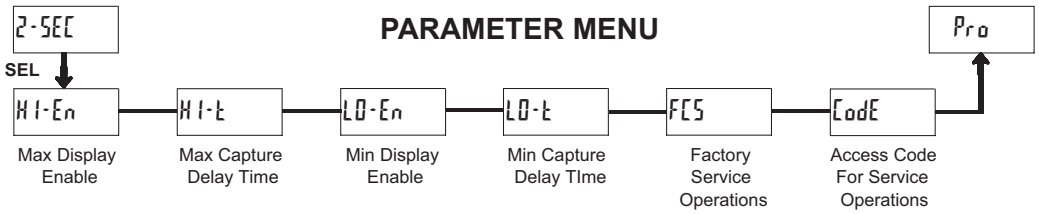
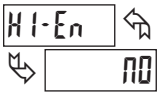
6.2 MODULE 2 - SECONDARY FUNCTION PARAMETERS (2-SEC)



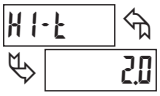
MAX DISPLAY ENABLE



NO YES

Enables the Maximum Display Capture capability.

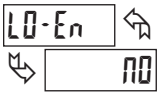
MAX CAPTURE DELAY TIME



0.0 to 999.9 seconds

When the Input Display is above the present MAX value for the entered delay time, the meter will capture that display value as the new MAX reading. A delay time helps to avoid false captures of sudden short spikes.

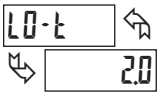
MIN DISPLAY ENABLE



NO YES

Enables the Minimum Display Capture capability.

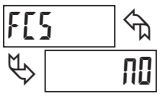
MIN CAPTURE DELAY TIME



0.0 to 999.9 seconds

When the Input Display is below the present MIN value for the entered delay time, the meter will capture that display value as the new MIN reading. A delay time helps to avoid false captures of sudden short spikes.

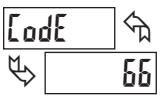
FACTORY SERVICE OPERATIONS



NO YES

Select YES to perform any of the Factory Service Operations shown below.

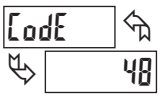
RESTORE FACTORY DEFAULT SETTINGS



Entering Code 66 will overwrite all user settings with the factory settings. The meter will display rESEt and then return to CodE 00. Press **SEL** button to exit the module.

Pressing both the **SEL** and the **RST** button on power-up will also load the factory settings and display rESEt. This allows operation in the event of a memory failure or corruted data.

CALIBRATION



The CUB5RT uses stored resistance calibration values to provide accurate temperature measurements. Over time, the electrical characteristics of the components inside the meter could slowly change. The result is that the stored calibration values may no longer accurately define the input circuit. For most applications, recalibration every 1 to 2 years should be sufficient.

Calibration of the CUB5RT involves a resistance calibration. Allow 30 minute warm up before performing any calibration related procedure. The following procedures should be performed at an ambient temperature of 15 to 35 °C (59 to 95 °F).

Calibration should only be performed by individuals experienced in calibrating electronic equipment.

***CAUTION**: The accuracy of the calibration equipment will directly affect the accuracy of the CUB5RT.*

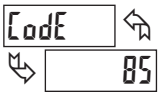
10 OHM RTD Range Calibration

1. Set the Input Range Jumper to 10 ohm.
2. With the display at CodE 48, press and hold the SEL button for 2 seconds. Unit will display CAL A0.
3. Press the RST button. Display reads CAL r10.
4. Press the SEL button. Display reads 00r.
5. Apply a direct short to terminals INP+, EXC, and COMM using a three wire link. Press SEL. Display reads CALC for about 15 seconds.
6. When the display reads 15.0r, apply a precision resistance of 15 ohms (with an accuracy of 0.01% or better) to terminals INP+, EXC, and COMM using a three wire link. Press SEL. Display reads CALC for about 15 seconds.
7. When display reads CAL A0, press the SEL button to exit calibration, or proceed to the 100 ohm RTD Range Claibration.

100 OHM RTD Range Calibration

1. Set the Input Range Jumper to 100 ohm.
2. With the display at CodE 48, press and hold the SEL button for 2 seconds. Unit will display CAL A0.
3. Press the RST button until the display reads CAL r100.
4. Press the SEL button. Display reads 00r.
5. Apply a direct short to terminals INP+, EXC, and COMM using a three wire link. Press SEL. Display reads CALC for about 15 seconds.
6. When the display reads 300.0r, apply a precision resistance of 300 ohms (with an accuracy of 0.01% or better) to terminals INP+, EXC, and COMM using a three wire link. Press SEL. Display reads CALC for about 15 seconds.
7. When display reads CAL A0, press the SEL button to exit calibration.

RESISTANCE DISPLAY MODE



Entering Code 85 will place the CUB5RT in a resistance display mode. This mode is useful for diagnostic purposes before and after calibration, or to display the measured resistance of a connected RTD probe. If the RTD type is set for Cu427 with the jumper set to the 10 ohm position, the display will read resistance in 0.000 ohms resolution. For all other RTD types, with the jumper in the 100 ohm position, the display will read in 0.00 ohms resolution.

Re-entering code 85 toggles the display back to the temperature display mode without having to remove power from the meter. If power is removed, the display always returns to the temperature display mode when power is reapplied.

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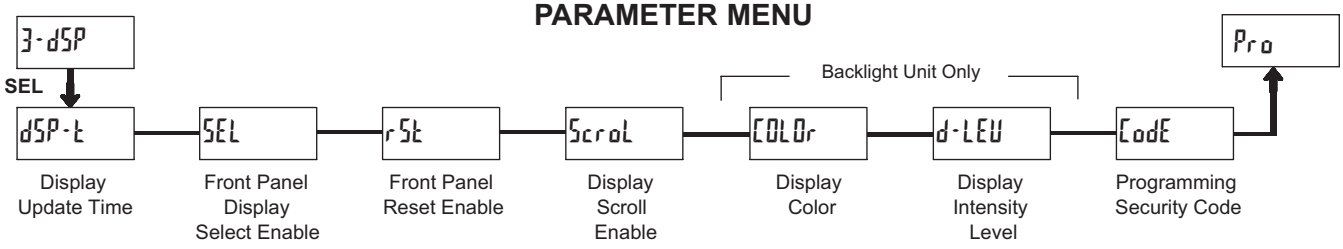
6.3 MODULE 3 - DISPLAY AND FRONT PANEL BUTTON PARAMETERS (3-dSP)

PARAMETER MENU



DISPLAY UPDATE TIME

dSP-t → 1 — 0.5 1 2 seconds

This parameter sets the display update time in seconds.

FRONT PANEL DISPLAY SELECT ENABLE (SEL)

SEL → YES — YES NO

The YES selection allows the **SEL** button to toggle through the enabled displays.

FRONT PANEL RESET ENABLE (RST)

rSt → dSP — NO LO dSP HI HI-LO

This selection allows the **RST** button to reset the selected value(s).

DISPLAY SCROLL ENABLE

ScroL → NO — YES NO

The YES selection allows the display to automatically scroll through the enabled displays. The scroll rate is every 4 seconds.

DISPLAY COLOR (BACKLIGHT UNIT ONLY)

COLOr → rEd — rEd Grn

Enter the desired display color, red or green. This parameter is active for backlight units only.

DISPLAY INTENSITY LEVEL (BACKLIGHT UNIT ONLY)

d-LEU → 5 — 1 to 5

Enter the desired Display Intensity Level (1-5). The display will actively dim or brighten as levels are changed. This parameter is active for backlight units only.

PROGRAMMING SECURITY CODE

CodE → 000 — 000 to 999

The Security Code determines the programming mode and the accessibility of programming parameters. This code can be used along with the Program Mode Lock-out (P-Loc) in the User Input Function parameter (Module 1).

Two programming modes are available. Full Programming mode allows all parameters to be viewed and modified. Quick Programming mode permits only the Setpoint values to be modified, but allows direct access to these values without having to enter Full Programming mode.

Programming a Security Code other than 0, requires this code to be entered at the CodE prompt in order to access Full Programming mode. Depending on the code value, Quick Programming may be accessible before the CodE prompt appears (see chart).

USER INPUT FUNCTION	USER INPUT STATE	SECURITY CODE	MODE WHEN "SEL" BUTTON IS PRESSED	FULL PROGRAMMING MODE ACCESS
not P-Loc	_____	0	Full Programming	Immediate Access
		1-99	Quick Programming	After Quick Programming with correct code entry at CodE prompt *
		100-999	CodE prompt	With correct code entry at CodE prompt *
P-Loc	Active	0	Programming Lock	No Access
		1-99	Quick Programming	No Access
		100-999	CodE prompt	With correct code entry at CodE prompt *
	Not Active	0-999	Full Programming	Immediate Access

** Entering Code 222 allows access regardless of security code.*

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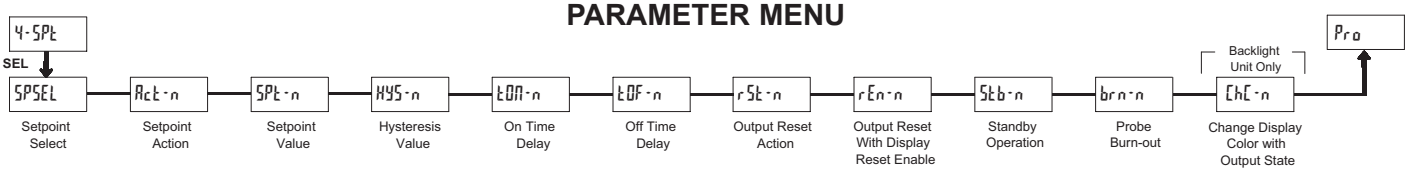
6.4 MODULE 4 - SETPOINT OUTPUT PARAMETERS (4-SPt)

PARAMETER MENU



The Setpoint Output Parameters are only active when an optional output module is installed in the meter.

SETPOINT SELECT

SPSEL — NO SP-1 SP-2

NO

Enter the setpoint (output) to be programmed. The n in the following parameters will reflect the chosen setpoint number. After the chosen setpoint is completely programmed, the display will return to SPSEL. Repeat steps for each setpoint to be programmed. Select NO to exit the module. The number of setpoints available is setpoint output card dependent.

SETPOINT 2 ENABLE

Enb-2 — YES NO

NO

Select YES to enable Setpoint 2 and access the setup parameters. If NO is selected, the unit returns to SPSEL and setpoint 2 is disabled.

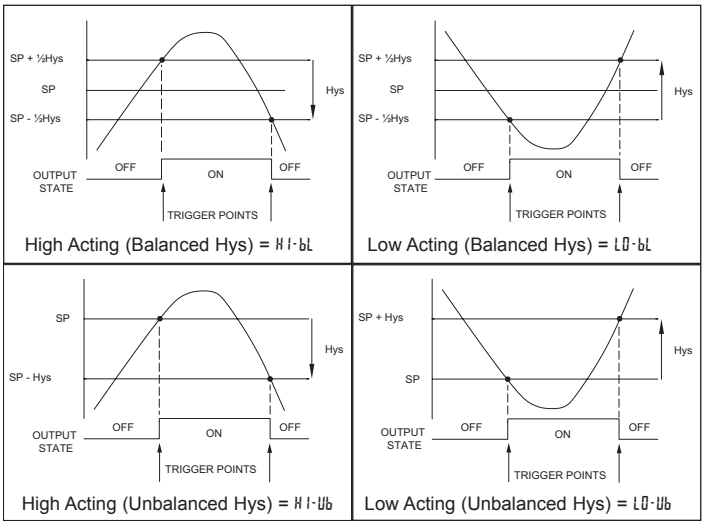
SETPOINT ACTION

Act-n — HI-bL LO-bL HI-Ub LO-Ub

HI-Ub

Enter the action for the selected setpoint (output). See Setpoint Output Figures for a visual detail of each action.

HI-bL = High Acting, with balanced hysteresis
LO-bL = Low Acting, with balanced hysteresis
HI-Ub = High Acting, with unbalanced hysteresis
LO-Ub = Low Acting, with unbalanced hysteresis



SETPOINT VALUE

SPt-n

100

-99999 to 99999

Enter the desired setpoint value. The decimal point position for the setpoint and hysteresis values follow the selection set in Module 1.

HYSTERESIS VALUE

HYS-n

2

1 to 59999

Enter desired hysteresis value. See Setpoint Output Figures for visual explanation of how setpoint output actions (balanced and unbalanced) are affected by the hysteresis. When the setpoint is a control output, usually balanced hysteresis is used. For alarm applications, usually unbalanced hysteresis is used. For unbalanced hysteresis modes, the hysteresis functions on the low side for high acting setpoints and functions on the high side for low acting setpoints.

Note: Hysteresis eliminates output chatter at the switch point, while time delay can be used to prevent false triggering during process transient events.

ON TIME DELAY

tON-n

0.0

0.0 to 599.9 Sec

Enter the time value in seconds that the output is delayed from turning on after the trigger point is reached. A value of 0.0 allows the meter to update the output status per the response time listed in the Specifications.

OFF TIME DELAY

tOF-n

0.0

0.0 to 599.9 Sec

Enter the time value in seconds that the output is delayed from turning off after the trigger point is reached. A value of 0.0 allows the meter to update the output status per the response time listed in the Specifications.

OUTPUT RESET ACTION

rSt-n — Auto LATCH L-dLY

Auto

Enter the reset action of the output. See figure for details.

Auto = Automatic action; This action allows the output to automatically reset off at the trigger points per the Setpoint Action shown in Setpoint Output Figures. The "on" output may be manually reset (off) immediately by the front panel **RST** button or user input.The output remains off until the trigger point is crossed again.

LATCH = Latch with immediate reset action; This action latches the output on at the trigger point per the Setpoint Action shown in Setpoint Output Figures. Latch means that the output can only be turned off by the front panel **RST** button or user input manual reset, serial reset command or meter power cycle.

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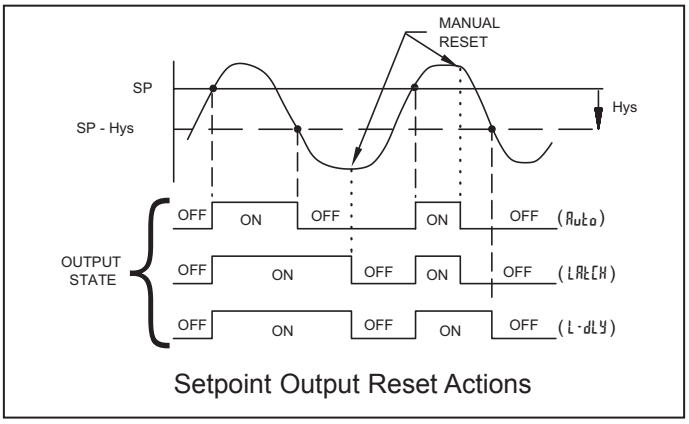
When the user input or **RST** button is activated (momentary action), the corresponding "on" output is reset immediately and remains off until the trigger point is crossed again. (Previously latched alarms will be off if power up Display Value is lower than setpoint value.)

L-dLY = Latch with delay reset action; This action latches the output on at the trigger point per the Setpoint Action shown in Setpoint Output Figures. Latch means that the output can only be turned off by the front panel **RST** button or user input manual reset, serial reset command or meter power cycle. When the user input or **RST** button is activated (momentary action), the meter delays the event until the corresponding "on" output crosses the trigger off point. (Previously latched outputs are off if power up Display Value is lower than setpoint value. During a power cycle, the meter erases a previous L-dLY reset if it is not activated at power up.)



Setpoint Output Reset Actions

OUTPUT RESET WITH DISPLAY RESET

rEn-n → NO / YES

This parameter enables the **RST** button or user input to reset the output when the display is reset.

Note: For this parameter to operate, the **RST** button or User Input being used must be set to dSP and the Input value must be displayed. If these conditions are not met, the output will not reset.

STANDBY OPERATION

Stb-n → NO / YES

When YES, the output is disabled (after a power up) until the trigger point is crossed. Once the output is on, the output operates normally per the Setpoint Action and OutputReset Action.

PROBE BURN-OUT ACTION

brn-n → OFF / ON

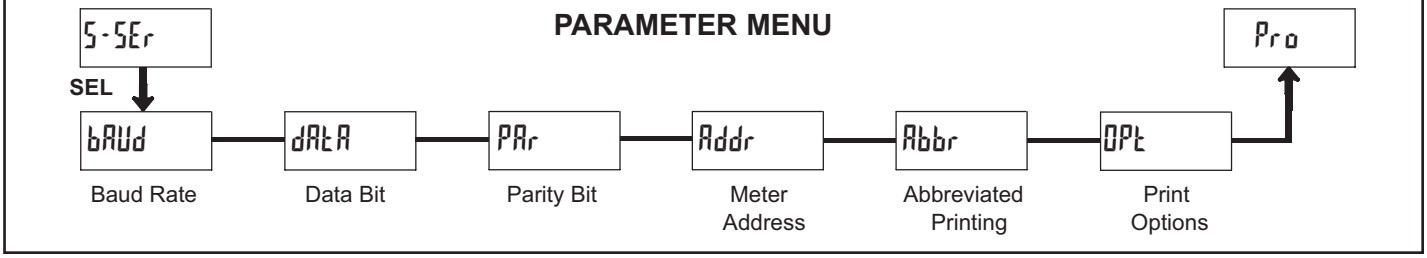
Enter the probe burn-out action. In the event of a temperature probe failure (open or short), the output can be programmed to be on or off.

CHANGE DISPLAY COLOR w/OUTPUT STATE

ChC-n → NO / YES

This parameter enables the backlight CUB5 to switch the backlight color when the output state changes. This parameter is only active for the backlight version.

6.5 MODULE 5 - SERIAL SETUP PARAMETERS (5-SEr)



The Serial Setup Parameters are only active when one of the optional serial communications/programming cards is installed in the meter.
Refer to the CUB5COM bulletin for details and setup for the CUB5 RS232 or RS485 serial communications.
Refer to the CUB5USB bulletin for details on the CUB5 USB programming and programming requirements.

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MODEL PAXLTC - PAX LITE THERMOCOUPLE METER

c UL US LISTED
IND. CONT. EQ.
51EB

- *PROGRAMMABLE TC TYPE (T, E, J, K, R, S, B, N or mV SCALE)*
- *CONFORMS TO ITS-90 STANDARDS*
- *SELECTABLE °F OR °C WITH 0.1 OR 1 DEGREE DISPLAY RESOLUTION*
- *STATE-OF-THE-ART DIGITAL ELECTRONICS FOR GREATER ACCURACY AND RELIABILITY*
- *FULL 4-DIGIT, HIGH VISIBILITY, 0.56" (14.2 mm) HIGH RED LED DISPLAY*
- *PROGRAMMABLE TEMPERATURE OFFSET*
- *PROGRAMMABLE DIGITAL FILTERING ENHANCES STABILITY*
- *PEAK/VALLEY (HI/LO READING) MEMORY*
- *NEMA 4X/IP65 SEALED FRONT BEZEL*
- *CUSTOM UNITS OVERLAY WITH BACKLIGHT*

CE

GENERAL DESCRIPTION

The Pax Lite Thermocouple Meter accepts inputs from standard thermocouples and precisely linearizes them. A full 4-digit display accommodates a wide range of temperature inputs. The unit automatically compensates for cold junction, NBS linearity and the meter's zero and span.

The meter features a readout choice of either Fahrenheit or Celsius with 0.1 or 1 degree resolution. English Style display prompts and front panel buttons aid the operator through set-up and operation. With a few simple steps the unit can be used as a millivolt meter by selecting "VOLt" for thermocouple type. This mode is useful in monitoring and displaying the actual voltage produced at the thermocouple probe junction and as an aid in troubleshooting for a faulty thermocouple probe.

The meter provides a Peak (HI) and Valley (LO) reading memory with selectable capture delay time. The capture delay is used to prevent detection of false Peak or Valley readings that may occur during start-up or unusual process events. The Peak and Valley readings are stored at power-down to allow monitoring the process limits over any length of time (shifts, days, etc.).

Programmable digital filtering enhances the stability of the reading. All set-up data is stored in EEPROM, which will hold data for a minimum of 10 years without power. The meter has several built-in diagnostic functions to alert operators of any malfunction.

Extensive testing of noise interference mechanisms and full burn-in makes the indicator extremely reliable in industrial environments. The front bezel meets NEMA 4X/IP65 requirements for wash down applications.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the literature or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired. Do not use this unit to directly command motors, valves, or other actuators not equipped with safeguards. To do so, can be potentially harmful to persons or equipment in the event of a fault to the unit.

CAUTION: Read complete instructions prior to installation and operation of the unit.

CAUTION: Risk of electric shock.

DEFINITION OF TERMS

INSTALLATION CATEGORY (overvoltage category) **I**:
Signal level, special equipment or parts of equipment, telecommunication, electronic, etc. with smaller transient overvoltages than Installation Category (overvoltage category) II.

INSTALLATION CATEGORY (overvoltage category) **II**:
Local level, appliances, portable equipment, etc. with smaller transient overvoltages than Installation Category (overvoltage category) III.

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DIMENSIONS In inches (mm)

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 2.1" (53.4) H x 5" (127) W.

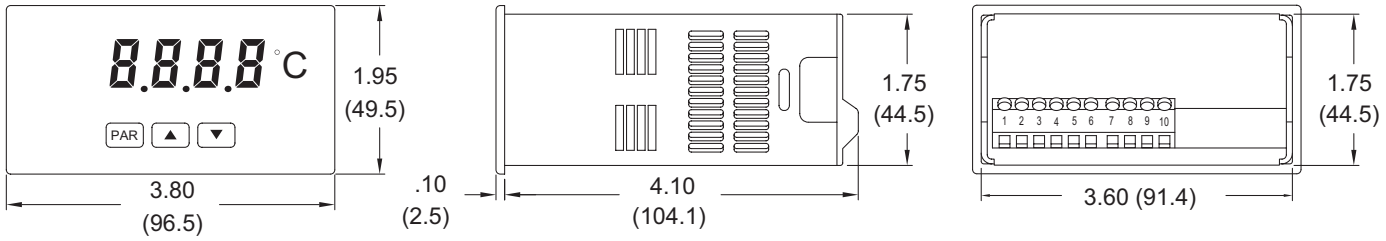

Table of Contents

Ordering Information

Meter Part Numbers

PAXL	TC	0	0

TC - Thermocouple Temperature Meter

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Accessories Part Numbers*

TYPE	MODEL NO.	DESCRIPTION	PART NUMBERS
Accessories	**PAXLBK**	Units Label Kit Accessory	PAXLBK30

*This meter is shipped with °F and °C overlay labels. The label kit is only needed if another units label is desired.

General Meter Specifications

1. **DISPLAY**: 4-digit, 0.56" (14.2 mm) high red LED, minus sign displayed for negative temperatures.
   Overrange/Underrange Input: Flashing "OLOL" or "ULUL"
   Overrange/Underrange Display: "...." or "-...."
2. **POWER**: 85 to 250 VAC, 50/60 Hz, 6 VA
   Isolation: 2300 Vrms for 1 min. between input and supply (300 V working voltage)
3. **CONTROLS**: Three front panel push buttons for meter set-up. Rear terminal input for disabling the front panel.
4. **THERMOCOUPLE TYPES**: T, E, J, K, R, S, B, N or mV scale
5. **RESOLUTION**: 1 degree for all types, or 0.1 degree for T, E, J, K and N only
6. **THERMOCOUPLE RANGE AND ACCURACY**: All errors include NBS conformity, cold junction effect and A/D conversion errors at 23°C after 60 minutes warm-up. Relative Humidity less than 85%.

TC TYPE	RANGE	ACCURACY	WIRE COLOR
T	-200 to +400ºC -328 to +752ºF	0.8ºC 1.4ºF	blue
E	-200 to +1000ºC -328 to +1832ºF	0.8ºC 1.4ºF	purple
J	-200 to +760ºC -328 to +1400ºF	0.8ºC 1.4ºF	white
K	-200 to +1250ºC -328 to +2282ºF	0.8ºC 1.4ºF	yellow
R	0 to +1768ºC +32 to +3214ºF	2.1ºC 3.8ºF	black
S	0 to +1768ºC +32 to +3214ºF	2.1ºC 3.8ºF	black
B	+150 to +1820ºC +302 to +3308ºF	2.3ºC 4.1ºF	grey
N	-200 to +1300ºC -328 to +2372ºF	0.8ºC 1.4ºF	orange
mV	-10.00 to +80.00 mV	0.01%	

7. **INPUT IMPEDANCE**: 20 MΩ, all types
8. **LEAD RESISTANCE EFFECT**: 20 µV/350 Ω
   Max Input Voltage Protection: 70 VDC continuous
9. **OPEN THERMOCOUPLE DETECTION**: Display Flashes: "OPEN"
10. **COLD JUNCTION COMPENSATION**: Automatic, 0.02 degree/degree. Disabled for linear mV scale.
11. **READING RATE**: 2.5 readings/second
12. **RESPONSE TIME**: 2 seconds to settle for step input (increases with programmable digital filtering)
13. **LOW FREQUENCY NOISE REJECTION**:
    Normal Mode Rejection: 45 dB @ 50/60 Hz (may be improved by programmable digital filtering)
    Common Mode Rejection: 120 dB, DC to 50/60 Hz
14. **ENVIRONMENTAL CONDITIONS**:
    Operating Temperature Range: 0 to 50 °C
    Storage Temperature Range: -40 to 80 °C
    Operating and Storage Humidity: 85% max (non-condensing) from 0 to 50 °C
    Vibration According to IEC 68-2-6: Operational 5 to 150 Hz, in X, Y, Z direction for 1.5 hours, 2g's.
    Shock According to IEC 68-2-27: Operational 30 g, 11 msec in 3 directions.
    Span Drift: 40 ppm/°C
    Zero Drift: 1 µV/°C
    Altitude: Up to 2000 meters.
15. **CERTIFICATIONS AND COMPLIANCES**:
    SAFETY
    UL Recognized Component, File # E179259, UL61010-1, CSA C22.2 No. 61010-1
    Recognized to U.S. and Canadian requirements under the Component Recognition Program of Underwriters Laboratories, Inc.
    UL Listed, File # E137808, UL508, CSA C22.2 No. 14-M95
    LISTED by Und. Lab. Inc. to U.S. and Canadian safety standards
    Type 4X Enclosure rating (Face only), UL50
    IECEE CB Scheme Test Report # 04ME11209-20041018
    Issued by Underwriters Laboratories, Inc.
    IEC 61010-1, EN 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1.
    IP65 Enclosure rating (Face only), IEC 529
    ELECTROMAGNETIC COMPATIBILITY
    Emissions and Immunity to EN 61326: Electrical Equipment for Measurement, Control and Laboratory use.

Immunity:		
Electrostatic discharge	EN 61000-4-2	Criterion A 4 kV contact discharge 8 kV air discharge
Electromagnetic RF fields	EN 61000-4-3	Criterion A 10 V/m
Fast transients (burst)	EN 61000-4-4	Criterion A 2 kV power 2 kV signal
Surge	EN 61000-4-5	Criterion A 1 kV L-L, 2 kV L&N-E power 1 kV signal
RF conducted interference	EN 61000-4-6	Criterion A 3 V/rms
Voltage dip/interruptions	EN 61000-4-11	Criterion A 0.5 cycle
Emissions:		
Emissions	EN 55011	Class B

Note:
1. Criterion A: Normal operation within specified limits.

16. **CONSTRUCTION**: This unit is rated for NEMA 4X/IP65 outdoor use. One piece bezel/case. Flame resistant. Panel gasket and mounting clip included.
17. **CONNECTIONS**: High compression cage-clamp terminal block
    Wire Strip Length: 0.3" (7.5 mm)
    Wire Gage: 30-14 AWG copper wire
    Torque: 4.5 inch-lbs (0.51 N-m) max.
18. **WEIGHT**: 0.65 lbs. (0.24 Kg)

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Accessories

UNITS LABEL KIT (PAXLBK)

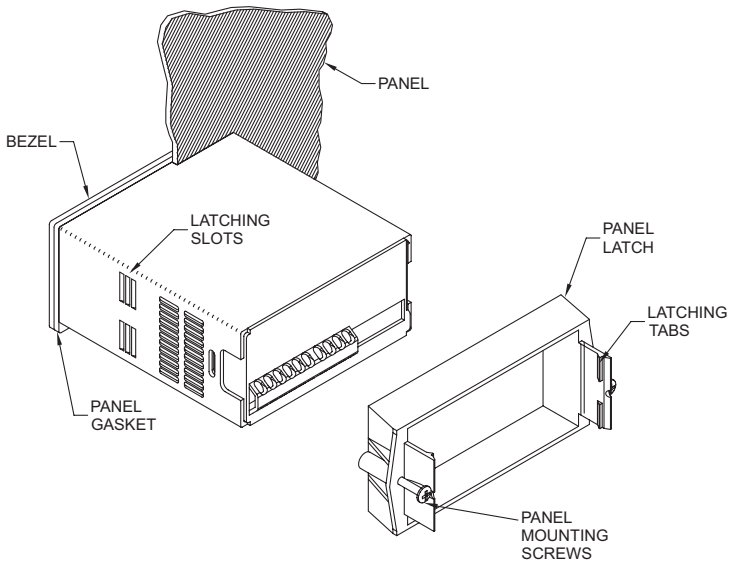
Each meter has a units indicator with backlighting that can be customized using the Units Label Kit. The backlight is controlled in the programming.

Each meter is shipped with °F and °C overlay labels which can be installed into the meter's bezel display assembly.

1.0 Installing the Meter

Installation

The PAX meets NEMA 4X/IP65 requirements when properly installed. The unit is intended to be mounted into an enclosed panel. Prepare the panel cutout to the dimensions shown. Remove the panel latch from the unit. Slide the panel gasket over the rear of the unit to the back of the bezel. The unit should be installed fully assembled. Insert the unit into the panel cutout.



While holding the unit in place, push the panel latch over the rear of the unit so that the tabs of the panel latch engage in the slots on the case. The panel latch should be engaged in the farthest forward slot possible. To achieve a proper seal, tighten the latch screws evenly until the unit is snug in the panel (Torque to approximately 7 in-lbs [79N-cm]). Do not over-tighten the screws.

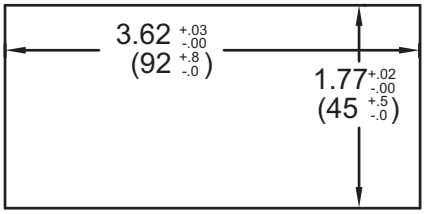
Installation Environment

The unit should be installed in a location that does not exceed the maximum operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.

The bezel should be cleaned only with a soft cloth and neutral soap product. Do NOT use solvents. Continuous exposure to direct sunlight may accelerate the aging process of the bezel.

Do not use tools of any kind (screwdrivers, pens, pencils, etc.) to operate the keypad of the unit.

PANEL CUT-OUT

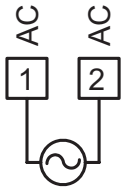


2.0 Wiring the Meter

POWER WIRING

Primary AC power is connected to Terminals 1 and 2. To reduce the chance of noise spikes entering the AC line and affecting the indicator, the AC power should be relatively "clean" and within the specified limits. Drawing power from heavily loaded circuits or circuits which also power loads that cycle on and off, (contactors, relays, motors, machinery, etc.) should be avoided.

AC Power
Terminal 1: VAC
Terminal 2: VAC



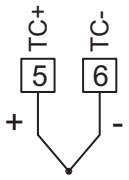
PROGRAM DISABLE INPUT WIRING

PGM.DIS. (Terminal 3) is a digital input that is active when connected to Comm (Terminal 4). Any form of mechanical switch or current sinking logic with less than 0.7 V saturation may be used. The use of shielded cable is recommended. Follow the EMC Installation Guidelines for shield connection.

SIGNAL WIRING (TC SENSOR)

Remove power and connect the negative thermocouple lead (always red) to TC- (Terminal 6) and the positive lead to TC+ (Terminal 5). Be certain that connections are clean and tight. If the thermocouple probe is to be mounted away from the meter, thermocouple extension grade wire must be used (copper wire will not work). Use the correct type and observe the correct polarity. Always refer to the sensor manufacturer's instructions for probe wiring connections, if available. For multi-probe temperature averaging applications, two or more thermocouple probes may be connected at the meter. (Always use the same type.) In order to minimize the chances of coupling noise into the wires and subsequently causing bouncy and erroneous readings, proper guidelines for thermocouple wire routing must be followed.

Thermocouple



WIRING OVERVIEW

Electrical connections are made via screw-clamp terminals located on the back of the meter. All conductors should conform to the meter's voltage and current ratings. All cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that the power supplied to the meter be protected by a fuse or circuit breaker.

When wiring the meter, compare the numbers embossed on the back of the meter case against those shown in wiring drawings for proper wire position. Strip the wire, leaving approximately 0.3" (7.5 mm) bare lead exposed (stranded wires should be tinned with solder). Insert the lead under the correct screw-clamp terminal and tighten until the wire is secure. (Pull wire to verify tightness.)

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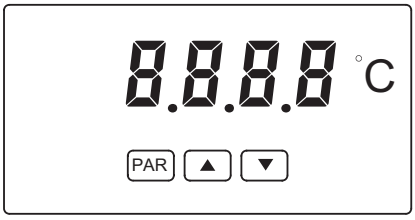
EMC INSTALLATION GUIDELINES

Although this meter is designed with a high degree of immunity to Electro-Magnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, source or coupling method into the meter may be different for various installations. The meter becomes more immune to EMI with fewer I/O connections. Cable length, routing, and shield termination are very important and can mean the difference between a successful or troublesome installation. Listed below are some EMC guidelines for successful installation in an industrial environment.

1. The meter should be mounted in a metal enclosure, which is properly connected to protective earth.
2. Use shielded (screened) cables for all Signal and Control inputs. The shield (screen) pigtail connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield only at the panel where the unit is mounted to earth ground (protective earth).
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is above 1 MHz.
   c. Connect the shield to common of the meter and leave the other end of the shield unconnected and insulated from earth ground.
3. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be run in metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter.
4. Signal or Control cables within an enclosure should be routed as far as possible from contactors, control relays, transformers, and other noisy components.
5. In extremely high EMI environments, the use of external EMI suppression devices, such as ferrite suppression cores, is effective. Install them on Signal and Control cables as close to the unit as possible. Loop the cable through the core several times or use multiple cores on each cable for additional protection. Install line filters on the power input cable to the unit to suppress power line interference. Install them near the power entry point of the enclosure. The following EMI suppression devices (or equivalent) are recommended:
   Ferrite Suppression Cores for signal and control cables:
   Fair-Rite # 0443167251 (RLC# FCOR0000)
   TDK # ZCAT3035-1330A
   Steward # 28B2029-0A0
   Line Filters for input power cables:
   Schaffner # FN610-1/07 (RLC# LFIL0000)
   Schaffner # FN670-1.8/07
   Corcom # 1 VR3
   Note: Reference manufacturer's instructions when installing a line filter.
6. Long cable runs are more susceptible to EMI pickup than short cable runs. Therefore, keep cable runs as short as possible.

3.0 REVIEWING THE FRONT BUTTONS AND DISPLAY



KEY	DISPLAY MODE OPERATION	PROGRAMMING MODE OPERATION
PAR	Access Programming Mode or Display Input Reading	Store selected parameter and index to next parameter
▲	Display Peak (HI) Reading	Increment value or change selection
▼	Display Valley (LO) Reading	Decrement value or change selection

PEAK/VALLEY DETECTION

The meter will automatically record the highest input reading (peak) and the lowest input reading (valley) for later recall. These values are stored at power-down to allow monitoring the process limits over any length of time (shifts, days, etc.). A selectable capture delay time is used to prevent detection of false peak or valley readings caused by sudden short spikes or unusual process events.

The peak and valley readings can be viewed and reset using the front panel keys as described below.

View Peak, Valley and Input readings:
To view Peak, press ▲. Meter displays HI followed by the Peak reading.
To view Valley, press ▼. Meter displays LO followed by the Valley reading.
To view Input, press **PAR**. Meter displays INPt followed by the current Input reading.

Note: The decimal point to the right of digit 1 flashes while the peak or valley reading is displayed.

Reset Peak and/or Valley to the current Input reading:
To reset Peak and Valley, press ▲ and ▼ simultaneously.
To reset Peak only, press and hold ▲ then press **PAR**.
To reset Valley only, press and hold ▼ then press **PAR**.
In each case, the meter displays rSEt followed by the current Input reading.

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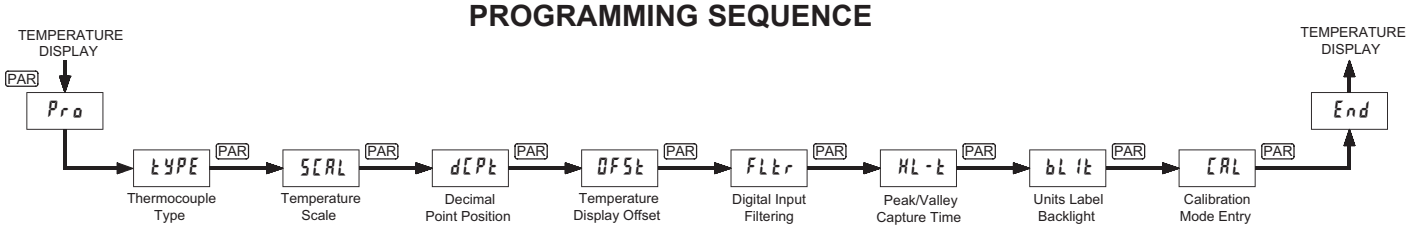
4.0 PROGRAMMING THE METER

PROGRAMMING SEQUENCE



The Thermocouple Meter has up to seven programmable parameters that are entered in the sequence shown above, using the front panel push buttons. Depending on the thermocouple type selected, some parameters are not applicable and are bypassed in the sequence.

The last programming step offers the choice of entering calibration mode. From this mode, the user can restore the meter to factory default settings, or recalibrate the signal input and cold junction temperature if necessary. To prevent inadvertent entries, an access code must be keyed-in to perform any operations in calibration mode.

Note: Programming mode can be locked out using the Program Disable input terminal. With the PGM.DIS. terminal connected to COMM, the meter displays "LOC" when the **PAR** *key is pressed, and will not enter programming mode.*

PROGRAMMING MODE ENTRY

Press the **PAR** key to enter Programming Mode. The meter briefly displays Pro followed by the first programming parameter described below.

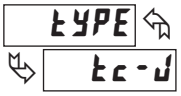
PROGRAMMING MODE TIMEOUT

The Programming Mode has an automatic time out feature. If no keypad activity is detected for approximately 60 seconds, the meter automatically exits Programming Mode. The meter briefly displays End and returns to the normal display mode. When automatic timeout occurs, any changes that were made to the parameter currently being programmed will not be saved.

PROGRAMMING PARAMETERS

In Programming Mode, the display alternates between the parameter and the current selection or value for that parameter. The dual display with arrows is used below to illustrate the alternating display. The selection choices or value range for each parameter is shown to the right of the alternating display.

THERMOCOUPLE TYPE



SELECTION	TC TYPE	SELECTION	TC TYPE
tc-t	T	tc-S	S
tc-E	E	tc-b	B
tc-J	J	tc-n	N
tc-K	K	VOLt	mV indicator
tc-r	R		

Select the thermocouple type by pressing the arrow keys (▲ or ▼) to sequence through the selection list. When the desired selection is displayed, press the **PAR** key to save the selection and advance to the next parameter. Refer to the thermocouple range and accuracy specification for additional TC information.

TEMPERATURE SCALE

oF oC

Select the desired temperature scale by pressing the up or down arrow keys. This setting does not change the Custom Units Overlay display (if installed). Press the **PAR** key to save the selection and advance to the next parameter.

DECIMAL POINT POSITION

0 0.0

Select the decimal point position by pressing the up or down arrow keys. This sets the display resolution to 1 or 0.1 degree. This parameter is not available for thermocouple types R, S and B, where the display resolution is always 1 degree. When mV indicator mode is selected for thermocouple type, the display resolution is fixed at 0.01 mV (10 µV).

Press the **PAR** key to save the selection and advance to the next parameter.

TEMPERATURE DISPLAY OFFSET

-1999 to 9999

The temperature display can be corrected with an offset value. This can be used to compensate for probe errors or errors due to variances in probe placement, or to adjust the readout to a reference thermometer. Set the desired display offset value by pressing (and/or holding) the up or down arrow keys. When the desired offset value is displayed, press the **PAR** key to save the selection and advance to the next parameter. The display resolution for the offset value is the same as the decimal point position programmed above. The display offset is not available when mV indicator mode is selected for thermocouple type.

DIGITAL FILTERING

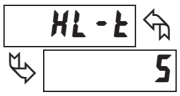
0 1 2 3

This parameter sets the amount of digital filtering applied to the input signal. If the temperature display is difficult to read due to small variations or noise, increased levels of filtering will help to stabilize the display. Although the digital filter features a "moving window" to help minimize response time, higher levels of filtering will result in slightly longer response times.

0 - no digital filtering
1 - normal filtering
2 - increased filtering
3 - maximum filtering

Set the desired level of input filtering by pressing the up or down arrow keys. Press the **PAR** key to save the selection and advance to the next parameter.

PEAK (HI)/ VALLEY (LO) CAPTURE DELAY TIME



0 2 5 10 20 seconds

When the Input display is above the present HI value or below the present LO value for the entered delay time, the meter will capture the Input display as the new HI or LO reading. A delay time helps to avoid false captures of sudden short spikes or Input display variations that may occur during start-up.

Set the desired capture delay time by pressing the up or down arrow keys. Press the **PAR** key to save the selection and advance to the next parameter.

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UNITS LABEL BACKLIGHT

The Units Label Kit Accessory contains a sheet of custom unit overlays, which can be installed in the meter bezel display assembly. The unit of measure for the meter display is then visible when the label backlight is illuminated. The two most commonly used temperature unit labels (°F and °C) are supplied with the meter. Press the up or down arrow keys to select whether the units label backlight is illuminated. Press the **PAR** key to save the selection and advance to the next parameter.

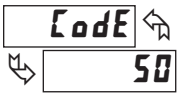
PROGRAMMING MODE EXIT

Before exiting Programming Mode, the meter offers the choice of entering Calibration Mode. To exit Programming Mode without entering Calibration Mode, select NO and press the **PAR** key. The meter briefly displays End and returns to the normal display mode. All programmed selections are now transferred to non-volatile memory and are retained if power is removed from the meter.

(If power loss occurs during Programming Mode, verify parameter changes and reprogram, if necessary, when power is restored.)

5.0 CALIBRATING THE METER

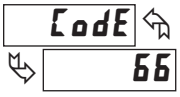
CALIBRATION MODE



To enter Calibration Mode, select CAL < > YES at the end of Programming Mode, and press the **PAR** key. In Calibration Mode, the user can restore the meter to factory default settings or recalibrate the signal input if necessary.

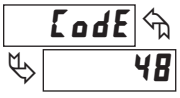
To prevent inadvertent entries, an access code must be entered to perform any operation in Calibration Mode. Upon entering Calibration Mode, the meter initially displays Code 50. Press the up or down arrow keys to select the access code for the desired operation. If an access code other than those shown below is entered, the meter exits Calibration Mode and returns to normal display mode.

FACTORY SETTINGS



The factory settings for the programming parameters are shown in the previous section in the alternating display illustrations. All programming parameters can be restored to the factory default settings by entering the access Code 66 and pressing the **PAR** key. The meter briefly displays rSEt and then returns to Code 50. This procedure resets only parameters that are accessed through Programming Mode. The Calibration Mode settings (input calibration levels) are not affected.

METER INPUT CALIBRATION



The meter has been fully calibrated at the factory. If the meter appears to be indicating incorrectly or inaccurately, refer to the troubleshooting section before attempting this procedure. When re-calibration is required *(generally every 2 years)*, the procedure should only be performed by qualified technicians using appropriate equipment. A precision thermometer (RTD, thermistor or similar type with an accuracy of ±0.3° C) and an accurate voltage source (0.01%) are required. The procedure consists of setting the cold junction temperature and applying accurate voltages to the meter input in a series of three steps. Allow a 60-minute warm-up before starting calibration.

COLD JUNCTION TEMPERATURE CALIBRATION

1. Connect a calibrated thermocouple (types T, E, J, K or N only) to the panel meter. Select the thermocouple type used in programming.
2. Connect the reference thermometer to the measuring end of the thermocouple. The two probes should be shielded from air movement and allowed sufficient time to equalize in temperature. (As an alternative, the PAXLTC thermocouple probe may be placed in a calibration bath of known temperature.)
3. From the normal indicator display mode, compare the display temperature to that of the reference thermometer. Allow 10 minutes for the temperature to equalize. The meter and the reference thermometer should agree to within 1° F (0.6° C).
4. If cold junction re-calibration is necessary (temperature out of tolerance), enter meter calibration mode and enter access Code 48. The meter display will alternate between CJC and the old cold junction reading. At this point, key-in the new cold junction temperature according to the formula:

WHERE:

New Cold Junction Reading = Old Cold Junction Reading + Difference
(Difference = Reference Thermometer Temperature - Meter Display Temperature)

5. Press **PAR**. The meter briefly displays ---- to acknowledge the new cold junction value.

VOLTAGE CALIBRATION

Following cold junction calibration, the display VCAL < > YES/NO appears. Enter YES if input voltage calibration is desired. If NO is entered, the meter exits calibration and returns to normal display mode.

DISPLAY	PARAMETERS	DESCRIPTION/COMMENT
0.0u	0.000 mV	Apply 0.000 mV, wait 20 seconds, press **PAR**.
30.0u	30.000 mV	Apply 30.000 mV, wait 20 seconds, press **PAR**.
60.0u	60.000 mV	Apply 60.000 mV, wait 20 seconds, press **PAR**.

The meter briefly displays End and returns to the normal display mode. Calibration is now complete.

It is recommended to check calibration by selecting mV indication mode for thermocouple type (tYPE < > VOLt) and verifying unit accuracy at various points over the range of the meter (-10 to +80 mV).

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TROUBLESHOOTING

The majority of all problems with the meter can be traced to improper connections or improper programming set-ups. Be sure all connections are clean and tight and check the programming set-ups for correct data.

For further technical assistance, contact technical support at the appropriate company numbers listed.

PROBLEM	POSSIBLE CAUSE	REMEDIES
NO DISPLAY	1. Power off, improperly connected, or brown-out.	1a. Check wiring. 1b. Verify power.
"EEEE" IN DISPLAY	1. Program data error.	1. Press **PAR** and check data set-ups.
". . . ." or "-. . . ." IN DISPLAY	1. Input display out of range. 2. Loss of data set-ups.	1a. Change display resolution to "1" degree. 1b. Reduce offset value. 2a. Check data set-ups. 2b. Check for electrical disturbance. 2c. Disconnect and reconnect power.
DISPLAY WANDERS	1. Loss of data set-ups.	1a. Check data set-ups. 1b. Disconnect and reconnect power. 1c. Check for electrical disturbance.
JITTERY DISPLAY	1. Electrical "Noise" in process or sensor lines. 2. Process inherently unstable. 3. Corroded or dirty thermocouple wire connections.	1a. Increase digital filtering. 1b. Re-route sensor wires. 2. Dampen process to eliminate oscillations. 3. Clean and tighten connections.
"OPEN" IN DISPLAY	1. Probe unconnected. 2. Broken or burnout probe.	1. Connect probe. 2. Repair or obtain new probe.
"OLOL" IN DISPLAY	1. Excessive positive probe temperature.	1. Reduce temperature.
"ULUL" IN DISPLAY	1. Excessive negative probe temperature.	1. Increase temperature.

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MODEL PAXLRT - PAX LITE RTD METER

c UL US LISTED
IND. CONT. EQ.
51EB

- *ACCEPTS STANDARD 3-WIRE 100 Ω RTD SENSORS (ALPHA = 0.00385 or ALPHA = 0.00392)*
- *CONFORMS TO ITS-90 STANDARDS*
- *SELECTABLE °F OR °C WITH 0.1 OR 1 DEGREE DISPLAY RESOLUTION*
- *STATE-OF-THE-ART DIGITAL ELECTRONICS FOR GREATER ACCURACY AND RELIABILITY*
- *FULL 4-DIGIT, HIGH VISIBILITY, 0.56" (14.2 mm) HIGH RED LED DISPLAY*
- *PROGRAMMABLE TEMPERATURE OFFSET*
- *PROGRAMMABLE DIGITAL FILTERING*
- *PEAK/VALLEY (HI/LO READING) MEMORY*
- *NEMA 4X/IP65 SEALED FRONT BEZEL*
- *CUSTOM UNITS OVERLAY WITH BACKLIGHT*

CE

GENERAL DESCRIPTION

The Pax Lite RTD Meter accepts standard RTD inputs and precisely linearizes them into temperature readings. A full 4-digit display accommodates a wide range of temperature inputs. State-of-the-art digital circuitry virtually eliminates errors due to drift.

The meter features a readout choice of either Fahrenheit or Celsius with 0.1 or 1 degree resolution. English Style display prompts and front panel buttons aid the operator through set-up and operation. Programmable digital filtering enhances the stability of the reading. All set-up data is stored in EEPROM, which will hold data for a minimum of 10 years without power.

The meter provides a Peak (HI) and Valley (LO) reading memory with selectable capture delay time. The capture delay is used to prevent detection of false Peak or Valley readings that may occur during start-up or unusual process events. The Peak and Valley readings are stored at power-down to allow monitoring the process limits over any length of time (shifts, days, etc.).

The meter has several built-in diagnostic functions to alert operators of any malfunction. Extensive testing of noise interference mechanisms and full burn-in makes the meter extremely reliable in industrial environments. The front bezel meets NEMA 4X/IP65 requirements for wash down applications.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the literature or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired. Do not use this unit to directly command motors, valves, or other actuators not equipped with safeguards. To do so, can be potentially harmful to persons or equipment in the event of a fault to the unit.

CAUTION: Risk of Danger
Read complete instructions prior to installation and operation of the unit.

CAUTION: Risk of electric shock.

DEFINITION OF TERMS

INSTALLATION CATEGORY (overvoltage category) **I**:
Signal level, special equipment or parts of equipment, telecommunication, electronic, etc. with smaller transient overvoltages than Installation Category (overvoltage category) II.

INSTALLATION CATEGORY (overvoltage category) **II**:
Local level, appliances, portable equipment, etc. with smaller transient overvoltages than Installation Category (overvoltage category) III.

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DIMENSIONS In inches (mm)

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 2.1" (53.4) H x 5" (127) W.

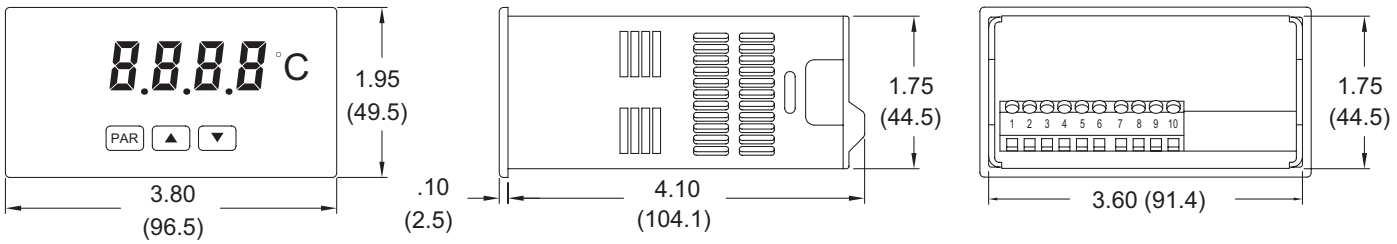

Table of Contents

Ordering Information

Meter Part Numbers

PAXL	RT	0	0

RT - RTD Temperature Meter

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Accessories Part Numbers*

TYPE	MODEL NO.	DESCRIPTION	PART NUMBERS
Accessories	**PAXLBK**	Units Label Kit Accessory	PAXLBK30

*This meter is shipped with °F and °C overlay labels. The label kit is only needed if another units label is desired.

General Meter Specifications

1. **DISPLAY**: 4-digit, 0.56" (14.2 mm) high red LED, minus sign displayed for negative temperatures.
   Overrange/Underrange Input: Flashing "OLOL" or "ULUL"
   Overrange/Underrange Display: "...." or "-...."
2. **POWER**: 85 to 250 VAC, 50/60 Hz, 6 VA
   Isolation: 2300 Vrms for 1 min. between input and supply (300 V working voltage)
3. **CONTROLS**: Three front panel push buttons for meter set-up. Rear terminal input for disabling the front panel.
4. **RESOLUTION**: 0.1 or 1 degree
5. **RANGE**: Decimal Point Dependent
   0.1° res: -199.9° to 850.0 °C (-199.9° to 999.9 °F);
   1° res: -200° to 850 °C (-328° to 1562 °F)
6. **OPEN/SHORTED RTD DETECTION**: Display flashes: "OPEN" or "SHrt"
7. **LEAD RESISTANCE EFFECT**: 20 Ω max., 2.5 °C/Ω error for V exc. and common lead unbalance
8. **ACCURACY**: 0.3 °C, @ 23 °C and 30 min. warm-up
9. **READING RATE**: 2.5 readings/second
10. **RESPONSE TIME**: 2 seconds to settle for step input (increases with programmable digital filtering)
11. **LOW FREQUENCY NOISE REJECTION**:
    Normal Mode Rejection: 40 dB @ 50/60 Hz (may be improved by programmable digital filtering)
    Common Mode Rejection: 120 dB, DC to 50/60 Hz
12. **CERTIFICATIONS AND COMPLIANCES**:
    SAFETY
    UL Recognized Component, File # E179259, UL61010A-1, CSA C22.2 No. 61010-1
    Recognized to U.S. and Canadian requirements under the Component Recognition Program of Underwriters Laboratories, Inc.
    UL Listed, File # E137808, UL508, CSA C22.2 No. 14-M95
    LISTED by Und. Lab. Inc. to U.S. and Canadian safety standards
    Type 4X Enclosure rating (Face only), UL50
    IECEE CB Scheme Report # 04ME11209-20041018
    Issued by Underwriters Laboratories, Inc.
    IEC 61010-1, EN 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1.
    IP65 Enclosure rating (Face only), IEC 529

ELECTROMAGNETIC COMPATIBILITY
Emissions and Immunity to EN 61326: Electrical Equipment for Measurement, Control and Laboratory use.

Immunity:		
Electrostatic discharge	EN 61000-4-2	Criterion A 4 kV contact discharge 8 kV air discharge
Electromagnetic RF fields	EN 61000-4-3	Criterion A 10 V/m
Fast transients (burst)	EN 61000-4-4	Criterion A 2 kV power 2 kV signal
Surge	EN 61000-4-5	Criterion A 1 kV L-L, 2 kV L&N-E power 1 kV signal
RF conducted interference	EN 61000-4-6	Criterion A 3 V/rms
Voltage dip/interruptions	EN 61000-4-11	Criterion A 0.5 cycle
Emissions:		
Emissions	EN 55011	Class B

Note:
1. Criterion A: Normal operation within specified limits.

13. **ENVIRONMENTAL CONDITIONS**:
    Operating Temperature Range: 0 to 50 °C
    Storage Temperature Range: -40 to 80 °C
    Operating and Storage Humidity: 85% max (non-condensing) from 0 to 50 °C
    Span Drift: 50 ppm/ °C
    Zero Drift: 0.001 °C/°C
    Vibration According to IEC 68-2-6: Operational 5 to 150 Hz, in X, Y, Z direction for 1.5 hours, 2 g's.
    Shock According to IEC 68-2-27: Operational 30 g's, 11 msec in 3 directions.
    Altitude: Up to 2000 meters.
14. **CONSTRUCTION**: This unit is rated for NEMA 4X/IP65 outdoor use. One piece bezel/case. Flame resistant. Panel gasket and mounting clip included.
15. **CONNECTIONS**: High compression cage-clamp terminal block
    Wire Strip Length: 0.3" (7.5 mm)
    Wire Gage: 30-14 AWG copper wire
    Torque: 4.5 inch-lbs (0.51 N-m) max.
16. **WEIGHT**: 0.65 lbs. (0.24 Kg)

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Accessories

UNITS LABEL KIT (PAXLBK)

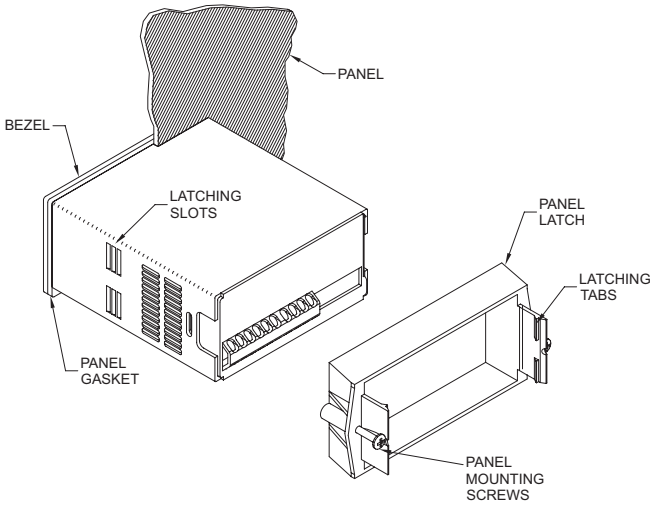
Each meter has a units indicator with backlighting that can be customized using the Units Label Kit. The backlight is controlled in the programming.

Each meter is shipped with °F and °C overlay labels which can be installed into the meter's bezel display assembly.

1.0 Installing the Meter

Installation

The PAX meets NEMA 4X/IP65 requirements when properly installed. The unit is intended to be mounted into an enclosed panel. Prepare the panel cutout to the dimensions shown. Remove the panel latch from the unit. Slide the panel gasket over the rear of the unit to the back of the bezel. The unit should be installed fully assembled. Insert the unit into the panel cutout.



While holding the unit in place, push the panel latch over the rear of the unit so that the tabs of the panel latch engage in the slots on the case. The panel latch should be engaged in the farthest forward slot possible. To achieve a proper seal, tighten the latch screws evenly until the unit is snug in the panel (Torque to approximately 7 in-lbs [79N-cm]). Do not over-tighten the screws.

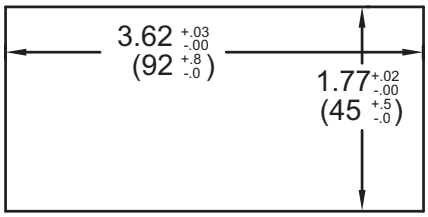
Installation Environment

The unit should be installed in a location that does not exceed the maximum operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.

The bezel should be cleaned only with a soft cloth and neutral soap product. Do NOT use solvents. Continuous exposure to direct sunlight may accelerate the aging process of the bezel.

Do not use tools of any kind (screwdrivers, pens, pencils, etc.) to operate the keypad of the unit.

PANEL CUT-OUT

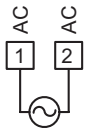


2.0 Wiring the Meter

POWER WIRING

Primary AC power is connected to Terminals 1 and 2. To reduce the chance of noise spikes entering the AC line and affecting the indicator, the AC power should be relatively "clean" and within the specified limits. Drawing power from heavily loaded circuits or circuits that also power loads that cycle on and off (contactors, relays, motors, machinery, etc.) should be avoided.

AC Power
Terminal 1: VAC
Terminal 2: VAC

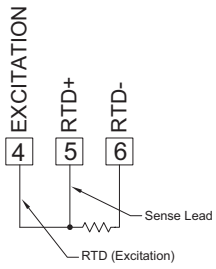


SIGNAL WIRING (RTD SENSOR)

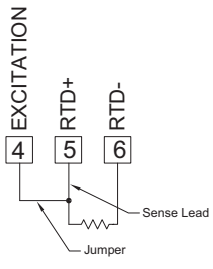
RTD sensors are used in applications where a high degree of accuracy is required. Most RTD sensors available are the 3-wire type. The 3rd additional wire is a sense lead for canceling the effects of lead resistance at the probe. The sense lead connects to Terminal 5 (RTD+), the common lead to Terminal 6 (RTD-), and the excitation lead to Terminal 4 (+ Excitation). The excitation and sense leads are generally the same color because they are functionally the same and may be interchanged at the meter. Four wire sensors have an additional sense lead connected (at the probe) to the common lead. Leave the extra sense lead disconnected when using a four wire probe with the PAXLRT meter. Always refer to the sensor manufacturer's instructions for probe wiring connections, if available. Two wire RTD sensors may be used with the PAXLRT by shorting Terminal 4 to Terminal 5, if the distance between sensor and meter is less than 30 feet. The total lead resistance can be used to predict the temperature error for 2-wire sensors, according to 2.5°C/Ω of lead resistance.

Note: Extended cable runs can be made provided the lead resistance is less than 20 Ω/lead and the resistance is equal in each lead.

3-Wire RTD



2-Wire RTD



PROGRAM DISABLE INPUT WIRING

PGM.DIS. (Terminal 3) is a digital input that is active when connected to RTD- (Terminal 6). Any form of mechanical switch or current sinking logic with less than 0.7 V saturation may be used. The use of shielded cable is recommended. Follow the EMC Installation Guidelines for shield connection.

WIRING OVERVIEW

Electrical connections are made via screw-clamp terminals located on the back of the meter. All conductors should conform to the meter's voltage and current ratings. All cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that the power supplied to the meter be protected by a fuse or circuit breaker.

When wiring the meter, compare the numbers embossed on the back of the meter case against those shown in wiring drawings for proper wire position. Strip the wire, leaving approximately 0.3" (7.5 mm) bare lead exposed (stranded wires should be tinned with solder). Insert the lead under the correct screw-clamp terminal and tighten until the wire is secure. (Pull wire to verify tightness.)

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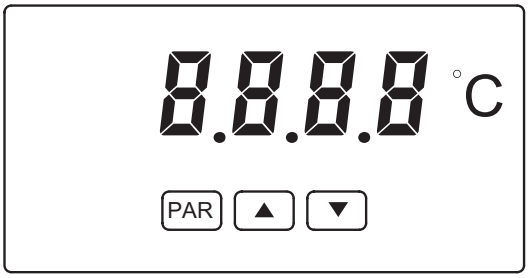
EMC INSTALLATION GUIDELINES

Although this meter is designed with a high degree of immunity to Electro-Magnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, source or coupling method into the meter may be different for various installations. The meter becomes more immune to EMI with fewer I/O connections. Cable length, routing, and shield termination are very important and can mean the difference between a successful or troublesome installation. Listed below are some EMC guidelines for successful installation in an industrial environment.

1. The meter should be mounted in a metal enclosure, which is properly connected to protective earth.
2. Use shielded (screened) cables for all Signal and Control inputs. The shield (screen) pigtail connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield only at the panel where the unit is mounted to earth ground (protective earth).
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is above 1 MHz.
   c. Connect the shield to common of the meter and leave the other end of the shield unconnected and insulated from earth ground.
3. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be run in metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter.
4. Signal or Control cables within an enclosure should be routed as far as possible from contactors, control relays, transformers, and other noisy components.
5. In extremely high EMI environments, the use of external EMI suppression devices, such as ferrite suppression cores, is effective. Install them on Signal and Control cables as close to the unit as possible. Loop the cable through the core several times or use multiple cores on each cable for additional protection. Install line filters on the power input cable to the unit to suppress power line interference. Install them near the power entry point of the enclosure. The following EMI suppression devices (or equivalent) are recommended:
   Ferrite Suppression Cores for signal and control cables:
   Fair-Rite # 0443167251 (RLC# FCOR0000)
   TDK # ZCAT3035-1330A
   Steward # 28B2029-0A0
   Line Filters for input power cables:
   Schaffner # FN610-1/07 (RLC# LFIL0000)
   Schaffner # FN670-1.8/07
   Corcom # 1 VR3
   Note: Reference manufacturer's instructions when installing a line filter.
6. Long cable runs are more susceptible to EMI pickup than short cable runs. Therefore, keep cable runs as short as possible.

3.0 REVIEWING THE FRONT BUTTONS AND DISPLAY



KEY	DISPLAY MODE OPERATION	PROGRAMMING MODE OPERATION
PAR	Access Programming Mode or Display Input Reading	Store selected parameter and index to next parameter
▲	Display Peak (HI) Reading	Increment value or change selection
▼	Display Valley (LO) Reading	Decrement value or change selection

PEAK/VALLEY DETECTION

The meter will automatically record the highest input reading (peak) and the lowest input reading (valley) for later recall. These values are stored at power-down to allow monitoring the process limits over any length of time (shifts, days, etc.). A selectable capture delay time is used to prevent detection of false peak or valley readings caused by sudden short spikes or unusual process events.

The peak and valley readings can be viewed and reset using the front panel keys as described below.

View Peak, Valley and Input readings:
To view Peak, press ▲. Meter displays HI followed by the Peak reading.
To view Valley, press ▼. Meter displays LO followed by the Valley reading.
To view Input, press **PAR**. Meter displays InPt followed by the current Input reading.

Note: The decimal point to the right of digit 1 flashes while the peak or valley reading is displayed.

Reset Peak and/or Valley to the current Input reading:
To reset Peak and Valley, press ▲ and ▼ simultaneously.
To reset Peak only, press and hold ▲ then press **PAR**.
To reset Valley only, press and hold ▼ then press **PAR**.
In each case, the meter displays rSEt followed by the current Input reading.

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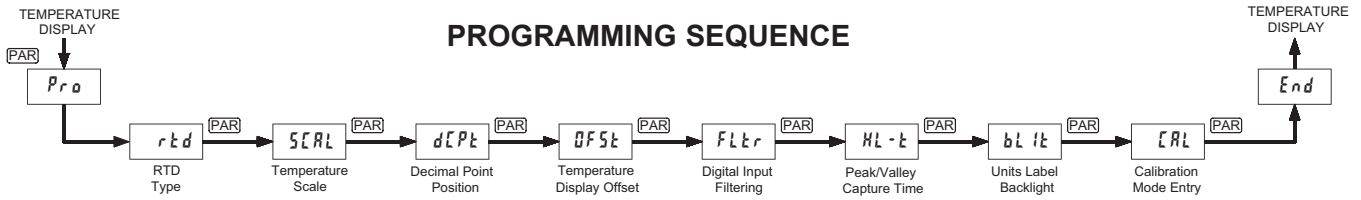
4.0 PROGRAMMING THE METER

PROGRAMMING SEQUENCE



The RTD Meter has seven programmable parameters that are entered in the sequence shown above, using the front panel push buttons.

The last programming step offers the choice of entering calibration mode. From this mode, the user can restore the meter to factory default settings or recalibrate the signal input if necessary. To prevent inadvertent entries, an access code must be keyed-in to perform any operations in calibration mode.

Note: Programming mode can be locked out using the Program Disable input terminal. With the PGM.DIS. terminal connected to RTD-, the meter displays "LOC" when the **PAR** *key is pressed, and will not enter programming mode.*

PROGRAMMING MODE ENTRY

Press the **PAR** key to enter Programming Mode. The meter briefly displays Pro followed by the first programming parameter described below.

PROGRAMMING MODE TIMEOUT

The Programming Mode has an automatic timeout feature. If no keypad activity is detected for approximately 60 seconds, the meter automatically exits Programming Mode. The meter briefly displays End and returns to the normal display mode. When automatic timeout occurs, any changes that were made to the parameter currently being programmed will not be saved.

PROGRAMMING PARAMETERS

In Programming Mode, the display alternates between the parameter and the current selection or value for that parameter. The dual display with arrows is used below to illustrate the alternating display. The selection choices or value range for each parameter is shown to the right of the alternating display.

RTD TYPE

rtd / 385 — 385 392

Select the RTD type by pressing the up or down arrow keys (▲ or ▼). When the desired selection is displayed, press the **PAR** key to save the selection and advance to the next parameter.

TEMPERATURE SCALE

SCAL / °F — °F °C

Select the desired temperature scale by pressing the up or down arrow keys. This setting does not change the Custom Units Overlay display (if installed). Press the **PAR** key to save the selection and advance to the next parameter.

DECIMAL POINT POSITION

dCPt / 0 — 0 0.0

Select the decimal point position by pressing the up or down arrow keys. This sets the display resolution to 1 or 0.1 degree. Press the **PAR** key to save the selection and advance to the next parameter.

TEMPERATURE DISPLAY OFFSET

OFSt / 0 — -1999 to 9999

The temperature display can be corrected with an offset value. This can be used to compensate for probe errors or errors due to variances in probe placement, or to adjust the readout to a reference thermometer. Set the desired display offset value by pressing (and/or holding) the up or down arrow keys. When the desired offset value is displayed, press the **PAR** key to save the selection and advance to the next parameter. The display resolution for the offset value is the same as the decimal point position programmed above.

DIGITAL FILTERING

FLtr / 1 — 0 1 2 3

This parameter sets the amount of digital filtering applied to the input signal. If the temperature display is difficult to read due to small variations or noise, increased levels of filtering will help to stabilize the display. Although the digital filter features a "moving window" to help minimize response time, higher levels of filtering will result in slightly longer response times.

0 - no digital filtering
1 - normal filtering
2 - increased filtering
3 - maximum filtering

Set the desired level of input filtering by pressing the up or down arrow keys. Press the **PAR** key to save the selection and advance to the next parameter.

PEAK (HI)/ VALLEY (LO) CAPTURE DELAY TIME

HL-t / 5 — 0 2 5 10 20 seconds

When the Input display is above the present HI value or below the present LO value for the entered delay time, the meter will capture the Input display as the new HI or LO reading. A delay time helps to avoid false captures of sudden short spikes or Input display variations that may occur during start-up.

Set the desired capture delay time by pressing the up or down arrow keys. Press the **PAR** key to save the selection and advance to the next parameter.

UNITS LABEL BACKLIGHT

bL It / OFF — ON OFF

The Units Label Kit Accessory contains a sheet of custom unit overlays, which can be installed in the meter bezel display assembly. The unit of measure for the meter display is then visible when the label backlight is illuminated. The two most commonly used temperature unit labels (°F and °C) are supplied with the meter. Press the up or down arrow keys to select whether the units label backlight is illuminated. Press the **PAR** key to save the selection and advance to the next parameter.

PROGRAMMING MODE EXIT

CAL / NO — YES NO

Before exiting Programming Mode, The meter offers the choice of entering Calibration Mode. To exit Programming Mode without entering Calibration Mode, select NO and press the **PAR** key. The meter briefly displays End and returns to the normal display mode. All programmed selections are now transferred to non-volatile memory and are retained if power is removed from the meter.

(If power loss occurs during Programming Mode, verify parameter changes and reprogram, if necessary, when power is restored.)

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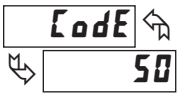
5.0 CALIBRATING THE METER

CALIBRATION MODE

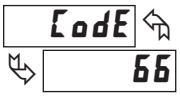


0 to 99

To enter Calibration Mode, select CAL <> YES at the end of Programming Mode, and press the **PAR** key. In Calibration Mode, the user can restore the meter to factory default settings or recalibrate the signal input if necessary.

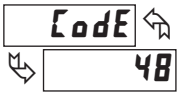
To prevent inadvertent entries, an access code must be entered to perform any operation in Calibration Mode. Upon entering Calibration Mode, the meter initially displays Code 50. Press the up or down arrow keys to select the access code for the desired operation. If an access code other than those shown below is entered, the meter exits Calibration Mode and returns to normal display mode.

FACTORY SETTINGS



The factory settings for the programming parameters are shown in the previous section in the alternating display illustrations. All programming parameters can be restored to the factory default settings by entering the access Code 66 and pressing the **PAR** key. The meter briefly displays rSEt and then returns to Code 50. This procedure resets only parameters that are accessed through Programming Mode. The Calibration Mode settings (input calibration levels) are not affected.

METER INPUT CALIBRATION



The meter has been fully calibrated at the factory. If the meter appears to be indicating incorrectly or inaccurately, refer to the troubleshooting section before attempting this procedure. When re-calibration is required *(generally every 2 years)*, the procedure should only be performed by qualified technicians using appropriate equipment. Resistance source accuracies of 0.02% or better are required.

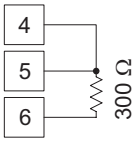
The procedure consists of applying accurate signal levels to the meter input in a series of two steps. Allow a 30-minute warm-up period before starting calibration. To begin the input calibration, enter access Code 48 and press the **PAR** key.

ENTER ZERO REFERENCE

Meter displays 0r. Apply 0 ohms to the meter input by shorting Terminals 4, 5, and 6. Allow the meter to stabilize at least 20 seconds after shorting the terminals, and then press **PAR**.

APPLY PRECISION RESISTANCE

Meter displays 300r. Connect a precision 300 ohm resistor across Terminals 5 and 6. Terminals 4 and 5 remain shorted. *(Note: Be certain to short Terminals 4 and 5 at the resistor as shown in the drawing below. Shorting terminals may lead to incorrect calibration.)*



Allow the meter to stabilize at least 20 seconds after making the connections, and then press **PAR**. The meter briefly displays End and returns to the normal display mode. Calibration is now complete. It is recommended to check calibration by comparing the displayed temperature with a precision thermometer.

TROUBLESHOOTING

The majority of all problems with the meter can be traced to improper connections or improper programming set-ups. Be sure all connections are clean and tight and check the programming set-ups for correct data.

For further technical assistance, contact technical support at the appropriate company numbers listed.

PROBLEM	POSSIBLE CAUSE	REMEDIES
NO DISPLAY	1. Power off, improperly connected, or brown-out.	1a. Check wiring. 1b. Verify power.
"EEEE" IN DISPLAY	1. Program data error.	1. Press **PAR** and check data set-ups.
". . . ." or "-. . . ." IN DISPLAY	1. Input display out of range. 2. Loss of data set-ups.	1a. Change display resolution to "1" degree. 1b. Reduce offset value. 2a. Check data set-ups. 2b. Check for electrical disturbance. 2c. Disconnect and reconnect power.
DISPLAY WANDERS	1. Loss of data set-ups.	1a. Check data set-ups. 1b. Disconnect and reconnect power. 1c. Check for electrical disturbance.
JITTERY DISPLAY	1. Electrical "Noise" in process or sensor lines. 2. Process inherently unstable.	1a. Increase digital filtering. 1b. Re-route signal wires. 2. Dampen process to eliminate oscillations.
"OPEn" IN DISPLAY	1. Probe unconnencted. 2. Broken or burnout probe. 3. Excessive probe temperature. 4. Input overload.	1. Connect probe. 2. Repair or obtain new probe. 3. Reduce temperature. 4. Check input levels.
"SHrt" IN DISPLAY	1. Input shorted.	1. Check input connections.

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MODEL PAXLT - PAX LITE TEMPERATURE METER

- *5 DIGIT, 0.56" HIGH RED LED DISPLAY*
- *DISPLAYS °C OR °F WITH 1° OR 0.1° RESOLUTION*
- *BACKLIGHT OVERLAYS INCLUDED (°C AND °F)*
- *MAX AND MIN READING MEMORY*
- *TC COLD JUNCTION COMPENSATION (ON/OFF)*
- *PROGRAMMABLE TEMPERATURE OFFSET*
- *PROGRAMMABLE USER INPUT*
- *DUAL 5 AMP FORM C RELAYS*
- *UNIVERSALLY POWERED*
- *NEMA 4X/IP65 SEALED FRONT BEZEL*
- *THERMOCOUPLE AND RTD INPUTS*
- *CONFORMS TO ITS-90 STANDARDS*

c UL US LISTED IND. CONT. EQ. 51EB

For Model No. PAXLT0U0 Only

GENERAL DESCRIPTION

The PAXLT is a versatile meter that accepts a variety of thermocouple and RTD inputs and provides a temperature display in Celsius or Fahrenheit. The readout conforms to ITS-90 standards, with 1° or 0.1° resolution. The 5-digit display has 0.56" high digits with adjustable intensity. Backlight overlay labels for °F and °C are included.

The meter features a Maximum and Minimum reading memory, with programmable capture time. The capture time is used to prevent detection of false max or min readings which may occur during start-up or unusual process events. Either value can be displayed if desired. The display can be toggled manually or automatically between the selected values.

Other features include thermocouple cold junction compensation, display offset and a programmable user input to perform a variety of meter control functions. Two setpoint outputs are provided, each with a Form C relay. Output modes and setup options are fully programmable to suit a variety of control requirements.

The PAXLT can be universally powered from a wide range of AC or DC voltage. The meter has been specifically designed for harsh industrial environments. With a NEMA 4X/IP65 sealed bezel and extensive testing to meet CE requirements, the meter provides a tough yet reliable application solution.

SAFETY SUMMARY

All safety regulations, local codes and instructions that appear in this and corresponding literature, or on equipment, must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Do not use this meter to directly command motors, valves, or other actuators not equipped with safeguards. To do so can be potentially harmful to persons or equipment in the event of a fault to the meter

CAUTION: Risk of Danger.
Read complete instructions prior to installation and operation of the unit.

CAUTION: Risk of electric shock.

SPECIFICATIONS

1. **DISPLAY**: 5 digit, 0.56" (14.2 mm) intensity adjustable Red LED
2. **POWER REQUIREMENTS**:
   AC POWER: 50 to 250 VAC 50/60 Hz, 12 VA
   Isolation: 2300 Vrms for 1 min. to all inputs and outputs
   DC POWER: 21.6 to 250 VDC, 6 W
3. **READOUT:**
   Display Range: -19999 to 99999
   Scale: °F or °C
   Resolution: 1° or 0.1°
   Response Time: 500 msec min.
   Display Overrange/Underrange Indication: "….." / "-…."
   Input Overrange/Underrange Indication: OLOL / ULUL

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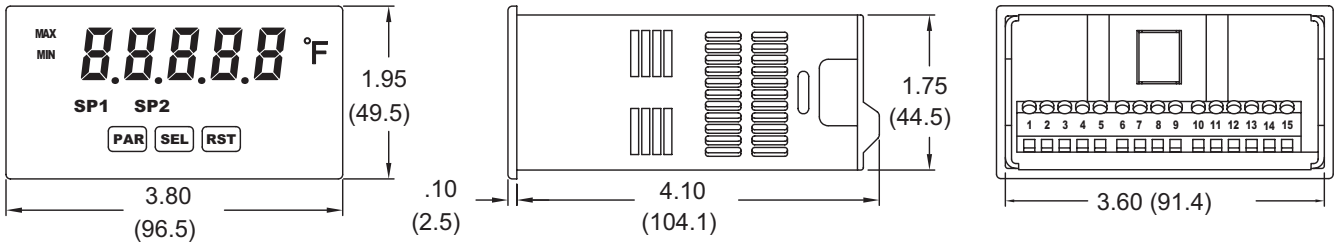
ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER
PAXLT	TC/RTD Temperature Meter with Dual Relay Output	PAXLT000
	UL Listed TC/RTD Temperature Meter with Dual Relay Output	PAXLT0U0

DIMENSIONS In inches (mm)

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 2.1" (53.4) H x 5.0" (127) W.



4. **THERMOCOUPLE INPUTS:**
Input Impedance: 20 MΩ
Max. Continuous Overvoltage: 30 VDC
Failed Sensor Indication: OPEN

TC TYPE	RANGE	ACCURACY @ 23°C ±°C *	ACCURACY @ 0 to 50°C ±°C *	WIRE COLOR	
				ANSI	BS 1843
T	-200 to 400°C -328 to 752°F	2.3	5.8	(+) blue (-) red	(+) white (-) blue
E	-200 to 871°C -328 to 1600°F	2.7	4.9	(+) purple (-) red	(+) brown (-) blue
J	-200 to 760°C -328 to 1400°F	1.9	4.3	(+) white (-) red	(+) yellow (-) blue
K	-200 to 1372°C -328 to 2502°F	2.3	5.8	(+) yellow (-) red	(+) brown (-) blue
R	-50 to 1768°C -58 to 3214°F	4.5	15.0	no standard	(+) white (-) blue
S	-50 to 1768°C -58 to 3214°F	4.5	15.0	no standard	(+) white (-) blue
B	200 to 1820°C 392 to 3308°F	9.1<540°C 4.5>540°C	42.6<540°C 15.0>540°C	no standard	no standard
N	-200 to 1300°C -328 to 2372°F	2.8	8.1	(+) orange (-) red	(+) orange (-) blue
C (W5/W26)	0 to 2315°C 32 to 4199°F	1.9	6.1	no standard	no standard
mV	-10.00 to 65.00	0.02 mV	0.08 mV	no standard	no standard

*After 20 min. warm-up. Accuracy is specified in two ways: Accuracy at 23°C and 15 to 75% RH environment; and Accuracy over a 0 to 50 °C and 0 to 85% RH (non condensing) environment. Accuracy specified over the 0 to 50 °C operating range includes meter tempco and cold junction tracking effects.

The specification includes the A/D conversion errors, linearization conformity, and thermocouple cold junction compensation. Total system accuracy is the sum of meter and probe errors. Accuracy may be improved by field calibrating the meter readout at the temperature of interest.

5. **RTD INPUTS**:
Type: 2, 3 or 4 wire
Excitation Current:
100 ohm range: 165 µA; 10 ohm range: 2.5 mA
Lead Resistance:
100 ohm range: 10 Ω/lead max.; 10 ohm range: 3 Ω/lead max.
Balanced Lead Resistance: Automatically compensated up to max per lead
Unbalanced Lead Resistance: Uncompensated
Max. Continuous Overvoltage: 30 VDC
Failed Sensor Indication: OPEN or Short

RTD TYPE	RANGE	ACCURACY* @ 23°C	ACCURACY* @0 to 50°C	STANDARD
100 ohm Pt alpha = .00385	-200 to 850°C	0.4°C	1.6°C	IEC 751
100 ohm Pt alpha = .00392	-200 to 850°C	0.4°C	1.6°C	no official standard
120 ohm Nickel alpha = .00672	-80 to 260°C	0.2°C	0.5°C	no official standard
10 ohm Copper alpha = .00427	-100 to 260°C	0.4°C	0.9°C	no official standard

*After 20 min. warm-up. Accuracy is specified in two ways: Accuracy at 23°C and 15 to 75% RH environment; and Accuracy over a 0 to 50°C and 0 to 85% RH (non condensing) environment. Accuracy specified over the 0 to 50°C operating range includes meter tempco effects.

The specification includes the A/D conversion errors and linearization conformity. Total system accuracy is the sum of meter and probe errors. Accuracy may be improved by field calibrating the meter readout at the temperature of interest.

6. **USER INPUT**: Programmable input
Software selectable for active logic state: active low, pull-up (24.7 KΩ to +5 VDC) or active high, pull-down resistor (20 KΩ).
Trigger levels: V_{IL} = 1.0 V max; V_{IH} = 2.4 V min; V_{MAX} = 28 VDC
Response Time: 10 msec typ.; 50 msec debounce (activation and release)
7. **MEMORY**: Nonvolatile E^2PROM retains all programming parameters and max/min values when power is removed.
8. **OUTPUTS**:
Type: Dual Form C contacts
Isolation to Sensor & User Input Commons: 1400 Vrms for 1 min. Working Voltage: 150 Vrms
Contact Rating: 5 amps @ 120/240 VAC or 28 VDC (resistive load), 1/8 H.P. @ 120 VAC (inductive load)
Life Expectancy: 100 K cycles min. at full load rating. External RC snubber extends relay life for operation with inductive loads.
Response Time: Turn On or Off: 4 msec max.
9. **ENVIRONMENTAL CONDITIONS**:
Operating temperature: 0 to 50 °C
Storage temperature: -40 to 70 °C
Operating and storage humidity: 0 to 85% max. RH (non-condensing)
Vibration to IEC 68-2-6: Operational 5 to 150 Hz, 2 g.
Shock to IEC 68-2-27: Operational 30 g (10 g relay).
Altitude: Up to 2,000 meters
10. **CONNECTIONS**: High compression cage-clamp terminal block
Wire Strip Length: 0.3" (7.5 mm)
Wire Gage: 30-14 AWG copper wire
Torque: 4.5 inch-lbs (0.51 N-m) max.
11. **CONSTRUCTION**: This unit is rated for NEMA 4X/IP65 outdoor use. IP20 Touch safe. Installation Category II, Pollution Degree 2. One piece bezel/case. Flame resistant. Synthetic rubber keypad. Panel gasket and mounting clip included.
12. **CERTIFICATIONS AND COMPLIANCES**:
CE Approved
EN 61326-1 Immunity to Industrial Locations
Emission CISPR 11 Class A
IEC/EN 61010-1
RoHS Compliant
Type 4X Outdoor Enclosure rating (Face only)
IP65 Enclosure rating (Face only)
IP20 Enclosure rating (Rear of unit)
For Model No. PAXLT0U0 Only: UL Listed: File #E137808
Refer to EMC Installation Guidelines section of the bulletin for additional information.
13. **WEIGHT**: 10.4 oz. (295 g)

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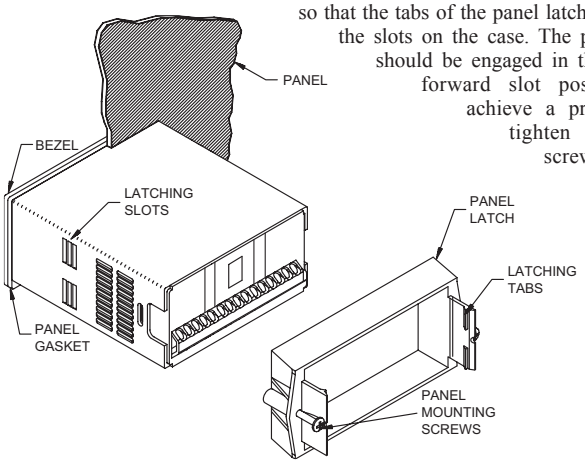
1.0 Installing the Meter

Installation

The PAX Lite meets NEMA 4X/IP65 requirements when properly installed. The unit is intended to be mounted into an enclosed panel. Prepare the panel cutout to the dimensions shown. Remove the panel latch from the unit. Slide the panel gasket over the rear of the unit to the back of the bezel. The unit should be installed fully assembled. Insert the unit into the panel cutout.

While holding the unit in place, push the panel latch over the rear of the unit so that the tabs of the panel latch engage in the slots on the case. The panel latch should be engaged in the farthest forward slot possible. To achieve a proper seal, tighten the latch screws evenly until the unit is snug in the panel (Torque to approximately 7 in-lbs [79N-cm]). Do not over-tighten the screws.



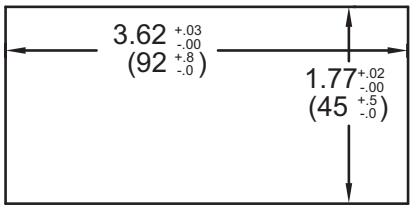
Installation Environment

The unit should be installed in a location that does not exceed the maximum operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.

The bezel should be cleaned only with a soft cloth and neutral soap product. Do NOT use solvents. Continuous exposure to direct sunlight may accelerate the aging process of the bezel.

Do not use tools of any kind (screwdrivers, pens, pencils, etc.) to operate the keypad of the unit.

PANEL CUT-OUT

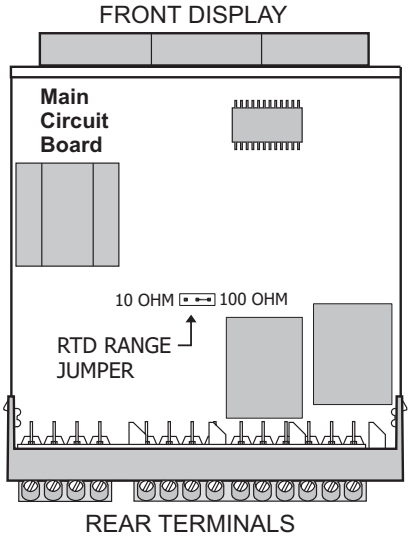


2.0 Setting the Jumper

INPUT RANGE JUMPER (RTD ONLY)

This jumper is used to select the proper input range for the RTD probe being used (10 ohm or 100 ohm). For thermocouple inputs, this jumper has no effect and can be left in either position.

To access the jumper, remove the meter base from the case by firmly squeezing and pulling back on the side rear finger tabs. This should lower the latch below the case slot (which is located just in front of the finger tabs). It is recommended to release the latch on one side, then start on the other side latch.



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3.0 Wiring the Meter

WIRING OVERVIEW

Electrical connections are made via screw-clamp terminals located on the back of the meter. All conductors should conform to the meter's voltage and current ratings. All cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that the power supplied to the meter (DC or AC) be protected by a fuse or circuit breaker.

When wiring the meter, compare the numbers embossed on the back of the meter case against those shown in wiring drawings for proper wire position. Strip the wire, leaving approximately 0.3" (7.5 mm) bare lead exposed (stranded wires should be tinned with solder.) Insert the lead under the correct screw-clamp terminal and tighten until the wire is secure. (Pull wire to verify tightness.)

EMC INSTALLATION GUIDELINES

Although Red Lion Controls Products are designed with a high degree of immunity to Electromagnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, source or coupling method into a unit may be different for various installations. Cable length, routing, and shield termination are very important and can mean the difference between a successful or troublesome installation. Listed are some EMI guidelines for a successful installation in an industrial environment.

1. A unit should be mounted in a metal enclosure, which is properly connected to protective earth.
2. Use shielded cables for all Signal and Control inputs. The shield connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.

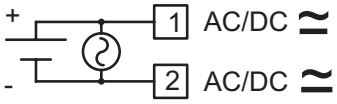
a. Connect the shield to earth ground (protective earth) at one end where the unit is mounted.
b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is over 1 MHz.

3. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors, feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be run through metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter. Also, Signal or Control cables within an enclosure should be routed as far away as possible from contactors, control relays, transformers, and other noisy components.
4. Long cable runs are more susceptible to EMI pickup than short cable runs.
5. In extremely high EMI environments, the use of external EMI suppression devices such as Ferrite Suppression Cores for signal and control cables is effective. The following EMI suppression devices (or equivalent) are recommended:
   Fair-Rite part number 0443167251 (RLC part number FCOR0000)
   Line Filters for input power cables:
   Schaffner # FN2010-1/07 (Red Lion Controls # LFIL0000)
6. To protect relay contacts that control inductive loads and to minimize radiated and conducted noise (EMI), some type of contact protection network is normally installed across the load, the contacts or both. The most effective location is across the load.
   a. Using a snubber, which is a resistor-capacitor (RC) network or metal oxide varistor (MOV) across an AC inductive load is very effective at reducing EMI and increasing relay contact life.
   b. If a DC inductive load (such as a DC relay coil) is controlled by a transistor switch, care must be taken not to exceed the breakdown voltage of the transistor when the load is switched. One of the most effective ways is to place a diode across the inductive load. Most RLC products with solid state outputs have internal zener diode protection. However external diode protection at the load is always a good design practice to limit EMI. Although the use of a snubber or varistor could be used.
   RLC part numbers: Snubber: SNUB0000
   Varistor: ILS11500 or ILS23000
7. Care should be taken when connecting input and output devices to the instrument. When a separate input and output common is provided, they should not be mixed. Therefore a sensor common should NOT be connected to an output common. This would cause EMI on the sensitive input common, which could affect the instrument's operation.

Visit RLC's web site at http://www.redlion.net/Support/InstallationConsiderations.html for more information on EMI guidelines, Safety and CE issues as they relate to Red Lion Controls products.

3.1 POWER WIRING

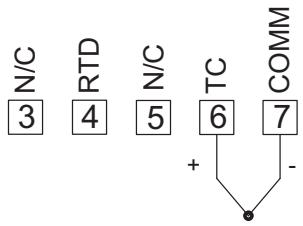
Power
Terminal 1: VAC/DC +
Terminal 2: VAC/DC -



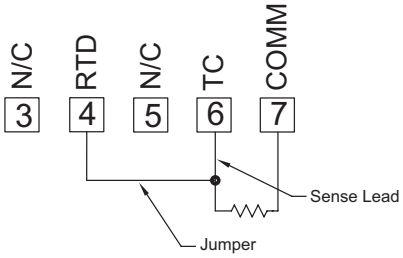
3.2 INPUT SIGNAL WIRING

CAUTION: Sensor input common (Terminal 7) is NOT isolated from user common (Terminal 9). In order to preserve the safety of the meter application, the sensor input common must be suitably isolated from hazardous live earth referenced voltages; or input common and user common must be at protective earth ground potential. If not, hazardous live voltage may be present at the user input and user common terminals. Appropriate considerations must then be given to the potential of the sensor input common and the user common with respect to earth ground.

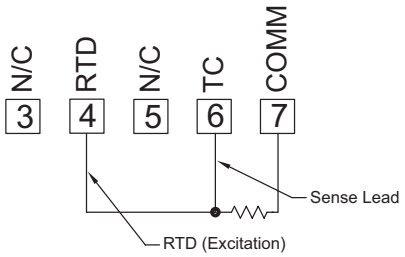
THERMOCOUPLE



2-WIRE RTD



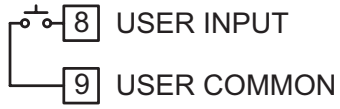
3-WIRE RTD



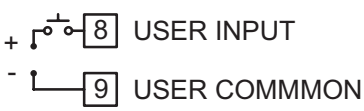
3.3 USER INPUT WIRING

Terminal 8: User Input
Terminal 9: User Common

Current Sinking (Active Low Logic)

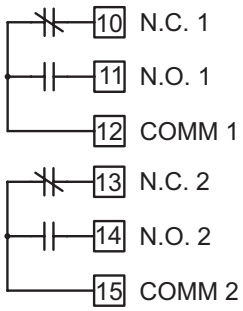


Current Sourcing (Active High Logic)



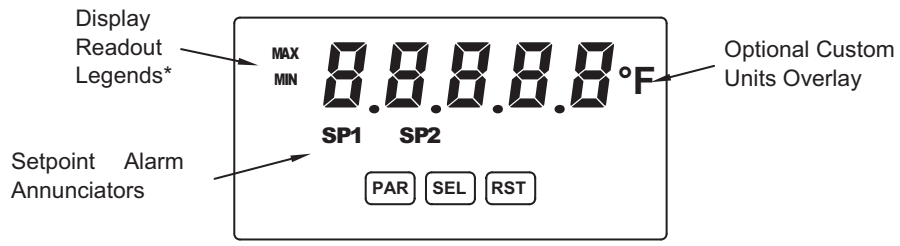
3.4 SETPOINT (OUTPUT) WIRING

Terminal 10: NC 1
Terminal 11: NO 1
Terminal 12: Relay 1 Common
Terminal 13: NC 2
Terminal 14: NO 2
Terminal 15: Relay 2 Common



F

4.0 Reviewing the Front Buttons and Display



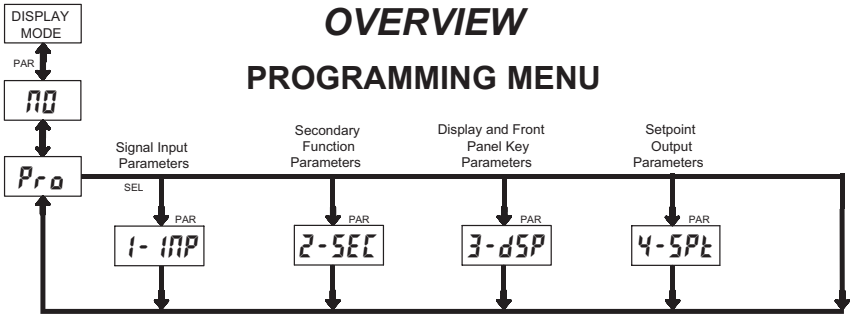
BUTTON	DISPLAY MODE OPERATION	PROGRAMMING MODE OPERATION
PAR	Access Programming Mode	Store selected parameter and index to next parameter
SEL	Index display through enabled values	Advance through selection list/select digit position in parameter value
RST	Resets values (min/max) or outputs	Increment selected digit of parameter value

OPERATING MODE DISPLAY DESIGNATORS

MAX - Maximum display capture value
MIN - Minimum display capture value
"SP1" - Indicates setpoint 1 output activated.
"SP2" - Indicates setpoint 2 output activated.

Pressing the **SEL** button toggles the meter through the selected displays. If display scroll is enabled, the display will toggle automatically every four seconds between the enabled display values.

5.0 Programming the Meter



OVERVIEW

PROGRAMMING MENU

PROGRAMMING MODE ENTRY (PAR BUTTON)

It is recommended all programming changes be made off line, or before installation. The meter normally operates in the Display Mode. No parameters can be programmed in this mode. The Programming Mode is entered by pressing the **PAR** button. If it is not accessible, then it is locked by either a security code or a hardware lock.

MODULE ENTRY (SEL & PAR BUTTONS)

The Programming Menu is organized into four modules. These modules group together parameters that are related in function. The display will alternate between **Pro** and the present module. The **SEL** button is used to select the desired module. The displayed module is entered by pressing the **PAR** button.

MODULE MENU (PAR BUTTON)

Each module has a separate module menu (which is shown at the start of each module discussion). The **PAR** button is pressed to advance to a particular parameter to be changed, without changing the programming of preceding parameters. After completing a module, the display will return to **Pro no**. Programming may continue by accessing additional modules.

SELECTION / VALUE ENTRY

For each parameter, the display alternates between the present parameter and the selections/value for that parameter. The **SEL** and **RST** buttons are used to move through the selections/values for that parameter. Pressing the **PAR** button, stores and activates the displayed selection/value. This also advances the meter to the next parameter.

For numeric values, the value is displayed with one digit flashing (initially the right most digit). Pressing the **RST** button increments the digit by one or the user can hold the **RST** button and the digit will automatically scroll. The **SEL** button will select the next digit to the left. Pressing the **PAR** button will enter the value and move to the next parameter.

PROGRAMMING MODE EXIT (PAR BUTTON)

The Programming Mode is exited by pressing the **PAR** button with **Pro no** displayed. This will commit any stored parameter changes to memory and return the meter to the Display Mode. (If power loss occurs before returning to the Display Mode, verify recent parameter changes.)

PROGRAMMING TIPS

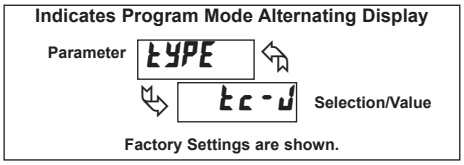
It is recommended to start with Module 1 and proceed through each module in sequence. When programming is complete, it is recommended to record the parameter programming and lock out parameter programming with the user input or programming security code.

FACTORY SETTINGS

Factory Settings may be completely restored in Module 2. This is useful when encountering programming problems.

ALTERNATING SELECTION DISPLAY

In the explanation of the modules, the following dual display with arrows will appear. This is used to illustrate the display alternating between the parameter on top and the parameter's Factory Setting on the bottom. In most cases, selections and values for the parameter will be listed on the right.



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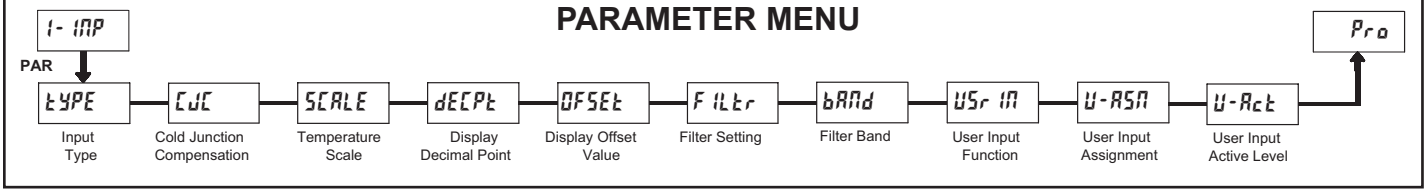
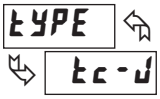
5.1 MODULE 1 - INPUT SETUP PARAMETERS (1-INP)

PARAMETER MENU



INPUT TYPE

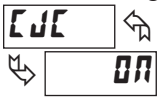


SELECTION	INPUT TYPE	SELECTION	INPUT TYPE
tC-t	T	tC-n	N
tC-E	E	tC-C	C
tC-J	J	VOLt	mV
tC-K	K	Pt385	Platinum 385 100 Ω
tC-r	R	Pt392	Platinum 392 100 Ω
tC-S	S	n.672	Nickel 672 100 Ω
tC-b	B	Cu427	Copper 427 10 Ω

Select the thermocouple or RTD type used for the application. For RTDs, position the Input Range Jumper to match the RTD type (10Ω or 100Ω).

Selecting VOLt displays a millivolt signal readout with 10 µV resolution.

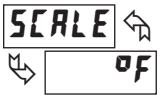
COLD JUNCTION COMPENSATION



On OFF

This parameter enables or disables internal cold junction compensation for thermocouples. For most applications, cold junction compensation should be enabled (On). This parameter only appears for thermocouple input selections.

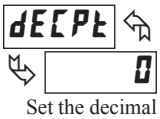
TEMPERATURE SCALE



°F °C

Select the desired temperature scale. This selection applies for the Input, MAX and MIN displays. This parameter does not appear when mV or RTD resistance display is enabled.

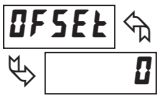
DISPLAY DECIMAL POINT



0 0.0

Set the decimal point for the desired display resolution. This selection applies for the Input, MAX and MIN displays, and also affects the Setpoint and Display Offset values. For mV or RTD resistance displays, the decimal point location is fixed and this parameter does not appear.

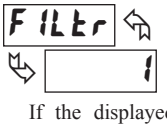
DISPLAY OFFSET VALUE



-19999 to 99999

The temperature display can be corrected with an offset value. This can be used to compensate for probe errors, errors due to variances in probe placement or adjusting the readout to a reference thermometer.

FILTER SETTING

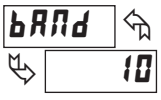


0 1 2 3

If the displayed temperature is difficult to read due to small process variations or noise, increased levels of filtering will help to stabilize the display. Software filtering effectively combines a fraction of the current input reading with a fraction of the previous displayed reading to generate the new display.

Filter values represent no filtering (0), up to heavy filtering (3). A value of 1 for the filter uses 1/4 of the new input and 3/4 of the previous display to generate the new display. A filter value of 2 uses 1/8 new and 7/8 previous. A filter value of 3 uses 1/16 new and 15/16 previous.

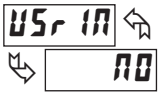
FILTER BAND



0 to 199 display units

The filter will adapt to variations in the input signal. When the variation exceeds the input filter band value, the filter disengages. When the variation becomes less than the band value, the filter engages again. This allows for a stable readout, but permits the display to settle rapidly after a large process change. The value of the band is in display units, independent of the Display Decimal Point position. A band setting of '0' keeps the filter permanently engaged at the filter level selected above.

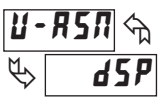
USER INPUT FUNCTION



DISPLAY	MODE	DESCRIPTION
no	No Function	User Input disabled.
P-Loc	Program Mode Lock-out	See Programming Mode Access chart (Module 3).
rESEt	Reset *	Reset the assigned value(s) to the current input value.
d-HLd	Display Hold	Holds the assigned display, but all other meter functions continue as long as activated (maintained action).
d-SEL	Display Select *	Advance once for each activation.
d-LEU	Display Intensity Level *	Increase intensity one level for each activation.
rSt-1	Setpoint 1 Reset *	Reset setpoint 1 output.
rSt-2	Setpoint 2 Reset *	Reset setpoint 2 output.
rSt 12	Setpoint 1 and 2 Reset *	Reset both setpoint 1 and 2 outputs.

** Indicates Edge Triggered function. All others are Level Active functions.*

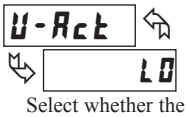
USER INPUT ASSIGNMENT



HI HI-LO
LO dSP

Select the value(s) to which the User Input Function is assigned. The User Input Assignment only applies if a selection of reset or display hold is selected in the User Input Function menu.

USER INPUT ACTIVE LEVEL



HI LO

Select whether the user input is configured as active low or active high.

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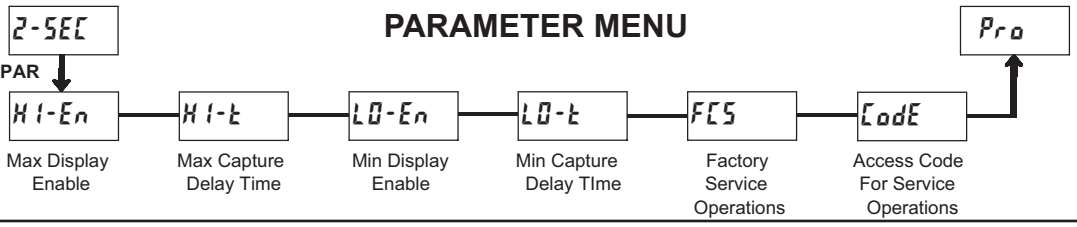
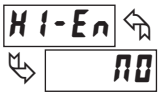
5.2 MODULE 2 - SECONDARY FUNCTION PARAMETERS (2-SEC)



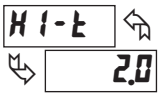
MAX DISPLAY ENABLE



NO YES

Enables the Maximum Display Capture capability.

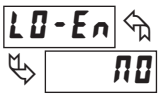
MAX CAPTURE DELAY TIME



0.0 to 999.9 sec.

When the Input Display is above the present MAX value for the entered delay time, the meter will capture that display value as the new MAX reading. A delay time helps to avoid false captures of sudden short spikes.

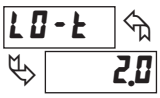
MIN DISPLAY ENABLE



NO YES

Enables the Minimum Display Capture capability.

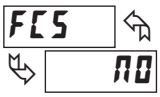
MIN CAPTURE DELAY TIME



0.0 to 999.9 sec.

When the Input Display is below the present MIN value for the entered delay time, the meter will capture that display value as the new MIN reading. A delay time helps to avoid false captures of sudden short spikes.

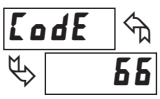
FACTORY SERVICE OPERATIONS



NO YES

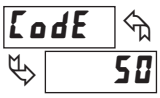
Select YES to perform any of the Factory Service Operations shown below.

RESTORE FACTORY DEFAULT SETTINGS



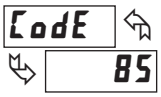
Entering Code 66 will overwrite all user settings with the factory settings. The meter will display rESEt and then return to CodE 00. Press the **PAR** button to exit the module

VIEW MODEL AND VERSION DISPLAY



Entering Code 50 will display the version (x.x) of the meter. The display then returns to CodE 00. Press the **PAR** button to exit the module.

TOGGLE RTD INPUT DISPLAY MODE

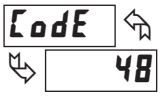


Entering Code 85 toggles the selected RTD input display mode between a temperature or resistance readout. The resistance readout is useful for diagnostic purposes before and after calibration, or to display the measured resistance of a connected RTD probe.

For RTD type Cu427 (Input Range Jumper in 10Ω position), resistance is displayed in 0.000 ohms resolution. For all other RTD types (100Ω position), resistance is displayed in 0.00 ohms resolution.

Upon entering Code 85, the meter displays either dSP-t or dSP-r to indicate temperature or resistance readout selected. The display then returns to CodE 00. Press the **PAR** button to exit the module.

CALIBRATION



The PAXLT uses stored calibration values to provide accurate temperature measurements. Over time, the electrical characteristics of the components inside the meter could slowly change, with the result being that the stored calibration values may no longer accurately define the input circuit. For most applications, recalibration every 1 to 2 years should be sufficient.

Calibration for thermocouple inputs involves a voltage calibration and a cold junction calibration. It is recommended that both calibrations be performed. The voltage calibration must precede cold junction calibration.

Calibration of the meter should only be performed by persons experienced in calibrating electronic equipment. Allow a minimum 30 minute warm up before performing any calibration procedures. The following procedures should be performed at an ambient temperature of 15 to 35°C (59 to 95°F).

CAUTION: The accuracy of the calibration equipment will directly affect the accuracy of the meter.

10 OHM RTD Range Calibration

1. Set the Input Range Jumper to 10 ohm position.
2. With the display at CodE 48, press the **PAR** key. Unit displays CAL NO.
3. Press **SEL** to select 10 ohm range. Display reads CAL r10.
4. Press **PAR**. Display reads 0.0r.
5. Apply a direct short to terminals RTD (4), TC (6) and COMM (7) using a three wire link. Press **PAR**. Display reads CALC for about 10 seconds.
6. When the display reads 15.0r, apply a precision resistance of 15 ohms (with an accuracy of 0.01% or better) to terminals RTD, TC and COMM using a three wire link. Press **PAR**. Display reads CALC for about 10 seconds.
7. When display reads CAL NO, press **PAR** twice to exit calibration and return to the normal display mode.

100 OHM RTD Range Calibration

1. Set the Input Range Jumper to 100 ohm position.
2. With the display at CodE 48, press the **PAR** key. Unit displays CAL NO.
3. Press **SEL** twice to select 100 ohm range. Display reads CAL r100.
4. Press **PAR**. Display reads 0.0r.
5. Apply a direct short to terminals RTD (4), TC (6) and COMM (7) using a three wire link. Press **PAR**. Display reads CALC for about 10 seconds.
6. When the display reads 300.0r, apply a precision resistance of 300 ohms (with an accuracy of 0.01% or better) to terminals RTD, TC and COMM using a three wire link. Press **PAR**. Display reads CALC for about 10 seconds.
7. When display reads CAL NO, press **PAR** twice to exit calibration and return to the normal display mode.

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THERMOCOUPLE Voltage Calibration

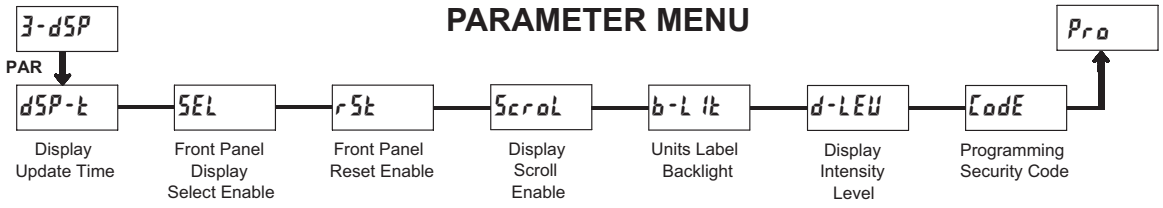
1. Connect a precision DC voltage source with an accuracy of 0.01% or better to the TC and COMM terminals. Set the voltage source to zero.
2. With the display at CodE 48, press the **PAR** key. Unit displays CAL no.
3. Press **SEL** until the display reads CAL tc to select thermocouple input.
4. Press **PAR**. Display reads 0.0u.
5. With the voltage source set to zero, press **PAR**. Display reads CALC for about 6 seconds.
6. When the display reads 60.0u, set the voltage source output to 60.000 mV. Press **PAR**. Display reads CALC for about 6 seconds.
7. When display reads CAL no, press **PAR** twice to exit calibration and return to the normal display mode. Proceed to Cold Junction Calibration.

THERMOCOUPLE Cold Junction Calibration

1. The ambient temperature must be between 20°C and 30°C.
2. Connect a thermocouple (types T, E, J, K or N only) with an accuracy of 1°C or better to the meter.
3. Enter programming mode and verify the following settings in Module 1:
   tYPE = thermocouple type connected to the meter
   CJC = on; SCALE = °C; dECPt = 0.0; OFSEt = 0.0
4. Place the thermocouple in close thermal contact to a reference thermometer probe. (Use a reference thermometer with an accuracy of 0.25°C or better.) The two probes should be shielded from air movement and allowed sufficient time to equalize in temperature. (A calibration bath of known temperature could be used in place of the thermometer.)
5. Compare the unit display with the reference temperature indicator (or calibration bath). If a difference of more than +/- 1.0°C exists, note the difference (CJ Error) and continue with cold junction calibration.
   CJ Error = Reference Temperature - Unit Display
6. Enter programming mode and proceed through Module 2 to the Service Access Code. Select CodE 48 and press **PAR**. Unit displays CAL no. Press **RST** to select CJC.
7. Press **PAR**. Display reads CJC followed by the current cold junction value. Calculate a new cold junction value as follows:
   New cold junction = Current cold junction + CJ Error (noted above)
8. Press **PAR** and set the display to the new cold junction value. Press **PAR** to enter the new value. Display reads CALC for 6 seconds and returns to CAL no.
9. Press **PAR** twice to exit calibration and return to the normal display mode. Verify the input reading is correct. If not, repeat steps 5 through 9.

5.3 MODULE 3 - DISPLAY AND FRONT PANEL KEY PARAMETERS (3-dSP)

PARAMETER MENU



DISPLAY UPDATE TIME

dSP-t / 1 — 0.5 1 2 seconds

This parameter sets the display update time in seconds.

FRONT PANEL DISPLAY SELECT ENABLE (SEL)

SEL / YES — no YES

The YES selection allows the **SEL** key to toggle through the enabled displays.

FRONT PANEL RESET ENABLE (RST)

rSt / dSP — no LO dSP HI HI-LO

This selection allows the **RST** button to reset the selected value(s).

DISPLAY SCROLL ENABLE

ScroL / no — no YES

The YES selection allows the display to automatically scroll through the enabled displays. The scroll rate is every 4 seconds. This parameter only appears when the MAX or MIN displays are enabled.

UNITS LABEL BACKLIGHT

b-Lit / OFF — on OFF

The PAXLT includes two units overlay labels (°C and °F) which can be installed into the meter's bezel display assembly. The backlight for the units label is activated by this parameter.

DISPLAY INTENSITY LEVEL

d-LEV / 3 — 1 to 5

Enter the desired Display Intensity Level (1-5). The display will actively dim or brighten as levels are changed.

PROGRAMMING SECURITY CODE

CodE / 000 — 0 to 999

The Security Code determines the programming mode and the accessibility of programming parameters. This code can be used along with the Program Mode Lock-out (P-Loc) in the User Input Function parameter (Module 1).

Two programming modes are available. Full Programming mode allows all parameters to be viewed and modified. Quick Programming mode permits only user selected values to be modified, but allows direct access to these values without having to enter Full Programming mode.

Entering a Security Code from 1-99 enables Quick Programming mode, and displays a sublist to select which values appear in the Quick Programming menu. Values set to YES in the sublist are accessible in Quick Programming. These values include the Setpoints (SP-1, SP-2) and Display Intensity (d-LEV).

Programming any Security Code other than 0, requires this code to be entered at the CodE prompt in order to access Full Programming mode. Quick Programming mode, if enabled, is accessed before the CodE prompt appears.

USER INPUT FUNCTION	USER INPUT STATE	SECURITY CODE	MODE WHEN "PAR" BUTTON IS PRESSED	FULL PROGRAMMING MODE ACCESS
not P-Loc	———	0	Full Programming	Immediate Access
		1-99	Quick Programming	After Quick Programming with correct code entry at CodE prompt *
		100-999	CodE prompt	With correct code entry at CodE prompt *
P-Loc	Active	0	Programming Lock	No Access
		1-99	Quick Programming	No Access
		100-999	CodE prompt	With correct code entry at CodE prompt *
	Not Active	0-999	Full Programming	Immediate Access

** Entering Code 222 allows access regardless of security code.*

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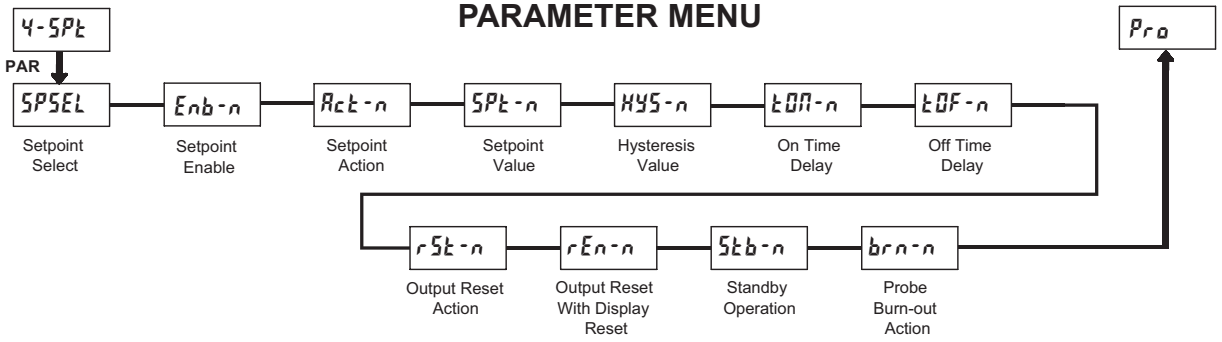
5.4 MODULE 4 - SETPOINT OUTPUT PARAMETERS (4-SPt)

PARAMETER MENU



SETPOINT SELECT

SPSEL → nO / SP-1 / SP-2

Select the Setpoint Output to be programmed, starting with Setpoint 1. The "n" in the following parameters reflects the chosen Setpoint number. After the selected setpoint is completely programmed, the display returns to SPSEL. Repeat steps for Setpoint 2 if both Setpoints are being used. Select nO to exit the Setpoint programming module.

SETPOINT ENABLE

Enb-n → nO / YES

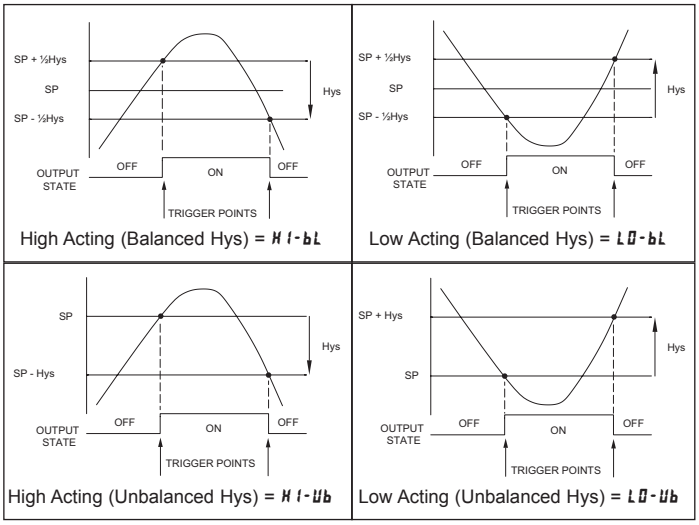
Select YES to enable Setpoint n and access the setup parameters. If nO is selected, the unit returns to SPSEL and Setpoint n is disabled.

SETPOINT ACTION

Act-n → HI-bL / LO-bL / HI-Ub / LO-Ub

Enter the action for the selected setpoint (output). See Setpoint Output Figures for a visual detail of each action.

- HI-bL = High Acting, with balanced hysteresis
- LO-bL = Low Acting, with balanced hysteresis
- HI-Ub = High Acting, with unbalanced hysteresis
- LO-Ub = Low Acting, with unbalanced hysteresis



SETPOINT VALUE

SPt-n → 00100

-19999 to 99999

Enter the desired setpoint value. The decimal point position for the setpoint and hysteresis values follow the selection set in Module 1.

HYSTERESIS VALUE

HYS-n → 2

1 to 59999

Enter desired hysteresis value. See Setpoint Output Figures for visual explanation of how setpoint output actions (balanced and unbalanced) are affected by the hysteresis. When the setpoint is a control output, usually balanced hysteresis is used. For alarm applications, usually unbalanced hysteresis is used. For unbalanced hysteresis modes, the hysteresis functions on the low side for high acting setpoints and functions on the high side for low acting setpoints.

Note: Hysteresis eliminates output chatter at the switch point, while time delay can be used to prevent false triggering during process transient events.

ON TIME DELAY

tON-n → 0.0

0.0 to 599.9 Sec

Enter the time value in seconds that the output is delayed from turning on after the trigger point is reached. A value of 0.0 allows the meter to update the output status per the response time listed in the Specifications.

OFF TIME DELAY

tOF-n → 0.0

0.0 to 599.9 Sec

Enter the time value in seconds that the output is delayed from turning off after the trigger point is reached. A value of 0.0 allows the meter to update the output status per the response time listed in the Specifications.

OUTPUT RESET ACTION

rSt-n → Auto

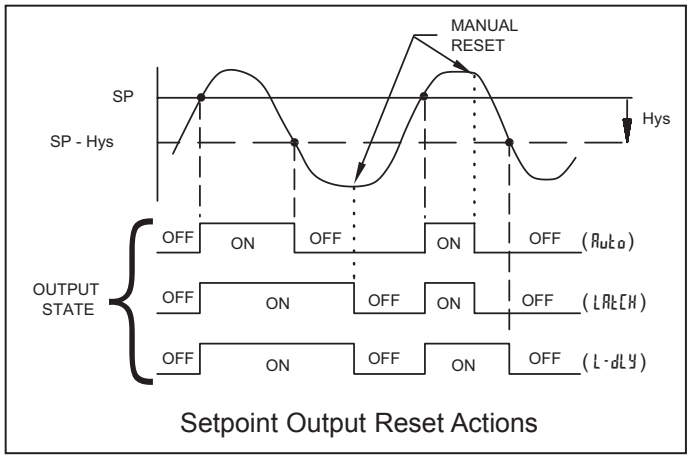
Auto / LAtCH / L-dLY

Enter the reset action of the output. See figure for details.

Auto = Automatic action; This action allows the output to automatically reset off at the trigger points per the Setpoint Action shown in Setpoint Output Figures. The "on" output may be manually reset (off) immediately by the front panel **RST** button or user input.The output remains off until the trigger point is crossed again.

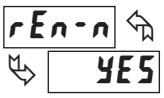
LAtCH = Latch with immediate reset action; This action latches the output on at the trigger point per the Setpoint Action shown in Setpoint Output Figures. Latch means that the output can only be turned off by the front panel **RST** button or user input manual reset, or meter power cycle. When the user input or **RST** button is activated (momentary action), the corresponding "on" output is reset immediately and remains off until the trigger point is crossed again. (Previously latched alarms will be off if power up Display Value is lower than setpoint value.)

L-dLY = Latch with delay reset action; This action latches the output on at the trigger point per the Setpoint Action shown in Setpoint Output Figures. Latch means that the output can only be turned off by the front panel **RST** button or user input manual reset, or meter power cycle. When the user input or **RST** button is activated (momentary action), the meter delays the event until the corresponding "on" output crosses the trigger off point. (Previously latched outputs are off if power up Display Value is lower than setpoint value. During a power cycle, the meter erases a previous **L-dLY** reset if it is not activated at power up.)



Setpoint Output Reset Actions

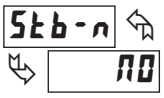
OUTPUT RESET WITH DISPLAY RESET



This parameter enables the **RST** button or user input to reset the output when the display is reset.

Note: For this parameter to operate, the **RST** button or User Input being used must be set to **dSP** and the Input value must be displayed. If these conditions are not met, the output will not reset.

STANDBY OPERATION



When **YES**, the output is disabled (after a power up) until the trigger point is crossed. Once the output is on, the output operates normally per the Setpoint Action and Output Reset Action.

PROBE BURN-OUT ACTION

Enter the probe burn-out action. In the event of a temperature probe failure (TC open; RTD open or short), the output can be programmed to be on or off.

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MODEL DP5T - THERMOCOUPLE AND RTD INPUT

This is a brief overview of the DP5T. For complete specifications and programming information, see the **DP5 Analog Input Panel Meters Bulletin** starting on **page 283**.

- *THERMOCOUPLE AND RTD INPUTS*
- *CONFORMS TO ITS-90 STANDARDS*
- *TIME-TEMPERATURE INTEGRATOR*
- 5-DIGIT 0.56" *HIGH RED LED DISPLAY*
- *PROGRAMMABLE FUNCTION KEYS/USER INPUT*
- *9 DIGIT TOTALIZER (INTEGRATOR) WITH BATCHING*

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DP5T SPECIFICATIONS

READOUT:
Resolution: Variable: 0.1, 0.2, 0.5, or 1, 2, or 5 degree
Scale: F or C
Offset Range: -19,999 to 99,999 display units

THERMOCOUPLE INPUTS:
Input Impedance: 20 MΩ
Lead Resistance Effect: 0.03 µV/ohm
Max. Continuous Overvoltage: 30 V

INPUT TYPE	RANGE	ACCURACY* (18 to 28°C)	ACCURACY* (0 to 50°C)	STANDARD	WIRE COLOR	
					ANSI	BS 1843
T	-200 to 400°C -270 to -200°C	1.2°C **	2.1°C	ITS-90	(+) blue (-) red	(+) white (-) blue
E	-200 to 871°C -270 to -200°C	1.0°C **	2.4°C	ITS-90	(+) purple (-) red	(+) brown (-) blue
J	-200 to 760°C	1.1°C	2.3°C	ITS-90	(+) white (-) red	(+) yellow (-) blue
K	-200 to 1372°C -270 to -200°C	1.3°C **	3.4°C	ITS-90	(+) yellow (-) red	(+) brown (-) blue
R	-50 to 1768°C	1.9°C	4.0°C	ITS-90	no standard	(+) white (-) blue
S	-50 to 1768°C	1.9°C	4.0°C	ITS-90	no standard	(+) white (-) blue
B	100 to 300°C 300 to 1820°C	3.9°C 2.8°C	5.7°C 4.4°C	ITS-90	no standard	no standard
N	-200 to 1300°C -270 to -200°C	1.3°C **	3.1°C	ITS-90	(+) orange (-) red	(+) orange (-) blue
C (W5/W26)	0 to 2315°C	1.9°C	6.1°C	ASTM E988-90***	no standard	no standard

*After 20 min. warm-up. Accuracy is specified in two ways: Accuracy over an 18 to 28°C and 15 to 75% RH environment; and Accuracy over a 0 to 50°C and 0 to 85% RH (non condensing) environment. Accuracy specified over the 0 to 50°C operating range includes meter tempco and ice point tracking effects. The specification includes the A/D conversion errors, linearization conformity, and thermocouple ice point compensation. Total system accuracy is the sum of meter and probe errors. Accuracy may be improved by field calibrating the meter readout at the temperature of interest.

** The accuracy over the interval -270 to -200°C is a function of temperature, ranging from 1°C at -200°C and degrading to 7°C at -270°C. Accuracy may be improved by field calibrating the meter readout at the temperature of interest.

*** These curves have been corrected to ITS-90.

RTD INPUTS:
Type: 3 or 4 wire, 2 wire can be compensated for lead wire resistance
Excitation current: 100 ohm range: 165 µA
10 ohm range: 2.6 mA
Lead resistance: 100 ohm range: 10 ohm/lead max.
10 ohm range: 3 ohms/lead max.
Max. continuous overload: 30 V

INPUT TYPE	RANGE	ACCURACY* (18 to 28°C)	ACCURACY* (0 to 50°C)	STANDARD ***
100 ohm Pt alpha = .00385	-200 to 850°C	0.4°C	1.6°C	IEC 751
100 ohm Pt alpha = .003919	-200 to 850°C	0.4°C	1.6°C	no official standard
120 ohm Nickel alpha = .00672	-80 to 260°C	0.2°C	0.5°C	no official standard
10 ohm Copper alpha = .00427	-100 to 260°C	0.4°C	0.9°C	no official standard

DIRECT READOUT:
Input range: -10 to 65 mV
0 to 400 ohms, high range
0 to 25 ohms, low range
Display range: -19999 to 99999

INPUT TYPE	RANGE	ACCURACY* (18 to 28°C)	ACCURACY* (0 to 50°C)
Direct mV range	-10 to 65mV (1 µV res.)	0.02% of reading + 4µV	0.12% of reading + 5µV
Direct 100 ohm range	0 to 400 Ω (10 MΩ res.)	0.02% of reading + 0.04 Ω	0.12% of reading + 0.05 Ω
Direct 10 ohm range	0 to 25 Ω (1 MΩ res.)	0.04% of reading + 0.005 Ω	0.20% of reading + 0.007 Ω

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MODEL PAXT - THERMOCOUPLE AND RTD INPUT

This is a brief overview of the PAXT. For complete specifications and programming information, see the **PAX Analog Input Panel Meters Bulletin** starting on **page 301**.

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- *THERMOCOUPLE AND RTD INPUTS*
- *CONFORMS TO ITS-90 STANDARDS*
- *CUSTOM SCALING FOR NON-STANDARD PROBES*
- *TIME-TEMPERATURE INTEGRATOR*
- *5-DIGIT 0.56" RED SUNLIGHT READABLE OR STANDARD GREEN DISPLAY*
- *VARIABLE INTENSITY DISPLAY*
- *OPTIONAL CUSTOM UNITS OVERLAY W/BACKLIGHT*
- *FOUR SETPOINT ALARM OUTPUTS (W/OPTION CARD)*
- *COMMUNICATION AND BUS CAPABILITIES (W/OPTION CARD)*
- *RETRANSMITTED ANALOG OUTPUT (W/OPTION CARD)*
- *CRIMSON PROGRAMMING SOFTWARE*

PAXT SPECIFICATIONS

READOUT:
Resolution: Variable: 0.1, 0.2, 0.5, or 1, 2, or 5 degrees
Scale: F or C
Offset Range: -19,999 to 99,999 display units

THERMOCOUPLE INPUTS:
Input Impedance: 20 MΩ
Lead Resistance Effect: 0.03 µV/ohm
Max. Continuous Overvoltage: 30 V

INPUT TYPE	RANGE	ACCURACY* (18 to 28°C)	ACCURACY* (0 to 50°C)	STANDARD	WIRE COLOR	
					ANSI	BS 1843
T	-200 to 400°C -270 to -200°C	1.2°C **	2.1°C	ITS-90	(+) blue (-) red	(+) white (-) blue
E	-200 to 871°C -270 to -200°C	1.0°C **	2.4°C	ITS-90	(+) purple (-) red	(+) brown (-) blue
J	-200 to 760°C	1.1°C	2.3°C	ITS-90	(+) white (-) red	(+) yellow (-) blue
K	-200 to 1372°C -270 to -200°C	1.3°C **	3.4°C	ITS-90	(+) yellow (-) red	(+) brown (-) blue
R	-50 to 1768°C	1.9°C	4.0°C	ITS-90	no standard	(+) white (-) blue
S	-50 to 1768°C	1.9°C	4.0°C	ITS-90	no standard	(+) white (-) blue
B	100 to 300°C 300 to 1820°C	3.9°C 2.8°C	5.7°C 4.4°C	ITS-90	no standard	no standard
N	-200 to 1300°C -270 to -200°C	1.3°C **	3.1°C	ITS-90	(+) orange (-) red	(+) orange (-) blue
C (W5/W26	0 to 2315°C	1.9°C	6.1°C	ASTM E988-90***	no standard	no standard

*After 20 min. warm-up. Accuracy is specified in two ways: Accuracy over an 18 to 28°C and 15 to 75% RH environment; and Accuracy over a 0 to 50°C and 0 to 85% RH (non condensing) environment. Accuracy specified over the 0 to 50°C operating range includes meter tempco and ice point tracking effects. The specification includes the A/D conversion errors, linearization conformity, and thermocouple ice point compensation. Total system accuracy is the sum of meter and probe errors. Accuracy may be improved by field calibrating the meter readout at the temperature of interest.

** The accuracy over the interval -270 to -200°C is a function of temperature, ranging from 1°C at -200°C and degrading to 7°C at -270°C. Accuracy may be improved by field calibrating the meter readout at the temperature of interest.

*** These curves have been corrected to ITS-90.

RTD INPUTS:
Type: 3 or 4 wire, 2 wire can be compensated for lead wire resistance
Excitation current: 100 ohm range: 165 µA
10 ohm range: 2.6 mA
Lead resistance: 100 ohm range: 10 ohm/lead max.
10 ohm range: 3 ohms/lead max.
Max. continuous overload: 30 V

INPUT TYPE	RANGE	ACCURACY* (18 to 28°C)	ACCURACY* (0 to 50°C)	STANDARD ***
100 ohm Pt alpha = .00385	-200 to 850°C	0.4°C	1.6°C	IEC 751
100 ohm Pt alpha = .003919	-200 to 850°C	0.4°C	1.6°C	no official standard
120 ohm Nickel alpha = .00672	-80 to 260°C	0.2°C	0.5°C	no official standard
10 ohm Copper alpha = .00427	-100 to 260°C	0.4°C	0.9°C	no official standard

CUSTOM RANGE: Up to 16 data point pairs
Input range: -10 to 65 mV
0 to 400 ohms, high range
0 to 25 ohms, low range
Display range: -19999 to 99999

INPUT TYPE	RANGE	ACCURACY* (18 to 28°C)	ACCURACY* (0 to 50°C)
Custom mV range	-10 to 65mV (1 µV res.)	0.02% of reading + 4µV	0.12% of reading + 5µV
Custom 100 ohm range	0 to 400 Ω (10 MΩ res.)	0.02% of reading + 0.04 Ω	0.12% of reading + 0.05 Ω
Custom 10 ohm range	0 to 25 Ω (1 MΩ res.)	0.04% of reading + 0.005 Ω	0.20% of reading + 0.007 Ω

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MODEL PAX2A - 1/8 DIN ANALOG PANEL METER

This is a brief overview of the PAX2A. For complete specifications and programming information, see the **PAX2A Analog Panel Meter Bulletin** starting on **page 332.**

- *UNIVERSAL PROCESS, VOLTAGE, CURRENT, RESISTANCE AND TEMPERATURE INPUTS*
- *UNIVERSAL AC/DC POWER SUPPLY*
- *6 / 9 DIGIT DUAL LINE/TRI-COLOR DISPLAY WITH 0.71" & 0.35" DIGITS*
- *PROGRAMMABLE UNITS DISPLAY*
- *VARIABLE CONTRAST AND INTENSITY DISPLAY*
- *UP TO 160 SAMPLES PER SECOND CONVERSION RATE*
- *BUILT-IN USB PROGRAMMING PORT ENABLING UNIT CONFIGURATION WITH CRIMSON PROGRAMMING SOFTWARE*
- *NEMA 4X/IP65 SEALED FRONT BEZEL*

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PROCESS CONTROL EQUIPMENT

SPECIFICATIONS

POWER:
AC Power: 40 to 250 VAC, 50/60 Hz, 20 VA
DC Power: 21.6 to 250 VDC, 8 W
Isolation: 2300 Vrms for 1 min. to all inputs and outputs.

INPUT CAPABILITIES:
Current Input Ranges:
± 250 µADC ± 2.5 mADC ± 25 mADC
± 250 mADC ± 2 ADC

Voltage Input Ranges:
± 250 mVDC ± 2.0 VDC ± 10 VDC
± 25 VDC ± 100 VDC ± 200 VDC

Thermocouple Inputs:
Types: T, E, J, K, R, S, B, N, C (W5/W26)
Max Continuous Overvoltage: 30 V

RTD Inputs:
Type: 3 or 4 wire, 2 wire can be compensated for lead wire resistance
Excitation current: 100 ohm range: 136.5 µA ±10%
10 ohm range: 2.05 mA ±10%
Max. continuous overload: 30 VDC
Input Type:

100 ohm Pt alpha = .00385	100 ohm Pt alpha = .00392
120 ohm Nickel alpha = .00672	10 ohm Copper alpha = .00427

Resistance Inputs:
Max. continuous overload: 30 VDC

INPUT RANGE	COMPLIANCE
100 ohm	0.175 V
999 ohm	1.75 V
9999 ohm	17.5 V

EXCITATION POWER: Jumper selectable
Transmitter Power: +18 VDC, ± 5% @ 50 mA max.
Reference Voltage: + 2 VDC, ± 2%
Compliance: 1KΩ load min (2 mA max)
Temperature Coefficient: 40 ppm/ºC max.
Reference Current: 1.05 mADC, ± 2%
Compliance: 10 KΩ load max.

USER INPUTS: Two programmable user inputs
Max. Continuous Input: 30 VDC
Isolation To Sensor Input Common: Not isolated.

ENVIRONMENTAL CONDITIONS:
Operating Temperature Range: 0 to 50 °C
Storage Temperature Range: -40 to 60 °C
Vibration to IEC 68-2-6: Operational 5-150 Hz, 2 g
Shock to IEC 68-2-27: Operational 25 g (10 g relay)
Operating and Storage Humidity: 0 to 85% max. RH non-condensing
Altitude: Up to 2000 meters

CERTIFICATIONS AND COMPLIANCES:
CE Approved
EN 61326-1 Immunity to Industrial Locations
Emission CISPR 11 Class A
IEC/EN 61010-1
RoHS Compliant
UL Listed: File #E179259
Type 4X Indoor Enclosure rating (Face only)
IP65 Enclosure rating (Face only)
IP20 Enclosure rating (Rear of unit)

CONNECTIONS: High compression cage-clamp terminal block
Wire Strip Length: 0.3" (7.5 mm)
Wire Gauge Capacity: One 14 AWG (2.55 mm) solid, two 18 AWG (1.02 mm) or four 20 AWG (0.61 mm)

CONSTRUCTION: This unit is rated NEMA 4X/IP65 for indoor use only. IP20 Touch safe. Installation Category II, Pollution Degree 2. One piece bezel/ case. Flame resistant. Synthetic rubber keypad. Panel gasket and mounting clip included.

WEIGHT: 8 oz. (226.8 g)

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MODELS T16 & P16 - TEMPERATURE/PROCESS CONTROLLERS

- *T16 ACCEPTS TC AND RTD*
- *P16 ACCEPTS 0-10 V AND 0/4-20 mA SIGNALS*
- *ON DEMAND AUTO-TUNING OF PID SETTINGS*
- *DC ANALOG OUTPUT (OPTIONAL)*
- *USER PROGRAMMABLE FUNCTION BUTTON*
- *PC OR FRONT PANEL PROGRAMMING*
- *PC CONFIGURABLE WITH TP16KIT*

UL Recognized Component, File #E156876

GENERAL DESCRIPTION

The Model T16 Controller accepts signals from a variety of temperature sensors (thermocouple or RTD), while the Model P16 Controller accepts either a 0 to 10 VDC or 0/4 to 20 mA DC input signal. Both controllers can provide an accurate output control signal (time proportional or DC Analog Output) to maintain a process at a setpoint value. Dual 4-digit displays allow viewing of the process/temperature and setpoint simultaneously. Front panel indicators inform the operator of the controller and output status. The comprehensive programming allows these controllers to meet a wide variety of application requirements.

MAIN CONTROL

The controller operates in the PID Control Mode for both heating and cooling, with on-demand auto-tune, that establishes the tuning constants. The PID tuning constants may be fine-tuned through the front panel and then locked out from further modification. The controller employs a unique overshoot suppression feature, that allows the quickest response without excessive overshoot. Switching to Manual Mode provides the operator direct control of the output. The controller may also be programmed to operate in On/Off mode with adjustable hysteresis.

ALARMS

Optional alarm(s) can be configured independently for absolute high or low acting with balanced or unbalanced hysteresis. They can also be configured for deviation and band alarm. In these modes, the alarm trigger values track the setpoint value. Adjustable alarm hysteresis can be used for delaying output response. The alarms can be programmed for Automatic or Latching operation. A selectable standby feature suppresses the alarm during power-up until the temperature stabilizes outside the alarm region.

ANALOG OUTPUT OPTION

The optional DC Analog Output (10 V or 20 mA) can be configured and scaled for control or re-transmission purposes. The programmable output update time reduces valve or actuator activity.

PC PROGRAMMING KIT

The optional TP16KIT contains a programming module with a 9 pin RS232 connector, cable and Crimson, a Windows® based configuration software. The software allows downloading, uploading and storage of T16 and P16 program files. All controllers have a communications port that allows configuration by PC even without controller power connected. Controller calibration is also possible using the software when the proper calibration equipment and controller power is connected.

CONSTRUCTION

The controller is constructed of a lightweight, high impact, black plastic textured case and bezel with a clear display window. The front panel meets NEMA 4X/IP65 specifications when properly installed. In applications that do not require protection to NEMA 4X, multiple controllers can be stacked horizontally or vertically. Modern surface-mount technology, extensive testing, plus high immunity to noise interference makes the controller extremely reliable in industrial environments.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the manual or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Do not use the controller to directly command motors, valves, or other actuators not equipped with safeguards. To do so can be potentially harmful to persons or equipment in the event of a fault to the controller. An independent and redundant temperature limit indicator with alarm outputs is strongly recommended.

- *PID CONTROL WITH REDUCED OVERSHOOT*

CAUTION: Risk of Danger.
Read complete instructions prior to installation and operation of the unit.

CAUTION: Risk of electric shock.

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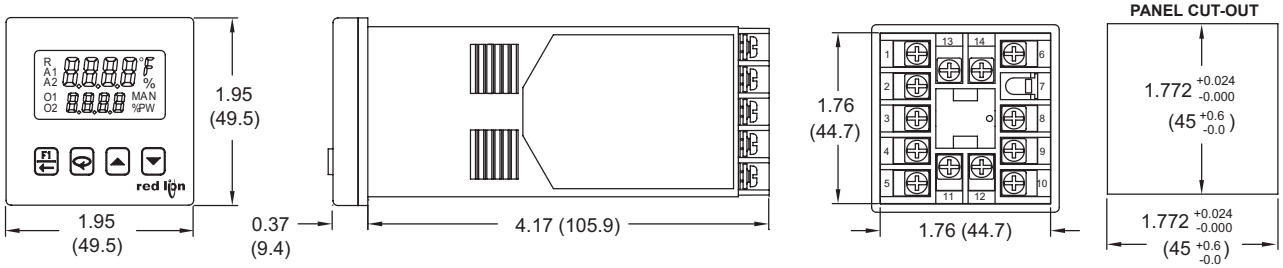
DIMENSIONS In inches (mm)



GENERAL SPECIFICATIONS

1. **DISPLAY**: 2 Line by 4-digit, LCD negative image transmissive with backlighting.
   Top (Process) Display: 0.3" (7.6 mm) high digits with red backlighting.
   Bottom (Parameter) Display: 0.2" (5.1 mm) high digits with green backlighting.
2. **ANNUNCIATORS**:
   Status Annunciators:
   O1 - Main control output is active.
   O2 - Cooling output is active (when Alarm 2 is used for cooling).
   A1 - Alarm 1 output is active.
   A2 - Alarm 2 output is active.
   °F, °C - Temperature units.
   %PW - Output power percentage is shown in Bottom display.
   MAN - Controller is in Manual Mode.
   R - Ramping Setpoint indicator.
   % - Percent indicator (P16 models only).
   Display Messages:
   OLOL - Measurement exceeds + sensor range
   ULUL - Measurement exceeds - sensor range
   OPEN - Open sensor is detected (T16 only)
   SHrt - Shorted sensor is detected (RTD only)
   SENS - Measurement exceeds controller limits (P16 only)
   dddd - Display value exceeds + display range
   -ddd - Display value exceeds - display range
3. **POWER**:
   Line Voltage Models:
   85 to 250 VAC, 50/60 Hz, 8 VA
   Low Voltage Models:
   DC Power: 18 to 36 VDC, 4 W
   AC Power: 24 VAC, ±10%, 50/60 Hz, 7 VA
4. **CONTROLS**: Three rubber push buttons for modification and setup of controller parameters. One additional button (F1) for user programmable function. One external user input (models with alarms) for parameter lockout or other user programmable functions.
5. **MEMORY**: Nonvolatile E^2PROM retains all programmable parameters.
6. **ISOLATION LEVEL**:
   AC power with respect to all other I/O: 250 V working (2300 V for 1 min.)
   Sensor input to analog output: 50 V working (500 V for 1 minute)
   Relay contacts to all other I/O: 300 V working (2300 V for 1 minute)
   DC power with respect to sensor input and analog output: 50 V working (500 V for 1 minute)
7. **CERTIFICATIONS AND COMPLIANCES**:
   CE Approved
   EN 61326-1 Immunity to Industrial Locations
   Emission CISPR 11 Class A
   IEC/EN 61010-1
   RoHS Compliant
   UL Recognized Component: File #E156876
   Type 4X Enclosure rating (Face only)
   IP65 Enclosure rating (Face only)
   IP20 Enclosure rating (Rear of unit)
   Refer to EMC Installation Guidelines section of the bulletin for additional information.
8. **ENVIRONMENTAL CONDITIONS**:
   Operating Temperature Range: 0 to 50°C
   Storage Temperature Range: -40 to 80°C
   Operating and Storage Humidity: 85% max relative humidity (non-condensing) from 0°C to 50°C
   Vibration to IEC 68-2-6: Operational 5 to 150 Hz, 2 g.
   Shock to IEC 68-2-27: Operational 20 g (10 g relay).
   Altitude: Up to 2000 meters
9. **CONNECTION**: Wire-clamping screw terminals
10. **CONSTRUCTION**: Black plastic alloy case and collar style panel latch. Panel latch can be installed for vertical or horizontal instrument stacking. Black plastic textured bezel with transparent display window. Controller meets NEMA 4X/IP65 requirements for indoor use when properly installed. Installation Category II, Pollution Degree 2.
11. **WEIGHT**: 6.3 oz (179 g)

INPUT SPECIFICATIONS

1. **SENSOR INPUT**:
   Sample Period: 100 msec (10 Hz rate)
   Step Response Time: 300 msec typical, 400 msec max to within 99% of final value with step input.
   Failed Sensor Response:
   Main Control Output(s): Programmable preset output
   Display: "OPEN"
   Alarms: Upscale drive
   Analog Output: Upscale drive when assigned to retransmitted input.
   Normal Mode Rejection: >40 dB @ 50/60 Hz
   Common Mode Rejection: >120 dB, DC to 60 Hz
   Overvoltage Protection: 120 VAC @ 15 sec max
2. **RTD INPUTS**: (T16 only)
   Type: 2 or 3 wire
   Excitation: 150 µA typical
   Lead Resistance: 15 Ω max per input lead
   Resolution: 1° or 0.1° for all types

TYPE	INPUT TYPE	RANGE	STANDARD
385	100 Ω platinum, Alpha = .00385	-200 to +600°C -328 to +1112°F	IEC 751
392	100 Ω platinum, Alpha = .003919	-200 to +600°C -328 to +1112°F	No official standard
672	120 Ω nickel, Alpha = .00672	-80 to +215°C -112 to +419°F	No official standard
Ohms	Linear Resistance	0.0 to 320.0 Ω	N/A

3. **THERMOCOUPLE INPUTS**: (T16 only)
   Types: T, E, J, K, R, S, B, N, C, and Linear mV
   Input Impedance: 20 MΩ for all types
   Lead Resistance Effect: 0.25 µV/Ω
   Cold Junction Compensation: Less than ±1°C typical (1.5°C max) error over ambient temperature range.
   Resolution: 1° for types R, S, B and 1° or 0.1° for all other types

TYPE	DISPLAY RANGE	WIRE COLOR		STANDARD
		ANSI	BS 1843	
T	-200 to +400°C -328 to +752°F	(+) Blue (-) Red	(+) White (-) Blue	ITS-90
E	-200 to 750°C -328 to +1382°F	(+) Violet (-) Red	(+) Brown (-) Blue	ITS-90
J	-200 to +760°C -328 to +1400°F	(+) White (-) Red	(+) Yellow (-) Blue	ITS-90
K	-200 to +1250°C -328 to +2282°F	(+) Yellow (-) Red	(+) Brown (-) Blue	ITS-90
R	0 to +1768°C +32 to +3214°F	No standard	(+) White (-) Blue	ITS-90
S	0 to +1768°C +32 to +3214°F	No standard	(+) White (-) Blue	ITS-90
B	+149 to +1820°C +300 to +3308°F	No standard	No standard	ITS-90
N	-200 to +1300°C -328 to +2372°F	(+) Orange (-) Red	(+) Orange (-) Blue	ITS-90
C W5/W6	0 to +2315°C +32 to +4199°F	No standard	No standard	ASTM E988-96
mV	-5.00 mV to 56.00mV	N/A	N/A	N/A

4. **SIGNAL INPUT**: (P16 only)

INPUT RANGE	ACCURACY *	IMPEDANCE	MAX CONTINUOUS OVERLOAD	RESOLUTION
10 VDC (-1 to 11)	0.30 % of reading +0.03V	1 MΩ	50 V	10 mV
20 mA DC (-2 to 22)	0.30 % of reading +0.04V	10 Ω	100 mA	10 µA

*Accuracies are expressed as ± percentages over 0 to 50 °C ambient range after 20 minute warm-up.

5. **TEMPERATURE INDICATION ACCURACY**: (T16 only)
   ± (0.3% of span, +1°C) at 23 °C ambient after 20 minute warm up. Includes NIST conformity, cold junction effect, A/D conversion errors and linearization conformity.
   Span Drift (maximum): 130 PPM/°C
6. **USER INPUT**: (Only controllers with alarms have a user input terminal.) Internally pulled up to +7 VDC (100 KΩ), $V_{IN\ MAX}$ = 35 V, V_{IL} = 0.6 V max, V_{IH} = 1.5 V min, I_{OFF} = 40 µA max
   Response Time: 120 msec max
   Functions: Programmable

F

OUTPUT SPECIFICATIONS

1. **CONTROL AND ALARM OUTPUTS**:
   Relay Output:
   Type: Form A
   Contact Rating: 3 A @ 250 VAC or 30 VDC (resistive load)
   Life Expectancy: 100,000 cycles at max. load rating
   (Decreasing load and/or increasing cycle time, increases life expectancy)
   Logic/SSR Output (main control output only):
   Rating: 45 mA max @ 4 V min., 7 V nominal
2. **MAIN CONTROL**:
   Control: PID or On/Off
   Output: Time proportioning or DC Analog
   Cycle Time: Programmable
   Auto-Tune: When selected, sets proportional band, integral time, derivative time, and output dampening time. Also sets input filter and (if applicable) cooling gain.
   Probe Break Action: Programmable
3. **ALARMS**: (optional) 2 relay alarm outputs.
   Modes:
   None
   Absolute High Acting (Balanced or Unbalanced Hysteresis)
   Absolute Low Acting (Balanced or Unbalanced Hysteresis)
   Deviation High Acting
   Deviation Low Acting
   Inside Band Acting
   Outside Band Acting
   Heat (Alarm 1 on Analog Output models only)
   Cool (Alarm 2)
   Reset Action: Programmable; automatic or latched
   Standby Mode: Programmable; enable or disable
   Hysteresis: Programmable
   Sensor Fail Response: Upscale
   Annunciator: "A1" and "A2" programmable for normal or reverse acting
4. **COOLING**: Software selectable (overrides Alarm 2).
   Control: PID or On/Off
   Output: Time proportioning
   Cycle Time: Programmable
   Proportional Gain Adjust: Programmable
   Heat/Cool Deadband Overlap: Programmable
5. **ANALOG DC OUTPUT**: (optional)
   Self-powered (Active)
   Action: Control or retransmission
   Update Rate: 0.1 to 250 sec

OUTPUT RANGE **	ACCURACY *	COMPLIANCE	RESOLUTION
0 to 10 V	0.3% of FS + ½ LSD	10 kΩ min	1/8000
0 to 20 mA	0.3% of FS + ½ LSD	500 Ω max	1/8000
4 to 20 mA	0.3% of FS + ½ LSD	500 Ω max	1/6400

* Accuracies are expressed as ± percentages over 0 to 50 °C ambient range after 20 minute warm-up.

** Outputs are independently jumper selectable for either 10 V or 20 mA. The output range may be field calibrated to yield approximately 5% overrange and a small underrange (negative) signal.

ORDERING INFORMATION

MODEL NO.	MAIN CONTROL	2 ALARMS & USER INPUT	PART NUMBERS	
			18-36 VDC/24 VAC	85 to 250 VAC
T16	Relay	—	T1610010	T1610000
	Relay	Yes	T1611110	T1611100
	Logic/SSR	—	T1620010	T1620000
	Logic/SSR	Yes	T1621110	T1621100
	Analog Out *	Yes	T1641110	T1641100
P16	Relay	—	P1610010	P1610000
	Relay	Yes	P1611110	P1611100
	Logic/SSR	—	P1620010	P1620000
	Logic/SSR	Yes	P1621110	P1621100
	Analog Out *	Yes	P1641110	P1641100

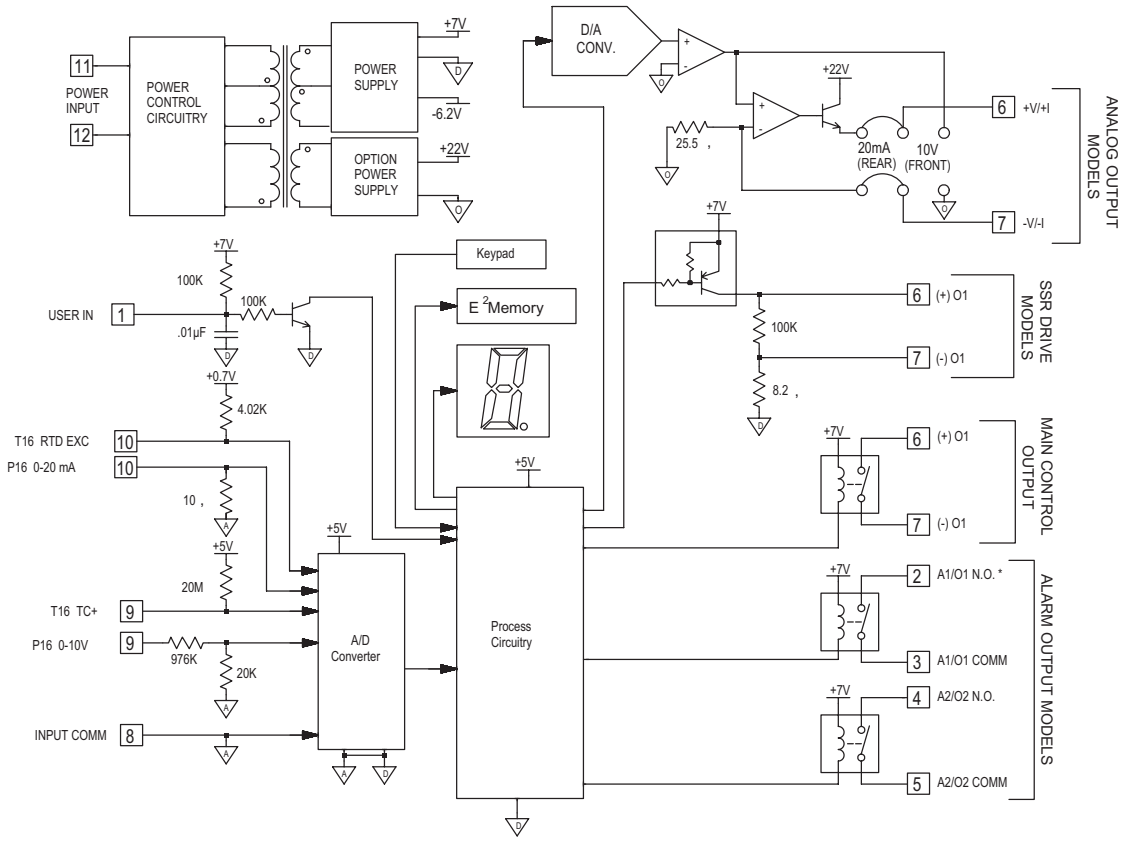
* Analog out may be used for retransmitted signals. When using analog output for retransmitted signals, AL1 becomes main control O1, if selected for heating in the analog out models.

ACCESSORIES

MODEL NO.	DESCRIPTION	PART NUMBERS
TP16	Programming Kit 1 : Includes Software, Comms Module w/ 9-pin connector and cable, and 115 VAC Power Adapter	TP16KIT1
	Programming Kit 2 : Includes Software, Comms Module w/ 9-pin connector and cable	TP16KIT2
RLY	External SSR Power Unit (for Logic/SSR models)	RLY50000
	25 A Single Phase Din Rail Mount Solid State Relay	RLY60000
	40 A Single Phase Din Rail Mount Solid State Relay	RLY6A000
	Three Phase Din Rail Mount Solid State Relay	RLY70000

F

BLOCK DIAGRAM



*A1 becomes main control O1, if selected for heating in the analog out models.

EMC INSTALLATION GUIDELINES

Although Red Lion Controls Products are designed with a high degree of immunity to Electromagnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, source or coupling method into a unit may be different for various installations. Cable length, routing, and shield termination are very important and can mean the difference between a successful or troublesome installation. Listed are some EMI guidelines for a successful installation in an industrial environment.

1. A unit should be mounted in a metal enclosure, which is properly connected to protective earth.
2. Use shielded cables for all Signal and Control inputs. The shield connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield to earth ground (protective earth) at one end where the unit is mounted.
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is over 1 MHz.
3. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors, feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be run through metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter. Also, Signal or Control cables within an enclosure should be routed as far away as possible from contactors, control relays, transformers, and other noisy components.
4. Long cable runs are more susceptible to EMI pickup than short cable runs.
5. In extremely high EMI environments, the use of external EMI suppression devices such as Ferrite Suppression Cores for signal and control cables is effective. The following EMI suppression devices (or equivalent) are recommended:
   Fair-Rite part number 0443167251 (RLC part number FCOR0000)
   Line Filters for input power cables:
   Schaffner # FN2010-1/07 (Red Lion Controls # LFIL0000)
6. To protect relay contacts that control inductive loads and to minimize radiated and conducted noise (EMI), some type of contact protection network is normally installed across the load, the contacts or both. The most effective location is across the load.
   a. Using a snubber, which is a resistor-capacitor (RC) network or metal oxide varistor (MOV) across an AC inductive load is very effective at reducing EMI and increasing relay contact life.
   b. If a DC inductive load (such as a DC relay coil) is controlled by a transistor switch, care must be taken not to exceed the breakdown voltage of the transistor when the load is switched. One of the most effective ways is to place a diode across the inductive load. Most RLC products with solid state outputs have internal zener diode protection. However external diode protection at the load is always a good design practice to limit EMI. Although the use of a snubber or varistor could be used.
   RLC part numbers: Snubber: SNUB0000
   Varistor: ILS11500 or ILS23000
7. Care should be taken when connecting input and output devices to the instrument. When a separate input and output common is provided, they should not be mixed. Therefore a sensor common should NOT be connected to an output common. This would cause EMI on the sensitive input common, which could affect the instrument's operation.

Visit RLC's web site at http://www.redlion.net/Support/InstallationConsiderations.html for more information on EMI guidelines, Safety and CE issues as they relate to Red Lion Controls products.

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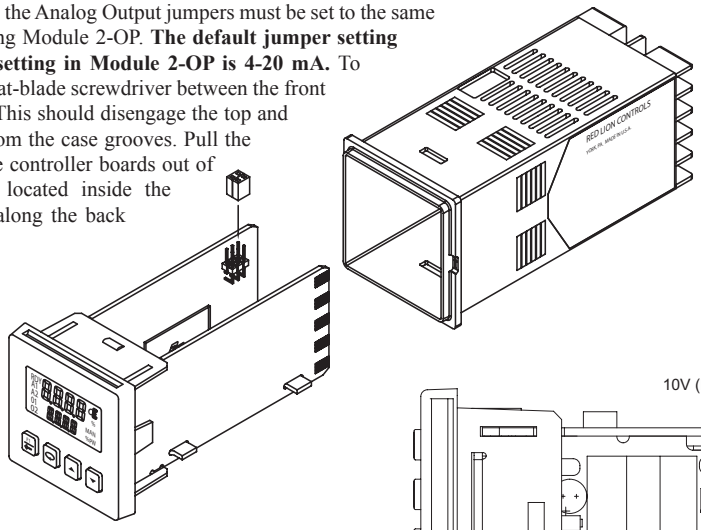
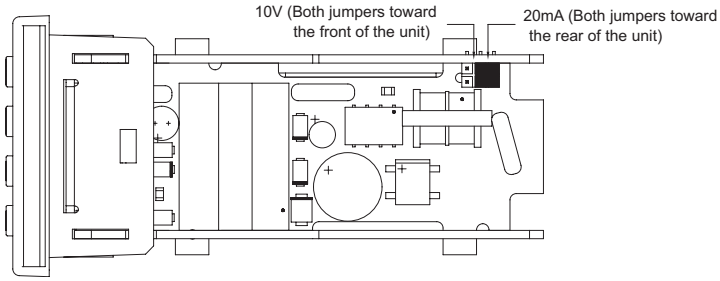
1.0 Setting the Jumpers (Analog Output Models Only)

To insure proper operation, the Analog Output jumpers must be set to the same range selected in programming Module 2-OP. **The default jumper setting is for 20 mA. The default setting in Module 2-OP is 4-20 mA.** To access the jumpers, insert a flat-blade screwdriver between the front panel and the side case slot. This should disengage the top and bottom front panel latches from the case grooves. Pull the front panel assembly with the controller boards out of the case. The jumpers are located inside the controller on the left board along the back top section.

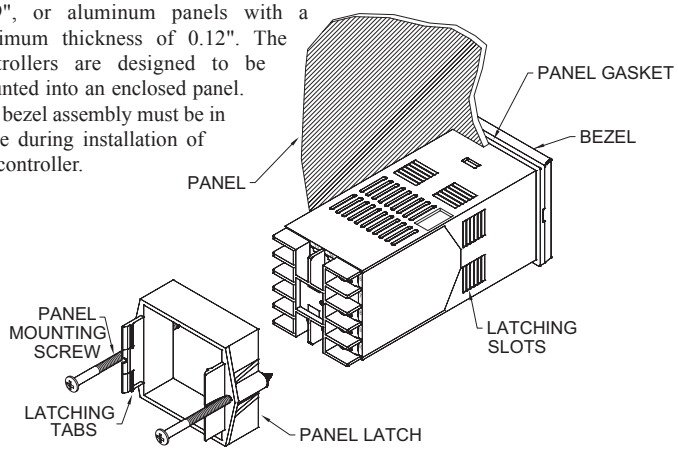




VIEW FROM TOP OF UNIT

2.0 Installing the Controller

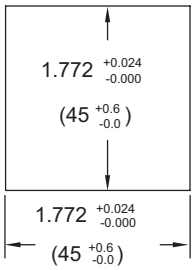
The T16 and P16 controllers meet NEMA 4X/IP65 requirements for indoor use to provide a watertight seal in steel panels with a minimum thickness of 0.09", or aluminum panels with a minimum thickness of 0.12". The controllers are designed to be mounted into an enclosed panel. The bezel assembly must be in place during installation of the controller.



Instructions:

1. Prepare the panel cutout to the proper dimensions.
2. Remove the panel latch from the controller. Discard the cardboard sleeve.
3. Carefully remove the center section of the panel gasket and discard. Slide the panel gasket over the rear of the controller, seating it against the lip at the front of the case.
4. Insert the controller into the panel cutout. While holding the controller in place, push the panel latch over the rear of the controller, engaging the tabs of the panel latch in the farthest forward slot possible.
5. To achieve a proper seal, tighten the panel latch screws evenly until the controller is snug in the panel, torquing the screws to approximately 7 in-lb (79 N-cm). Overtightening can result in distortion of the controller, and reduce the effectiveness of the seal.

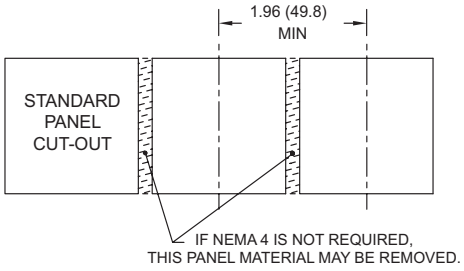
Note: The installation location of the controller is important. Be sure to keep it away from heat sources (ovens, furnaces, etc.) and away from direct contact with caustic vapors, oils, steam, or any other process by-products in which exposure may affect proper operation.

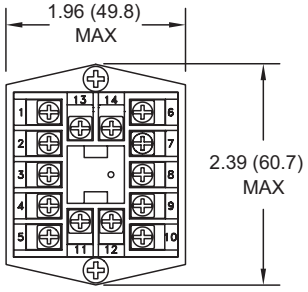


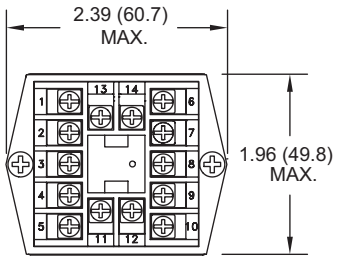
Multiple Controller Stacking

The controller is designed to allow for close spacing of multiple controllers in applications that do not require protection to NEMA 4X. Controllers can be stacked either horizontally or vertically. For vertical stacking, install the panel latch with the screws to the sides of the controller. For horizontal stacking, the panel latch screws should be at the top and bottom of the controller. The minimum spacing from centerline to centerline of controllers is 1.96" (49.8 mm). This spacing is the same for vertical or horizontal stacking.

Note: When stacking controllers, provide adequate panel ventilation to ensure that the maximum operating temperature range is not exceeded.







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3.0 Wiring the Controller

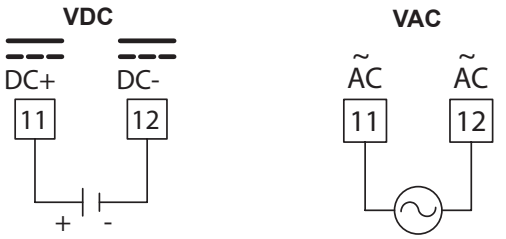
WIRING CONNECTIONS

All wiring connections are made to the rear screw terminals. When wiring the controller, use the numbers on the label and those embossed on the back of the case, to identify the position number with the proper function.

All conductors should meet voltage and current ratings for each terminal. Also, cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that power (AC or DC) supplied to the controller be protected by a fuse or circuit breaker. Strip the wire, leaving approximately 1/4" (6 mm) bare wire exposed (stranded wires should be tinned with solder). Insert the wire under the clamping washer and tighten the screw until the wire is clamped tightly.

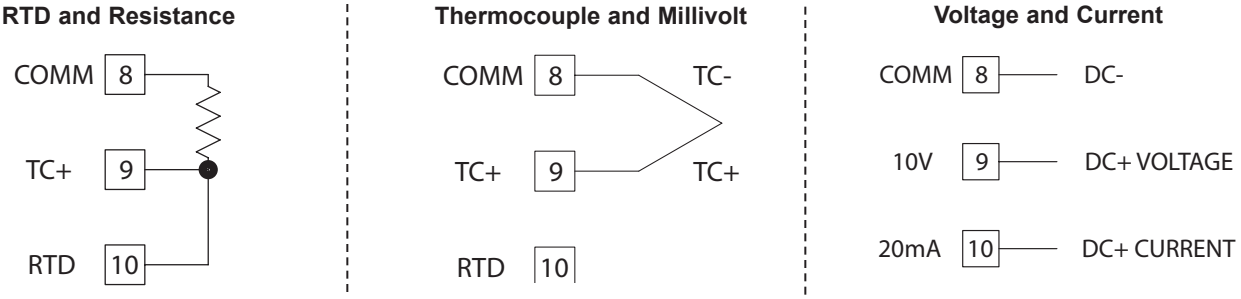
CONTROLLER POWER CONNECTIONS

For best results, the power should be relatively "clean" and within the specified limits. Drawing power from heavily loaded circuits or from circuits that also power loads that cycle on and off should be avoided. It is recommended that power supplied to the controller be protected by a fuse or circuit breaker.

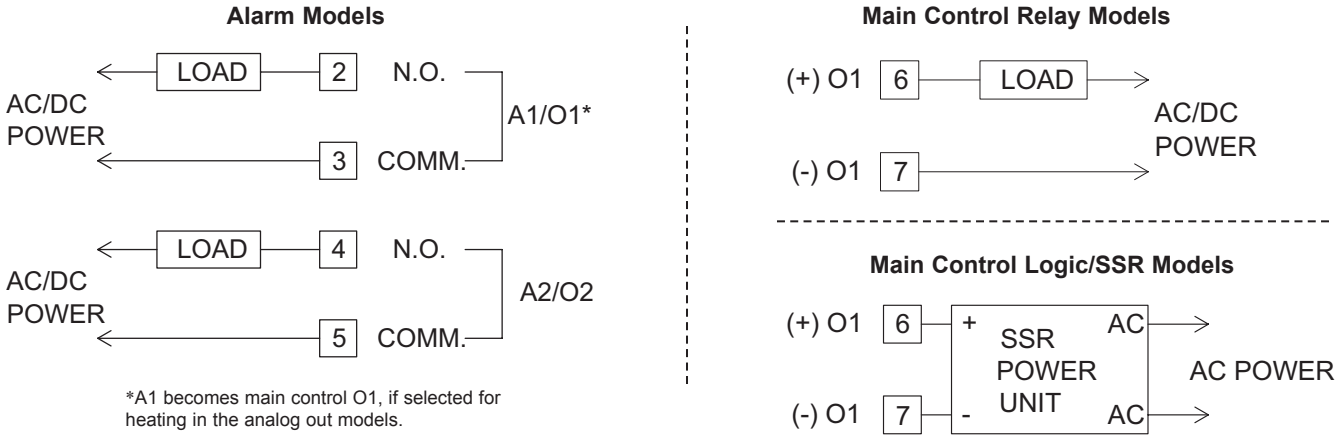


INPUT CONNECTIONS

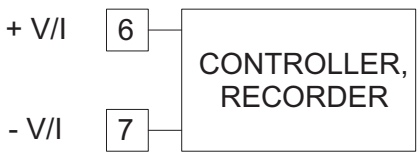
For two wire RTDs, install a copper sense lead of the same gauge and length as the RTD leads. Attach one end of the wire at the probe and the other end to input common terminal. Complete lead wire compensation is obtained. This is the preferred method. If a sense wire is not used, then use a jumper. A temperature offset error will exist. The error may be compensated by programming a temperature offset.



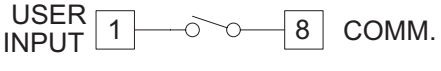
CONTROL AND ALARM OUTPUT CONNECTIONS



ANALOG DC OUTPUT CONNECTIONS



USER INPUT CONNECTIONS



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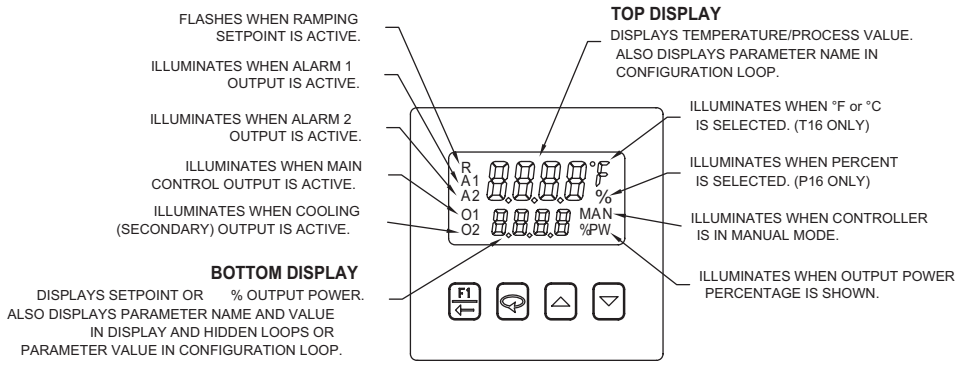
4.0 Reviewing the Front Keys and Display



FRONT PANEL KEYS

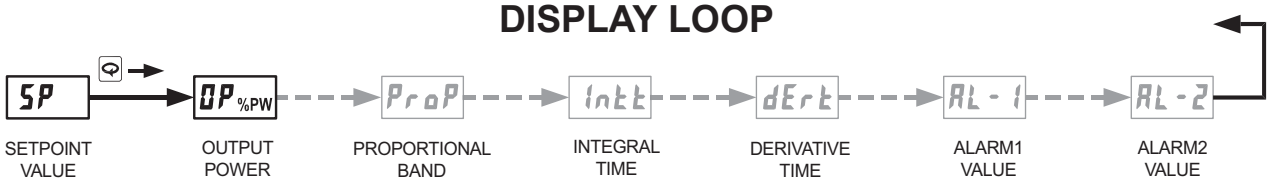
F1 The F1 key is pressed to exit (or escape) directly to the start of the Display Loop. While in the Display Loop, the F1 key can be pressed to activate its programmed function.

The Loop key is pressed to advance to the next parameter, to activate a changed selection/value, and when held for three seconds, enter the Hidden Loop.

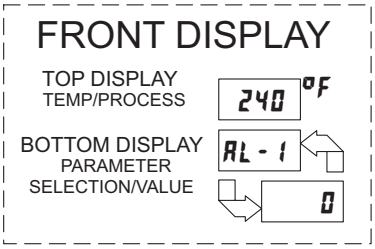
The Arrow keys are used to scroll through parameter selections/values and in the Configuration Loop they are used to scroll to the appropriate Parameter Module.

5.0 Programming: Display Loop

DISPLAY LOOP



Note: Setpoint and Output Power are the only parameters visible in the Display Loop with Factory Settings. The remaining parameters can be selected for the Display Loop within Module 3.
Parameter availability is model and programming dependent.



F1 ENDS AND RETURNS TO START OF DISPLAY LOOP.

ADVANCES TO NEXT PARAMETER.

CHANGES SELECTION/VALUE.

F

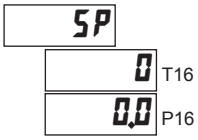
DISPLAY LOOP

At power up, all display segments light, and then the programmed input type and the controller's software version will flash. Then the Temperature/Process Value is shown in the top display, and the Setpoint Value is shown in the bottom display. This is the Display Loop. If the Setpoint is hidden or locked, the Display Loop will default to Output Power. If Output Power is also hidden or locked out, the bottom display is blank. During programming, the F1 key can be pressed to return the controller to this point. (Only in the Display Loop will the F1 key perform the user Fltn function programmed in Input Module 1-IN.)

When the is pressed the controller advances to the next parameter in the Display Loop. Except for Setpoint and % Output Power, the bottom display alternates between the parameter name and its selection/value. The arrow keys are pressed to change the selection/value for the shown parameter. The new selection/value is activated when the is pressed. Display Loop parameters may be locked out or hidden in Lockout Module 3-LC. Some parameters are model and programming dependent.

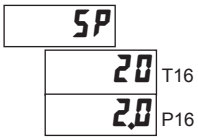
The values shown for the displays are the factory settings.

SETPOINT VALUE (SP1) *



-999 to 9999

SETPOINT VALUE (SP2) *



-999 to 9999

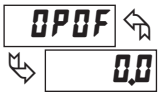
Typically, the controller is operating with the Setpoint value in the bottom display. There is no annunciator nor parameter indication for Setpoint in the Display Loop. The parameter name alternates with the setpoint value in the Hidden Loop. The Setpoint value can be changed, activated and stored by pressing the arrow keys. This is the only parameter that can be configured as read only in the Display Loop, but read/write in the Hidden Loop. It is possible to store a second Setpoint value that can be selected in the Hidden Loop, by the F1 key or the user input. Both Setpoint values are limited by the Setpoint Low and High Limits in Input Module 1-IN.

% OUTPUT POWER *

-100 to 100.0

The % Output Power is shown with the %PW annunciator. The parameter name alternates with the % Output Power value in the Hidden Loop. While the controller is in Automatic Mode, this value is read only. When the controller is placed in Manual Mode, the value can be changed, activated and stored by pressing the arrow keys. For more details on % Output Power, see Control Mode Explanations.

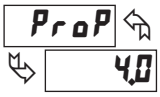
OUTPUT POWER OFFSET



-100 to 100.0

When the Integral Time is set to zero and the controller is in the Automatic Mode, this parameter will appear after % Output Power. It is also shown with the %PW annunciator illuminated. The power offset is used to shift the proportional band to compensate for errors in the steady state. If Integral Action is later invoked, the controller will re-calculate the internal integral value to provide "bumpless" transfer and Output Power Offset will not be necessary.

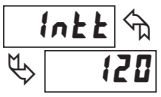
PROPORTIONAL BAND



0.0 to 999.9
(% of full input range)

The proportional band should be set to obtain the best response to a process disturbance while minimizing overshoot. A proportional band of 0.0% forces the controller into On/Off Control with its characteristic cycling at Setpoint. For more information, see Control Mode and PID Tuning Explanations.

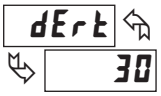
INTEGRAL TIME



0 to 9999 seconds

Integral action shifts the center point position of the proportional band to eliminate error in the steady state. The higher the integral time, the slower the response. The optimal integral time is best determined during PID Tuning. If time is set to zero, the previous Integral output power value is maintained. Offset Power can be used to provide Manual Reset.

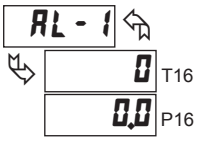
DERIVATIVE TIME



0 to 9999 seconds per repeat

Derivative time helps to stabilize the response, but too high of a derivative time, coupled with noisy signal processes, may cause the output to fluctuate too greatly, yielding poor control. Setting the time to zero disables derivative action.

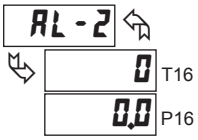
ALARM 1 VALUE



-999 to 9999

On models with alarms, the value for Alarm 1 can be entered here. The value is either absolute (absolute alarm types) or relative to the Setpoint value (deviation and band alarm types.) When Alarm 1 is programmed for HEAt or nonE, this parameter is not available. For more details on alarms, see Alarm Module 4-AL.

ALARM 2 VALUE



-999 to 9999

On models with alarms, the value for Alarm 2 can be entered here. The value is either absolute (absolute alarm types) or relative to the Setpoint value (deviation and band alarm types.) When Alarm 2 is programmed for CooL or nonE, this parameter is not available. For more details on alarms, see the Alarm Module 4-AL.

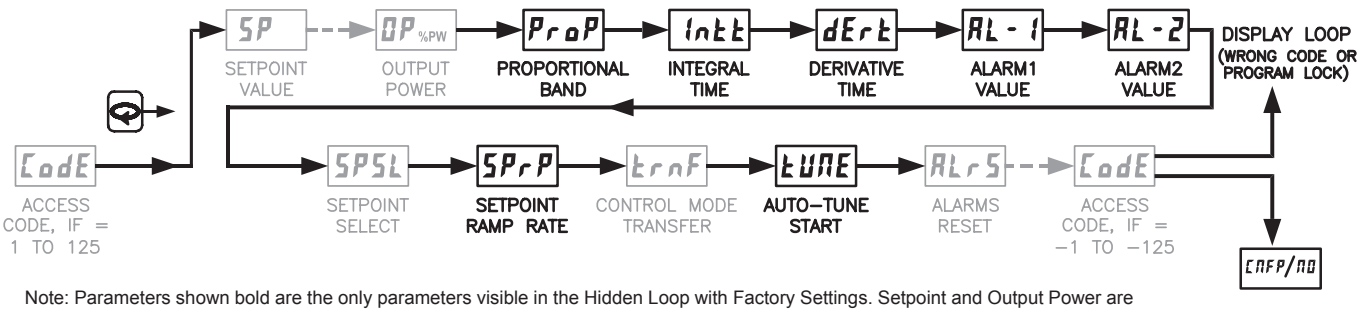
* Alternating indication only used in the Hidden Loop.

F

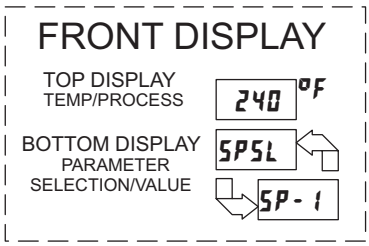
6.0 PROGRAMMING: HIDDEN LOOP

To enter Hidden Loop, press ⟲ for 3 seconds.

HIDDEN LOOP



Note: Parameters shown bold are the only parameters visible in the Hidden Loop with Factory Settings. Setpoint and Output Power are factory set for the Display Loop. The remaining parameters can be selected for the Hidden Loop within Module 3. Parameter availability is model and programming dependent.



F1 ENDS AND RETURNS TO START OF DISPLAY LOOP.

⟲ ADVANCES TO NEXT PARAMETER.

▲ ▼ CHANGES SELECTION/VALUE.

HIDDEN LOOP

When ⟲ is pressed and held for three seconds, the controller advances to the Hidden Loop. The Temperature/Process Value is shown in the top display. The bottom display alternates between the parameter and its selection/value. ▲ or ▼ is pressed to change the selection/value for the shown parameter. The new selection/value is activated after ⟲ is pressed. When F1 is pressed, the controller returns to the Display Loop and stores changed selection/values to permanent memory. Hidden Loop parameters may be locked out in Lockout Module 3-LC. Some parameters are model and programming dependent.

ACCESS CODE

CodE 0 — 1 to 125

If the Access Code is set from 1 to 125, in Lockout Module 3-LC, Access Code will appear here. By entering the proper Code, access to the Hidden Loop is permitted. With the factory setting of 0, Access Code will not appear in the Hidden Loop. A universal code of 111 can be entered to gain access, independent of the programmed code number.

SETPOINT SELECT

SPSL SP 1 — SP 1 or SP2

The SPSL function allows the operator to switch from or to, setpoint 1 and setpoint 2. In the Display Loop, there is no annunciator indicating the selected Setpoint, however, the selected Setpoint value is displayed and activated.

SETPOINT RAMP RATE

SPrP 0.0 — 0.0 to 999.9

The setpoint ramp rate can reduce sudden shock to the process and reduce overshoot on startup or after setpoint changes, by ramping the setpoint at a controlled rate. R annunciator flashes while ramping. With the T16, the ramp rate is always in tenths of degrees per minute, regardless of the resolution chosen for the process display. With the P16, the ramp rate is in least-significant (display units) digits per minute. A value of 0.0 or 0 disables setpoint ramping. Once the ramping setpoint reaches the target setpoint, the setpoint ramp rate disengages until the setpoint is changed again. If the ramp value is changed during ramping, the new ramp rate takes effect. If the setpoint is ramping prior to starting Auto-Tune, the ramping is suspended during Auto-Tune and then resumed afterward. Deviation and band alarms are relative to the target setpoint, not the ramping setpoint. A slow process may not track the programmed setpoint rate. At power up, the ramping setpoint is initialized at the ambient temperature/process value.

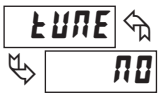
CONTROL MODE TRANSFER

trnF Auto — Auto USEr

In Automatic Mode, the percentage of Output Power is automatically determined by the controller. In Manual/User USEr Mode, the percentage of Output Power is adjusted manually while in the Display Loop. The Control Mode can also be transferred through the F1 Key or User Input. For more information, see Control Mode Explanations.

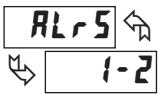
F

AUTO-TUNE START



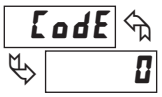
The Auto-Tune procedure of the controller sets the Proportional Band, Integral Time, Derivative Time, Digital Filter, Control Output Dampening Time, and Relative Gain (Heat/Cool) values appropriate to the characteristics of the process. This parameter allows front panel starting YES or stopping no of Auto-Tune. For more information, see PID Tuning Explanations.

ALARMS RESET



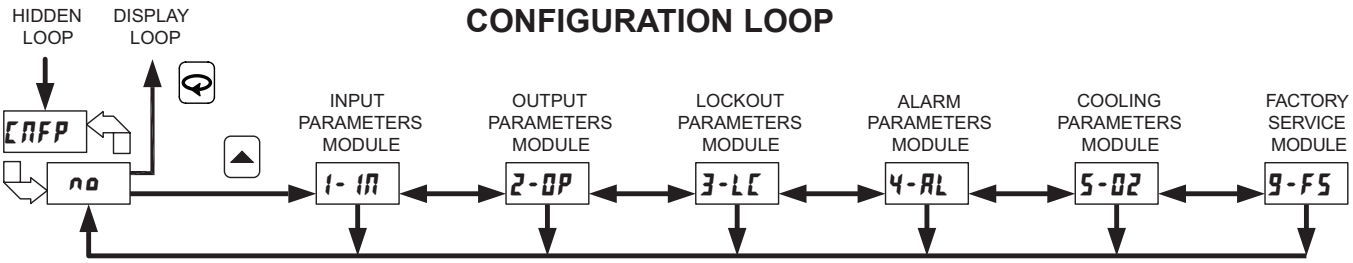
With alarm models, the alarms can be manually reset. The up key resets Alarm 1 and the down key resets Alarm 2.

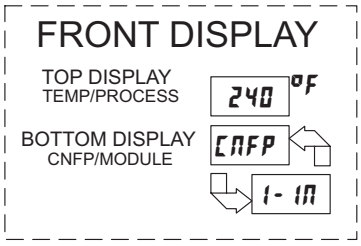
ACCESS CODE

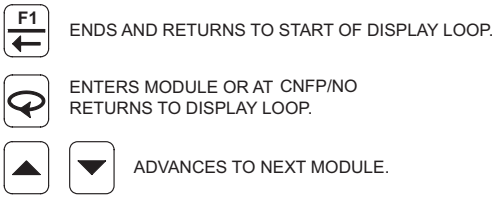


If the Access Code is set from -1 to -125, in Lockout Module 3-LC, Access Code will appear here. By entering the proper Code, access to the Configuration Loop is permitted (with a negative Code value, the Hidden Loop can be accessed without the use of a code). With the factory setting of 0 or with an active User Input configured for Program Lock (PLOC), Access Code will not appear here. An active user input configured for Program Lock (PLOC) always locks out the Configuration Loop, regardless of Access Code.

7.0 PROGRAMMING: CONFIGURATION LOOP





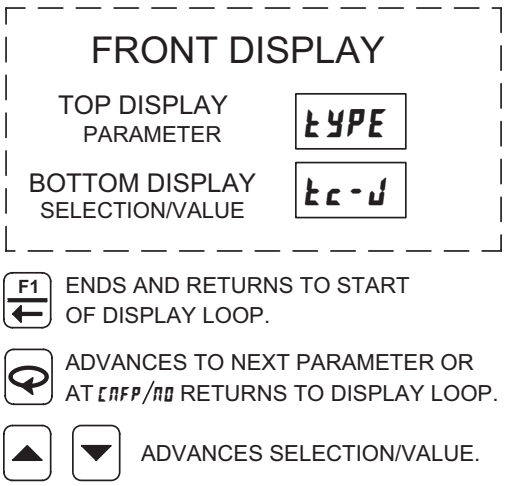


F

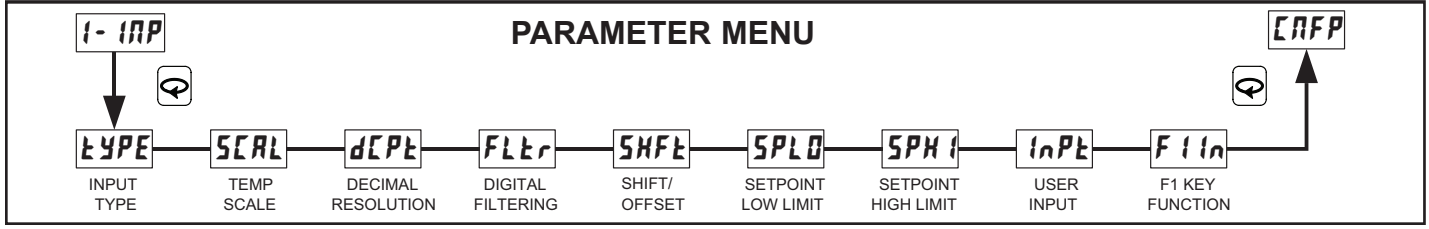
To access the Configuration Loop, press the up key when CNFP/no is displayed in the Hidden Loop. The arrow keys are used to select the parameter module (1-9). To enter a specific module press ⟲ while the module number is displayed. In the Configuration Loop, CNFP will alternate with the parameter number in the bottom display. The Temperature/Process Value is shown in the top display.

After entering a parameter module, press ⟲ to advance through the parameter names in the module. To change a parameter's selection/value, press the arrow keys while the parameter is displayed. In the modules, the top display shows the parameter name, and the bottom display shows the selection/value. Use ⟲ to enter any selection/values that have been changed. The change is not committed to permanent memory until the controller is returned to the Display Loop. If a power loss occurs before returning to the Display Loop, the new values must be entered again.

At the end of each module, the controller returns to CNFP/no. At this location, pressing ⟲ again returns the display to the the Display Loop. Pressing the Up key allows re-entrance to the Configuration Loop. Whenever F1 is pressed, End momentarily appears as the parameters are stored to permanent memory and the controller returns to the Display Loop.



7.1 MODULE 1 - INPUT PARAMETERS (1- 1N) T16 ONLY



INPUT TYPE

tYPE
tc-J

SELECTION	TYPE	SELECTION	TYPE
tc-t	T TC	tc-n	N TC
tc-E	E TC	tc-C	C TC
tc-J	J TC	L 1n	Linear mV
tc-K	K TC	r385	RTD 385
tc-r	R TC	r392	RTD 392
tc-S	S TC	r672	RTD 672
tc-b	B TC	rL 1n	Linear Ohms

Select the input type that corresponds to the input sensor.

TEMPERATURE SCALE

SCAL
°F

°F Fahrenheit
°C Celsius

Select either degrees Fahrenheit or Celsius. For linear mV and ohms input types, this has no effect. If changed, adjust related parameter values, as the controller does not automatically convert them.

DECIMAL RESOLUTION

dCPt
0

0 to 0.0 for temperature and resistance inputs
0.00 for mV inputs

Select whole degrees, or tenths of degrees for Temperature display, Setpoint values, and related parameters. For Linear Resistance inputs rL 1n, the same parameter selections apply in ohms or tenths of an ohm. For mV inputs L 1n, only hundredths of a mV resolution is available.

DIGITAL FILTERING

FLtr
1

0 = least to 4 = most

The filter is an adaptive digital filter that discriminates between measurement noise and actual process changes. If the signal is varying too greatly due to measurement noise, increase the filter value. If the fastest controller response is needed, decrease the filter value.

SHIFT/OFFSET

SHFt
0

-999 to 9999 degrees

This value offsets the controller's temperature display value by the entered amount. This is useful in applications in which the sensor cannot provide the actual temperature signal due to mounting constraints, inaccuracy, etc.

SETPOINT LOW LIMIT

SPLO
0

-999 to 9999

The controller has a programmable low setpoint limit value to restrict the setting range of the setpoint. Set the limit so that the setpoint value cannot be set below the safe operating area of the process.

SETPOINT HIGH LIMIT

SPH 1
9999

-999 to 9999

The controller has a programmable high setpoint limit value to restrict the setting range of the setpoint. Set the limit so that the setpoint value cannot be set above the safe operating area of the process.

USER INPUT FUNCTION (OPTIONAL)

InPt
PLOC

SELECTION	FUNCTION	SELECTION	FUNCTION
NONE	No Function	SPt	Setpoint 1 or 2 Select
PLOC	Program Lock	SPrP	Setpoint Ramp Disable
ILOC	Integral Action Lock	ALrS	Reset Both Alarms
trnF	Auto/Manual Select		

The controller performs the selected User Input function (User Input available only on models with alarms), when the User terminal 1 is connected (pulled low) to Common terminal 8.

No Function: No function is performed.
Program Lock: The Configuration Loop is locked, as long as activated (maintained action).
Integral Action Lock: The integral action of the PID computation is disabled (frozen), as long as activated (maintained action).
Auto/Manual Select: This function selects (maintained action) Automatic (open) or Manual Control (activated).
Setpoint 1 or 2 Select: This function selects (maintained action) Setpoint 1(open) or Setpoint 2 (activated) as the active setpoint.
Setpoint Ramp Disable: The setpoint ramping feature is disabled, as long as activated (maintained action). Any time the user input is activated with a ramp in process, ramping is aborted.
Reset Alarms: Active alarms are reset, as long as activated (maintained action). Active alarms are reset until the alarm condition is cleared and triggered again (momentary action).

F

F1 KEY FUNCTION

F1In
NONE

SELECTION	FUNCTION	SELECTION	FUNCTION
NONE	No Function	A1rS	Reset Alarm 1
trnF	Auto/Manual Select	A2rS	Reset Alarm 2
SPt	Setpoint 1 or 2 Select	ALrS	Reset Both Alarms

The controller performs the selected F1 Key Function, when F1 is pressed while in the Display Loop. In any other loop or module location, pressing F1 will perform an escape to the Display Loop.

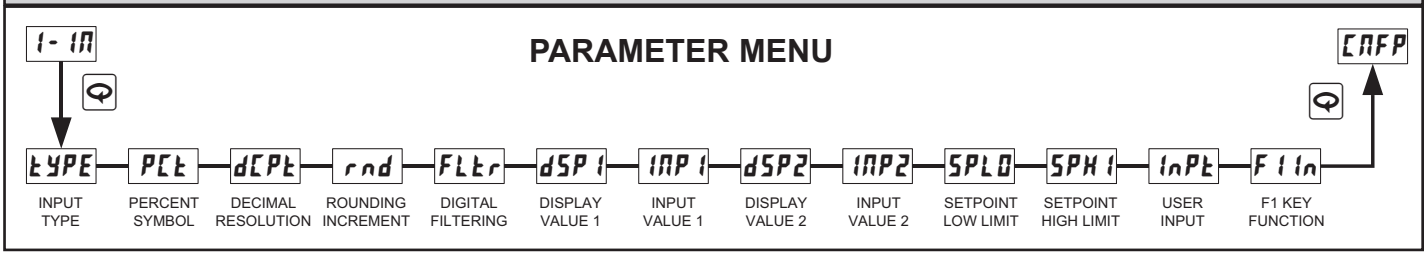
No Function: No function is performed.

Auto/Manual Select: This function toggles (momentary action) the controller between Automatic and Manual Control.

Setpoint 1 or 2 Select: This function toggles (momentary action) the controller between Setpoint 1 and Setpoint 2.

Reset Alarms: This function can be used to reset one or both of the alarms when activated (momentary action) The alarm will remain reset until the alarm condition is cleared and triggered again.

7.1 MODULE 1 - INPUT PARAMETERS (1- IN) P16 ONLY



INPUT TYPE

tYPE
Curr

SELECTION	TYPE
Curr	Current
VOLt	Voltage

Select the input type that corresponds to the input signal.

PERCENT ANNUNCIATOR

PCt
NO

YES On
NO Off

This only illuminates the % annunciator. It does not perform any type of percent function, but is useful in applications that have been scaled in percent.

DECIMAL RESOLUTION

dCPt
0.0

0 0.0 0.00 0.000

This selection affects the decimal point placement for the Process value, and related parameters.

ROUNDING INCREMENT

rnd
0.1

1 to 100
In steps of 1 least significant digit, regardless of decimal point.

Rounding selections other than 1 cause the process value display to round to the nearest rounding increment selected. (For example, rounding of 5 causes 122 to round to 120 and 123 to round to 125.) Rounding starts at the least significant digit of the process value. Setpoint values, Setpoint limits, Alarm values, Input Scaling values, and Analog Scaling values are not affected by rounding.

DIGITAL FILTERING

FLtr
1

0 = least to 4 = most

The filter is an adaptive digital filter that discriminates between measurement noise and actual process changes. If the signal is varying too greatly due to measurement noise, increase the filter value. If the fastest controller response is needed, decrease the filter value.

SCALING

To scale the controller, two scaling points are necessary. Each scaling point has a coordinate pair of Display Values and Input Values. It is recommended that the two scaling points be at the low and high ends of the input signal being measured. Process value scaling will be linear between and continue past the entered points to the limits of the input range. (Factory settings example will display 0.0 at 4.00 mA input and display 100.0 at 20.00 mA input.) Reverse acting indication can be accomplished by reversing the two signal points or the Display value points, but not both. If both are reversed, forward (normal) acting indication will occur. In either case, do not reverse the input wires to change the action.

DISPLAY VALUE SCALING POINT 1

dSP 1
0.0

-999 to 9999

Enter the first coordinate Display Value by using the arrow keys.

INPUT VALUE SCALING POINT 1

INP 1
4.00

0.00 to 20.00 mA
0.00 to 10.00 V

For Key-in Method, enter the first coordinate Input Value by using the arrow keys. To allow the P16 to "learn" the signal, use the Applied Method. For Applied Method, press F1. The ° annunciator is turned on to indicate the applied method. Adjust the applied signal level externally until the appropriate value appears under INP 1. Using either method, press ↻ to store the value for INP 1. (The controller can be toggled back to the Key-in Method by pressing F1 before ↻.)

DISPLAY VALUE SCALING POINT 2

dSP2
100.0

-999 to 9999

Enter the second coordinate Display Value by using the arrow keys.

F

INPUT VALUE SCALING POINT 2

0.00 to 20.00 mA
0.00 to 10.00 V

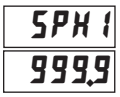
For Key-in Method, enter the second coordinate Input Value by using the arrow keys. To allow the P16 to "learn" the signal, use the Applied Method. For Applied Method, press F1. The ° annunciator is turned on to indicate the applied method. Adjust the applied signal level externally until the appropriate value appears under InP2. Using either method, press ⟲ to store the value for InP2. (The controller can be toggled back to the Key-in Method by pressing F1 before ⟲.)

SETPOINT LOW LIMIT

-999 to 9999

The controller has a programmable low setpoint limit value to restrict the setting range of the setpoint. Set the limit so that the setpoint value cannot be set below the safe operating area of the process.

SETPOINT HIGH LIMIT



-999 to 9999

The controller has a programmable high setpoint limit value to restrict the setting range of the setpoint. Set the limit so that the setpoint value cannot be set above the safe operating area of the process.

USER INPUT FUNCTION (OPTIONAL)

SELECTION	FUNCTION	SELECTION	FUNCTION
NONE	No Function	SPt	Setpoint 1 or 2 Select
PLOC	Program Lock	SPrP	Setpoint Ramp Disable
ILOC	Integral Action Lock	ALrS	Reset Both Alarms
trnF	Auto/Manual Select		

The controller performs the selected User Input function (User Input available only on models with alarms), when the User terminal 1 is connected (pulled low) to Common terminal 8.

No Function: No function is performed.
Program Lock: The Configuration Loop is locked, as long as activated (maintained action).
Integral Action Lock: The integral action of the PID computation is disabled (frozen), as long as activated (maintained action).
Auto/Manual Select: This function selects (maintained action) Automatic (open) or Manual Control (activated).
Setpoint 1 or 2 Select: This function selects (maintained action) Setpoint 1(open) or Setpoint 2 (activated) as the active setpoint.
Setpoint Ramp Disable: The setpoint ramping feature is disabled, as long as activated (maintained action). Any time the user input is activated with a ramp in process, ramping is aborted.
Reset Alarms: Active alarms are reset, as long as activated (maintained action). Active alarms are reset until the alarm condition is cleared and triggered again (momentary action).

F1 KEY FUNCTION

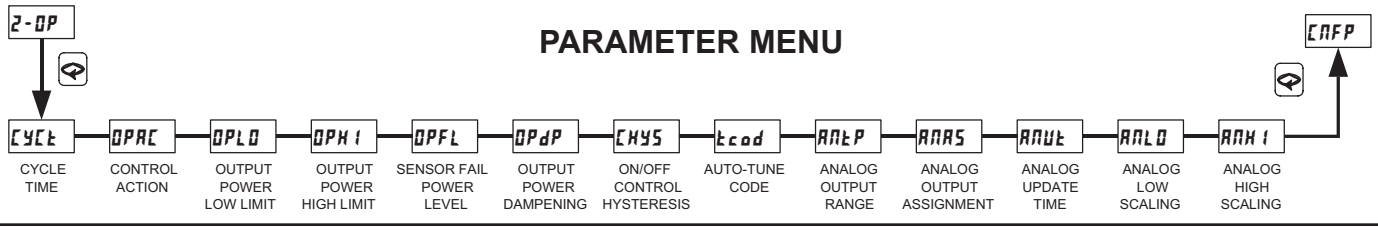
SELECTION	FUNCTION	SELECTION	FUNCTION
NONE	No Function	A1rS	Reset Alarm 1
trnF	Auto/Manual Select	A2rS	Reset Alarm 2
SPt	Setpoint 1 or 2 Select	ALrS	Reset Both Alarms

The controller performs the selected F1 key function, when F1 is pressed while in the Display Loop. In any other loop or module location, pressing F1 will perform an escape to the Display Loop.

No Function: No function is performed.
Auto/Manual Select: This function toggles (momentary action) the controller between Automatic and Manual Control.
Setpoint 1 or 2 Selection: This function toggles (momentary action) the controller between Setpoint 1 and Setpoint 2.
Reset Alarms: This function can be used to reset one or both of the alarms when activated (momentary action). The alarm will remain reset until the alarm condition is cleared and triggered again.

F

7.2 MODULE 2 - OUTPUT PARAMETERS (2-OP)



CYCLE TIME

CYCL
2.0

0.0 to 250.0 seconds

The Cycle Time is entered in seconds with one tenth of a second resolution. It is the total time for one on and one off period of the time proportioning control output O1. With time proportional control, the percentage of power is converted into an output on-time relative to the cycle time value set. (If the controller calculates that 65% power is required and a cycle time of 10.0 seconds is set, the output will be on for 6.5 seconds and off for 3.5 seconds.) For best control, a cycle time equal to one-tenth or less, of the natural period of oscillation of the process is recommended. When using the Analog Output signal for control, the Cycle Time setting has no effect. If the O1 output is not being used, a cycle time of 0 can be entered to prevent the output and indicator from cycling.

CONTROL ACTION

OPAC
rEu

drct Direct (cooling)
rEu Reverse (heating)

This determines the control action for the PID loop. Programmed for direct action (cooling), the output power will increase if the Process value is above the Setpoint value. Programmed for reverse action (heating), the output power decreases when the Process Value is above the Setpoint Value. For heat and cool applications, this is typically set to reverse. This allows O1 or A1 (models with Analog Output) to be used for heating, and A2/O2 to be used for cooling.

OUTPUT POWER LOWER LIMIT

OPLO
0

0 to 100 percent O1
-100 to 100 percent O1/O2

This parameter may be used to limit controller power at the lower end due to process disturbances or setpoint changes. Enter the safe output power limits for the process. If Alarm 2 is selected for cooling, the range is from -100 to +100%. At 0%, both O1 and O2 are off; at 100%, O1 is on; and at -100%, O2 is on. When the controller is in Manual Control Mode, this limit does not apply.

OUTPUT POWER UPPER LIMIT

OPH1
100

0 to 100 percent O1
-100 to 100 percent O1/O2

This parameter may be used to limit controller power at the upper end due to process disturbances or setpoint changes. Enter the safe output power limits for the process. If Alarm 2 is selected for cooling, the range is from -100 to +100%. At 0%, both O1 and O2 are off; at 100%, O1 is on; and at -100%, O2 is on. When the controller is in Manual Control Mode, this limit does not apply.

SENSOR FAIL POWER LEVEL

OPFL
0

0 to 100 percent O1
-100 to 100 percent O1/O2

This parameter sets the power level for the control outputs in the event of a sensor failure. If Alarm 2 is not selected for cooling, the range is from 0% (O1 output full off) to 100% (O1 output full on). If A2 is selected for cooling, the range is from -100 to +100%. At 0%, both O1 and O2 are off; at 100%, O1 is on; and at -100%, O2 is on. The alarm outputs are upscale drive with an open sensor, and downscale drive with a shorted sensor (RTD only), independent of this setting. Manual Control overrides the sensor fail preset.

OUTPUT POWER DAMPENING

OPdP
3 T16
1 P16

0 to 250 seconds

The Dampening Time, entered as a time constant in seconds, dampens (filters) the calculated output power. Increasing the value increases the dampening effect. Generally, dampening times in the range of one-twentieth to one-fiftieth of the controller's integral time (or process time constant) are effective. Dampening times longer than these may cause controller instability due to the added lag effect.

ON/OFF CONTROL HYSTERESIS

CHYS
2 T16
0.2 P16

1 to 250

The controller can be placed in the On/Off Control Mode by setting the Proportional Band to 0.0%. The On/Off Control Hysteresis (balanced around the setpoint) eliminates output chatter. In heat/cool applications, the control hysteresis value affects both Output O1 and Output O2 control. It is suggested to set the hysteresis band to Factory Setting prior to starting Auto-Tune. After Auto-Tune, the hysteresis band has no effect on PID Control. On/Off Control Hysteresis is illustrated in the On/Off Control Mode section.

AUTO-TUNE CODE

tcod
0

0 fastest to 2 slowest

Prior to starting Auto-Tune, this code should be set to achieve the necessary dampening level under PID Control. This value allows customization of the PID values that Auto-Tune will calculate. For the process to be controlled aggressively (fastest process response with possible overshoot), set the Auto-Tune Code to 0. For the process to be controlled conservatively (slowest response with the least amount of overshoot), set this value to 2. If the Auto-Tune Code is changed, Auto-Tune needs to be reinitiated for the changes to affect the PID settings. For more information, see PID Tuning Explanations Section.

F

ANALOG OUTPUT RANGE (OPTIONAL)

ANLP 4-20	0-10 V 0-20 mA 4-20 mA

Select the type of output and range. The Analog output jumpers are factory set to current. They must be changed if voltage output is desired. The Analog output can be calibrated to provide up to approximately 5% over range operation (0 mA current can only go slightly negative).

ANALOG OUTPUT ASSIGNMENT (OPTIONAL)

ANAS OP	OP Main Control % Output Power inP Input Signal Retransmission SP Active Setpoint

This setting selects the parameter that the Analog Output will retransmit or track.

ANALOG UPDATE TIME (OPTIONAL)

ANUt 0	0 to 250 seconds 0 = update rate of 0.1 second

The update time of the Analog Output can be used to reduce excess valve actuator or pen recorder activity.

ANALOG LOW SCALING (OPTIONAL)

ANLO 0.0	-999 to 9999

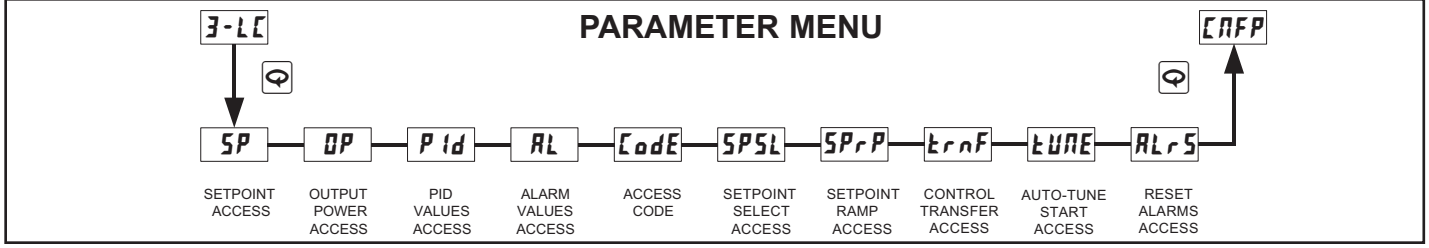
The Analog Output assignment value that corresponds to 0 V, 0 mA or 4 mA output as selected.

ANALOG HIGH SCALING (OPTIONAL)

ANH 1 100.0	-999 to 9999

The Analog Output assignment value that corresponds to 10 V or 20 mA output as selected. An inverse acting output can be achieved by reversing the low and high scaling points.

7.3 MODULE 3 - LOCKOUT PARAMETERS (3-LC)



SELECTION	DESCRIPTION
diSP	Display: accessible in Display Loop.
HIdE	Hide: accessible in Hidden Loop.
LOC	Locked: not accessible in either loop.
dSPr (SP only)	Display/read: read only in Display Loop, but read/write in Hidden Loop.

The following parameters can be configured for LOC, HIdE, and diSP.

SETPOINT ACCESS

SP
diSP

OUTPUT POWER ACCESS

OP
diSP

PID VALUES ACCESS

PId
HIdE

ALARM VALUES ACCESS

AL
HIdE

ACCESS CODE

CodE 0	-125 to 125

0	Full access to Display, Hidden, and Configuration Loops
-1 to -125	Code necessary to access Configuration Loop only.
1 to 125	Code necessary to access Hidden and Configuration Loops.

The following parameters can be configured for LOC or HIdE only.

SETPOINT SELECT ACCESS

SPSL
LOC

SETPOINT RAMP ACCESS

SPrP
HIdE

CONTROL TRANSFER ACCESS

trnF
LOC

AUTO-TUNE START ACCESS

tUNE
HIdE

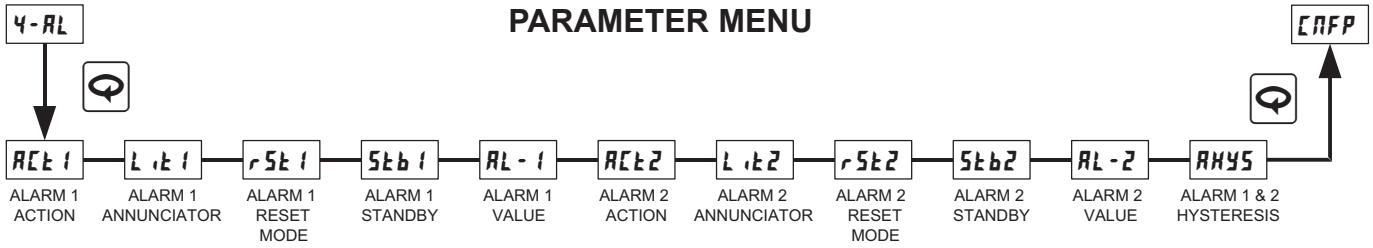
RESET ALARMS ACCESS

ALrS
LOC

F

7.4 MODULE 4 - ALARM PARAMETERS (4-AL) (OPTIONAL)

PARAMETER MENU

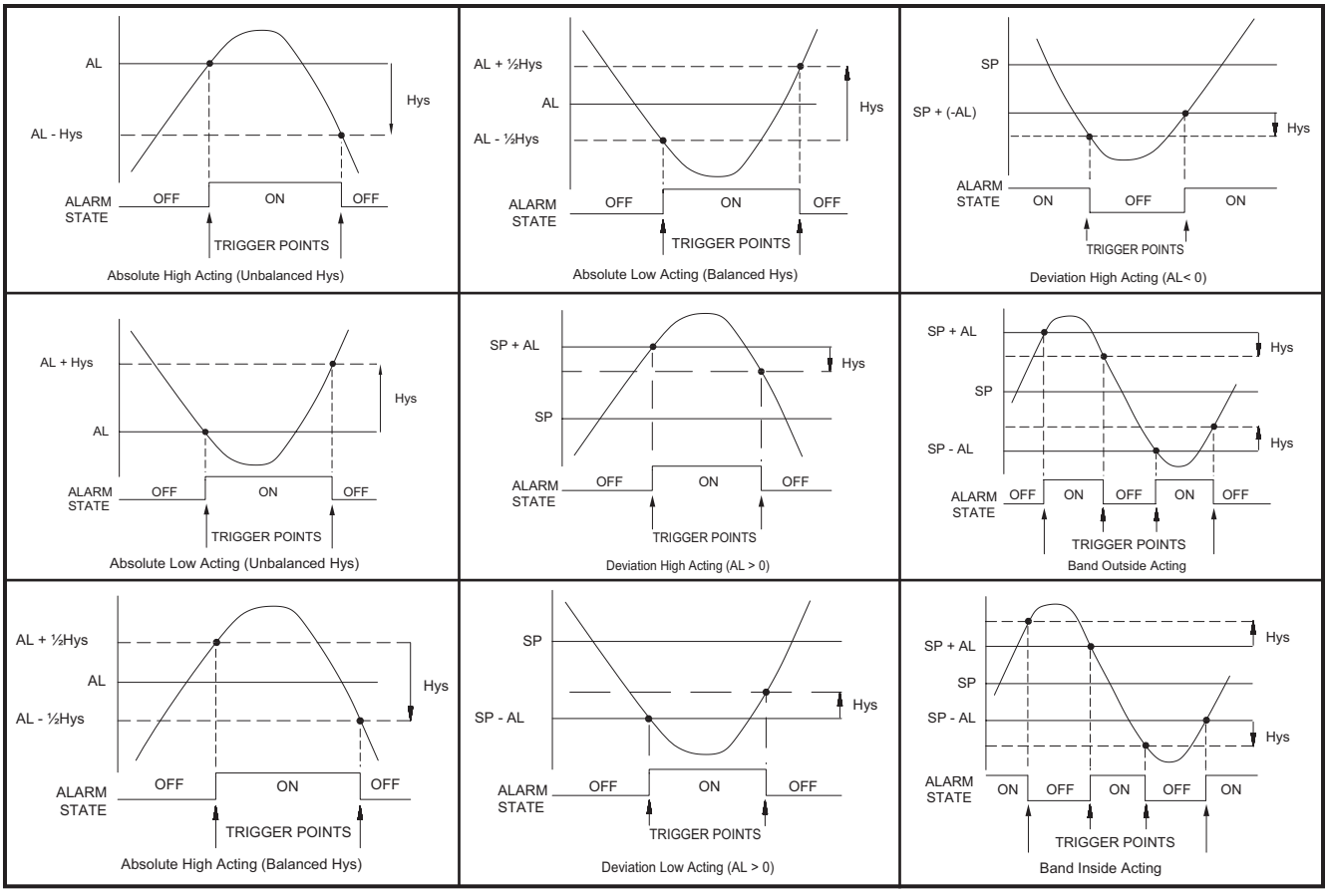


AVAILABLE ALARM ACTIONS

NONE	None	No action, the remaining Alarm parameters are not available.
AbH1	Absolute High (balanced hysteresis)	The alarm energizes when the Process Value exceeds the alarm value + 1/2 the hysteresis value.
AbLO	Absolute Low (balanced hysteresis)	The alarm energizes when the Process Value falls below the alarm value -1/2 the hysteresis value.
AuH1	Absolute High (unbalanced hysteresis)	The alarm energizes when the Process Value exceeds the alarm value.
AuLO	Absolute Low (unbalanced hysteresis)	The alarm energizes when the Process Value falls below the alarm value.

d-H1	Deviation High	Alarm 1 and 2 value tracks the Setpoint value
d-LO	Deviation Low	Alarm 1 and 2 value tracks the Setpoint value
b-IN	Band Acting (inside)	Alarm 1 and 2 value tracks the Setpoint value
b-ot	Band Acting (outside)	Alarm 1 and 2 value tracks the Setpoint value
HEAt	Heat (A1 Analog models only)	If heating is selected, the remaining Alarm 1 parameters are not available.
Cool	Cool (A2 only)	If cooling is selected, the remaining Alarm 2 parameters are not available.

ALARM ACTION FIGURES



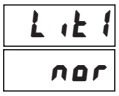
Note: Hys in the above figures refers to the Alarm Hysteresis.

F

ALARM ACTION ALARM 1

Select the action for the alarms. See Alarm Action Figures for a visual explanation.

ALARM ANNUNCIATOR ALARM 1



nor Normal
rEu Reverse

With normal selection, the alarm annunciator indicates “on” alarm output 1. With reverse selection, the alarm annunciator indicates “off” alarm output.

ALARM RESET MODE ALARM 1

Auto Automatic
LAtc Latched

In Automatic mode, an energized alarm turns off automatically after the Temperature/Process value leaves the alarm region. In Latched mode, an energized alarm requires an F1 key or user input alarm reset to turn off. After an alarm reset, the alarm remains reset off until the trigger point is crossed again.

ALARM STANDBY ALARM 1

yES Standby on
no Standby off

Standby prevents nuisance (typically low level) alarms after a power up or setpoint change. After powering up the controller or changing the setpoint, the process must leave the alarm region (enter normal non-alarm area of operation). After this has occurred, the standby is disabled and the alarm responds normally until the next controller power up or setpoint change.

ALARM VALUE ALARM 1

T16
P16

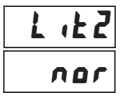
-999 to 9999

The alarm values are entered as process units or degrees. They can also be entered in the Display or Hidden Loops. When the alarm is configured as deviation or band acting, the associated output tracks the Setpoint as it is changed. The value entered is the offset or difference from the Setpoint.

ALARM ACTION ALARM 2

Select the action for the alarms. See Alarm Action Figures for a visual explanation.

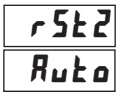
ALARM ANNUNCIATOR ALARM 2



nor Normal
rEu Reverse

With normal selection, the alarm annunciator indicates “on” alarm output 2. With reverse selection, the alarm annunciator indicates “off” alarm output.

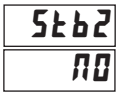
ALARM RESET MODE ALARM 2



Auto Automatic
LAtc Latched

In Automatic mode, an energized alarm turns off automatically after the Temperature/Process value leaves the alarm region. In Latched mode, an energized alarm requires an F1 key or user input alarm reset to turn off. After an alarm reset, the alarm remains reset off until the trigger point is crossed again.

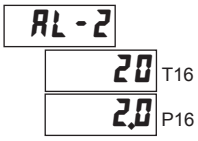
ALARM STANDBY ALARM 2



yES Standby on
no Standby off

Standby prevents nuisance (typically low level) alarms after a power up or setpoint change. After powering up the controller or changing the setpoint, the process must leave the alarm region (enter normal non-alarm area of operation). After this has occurred, the standby is disabled and the alarm responds normally until the next controller power up or setpoint change.

ALARM VALUE ALARM 2

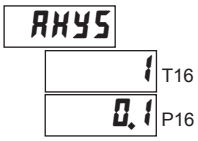


T16
P16

-999 to 9999

The alarm values are entered as process units or degrees. They can also be entered in the Display or Hidden Loops. When the alarm is configured as deviation or band acting, the associated output tracks the Setpoint as it is changed. The value entered is the offset or difference from the Setpoint.

ALARM HYSTERESIS



T16
P16

0 to 250

The Hysteresis Value is either added to or subtracted from the alarm value, depending on the alarm action selected. The same value applies to both alarms. See the Alarm Action Figures for a visual explanation of how alarm actions are affected by the hysteresis.

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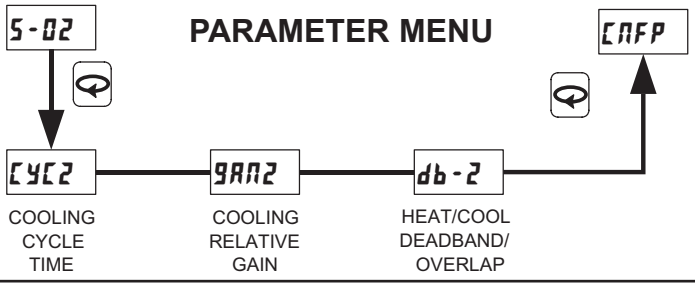
7.5 MODULE 5 - COOLING (SECONDARY) PARAMETERS (5-02)



To enable Cooling in Heat/Cool applications, the Alarm 2 Action must first be set for Cooling. (For P16 Controllers, the cooling output is sometimes referred to as secondary output.) When set to cooling, the output no longer operates as an alarm but operates as a cooling output. The O2 terminals are the same as A2, however a separate O2 annunciator indicates Cooling Operation. Cooling output power ranges from -100% (full cooling) to 0% (no cooling, unless a heat/cool overlap is used). The Power Limits in Output Module 2-OP also limit the cooling power. In applications requiring only a Cooling output, the main 01 output should be used.

CYCLE TIME

CYC2
2.0

0.0 to 250.0 seconds

This cycle time functions like the O1 Output Cycle Time but allows independent cycle time for cooling. A setting of zero will keep output O2 off.

RELATIVE GAIN

GAN2
1.0

0.0 to 10.0

This defines the gain of the cooling relative to the heating. It is generally set to balance the effects of cooling to that of heating. This is illustrated in the Heat/Cool Relative Gain Figures. A value of 0.0 places the cooling output into On/Off Control.

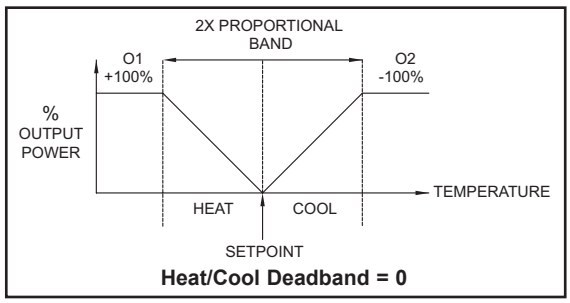
DEADBAND/OVERLAP

db-2
0

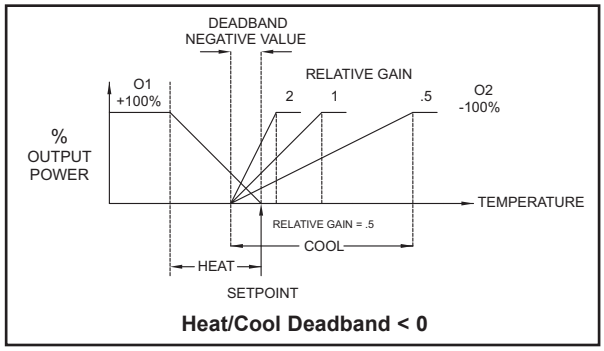
-999 to 9999

This defines the overlap area in which both heating and cooling are active (negative value) or the deadband area between the bands (positive value). If a heat/cool overlap is specified, the percent output power is the sum of the heat power (O1) and the cool power (O2). If Relative Gain is zero, the cooling output operates in the On/Off Control Mode, with the On/Off Control Hysteresis CHYS in Output Module 2-OP becoming the cooling output hysteresis. The function of Deadband is illustrated in the Control Mode Explanations. For most applications, set this parameter to 0.0 prior to starting Auto-Tune. After the completion of Auto-Tune, this parameter may be changed.

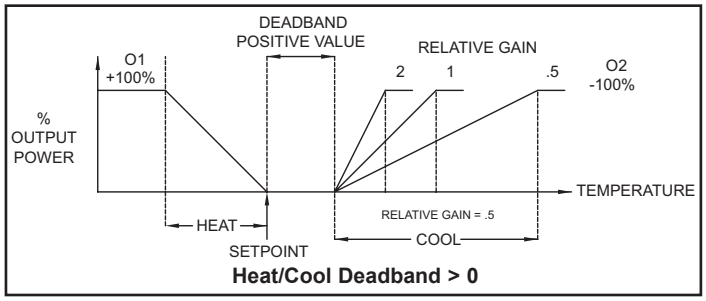
HEAT/COOL RELATIVE GAIN FIGURES



Heat/Cool Deadband = 0



Heat/Cool Deadband < 0



Heat/Cool Deadband > 0

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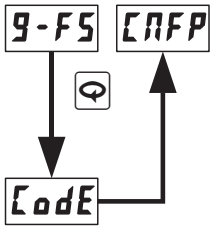
7.5 MODULE 9 FACTORY SERVICE OPERATIONS (9-FS)



FACTORY
SERVICE CODE

PARAMETER MENU

CALIBRATION

CodE
48

The controller is fully calibrated from the factory. Recalibration is recommended every two years by qualified technicians using appropriate equipment. Calibration may be performed by using the front panel or with the TP16KIT. The front panel method is explained below. (Refer to the TP16KIT bulletin for calibration instructions using TP16KIT cable and software.)

Calibration may be aborted by disconnecting power to the controller before exiting Factory Service Module 9-FS. In this case, the existing calibration settings remain in effect.

Note: Allow the controller to warm up for 30 minutes minimum and follow the manufacturer's warm-up recommendations for the calibration source or measuring device.

Millivolt Calibration (T16)

Millivolt calibration requires a precision voltage source with an accuracy of 0.03% (or better) connected to terminals 8 (comm.) and 9 (+). When calibrating the input, the millivolt calibration must be performed first, then the Cold Junction or RTD Resistance.

PROMPT	APPLY	FRONT PANEL ACTION
CodE		Press ▼ until 48, press ⟲.
CAL		Press ▲ for YES, press ⟲.
StP1	0.0 mV	After 5 seconds (minimum), press ⟲.
StP2	14.0 mV	After 5 seconds (minimum), press ⟲.
StP3	28.0 mV	After 5 seconds (minimum), press ⟲.
StP4	42.0 mV	After 5 seconds (minimum), press ⟲.
StP5	56.0 mV	After 5 seconds (minimum), press ⟲.

Cold Junction (T16)

Cold Junction calibration requires a thermocouple of known accuracy of types T, E, J, K, C or N (connected to terminals 8 and 9) and a calibrated external reference thermocouple probe measuring in °C with resolution to tenths. The two probes should be brought in contact with each other or in some way held at the same temperature. They should be shielded from air movement and allowed sufficient time to equalize in temperature. (As an alternative, the T16 thermocouple may be placed in a calibration bath of known temperature.) If performing the millivolt calibration prior, verify that the correct input type is configured in Input Module 1-IN before performing the following procedure. (After the millivolt calibration the controller will default to type J.) If using RTD only, the cold junction calibration need not be performed.

PROMPT	COMPARE	FRONT PANEL ACTION
CodE		Press ▼ until 48, press ⟲.
CAL		Press ⟲.
CJC		Press ▲ for YES, press ⟲.
	Top display to external reference	Press ▲ or ▼ to adjust the bottom display until the top process display matches the external reference then press ⟲.

RTD Resistance (T16)

RTD calibration requires a precision 277.0 ohm resistor with an accuracy of 0.1 Ω (or better). Connect a jumper between terminals 9 and 10 with a 0 ohm jumper between 9 and 8 at StP1 and the 277.0 ohm resistor between 9 and 8 at StP2. If using thermocouple only, the RTD calibration need not be performed.

PROMPT	APPLY	FRONT PANEL ACTION
CodE		Press ▼ until 48, press ⟲.
CAL		Press ⟲.
CJC		Press ⟲.
rtd		Press ▲ for YES, press ⟲.
StP1	0.0 ohm	After 5 seconds (minimum), press ⟲.
StP2	277.0 ohm	After 5 seconds (minimum), press ⟲.

Input Calibration (P16)

Process calibration requires a precision signal source with an accuracy of 0.03% (or better) that is capable of generating 10.0 V connected to terminals 8 (COMM) and 9 (+10V) and 20.00 mA connected to terminals 8 (COMM) and 10 (20mA). The current calibration can be skipped by pressing ⟲ at the not applicable prompts if using the controller for process voltage only.

PROMPT	APPLY	FRONT PANEL ACTION
CodE		Press ▼ until 48, press ⟲.
CAL		Press ▲ for YES, press ⟲.
StP1	0.0 ohm	After 5 seconds (minimum), press ⟲.
StP2	2.5 V	After 5 seconds (minimum), press ⟲.
StP3	5.0 V	After 5 seconds (minimum), press ⟲.
StP4	7.5 V	After 5 seconds (minimum), press ⟲.
StP5	10.0 V	After 5 seconds (minimum), press ⟲.
StPA	0.0 mA	After 5 seconds (minimum), press ⟲.
StPb	20.0 mA	After 5 seconds (minimum), press ⟲.

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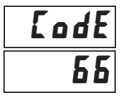
Analog Output Calibration (T16 and P16)

Set the controller Analog jumpers to the output type being calibrated. Connect an external meter with an accuracy of 0.05% (or better) that is capable of measuring 10.00 V or 20.00 mA to terminals 6 (+V/I) and 7 (-V/I). The voltage or current calibration that is not being used must be skipped by pressing ⟲ until End appears.

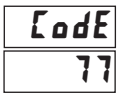
PROMPT	EXTERNAL METER	FRONT PANEL ACTION
CodE		Press ▼ until 48, press ⟲.
CAL		Press ⟲.
CJC		Press ⟲. (T16 only)
rtd		Press ⟲. (T16 only)
ANCL		Press ▲ for YES, press ⟲.
C 0u	0.00 V	Press ▲ or ▼ until external meter matches listing, press ⟲.
C 10u	10.00 V	Press ▲ or ▼ until external meter matches listing, press ⟲.
C 0c	0.0 mA	Press ▲ or ▼ until external meter matches listing, press ⟲.
C 20c	20.0 mA	Press ▲ or ▼ until external meter matches listing, press ⟲.

RESTORE FACTORY SETTINGS



Press and hold ▲ to display CodE 66. Press ⟲. The controller will display rSEt and then return to CNFP. Press F1 ⇐ to return to the Display Loop. This will overwrite all user settings with Factory Settings.

NOMINAL CALIBRATION SETTINGS



Press and hold ▲ to display CodE 77. Press ⟲. Press and hold ▲ to display CodE 77 again. Press ⟲. The controller will then return to CNFP. Press F1 ⇐ to return to the Display Loop. This will not overwrite any user settings but will erase the controller calibration values. This procedure does not require any calibration signals nor external meters. This can be used to clear calibration error flag E-CL.

CAUTION: This procedure will result in up to ±10% reading error and the controller will no longer be within factory specifications. For this reason, this procedure should only be performed if meter error is outside of this range to temporarily restore operation until the unit can be accurately calibrated.

TROUBLESHOOTING

For further technical assistance, contact technical support.

PROBLEM	CAUSE	REMEDIES
NO DISPLAY	1. Power off. 2. Brown-out condition. 3. Loose connection or improperly wired. 4. Bezel assembly not fully seated into rear of controller.	1. Check power. 2. Verify power reading. 3. Check connections. 4. Check installation.
CONTROLLER NOT WORKING	1. Incorrect setup parameters.	1. Check setup parameters.
E-E2 IN DISPLAY	1. Loss of setup parameters due to noise spike or other EMI event.	1. Press F1 to escape, then check controller accuracy. a. Recalibrate controller. (See Factory Service Module code 77.) b. Reset parameters to factory default settings.
E-CL IN DISPLAY	1. Loss of calibration parameters due to noise spike or other EMI event.	1. Press F1 to escape, then check controller accuracy. a. Recalibrate controller. (See Factory Service Module code 77.) b. Reset parameters to factory default settings.
dddd or -ddd IN DISPLAY	1. Display value exceeds 4 digit display range. 2. Defective or miscalibrated cold junction circuit. 3. Loss of setup parameters. 4. Internal malfunction.	1. Press F1 to escape, then check controller accuracy. a. Recalibrate controller. (See Factory Service Module code 77.) b. Reset parameters to factory default settings.
OPEN IN DISPLAY (T16)	1. Probe disconnected. 2. Broken or burned-out probe. 3. Corroded or broken terminations. 4. Excessive process temperature.	1. Change resolution to display whole number and verify reading. 2. Perform cold junction calibration. 3. Check setup parameters. 4. Perform Input calibration.
SENS IN DISPLAY (P16)	1. Input exceeds range of controller. 2. Incorrect input wiring. 3. Defective transmitter. 4. Internal malfunction.	1. Check input parameters. 2. Check input wiring. 3. Replace transmitter. 4. Perform input calibration.
OLOL IN TOP DISPLAY	1. Input exceeds range of controller. 2. Temperature exceeds range of input probe. 3. Defective or incorrect transmitter or probe. 4. Excessive high temperature for probe. 5. Loss of setup parameters.	1. Check input parameters. 2. Change to input sensor with a higher temperature range. 3. Replace transmitter or probe. 4. Reduce temperature. 5. Perform input calibration.
ULUL IN TOP DISPLAY	1. Input is below range of controller. 2. Temperature below range of input probe. 3. Defective or incorrect transmitter or probe. 4. Excessive low temperature for probe. 5. Loss of setup parameters.	1. Check input parameters. 2. Change to input sensor with a lower temperature range. 3. Replace transmitter or probe. 4. Raise temperature. 5. Perform input calibration.
SHrt IN DISPLAY (T16)	1. RTD probe shorted.	1. Check wiring and/or replace RTD probe.
CONTROLLER SLUGGISH OR NOT STABLE	1. Incorrect PID values. 2. Incorrect probe location.	1. See PID control. 2. Evaluate probe location.
SSr IN DISPLAY	1. Control output is damaged.	1. Return controller to factory for repair.

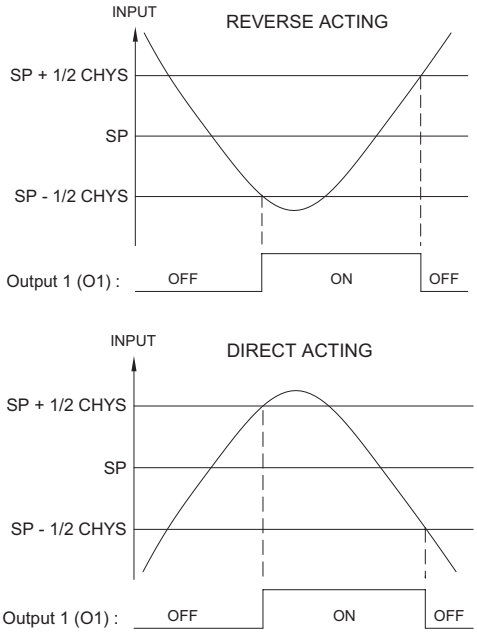
F

CONTROL MODE EXPLANATIONS

ON/OFF CONTROL

The controller operates in On/Off Control when the Proportional Band is set to 0.0%. In this control mode, the process will constantly oscillate around the setpoint value. The On/Off Control Hysteresis (balanced around the setpoint) can be used to eliminate output chatter. Output O1 Control Action can be set to reverse for heating (output on when below the setpoint) or direct for cooling (output on when above the setpoint) applications.

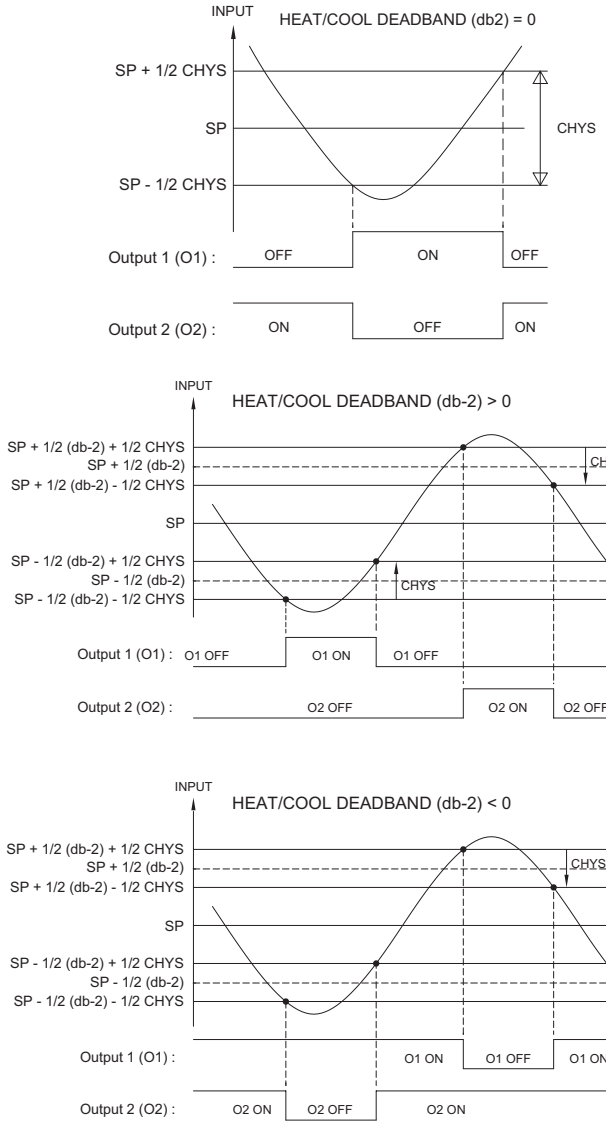
ON/OFF CONTROL - REVERSE OR DIRECT ACTING FIGURES



Note: CHYS in the On/Off Control Figures refers to the On/Off Control Hysteresis (CHYS) in parameter Module 2.

For heat and cool systems, O1 Control Action is set to reverse (heat) and the Alarm 2 Action is set to cooling (O2). The Proportional Band is set to 0.0 and the Relative Gain in Cooling to 0.0. The Deadband in Cooling sets the amount of operational deadband or overlap between the outputs. The setpoint and the On/Off Control Hysteresis applies to both O1 and O2 outputs. The hysteresis is balanced in relationship to the setpoint and deadband value.

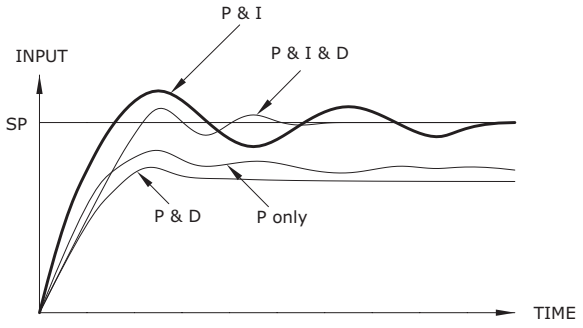
ON/OFF CONTROL - HEAT/COOL OUTPUT FIGURES



PID CONTROL

In PID Control, the controller processes the input and then calculates a control output power value by use of a modified Proportional Band, Integral Time, and Derivative Time control algorithm. The system is controlled with the new output power value to keep the process at the setpoint. The Control Action for PID Control can be set to reverse for heating (output on when below the setpoint) or direct for cooling (output on when above the setpoint) applications. For heat and cool systems, the heat (O1) and cool (O2) outputs are both used. The PID parameters can be established by using Auto-Tune, or they can be Manually tuned to the process.

TYPICAL PID RESPONSE CURVE



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TIME PROPORTIONAL PID CONTROL

In Time Proportional applications, the output power is converted into output On time using the Cycle Time. For example, with a four second cycle time and 75% power, the output will be on for three seconds (4 × 0.75) and off for one second.

The cycle time should be no greater than 1/10 of the natural period of oscillation for the process. The natural period is the time it takes for one complete oscillation when the process is in a continuously oscillating state.

LINEAR PID CONTROL

In Linear PID Control applications, the Analog Output Assignment **AnAS** is set to % Output Power, **oP**. The Analog Low Scaling, **AnLo** , is set to 0.0 and the Analog High Scaling, **AnHi** , is set to 100.0. The Analog Output will then be proportional to the PID calculated % output power for Heat or Cooling per the Control Action **oPAc**. For example, with 0 VDC to 10 VDC (scaled 0 to 100%) and 75% power, the analog output will be 7.5 VDC.

MANUAL CONTROL MODE

In Manual Control Mode, the controller operates as an open loop system (does not use the setpoint and process feedback). The user adjusts the percentage of power through the % Power display to control the power for Output O1. When Alarm 2 is configured for Cooling (O2), Manual operation provides 0 to 100% power to O1 (heating) and -100 to 0% power to O2 (Cooling). The Low and High Output Power limits are ignored when the controller is in Manual.

MODE TRANSFER

When transferring the controller mode between Automatic and Manual, the controlling outputs remain constant, exercising true "bumpless" transfer. When transferring from Manual to Automatic, the power initially remains steady, but Integral Action corrects (if necessary) the closed loop power demand at a rate proportional to the Integral Time.

AUTOMATIC CONTROL MODE

In Automatic Control Mode, the percentage of output power is automatically determined by PID or On/Off calculations based on the setpoint and process feedback. For this reason, PID Control and On/Off Control always imply Automatic Control Mode.

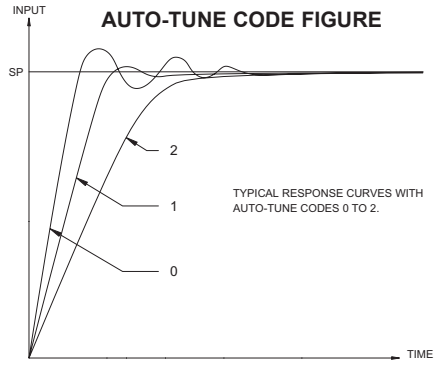
PID TUNING EXPLANATIONS

AUTO-TUNE

Auto-Tune is a user-initiated function that allows the controller to automatically determine the Proportional Band, Integral Time, Derivative Time, Digital Filter, Control Output Dampening Time, and Relative Gain (Heat/Cool) values based upon the process characteristics. The Auto-Tune operation cycles the controlling output(s) at a control point three-quarters of the distance between the present process value and the setpoint. The nature of these oscillations determines the settings for the controller's parameters.

Prior to initiating Auto-Tune, it is important that the controller and system be first tested. (This can be accomplished in On/Off Control or Manual Control Mode.) If there is a wiring, system or controller problem, Auto-Tune may give incorrect tuning or may never finish. Auto-Tune may be initiated at start-up, from setpoint or at any other process point. However, ensure normal process conditions (example: minimize unusual external load disturbances) as they will have an effect on the PID calculations.

AUTO-TUNE CODE FIGURE



Start Auto-Tune

Below are the parameters and factory settings that affect Auto-Tune. If these setting are acceptable then Auto-Tune can be started just by performing two steps. If changes are needed, then they must be made before starting Auto-Tune.

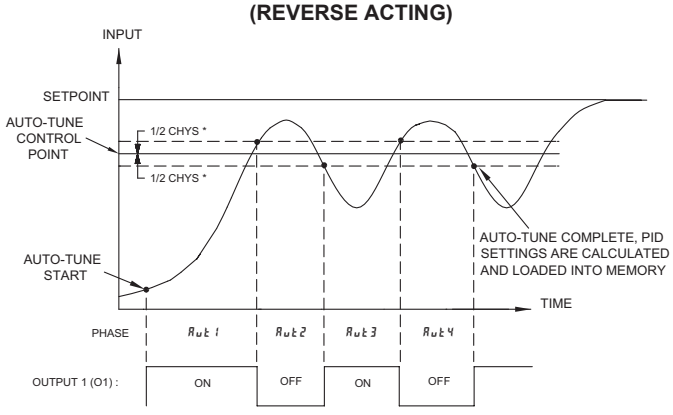
DISPLAY	PARAMETER	FACTORY SETTING	MODULE
tYPE	Input Type	tc-J T16 Curr P16	1-In
FLtr	Digital Filtering	1	1-In
CHYS	On/Off Control Hysteresis	2 T16 0.2 P16	2-oP
tcod	Auto-Tune Code	0	2-oP
db-2	Deadband	0	5-02
tUnE	Auto-Tune Access	HidE	3-LC

1. Enter the Setpoint value in the Display Loop.
2. Initiate Auto-Tune by changing Auto-Tune Start **tUnE** to **YES** in the Hidden Loop.

Auto-Tune Progress

The controller will oscillate the controlling output(s) for four cycles. The bottom display will flash the cycle phase number. Parameter viewing is permitted during Auto-Tune. The time to complete the Auto-Tune cycles is process dependent. The controller should automatically stop Auto-Tune and store the calculated values when the four cycles are complete. If the controller remains in Auto-Tune unusually long, there may be a process problem. Auto-Tune may be stopped by entering **no** in Auto-Tune Start **tUnE**.

AUTO-TUNE OPERATION (REVERSE ACTING)



* - On/Off Control Hysteresis

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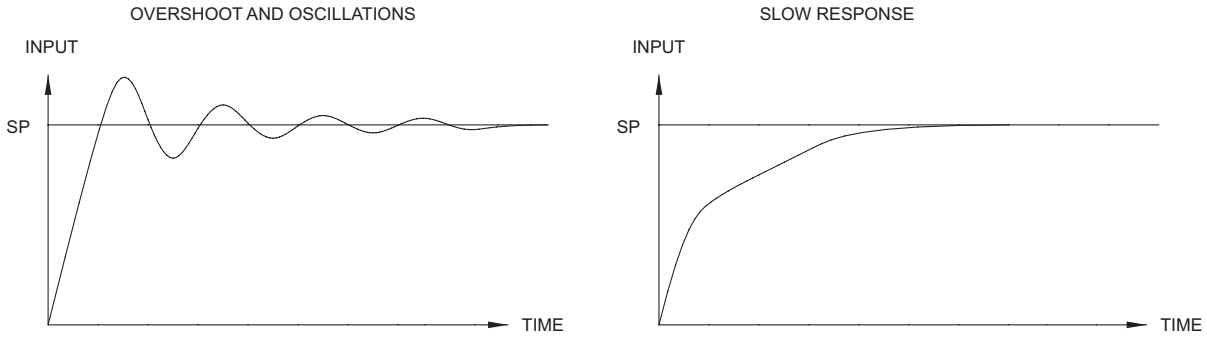
PID Adjustments

In some applications, it may be necessary to fine tune the Auto-Tune calculated PID parameters. To do this, a chart recorder or data logging device is needed to provide a visual means of analyzing the process. Compare the actual process response to the PID response figures with a step change to the process. Make changes to the PID parameters in no more than 20% increments from the starting value and allow the process sufficient time to stabilize before evaluating the effects of the new parameter settings.

In some unusual cases, the Auto-Tune function may not yield acceptable control results or induced oscillations may cause system problems. In these applications, Manual Tuning is an alternative.

PROCESS RESPONSE EXTREMES



TO DAMPEN RESPONSE:
- INCREASE PROPORTIONAL BAND.
- INCREASE INTEGRAL TIME.
- USE SETPOINT RAMPING.
- USE OUTPUT POWER LIMITS.
- RE-INVOKE AUTO-TUNE WITH A HIGHER AUTO-TUNE CODE.
- INCREASE DERIVATIVE TIME.
- CHECK CYCLE TIME.

TO QUICKEN RESPONSE:
- DECREASE PROPORTIONAL BAND.
- DECREASE INTEGRAL TIME.
- INCREASE OR DEFEAT SETPOINT RAMPING.
- EXTEND OUTPUT POWER LIMITS.
- RE-INVOKE AUTO-TUNE WITH A LOWER AUTO-TUNE CODE.
- DECREASE DERIVATIVE TIME.

MANUAL TUNING

A chart recorder or data logging device is necessary to measure the time between process cycles. This procedure is an alternative to the controller's Auto-Tune function. It will not provide acceptable results if system problems exist.

1. Set the Proportional Band (PropP) to 10.0% for temperature models (T16) and 100.0% for process models (P16).
2. Set both the Integral Time (intt) and Derivative Time (dErt) to 0 seconds.
3. Set the Output Dampening Time (OPdP) in Output Module 2-OP to 0 seconds.
4. Set the Output Cycle Time [CYCt] in Output Module 2-OP to no higher than one-tenth of the process time constant (when applicable).
5. Place the controller in Manual USEr Control Mode trnF in the Hidden Loop and adjust the % Power to drive the process value to the Setpoint value. Allow the process to stabilize after setting the % Power. Note: trnF must be set to Hidd in Parameter Lockouts Module 3-LC.
6. Place the controller in Automatic (Auto) Control Mode trnF in the Hidden Loop. If the process will not stabilize and starts to oscillate, set the Proportional Band two times higher and go back to Step 5.
7. If the process is stable, decrease Proportional Band setting by two times and change the Setpoint value a small amount to excite the process. Continue with this step until the process oscillates in a continuous nature.
8. Fix the Proportional Band to three times the setting that caused the oscillation in Step 7.
9. Set the Integral Time to two times the period of the oscillation.
10. Set the Derivative Time to 1/8 (0.125) of the Integral Time.
11. Set the Output Dampening Time to 1/40 (0.025) the period of the oscillation.

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MODEL T48 - 1/16 DIN TEMPERATURE CONTROLLER

- *PID CONTROL WITH REDUCED OVERSHOOT*
- *ON DEMAND AUTO-TUNING OF PID CONTROL SETTINGS*
- *NEMA 4X/IP65 BEZEL*
- *DUAL LED DISPLAYS FOR SIMULTANEOUS INDICATION OF TEMPERATURE AND SETPOINT*
- *STATUS INDICATORS FOR OUTPUTS AND CONTROL MODES*
- *ACCEPTS 10 TYPES OF SENSOR INPUTS (Thermocouple or RTD)*
- *OPTIONAL HEATER CURRENT MONITOR AND HEATER BREAK ALARM*
- *OPTIONAL DUAL ALARM OUTPUTS*
- *OPTIONAL TWO LINEAR DC OUTPUTS (0 to 10 V, 0/4 to 20 mA)*
- *MANUAL/AUTOMATIC CONTROL MODES*
- *SETPOINT RAMPING FOR PROCESS STARTUP*
- *PROGRAMMABLE USER INPUT (Digital) FOR ADDED FLEXIBILITY*
- *SENSOR ERROR COMPENSATION (Offset) AND BREAK DETECTION*
- *HEATING AND OPTIONAL COOLING OUTPUTS*
- *PARAMETER SECURITY VIA PROGRAMMABLE LOCKOUTS*
- *FIELD REPLACEABLE OUTPUT BOARD (Relay or Logic/SSR Drive)*

- *OPTIONAL TRIAC OUTPUT*
- *SECOND SETPOINT SETTING*
- *OPTIONAL REMOTE SETPOINT INPUT (0/4 to 20 mA)*
- *OPTIONAL RS485 SERIAL COMMUNICATIONS*
- *PC SOFTWARE AVAILABLE FOR CONTROLLER CONFIGURATION*

UL Recognized Component, File # E156876

DESCRIPTION

The T48 Controller accepts signals from a variety of temperature sensors (thermocouple or RTD elements), precisely displays the process temperature, and provides an accurate output control signal (time proportional or linear DC) to maintain the process at the desired temperature. The controller's comprehensive yet simple programming allows it to meet a wide variety of application requirements.

The controller operates in the PID control mode for both heating and cooling, with on-demand auto-tune, which will establish the tuning constants. The PID tuning constants may be fine-tuned by the operator at any time and then locked out from further modification. The controller employs a unique overshoot suppression feature, which allows the quickest response without excessive overshoot. The unit can be transferred to operate in the manual mode, providing the operator with direct control of the output. The controller may also be programmed to operate in the ON/OFF control mode with adjustable hysteresis. A second setpoint is available on select models to allow quick selection of a different setpoint setting.

CAUTION: Risk of Danger.
Read complete instructions prior to installation and operation of the unit.

CAUTION: Risk of electric shock.

Dual 4-digit displays allow viewing of the process temperature and setpoint simultaneously. Front panel indicators inform the operator of the controller and output status. On many models the main control output and the alarm outputs are field replaceable.

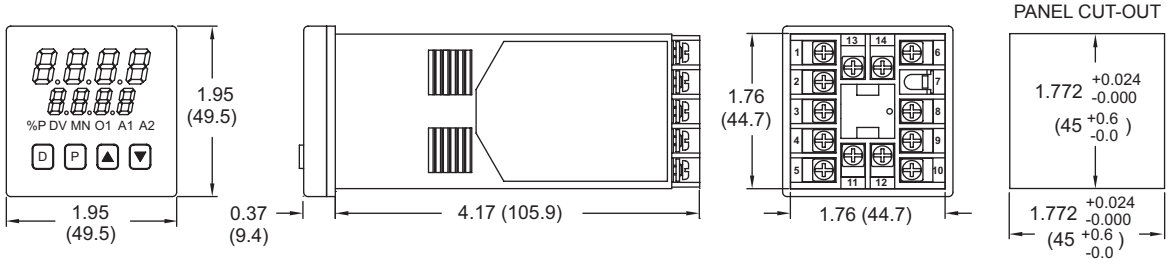
Optional alarm(s) can be configured to activate according to a variety of actions (Absolute HI or LO, Deviation HI or LO, Band IN or OUT, and Heater Current Break) with adjustable hysteresis. A standby feature suppresses the alarm during power-up until the temperature stabilizes outside the alarm region. The second alarm can be configured as a secondary PID output (heat/cool applications).

Optional Main Linear DC output (10 V or 20 mA) can be used for control or temperature re-transmission purposes. Programmable output update time reduces valve or actuator activity. The output range can be scaled independent of the input range.

Optional Second Linear DC output (10 V or 20 mA) provides an independent temperature re-transmission, while the main Linear DC output is being used for control. The output range can be scaled independent of the input range.

Optional Heater Current Monitor provides a direct readout of process heater current. An alarm can be programmed to signal when the heater has failed. This provides early warning of system failure before product quality is affected.

DIMENSIONS In inches (mm)



Optional Remote Setpoint input (0/4 to 20 mA) allows for cascade control loops, where tighter control is required; and allows for remotely driven setpoint signal from computers or other similar equipment. Straightforward end point scaling with independent filtering and local/remote transfer option expand the controller's flexibility.

The optional RS485 serial communication interface provides two-way communication between a T48 and other compatible equipment such as a printer, PLC, HMI, or a host computer. In multipoint applications (up to thirty-two), the address number of each T48 on the line can be programmed from 0 to 99. Data from the T48 can be interrogated or changed, and alarm output(s) may be reset by sending the proper command code via serial communications. PC software, SFCRM, allows for easy configuration of controller parameters. These settings can be saved to disk for later use or used for multi-controller down loading. On-line help is provided within the software.

The unit is constructed of a lightweight, high impact plastic case with a tinted front panel. The front panel meets NEMA 4X/IP65 specifications when properly installed. Multiple units can be stacked horizontally or vertically. Modern surface-mount technology, extensive testing, plus high immunity to noise interference makes the controller extremely reliable in industrial environments.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the manual or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Do not use the T48 to directly command motors, valves, or other actuators not equipped with safeguards. To do so can be potentially harmful to persons or equipment in the event of a fault to the controller. An independent and redundant temperature limit indicator with alarm outputs is strongly recommended.

SPECIFICATIONS

1. **DISPLAY:** Dual 4-digit
   Upper Temperature Display: 0.4" (10.2 mm) high red LED
   Lower Auxiliary Display: 0.3" (7.6 mm) high green LED
   Display Messages:
   "OLOL" - Appears when measurement exceeds + sensor range.
   "ULUL" - Appears when measurement exceeds - sensor range.
   "OPEN" - Appears when open sensor is detected.
   "SHrt" - Appears when shorted sensor is detected *(RTD only)*
   "..." - Appears when display values exceed + display range.
   "-.." - Appears when display values exceed - display range.
   LED Status Annunciators:
   %P - Lower auxiliary display shows power output in (%).
   MN - Flashing: Controller is in manual mode.
   On: Local Setpoint (Remote Setpoint option)
   Off: Remote Setpoint
   DV - Lower auxiliary display shows deviation *(error)* from temperature setpoint or shows heater current.
   O1 - Main control output is active.
   A1 - Alarm #1 is active *(for A1 option.)*.
   A2 - Alarm #2 is active OR
   - Cooling output (O2) is active
2. **POWER:**
   AC Versions: 85 VAC min. to 250 VAC max., 50 to 60 Hz, 8 VA max.
   DC Versions:
   DC Power: 18 to 36 VDC; 7 W
   AC Power: 24 VAC ± 10%; 50 to 60 Hz, 9 VA
3. **CONTROLS:** Four front panel push buttons for modification and setup of controller functions and one external input user for parameter lockout or other functions.
4. **MEMORY:** Nonvolatile E^2 PROM retains all programmable parameters and values.
5. **MAIN SENSOR INPUT:**
   Sample Period: 100 msec
   Response Time: Less than 300 msec typ., 400 msec max. *(to within 99% of final value w/step input; typically, response is limited to response time of probe)*
   Failed Sensor Response:
   Main Control Output(s): Programmable preset output
   Display: "OPEN"
   Alarms: Upscale drive
   Normal Mode Rejection: 40 dB @ 50/60 Hz (improves with increased digital filtering.)
   Common Mode Rejection: Greater than 120 dB, DC to 60 Hz
   Protection: Input overload 120 VAC max. for 15 seconds max.
6. **THERMOCOUPLE INPUT:**
   Types: T, E, J, K, R, S, B, N, Linear mV, software selectable
   Input Impedance: 20 MΩ all types
   Lead resistance effect: 0.25 µV/Ω
   Cold junction compensation: Less than ±1°C (±1.5°C max), error over 0 to 50°C max. ambient temperature range. Defeated for Linear mV indication mode.
   Resolution: 1° for all types, or 0.1° for T, E, J, K, and N only.

TC TYPE	RANGE	WIRE COLOR	
		ANSI	BS 1843
T	-200 to +400°C -328 to +752°F	blue (+) red (-)	white (+) blue (-)
E	-200 to +750°C -328 to +1382°F	violet (+) red (-)	brown (+) blue (-)
J	-200 to +760°C -328 to 1400°F	white (+) red (-)	yellow (+) blue (-)
K	-200 to +1250°C -328 to +2282°F	yellow (+) red (-)	brown (+) blue (-)
R	0 to 1768°C +32 to +3214°F	black (+) red (-)	white (+) blue (-)
S	0 to 1768°C +32 to 3214°F	black (+) red (-)	white (+) blue (-)
B	+149 to +1820°C +300 to +3308°F	grey (+) red (-)	no standard
N	-200 to +1300°C -328 to +2372°F	orange (+) red (-)	orange (+) blue (-)
mV	-5.00 to +56.00	no standard	no standard

7. **RTD INPUT:** 2 or 3 wire, 100 Ω platinum, alpha = 0.00385 (DIN 43760), alpha = 0.0039162
   Excitation: 150 µA typical
   Resolution: 1 or 0.1 degree
   Lead Resistance: 15 Ω max. per input lead

RTD TYPE	RANGE
385	-200 to +600°C -328 to +1100°F
392	-200 to +600°C -328 to +1100°F
OHMS	1.0 to 320.0

8. **INDICATION ACCURACY:** ±(0.3% of Span +1°C.) includes NIST conformity, cold junction effect and A/D conversion errors at 23°C after 20 min. warm-up.
9. **USER INPUT:** Internally pulled up to +5 VDC (1 MΩ).
   $V_{IN\ MAX}$ = 5.25 VDC, V_{IL} = 0.85 V max., V_{IH} = 3.65 V min.,
   I_{OFF} = 1µA max.
   Response Time: 120 msec max.
   Functions: Program Lock; Auto/Manual Mode Select; Reset Alarms; Local/Remote Setpoint Select; Integral Action Lock; Setpoint Ramp Enable; Setpoint 1/Setpoint 2 Select; Serial block print
10. **CONTROL AND ALARM OUTPUTS:** (Heating, Cooling or Alarm)
    Relay outputs with Form A contacts:
    Contact Rating: 3 A @ 250 VAC or 30 VDC (resistive load).
    Life Expectancy: 100,000 cycles at max. load rating.
    (Decreasing load and/or increasing cycle time, increases life expectancy.)
    Logic/SSR Drive Outputs:
    Rating: 45 mA @ 4 V min., 7 V nominal
    Triac Outputs:
    Type: Isolated, Zero Crossing Detection
    Rating:
    Voltage: 120/240 VAC
    Max. Load Current: 1 Amp @ 35°C
    0.75 Amp @ 50°C
    Min Load Current: 10 mA
    Offstate Leakage Current: 7 mA max. @ 60 Hz
    Operating Frequency: 20 to 400 Hz
    Protection: Internal transient snubber
11. **MAIN CONTROL:**
    Control: PID or ON/OFF
    Output: Time proportioning or Linear DC
    Cycle time: Programmable
    Auto-tune: When selected, sets proportional band, integral time, and derivative time values.
    Probe Break Action: Programmable
12. **ALARMS:** 1 or 2 alarms (optional)
    Modes: Absolute high acting
    Absolute low acting
    Deviation high acting
    Deviation low acting
    Inside band acting
    Outside band acting

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Heater break alarm
Reset Action: Programmable; automatic or latched
Standby Mode: Programmable; enable or disable
Hysteresis: Programmable
Probe Break Action: Upscale
Annunciator: LED backlight for "A1", "A2"

13. **COOLING:** Software selectable (overrides alarm 2)
Control: PID or ON/OFF
Output: Time Proportioning
Cycle time: Programmable
Proportional Gain Adjust: Programmable
Heat/Cool Deadband Overlap: Programmable

14. **MAIN AND SECOND LINEAR DC OUTPUT:** (optional)
Self-powered (active)
Main: Control or Re-transmission, programmable update rate from 0.1 sec to 250 sec
Second: Re-transmission only, fixed update rate of 0.1 sec

OUTPUT ** RANGE	ACCURACY * (18 to 28°C)	ACCURACY * (0 to 50°C)	COMPLIANCE	RESOLUTION
0 to 10 V	0.10% of FS + 1/2 LSD	0.30% of FS + 1/2 LSD	10k ohm min.	1/3500
0 to 20 mA	0.10% of FS + 1/2 LSD	0.30% of FS + 1/2 LSD	500 ohm max.	1/3500
4 to 20 mA	0.10% of FS + 1/2 LSD	0.30% of FS + 1/2 LSD	500 ohm max.	1/2800

* Accuracies are expressed as ± percentages after 20 minutes warm-up. Output accuracy is specified in two ways: Accuracy over an 18 to 28°C range at 10 to 75% RH environment; and accuracy over a 0 to 50°C range at 0 to 85% RH (non-condensing) environment. Accuracy over the wide temperature range reflects the temperature coeffecient of the internal circuitry.
** Outputs are independently jumper selectable for either 10 V or 20 mA. The output range may be field calibrated to yield approximately 10% overrange and a small underrange (negative) signal.

15. **REMOTE SETPOINT INPUT:** (optional)
Input type:
0/4 to 20 mA
Input Resistance: 10 Ω
Overrange: -5% to 105%
Overload: 100 mA (continuous)
Scale Range: -999 to 9999 degrees or -99.9 to 999.9 degrees.
Resolution: 1 part in 10,000.
Accuracy:
At 25° C: ±(0.1 % of full scale +½ LSD)
Over 0 to 50°C range: ±(0.2% of full scale +½ LSD)
Reading Rate: 10/sec.
Setpoint Filtering: Programmable Digital
Setpoint Ramping: Programmable, 0.1 to 999.9 degrees/minute.

16. **HEATER CURRENT MONITOR INPUT:** (optional)
Type: Single phase, full wave monitoring of load currents controlled by main output (01).
Input: 100 mA AC output from current transformer (RLC #CT004001) or any CT with 100 mA AC output.
Display Scale Range: 1.0 to 999.9 Amps or 0.0 to 100.0%
Input Resistance: 5 Ω
Accuracy:
At 25° C: ±(0.5 % of full scale +½ LSD), (5 to 100% of Range)
Over 0 to 50°C range: ±(1.0% of full scale +½ LSD), (5 to 100% of Range)
Frequency: 50 to 400 Hz.
Alarm Mode: Dual acting; heater element fail detect and control device fail detect.
Overrange: 105% Capacity
Overload: 200 mA (continuous).

17. **SERIAL COMMUNICATIONS:** (optional)
Type: RS485 multipoint, balanced interface
Baud Rate: 300 to 9600
Data Format: 7O1, 7E1, 7N2, 8N1
Node Address: 0-99, max of 32 units per line
Transmit Delay: 2-100 msec or 100-200 msec
Data Encoding: ASCII
Isolation w.r.t Main Input Common: 500 Vrms for 1 min. (50 V working)
Not isolated w.r.t. Remote Setpoint or Heater Current inputs, or Analog Output common
Note: RS485 and the Analog Output commons are not internally isolated within the controller. The terminating equipment of these outputs must not share the same common (ie. earth ground).

18. **ENVIRONMENTAL CONDITIONS:**
Operating Range: 0 to 50°C
Storage Range: -40 to 80°C
Span Drift *(max.)*: 130 ppm/°C, main input
Zero Drift *(max.)*: 1µV/°C, main input
Operating and Storage Humidity:
85% max. relative humidity (non-condensing) from 0°C to 50°C.
Vibration to IEC 68-2-6: Operational 5 to 150 Hz, 2 g.
Shock to IEC 68-2-27: Operational 20 g (10 g relay).
Altitude: Up to 2000 meters

19. **ISOLATION BREAKDOWN RATINGS:**
AC line with respect to all Inputs and outputs: 250 V working (2300 V for 1 minute).
Main input with respect to Analog Outputs, Remote Setpoint Input, Heater Current Input: 50 V working (2300 V for 1 minute).
All other inputs and outputs with respect to relay contacts: 2000 VAC
Not isolated between Analog Outputs, Remote Setpoint and Heater Current commons.

20. **CERTIFICATIONS AND COMPLIANCES:**
CE Approved
EN 61326-1 Immunity to Industrial Locations
Emission CISPR 11 Class A
IEC/EN 61010-1
RoHS Compliant
UL Recognized Component: File #E156876
Type 4X Enclosure rating (Face only)
IP65 Enclosure rating (Face only)
IP20 Enclosure rating (Rear of unit)
Refer to EMC Installation Guidelines section of the manual for additional information.

21. **CONNECTION:** Wire clamping screw terminals

22. **CONSTRUCTION:** Black plastic alloy case and collar style panel latch. Panel latch can be installed for vertical or horizontal instrument stacking. One piece tinted plastic bezel. Bezel assembly with circuit boards can be removed from the case to change the output board without removing the case from the panel or disconnecting wiring. Unit meets NEMA 4X/IP65 requirements for indoor use, when properly installed. Installation Category II, Pollution Degree 2.

23. **WEIGHT:** 0.38 lbs (0.17 kgs)

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BASIC OPERATION

The T48 controls a process temperature by measuring the temperature via an input probe, then calculating a control output power value by use of a modified PID control algorithm. The unit controls the system with the new output power value to keep the process temperature at setpoint. The PID control algorithm incorporates features which provide for high control accuracy and low temperature overshoot from process disturbances.

FRONT PANEL FEATURES

In the normal operating mode, the unit displays the process temperature in the upper display. One of the following parameters can be viewed in the lower display:

- Setpoint
- % Power Output
- Temperature Deviation
- Heater Current
- Temperature symbol (F or C)
- Blank Display

The user scrolls through these parameters by pressing the D button. If enabled, the control setpoint or power output (manual mode only) can be directly modified in this mode.

In the normal operating mode, parameters are selected by use of the P button and modified by use of the UP and DOWN buttons. Parameters are then entered by the P button, which advances the user to the next parameter. Pressing the D button immediately returns the controller to the normal operating mode without changing the currently selected parameter.

HARDWARE FEATURES

A fast 100 msec input sampling rate provides quick controller response to a process disturbance, thus providing excellent temperature control. Measurement accuracy of 0.3% of span ±1°C or better, provides close process control conforming to the desired control setpoint value. The T48 accepts a variety of both thermocouple and RTD temperature probes. An output board contains the Main Control output, Alarm 1 output, Alarm 2/Cooling output, and/or Linear DC output. Since the controller is serviceable from the front of the panel, the output board (on some models) may be easily changed or replaced without disturbing the wiring behind the panel. No re-programming is required when changing or replacing the output board for units without the Linear DC output option. Units with the linear output option require calibration procedure for the new linear output.

Low-drift, highly stable circuitry ensures years of reliable and accurate temperature control. The recommended two year re-calibration interval is easily accomplished via the programming menu.

REMOTE SETPOINT INPUT

The remote setpoint input facilitates the use of a remote signal to drive the controller's setpoint. The remote signal can be scaled independent to that of the controller's range. The controller's response to local/remote setpoint transfers can be programmed. Also, the remote signal is filtered by use of an adaptive filter. With this filter, relatively large filtering time constants can be used without suffering from long settling times. The time constant and filter disable band are programmable. Additionally, the remote signal can also be velocity limited (or ramped) to slow the controller's response to changes in setpoint. This results in a steady control response with no overshoot.

HEATER CURRENT MONITOR

The T48 provides a direct readout of process heater current. This provides valuable information regarding single phase heater system integrity. It is especially useful on extruder and large oven applications where adjacent controllers mask the effect of a failed heater. The heater break alarm senses two types of heater system faults:

1) Main control output is "on" and heater current is below alarm value. This indicates failed heater or failed parts of heater, breaker trip, failed power control device, etc.
2) Main control output is "off" and heater current is above 10% of alarm value. This indicates a failed power control device, wiring fault, etc.

LINEAR DC ANALOG OUTPUTS

The Main Linear DC output has independent scaling, programmable output update time and filter (damping) time. These parameters permit flexibility in process configuration. The output can be set for 0 to 10 V, 0 to 20 mA or 4 to 20 mA ranges, and can be configured for control or for transmission of temperature or setpoint values.

A Second Linear DC output is dedicated for retransmission of input temperature. The output can be scaled and converted independent of the input and Main Linear DC output. This output is isolated from the input.

SETPOINT FEATURES

The controller setpoint can be protected from out of range values by programming the setpoint range limit values. Additionally, safeguards from inadvertent data entry can be programmed.

A second setpoint value can be programmed which can be made active by a user input and/or through the front panel on selected models.

The setpoint ramp feature ramps the setpoint value at start-up or any time a setpoint change is made, at a user programmable rate. This feature reduces thermal shock to the process and helps to minimize temperature overshoot.

INPUT FEATURES

A programmable input filter can be used to stabilize readings from a process with varying or oscillating temperature characteristics, helping to provide better temperature control. A programmable temperature shift function can be used to compensate for probe errors or to have multiple T48 units indicate the same nominal temperature.

The programmable User Input can be used to control a variety of functions, such as auto/manual transfer of the controller, reset alarm output*(s)*, transfer to second setpoint, etc.

OUTPUT FEATURES

Programmable output power limits provide protection for processes where excessive power can cause damage. Automatic sensor probe break detection, for fail-safe operation, causes the controller to default to a programmed output power (upscale or downscale burnout). Programmable output cycle time, output hysteresis and dampening can reduce output activity without degrading control accuracy. The main outputs can operate in PID, ON/OFF, or manual control modes.

CONTROL AND ALARM OUTPUTS

In addition to the Linear DC outputs, there are up to three types of ON/OFF outputs.These outputs can be relay, logic, or triac for control or alarm purposes. Relay outputs can switch user applied AC or DC voltages. Logic/SSR drive outputs supply power to external SSR power units. One Logic/SSR Drive output can control up to four SSR power units at one time. The Triac output supplies one Amp of AC current for control of an external AC relay or triac device.

AUTO-TUNE

The T48 has an auto-tune feature which, on demand, automatically determines the PID control parameters for a particular thermal process. After completion of auto-tune, the PID parameters are automatically optimized for that process and loaded into non-volatile memory. The operator may view and modify the parameters as desired.

Auto-tune may be invoked either at start-up or at setpoint, depending on the process requirements. An auto-tune programmable dampening factor produces various levels of process control and response characteristics.

RS485 Communications

The RS485 communications option allows the connection of up to 32 devices on a single pair of wires with a distance of up to 4,000 feet and a maximum baud rate of 9600. Since the same pair of wires are used for both transmit and receive, only one way communication is possible at any given time. The controller has a programmable response time to allow the host device adequate time to release the communication line for a transmission.

Selected parameters from the T48 can be interrogated or changed, and alarm output(s) may be reset by sending the proper command code via serial communications. It is also possible to invoke Auto-tune through the serial port. Serial communications used with SFCRM software allows for easy controller parameter configuration by computer.

HEATING AND COOLING SYSTEMS

The T48 is available with dual outputs to provide heating and cooling to those processes that require them. For example, many extruder applications require both heating and cooling to maintain accurate extruder barrel and die temperatures. The T48 is easily configured for these types of applications.

CONTROLLER PROGRAMMING

Front Panel Program Disable allows all of the controller's set-ups to be locked-out from further operator intervention after the initial set-up.

The following four programming modes allow the controller to adapt to any required user-interface level:

Unprotected Parameter Mode
Protected Parameter Mode
Hidden Function Mode
Configuration Parameter Mode

UNPROTECTED PARAMETERS MODE *

The Unprotected Parameters Mode is accessible from the Normal Display Mode when program disable is inactive or when the proper access code number from the Protected Parameter Mode is entered. The Configuration Parameter Modes can be accessed only from this mode.

"SP"	- Enter setpoint
"OP"	- Enter output power
"ProP"	- Enter proportional band
"Intt"	- Enter integral time
"dErt"	- Enter derivative time
"AL-1"	- Enter value for alarm #1
"AL-2"	- Enter value for alarm #2
"CNFP"	- Select configuration access point
"End"	- Return to normal display mode

PROTECTED PARAMETERS MODE *

The Protected Parameters Mode is enabled when program disable is active. This mode prevents access to the Configuration Parameter Modes without the proper access code number. Only the parameters that are enabled in the Configuration 3 parameter (lock-out section) can be accessed.

"ProP"	- Enter proportional band
"Intt"	- Enter integral time
"dErt"	- Enter derivative time
"AL-1"	- Enter value for alarm #1
"AL-2"	- Enter value for alarm #2
"CodE"	- Enter value to access unprotected parameters and configuration parameters

HIDDEN FUNCTION MODE *

The Hidden Function Mode is accessible from the Normal Display Mode. The functions in this mode may be locked-out individually in Configuration 3 parameter (lock-out section).

"SPSL"	- Select local (SP1 or SP2) or remote setpoint
"trnF"	- Transfer between automatic (PID) control and manual control
"tUNE"	- Invoke/cancel PID Auto-tune
"ALrS"	- Reset latched alarms

CONFIGURATION PARAMETER MODE

The Configuration Parameter Mode allows the operator to set-up the basic requirements of the controller. It is divided into sections which group together related programming steps, such as inputs, outputs, alarms, etc. Upon completion of each section, the program returns to the Configuration Access Point, allowing the user to return to the Normal Display Mode.

Configuration 1, Inputs (1-IN)

"tYPE"	- Select input probe type
"SCAL"	- Select temperature scale
"dCPt"	- Select temperature resolution
"FLtr"	- Select level of input filtering
"SHFt"	- Enter input correction shift (offset)
"SPLO"	- Enter setpoint lower limit
"SPHI"	- Enter setpoint higher limit
"SPrP"	- Enter setpoint ramp rate
"InPt"	- Select user input function

Configuration 2, Outputs (2-OP) *

"CYCt"	- Enter time proportioning cycle time
"OPAC"	- Select output control action
"OPLO"	- Enter output power low limit
"OPHI"	- Enter output power high limit
"OPFL"	- Enter probe fail power preset
"OPdP"	- Enter output control dampening
"CHYS"	- Enter ON/OFF control hysteresis
"tcOd"	- Select auto-tuning dampening
"ANtP"	- Main Linear DC analog output range
"ANAS"	- Main Linear DC analog output source
"ANut"	- Main Linear DC analog output update time
"ANLO"	- Main Linear DC analog output scaling low
"ANHI"	- Main Linear DC analog output scaling high

Configuration 3, Parameter Lock-Outs (3-LC) *

"SP"	- Select setpoint access level
"OP"	- Select power access level
"dEv"	- Enable deviation display
"Hcur"	- Enable heater current display
"UdSP"	- Enable temperature scale display
"CodE"	- Enter parameter access code
"PId"	- Select PID access level
"AL"	- Select alarm access level
"ALrS"	- Enable alarm reset access
"SPSL"	- Enable local/remote selection
"trnF"	- Enable auto/manual mode selection
"tUNE"	- Enable auto-tune invocation

Configuration 4, Alarms (4-AL) *

"ACt1"	- Select operation mode of alarm #1, or select heat output
"rSt1"	- Select reset mode of alarm #1
"Stb1"	- Enable activation delay of alarm #1
"AL-1"	- Enter value for alarm #1
"ACt2"	- Select operation mode of alarm #2, or select cooling output
"rSt2"	- Select reset mode of alarm #2
"Stb2"	- Enable activation delay of alarm #2
"AL-2"	- Enter value for alarm #2
"AHYS"	- Enter hysteresis value for both alarms

Configuration 5, Cooling (5-O2) *

"CYC2"	- Enter cooling time proportioning cycle time
"GAN2"	- Enter cooling relative gain
"db-2"	- Enter heat/cool deadband or overlap

Configuration 6, Serial Communications (6-SC) *

"bAUd"	- Select baud rate
"ConF"	- Select character frame format
"Addr"	- Enter address
"Abrv"	- Select abbreviated or full transmission
"PoPt"	- Select print options

Configuration 7, Remote Setpoint Input (7-N2) *

"dSP1"	- Enter remote setpoint display scaling value #1
"INP1"	- Enter remote setpoint process scaling value #1
"dSP2"	- Enter remote setpoint display scaling value #2
"INP2"	- Enter remote setpoint process scaling value #2
"FLtr"	- Enter remote setpoint filter time constant
"bAnd"	- Enter remote setpoint filter disable band
"trnF"	- Select Local/Remote setpoint transfer response

Configuration 7 - Heater Current Parameters (7-N2) *

"Hcur"	- Enter full scale rating of CT

Configuration 8, Second Linear DC Analog Output (8-A2) *

"A2tP"	- Second linear DC analog range
"A2LO"	- Second linear DC analog scaling low
"A2HI"	- Second linear DC analog scaling high

Configuration 9, Factory Service Operations (9-FS)

"Code 48"	- Calibrate Instrument
"Code 66"	- Reset parameters to factory setting

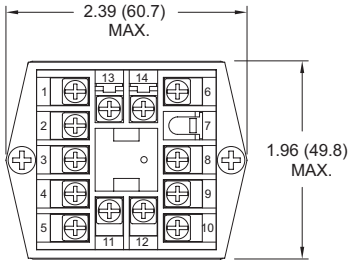
* *These parameters may not appear due to option configuration or other programming.*

F

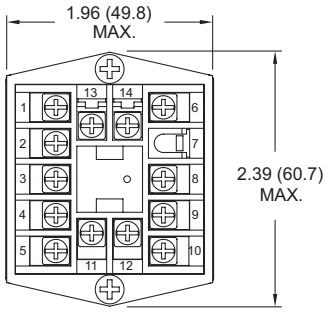
MULTIPLE UNIT STACKING

The T48 is designed for close spacing of multiple units. Units can be stacked either horizontally or vertically. For vertical stacking, install the panel latch with the screws to the sides of the unit. For horizontal stacking, the panel latch screws should be at the top and bottom of the unit. The minimum spacing from center line to center line of units is 1.96" (49.8 mm). This spacing is the same for vertical or horizontal stacking.

Note: When stacking units, provide adequate panel ventilation to ensure that the maximum operating temperature range is not exceeded.

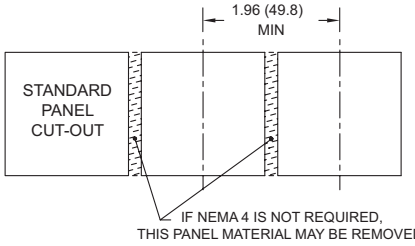


PANEL LATCH INSTALLED FOR VERTICAL UNIT STACKING



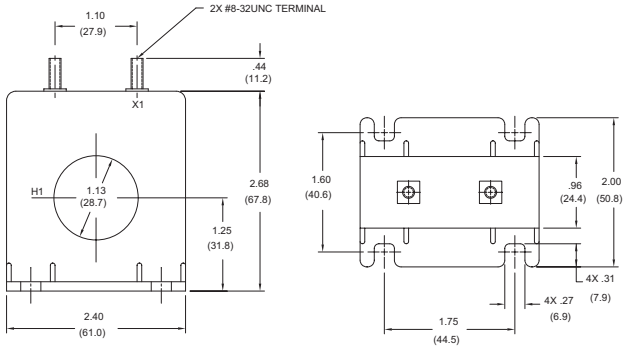
PANEL LATCH INSTALLED FOR HORIZONTAL UNIT STACKING

PANEL CUT-OUT SPACING FOR MULTIPLE UNIT STACKING.
HORIZONTAL ARRANGEMENT SHOWN.



ACCESSORY - CURRENT TRANSFORMER-50 A

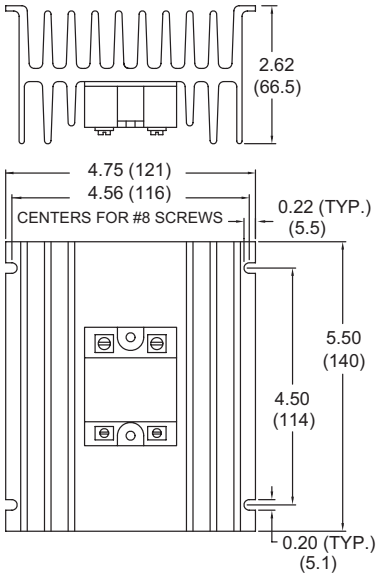
The external Current Transformer is used when specifying the T48s equipped with the Heater Current Monitor.



Part Number: CT005001
Current Ratio: 50 : 0.1 (Amperes)
Operation Frequency: 50 to 400 Hz
Insulation Class: 0.6 KV BIL, 10 KV full wave.
Terminals: Brass studs No. 8-32 UNC with flat washer and hex nuts.
Window Diameter: 1.13" (28.7 mm)
Weight: 8 oz (226.0 g)

ACCESSORY - EXTERNAL SSR POWER UNIT

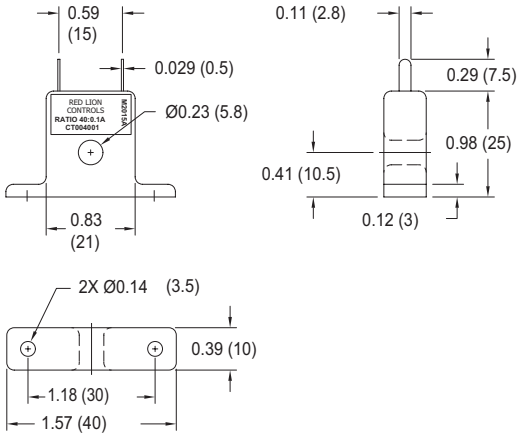
The external SSR Power Unit is used with T48s equipped with Logic/SSR Drive outputs to switch loads up to 240 VAC @ 45 Amps, 25°C ambient. The unit is operated by applying a low level DC control signal to the isolated input. The unit features zero cross detection circuits which reduces radiated RFI when switching load currents. With no contacts to wear out, the SSR Power Unit provides virtually limitless operational life. The unit is supplied with an integral heat sink for immediate installation.



External SSR Power Unit:
Part Number: RLY50000
Switched Voltage Range: 50 to 280 VAC
Load Current: 45 Amps max. @ 25°C ambient temperature
35 Amps max. @ 50°C ambient temperature
On State Input: 3 to 32 VDC @ 1500 Ω impedance. *(isolated)*
(Use Logic/SSR drive output.)
Off State Input: 0.0 to 1.0 VDC
Size: 5.5" (14 cm) L x 4.75" (12 cm) W x 2.62" (6.6 cm) H

ACCESSORY - CURRENT TRANSFORMER-40 A

The external Current Transformer is used when specifying the T48s equipped with the Heater Current Monitor.



Current Transformers:
Part Number: CT004001
Current Ratio: 40 : 0.1 (Amperes)
Max Heater Current: 50 A
Dielectric Strength: 1000 VAC (For 1 minute)
Vibration Resistance: 50 Hz (Approx 10 G)
Terminals: Solder Type
Window Diameter: 0.228" (5.8 mm)
Weight: 0.406 oz (11.5 g)

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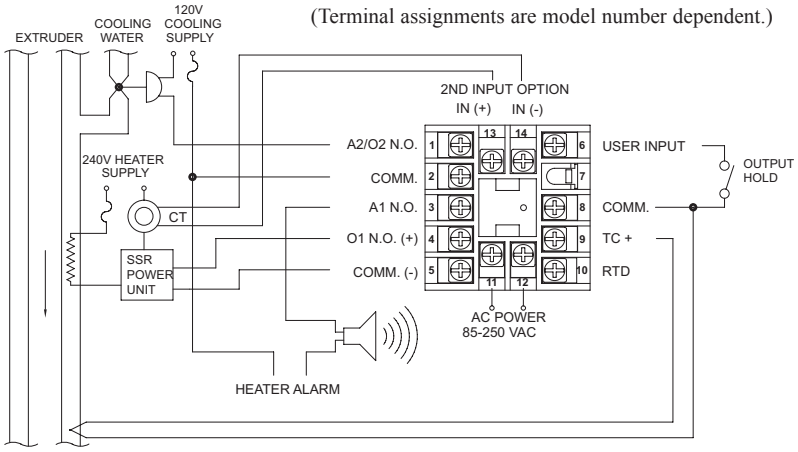
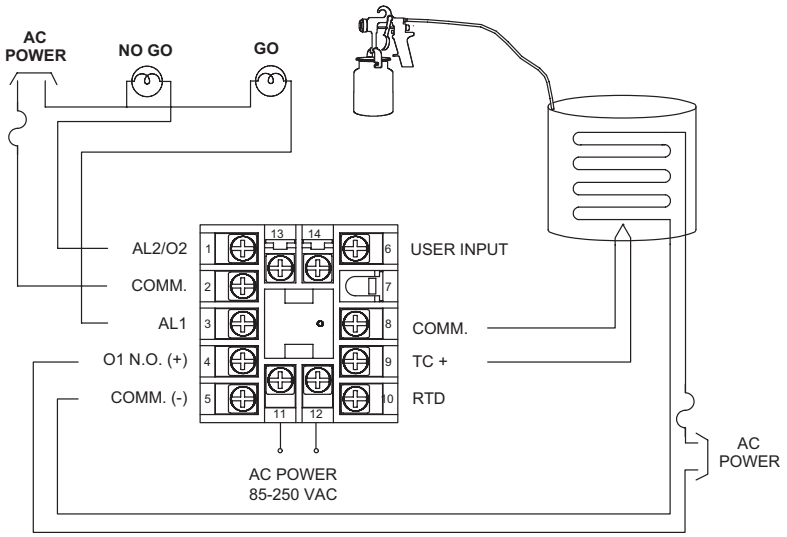
PLASTICS EXTRUDER APPLICATION

Several T48 controllers are employed to control the temperature of a plastics extruder. Each T48 controls a heating element and a cooling water solenoid to maintain each extruder zone at the desired temperature. The Heater Current Monitor option is used to provide a readout of the heater current. The multi-function User Input can be programmed to allow selection of manual operation when connected to common. This allows the user to hold the control output of the controller during abnormal process conditions.

(Terminal assignments are model number dependent.)





OEM PAINT SPRAYER APPLICATION

An OEM manufacturing spray painting equipment utilizes the T48 to maintain optimum paint temperature. In addition to the low cost, the 1/16 DIN package size permits the OEM to design temperature control into various sized painting equipment, from small hand sprayers to large paint booths. The heating element used to heat the paint, is connected to the Main Control Output (OP1) programmed for On/Off control. Alarm 1 is programmed as Band Inside Acting, so that as long as the paint temperature is within manufacturer's specifications for temperature, the "GO" light is on. Alarm 2 is programmed as Band Outside acting so that the "NO GO" light is lit when the paint temperature is more than 12° outside the manufacturer's specifications of 140 to 150°F.

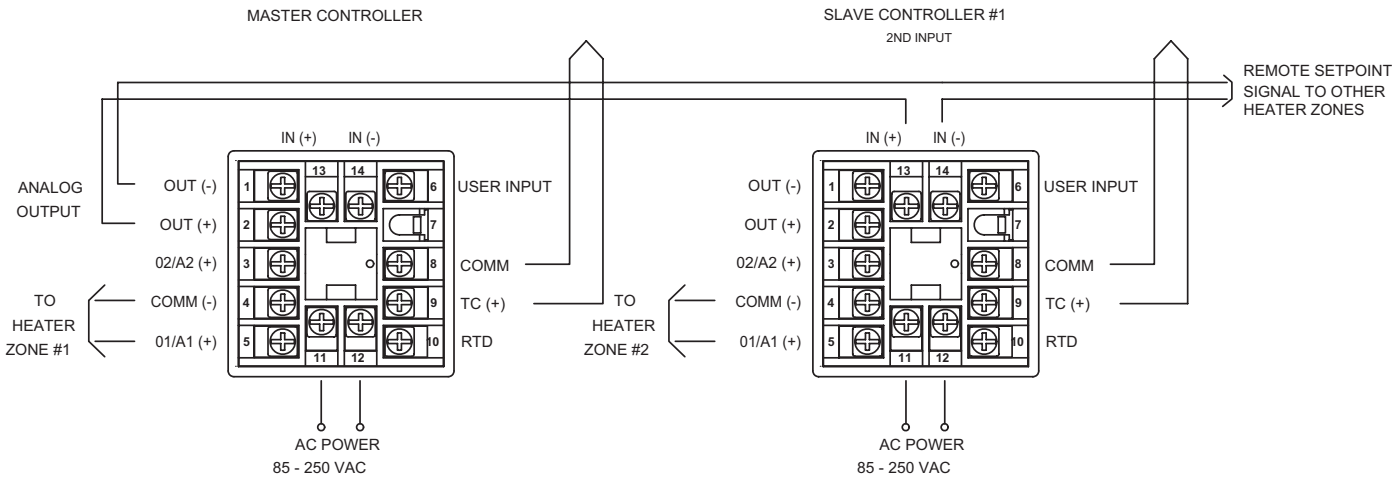
(Terminal assignments are model number dependent.)

MULTIPLE UNIT/REMOTE SETPOINT APPLICATION

Eight T48 controllers are used in a drying oven. Each T48 controls a zone within the oven. Depending upon the material to be dried, and its initial moisture content, the drying setpoint temperature varies. A master T48 controller transmits setpoint via linear DC output. This signal is received as a remote setpoint signal by the other slave controllers.

Whenever the master controller's setpoint is changed, the slave controller's setpoint changes automatically.

The remote setpoint input at each slave controller can be scaled independently.



(Terminal assignments are model number dependent.)

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ORDERING INFORMATION

Options and Output Boards are factory configured per the part number specified. Part numbers without replacement output boards listed must be returned to the factory for output board replacement.

MODELS WITHOUT RS485 AND LINEAR DC ANALOG OUTPUT

DEDICATED MAIN CONTROL 01 OUTPUT	DEDICATED ALARM 1 A1 OUTPUT	(ALARM 2) A2 OR 02 (COOL)*	REMOTE SETPOINT INPUT @	HEATER CURRENT INPUT @	REPLACEMENT OUTPUT BOARD	PART NUMBERS	
						18-36 VDC/24 VAC	85 TO 250 VAC
Relay					RBD48100	T4810010	T4810000
Relay	Relay				RBD48111	NA	T4811000
Relay	Relay	Relay			RBD48111	T4811110	T4811100
Relay	Relay	Relay	YES		RBD48111	T4811113	T4811103
Relay	Relay	Relay		YES	RBD48111	T4811114	T4811104
Logic/SSR					RBD48200	T4820010	T4820000
Logic/SSR	Relay				RBD48211	NA	T4821000
Logic/SSR	Relay	Relay			RBD48211	T4821110	T4821100
Logic/SSR	Relay	Relay	YES		RBD48211	T4821113	T4821103
Logic/SSR	Relay	Relay		YES	RBD48211	T4821114	T4821104
Triac	Logic/SSR	Logic/SSR			NA	T4832210	T4832200

* - This output is programmable as either Control (PID) or as an Alarm.
@ - These part numbers are equipped with a second setpoint.

Option Boards are installed at the factory for the appropriate models. These boards are only needed for field replacement.

MODELS WITH RS485 OR LINEAR DC ANALOG OUTPUT

DEDICATED MAIN CONTROL O1 OUTPUT	MAIN CONTROL O1 OR A1 (ALARM 1) *	DEDICATED ALARM 1 A1 OUTPUT	(ALARM 2) A2 OR O2 (COOL) *	REMOTE SETPOINT INPUT @	HEATER CURRENT INPUT @	RS485 @	MAIN ANALOG OUTPUT** @	SECOND ANALOG OUTPUT** @	PART NUMBERS	
									18-36 VDC/24 VAC	85 TO 250 VAC
Relay						YES [1]			NA	T4810002
	Relay		Relay				YES	YES	T481011A	T481010A
	Relay		Relay				YES		T4810111	T4810101
	Relay		Relay	YES			YES		T4810115	T4810105
	Relay		Relay		YES		YES		T4810116	T4810106
	Relay		Relay			YES	YES		T4810117	T4810107
Relay			Relay	YES		YES			T4810118	T4810108
Relay			Relay		YES	YES			T4810119	T4810109
Relay		Relay	Relay			YES [2]			T4811112	T4811102
	Logic/SSR		Logic/SSR				YES		T4820211	T4820201
	Logic/SSR		Logic/SSR	YES			YES		T4820215	T4820205
	Logic/SSR		Logic/SSR		YES		YES		T4820216	T4820206
Logic/SSR			Logic/SSR	YES		YES			T4820218	T4820208
Logic/SSR			Logic/SSR		YES	YES			T4820219	T4820209
Logic/SSR		Relay	Relay			YES			T4821112	T4821102

* - This output is programmable as either Control (PID) or as an Alarm.
** - This output is jumper and program selectable for either a current or voltage Linear DC output.
@ - These part numbers are equipped with a second setpoint.
[1] - Replacement Output Board RBD48100 may be used.
[2] - Replacement Output Board RBD48111 may be used.

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ACCESSORIES

MODEL NO.	DESCRIPTION	PART NUMBERS
RLY	External SSR Power Unit (for Logic/SSR output models)	RLY50000
	Single Phase 25 A DIN Rail Mount SSR	RLY60000
	Single Phase 40 A DIN Rail Mount SSR	RLY6A000
	Three Phase DIN Rail Mount SSR	RLY70000
CT	40 Ampere Current Transformer (for Heater Current Input models)	CT004001
	50 Ampere Current Transformer (for Heater Current Input models)	CT005001
SFCRM	Crimson 2 PC Configuration Software for Windows 98, ME, 2000 and XP (for RS485 models)	SFCRM
ICM4	RS232/RS485 Serial Converter Module	ICM40030
ICM5	Three way isolated RS232/RS485 Serial Converter	ICM50000

* Crimson software is available for download from http://www.redlion.net

MODEL PAX2C – 1/8 DIN TEMPERATURE/PROCESS PID CONTROLLER

PID CONTROL WITH REDUCED OVERSHOOT

UNIVERSAL PROCESS, TEMPERATURE, VOLTAGE, CURRENT AND RESISTANCE iNPUT

PROGRAMMABLE DUAL LINE DISPLAY WITH UNITS INDICATION AND BAR GRAPH

FOUR PROGRAMMABLE UNIVERSAL ANNUNCIATORS

TRI-COLOR DISPLAY, WITH 7 PROGRAMMABLE COLOR ZONES

UP TO 16 ALARMS WITH BOOLEAN LOGIC FUNCTIONALITY

BUILT-IN USB PROGRAMMING PORT ENABLING UNIT CONFIGURATION WITH CRIMSON PROGRAMMING SOFTWARE

NEMA 4X/IP65 SEALED FRONT BEZEL

c UL US LISTED
3RSD
PROCESS CONTROL EQUIPMENT

DESCRIPTION

The PAX2C Temperature/Process Controller offers many features and performance capabilities to suit a wide range of applications. The PAX2C has a universal input to handle various input signals including Temperature, DC Voltage/Current and Resistance. Optional plug-in cards allow the opportunity to configure the controller for present applications, while providing easy upgrades for future needs. The PAX2C employs a tri-color display with seven independently programmable color zones.

The controller has been specifically designed for harsh industrial environments. With NEMA 4X/IP65 sealed bezel, CE compliance and extensive testing of noise effects, the controller provides a tough reliable application solution.

MAIN CONTROL

The controller operates in the PID Control Mode for both heating and cooling, with on-demand auto-tune that establishes the tuning constants. The PID tuning constants may be fine-tuned and then locked out from further modification. The controller employs a unique overshoot suppression feature, that allows the quickest response without excessive overshoot. Switching to Manual Mode provides the operator direct control of the output.

DISPLAY

The PAX2C features a dual line display with units annunciators, dual bar graphs, four universal annunciators and tri-color capability. Each of the seven display zones may be configured independently of the others, providing a visual indication of control and/or alarm status.

ALARMS

The PAX2C has up to sixteen “soft” alarms that may be configured to suit a variety of control and alarm requirements. These alarms may be used to monitor and/or actuate the controller’s physical outputs as well as change display colors. Mapped “soft” alarms may be processed independently or logically combined using AND/OR Boolean logic.

OPTION CARDS

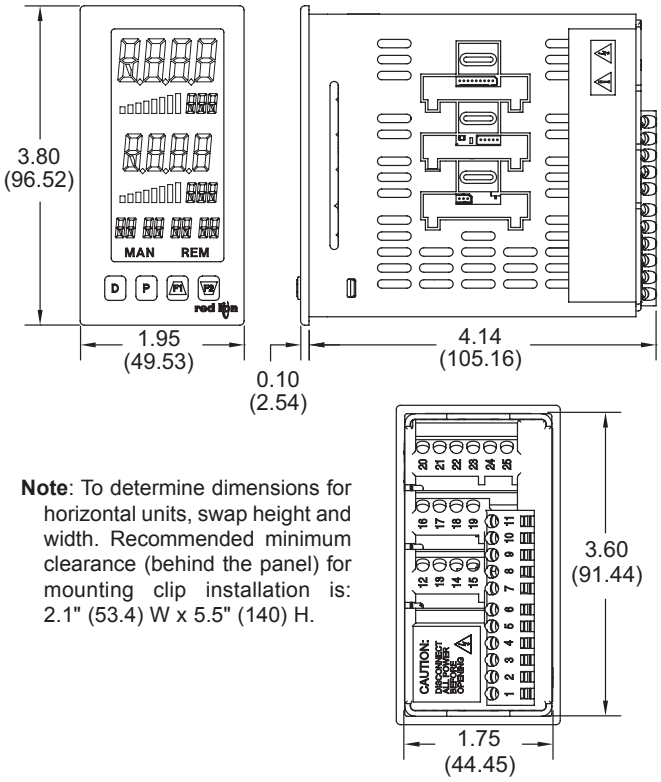
Optional plug-in cards provide dual FORM-C relays, quad FORM-A, quad sinking, or quad sourcing open collector logic outputs. These cards can be used as control outputs or for alarm indication.

A linear DC output signal is available as an optional plug-in card. The card provides either 20 mA or 10 V signals. The output can be scaled independent of the input range and can track the input, max and min readings or for control.

Communication and bus capabilities are also available as option cards. These include RS232, RS485, DeviceNet, and ProfibusDP. The PAX2C can be programmed to utilize Modbus protocol. With Modbus, the user has access to most configuration parameters. Readout values, setpoint, process and alarm values can be controlled through the bus. Additionally, the controller has a feature that allows a remote computer to directly control the outputs of the controller.

With a Windows® based program, made available by Red Lion Controls, configuration data can be downloaded to the PAX2C via a built-in USB programming port.

DIMENSIONS In inches (mm)



Note: To determine dimensions for horizontal units, swap height and width. Recommended minimum clearance (behind the panel) for mounting clip installation is: 2.1" (53.4) W x 5.5" (140) H.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in this literature or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired. Do not use this unit to directly command motors, valves, or other actuators not equipped with safeguards. To do so can be potentially harmful to persons or equipment in the event of a fault to the unit.

CAUTION: Risk of Danger.
Read complete instructions prior to installation and operation of the unit.

CAUTION: Risk of electric shock.

TABLE OF CONTENTS

ORDERING INFORMATION

Controller Part Numbers

MODEL NO.	DESCRIPTION	PART NUMBER
PAX2C	Universal Input Temperature/Process Controller, Horizontal	PX2C8H00
	Universal Input Temperature/Process Controller, Vertical	PX2C8V00

Option Card and Accessories Part Numbers

TYPE	MODEL NO.	DESCRIPTION	PART NUMBER
Optional Plug-In Cards	PAXCDS	Dual Setpoint Relay Output Card	PAXCDS10
		Quad Setpoint Relay Output Card	PAXCDS20
		Quad Setpoint Sinking Open Collector Output Card	PAXCDS30
		Quad Setpoint Sourcing Open Collector Output Card	PAXCDS40
	PAXCDC	RS485 Serial Communications Card with Terminal Block	PAXCDC10
		Extended RS485 Serial Communications Card with Dual RJ11 Connector	PAXCDC1C
		RS232 Serial Communications Card with Terminal Block	PAXCDC20
		Extended RS232 Serial Communications Card with 9 Pin D Connector	PAXCDC2C
		DeviceNet Communications Card	PAXCDC30
		Profibus-DP Communications Card	PAXCDC50
	PAXCDL	Analog Output Card	PAXCDL10
	CBLUSB	USB Programming Cable Type A-Mini B	CBLUSB01

Note:
[1.] For Modbus communications use RS485 Communications Output Card and configure communication (tYPE) parameter for Modbus.

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General Controller Specifications

1. **DISPLAY**: Negative image LCD with tri-color backlight.
   The display is divided into seven independently programmable color zones:
   Line 1, Line 2, Universal Annunciators (1-4) & Mnemonics
   Line 1 and 2: 4 digits each line
   Display Range: -1999 to 9999
   Units - Programmable 3 digit units annunciator
   Bar Graph - Programmable 8 segment bar graph
   Universal Annunciator 1 thru 4: Programmable 2 digit annunciator
   Status Mnemonics: MAN - Controller is in Manual Mode
   REM – Controller is in Remote Mode
   Vertical Model Digit Size: Line 1 - 0.51" (13 mm), Line 2 - 0.44" (11.2 mm)
   Horizontal Model Digit Size: Line 1 - 0.62" (15.7 mm), Line 2 - 0.47" (12.0 mm)
2. **POWER**:
   AC Power: 40 to 250 VAC, 50/60 Hz, 20 VA
   DC Power: 21.6 to 250 VDC, 8 W
   Isolation: 2300 Vrms for 1 min. to all inputs and outputs.
3. **KEYPAD**: 2 programmable function keys, 4 keys total
4. **A/D CONVERTER**: 24 bit resolution
5. **DISPLAY MESSAGES**:
   "OLOL" - Appears when measurement exceeds + signal range.
   "ULUL" - Appears when measurement exceeds - signal range
   "Shrt" - Appears when shorted sensor is detected. (RTD range only)
   "OPEN" - Appears when open sensor is detected. (TC/RTD range only)
   ". . . . " - Appears when display values exceed + display range.
   "- . . . " - Appears when display values exceed - display range.
6. **INPUT CAPABILITIES**:

Current Input:

INPUT RANGE	ACCURACY * (18 to 28°C)	ACCURACY * (0 to 50°C)	IMPEDANCE	‡ RESOLUTION
± 250 µADC	0.03% of rdg + 0.03µA	0.12% of rdg + 0.04µA	1.11 KΩ	0.1µA
± 2.5 mADC	0.03% of rdg + 0.3µA	0.12% of rdg + 0.4µA	111 Ω	1µA
± 25 mADC	0.03% of rdg + 3µA	0.12% of rdg + 4µA	11.1 Ω	10µA
± 250 mADC	0.05% of rdg + 30µA	0.12% of rdg + 40µA	1.1 Ω	0.1mA
± 2 ADC	0.5% of rdg + 0.3mA	0.7% of rdg + 0.4mA	0.1 Ω	1mA

Voltage Input:

INPUT RANGE	ACCURACY * (18 to 28°C)	ACCURACY * (0 to 50°C)	IMPEDANCE	‡ RESOLUTION
± 250 mVDC	0.03% of rdg + 30µV	0.12% of rdg + 40µV	451 KΩ	0.1mV
± 2.0 VDC	0.03% of rdg + 0.3mV	0.12% of rdg + 0.4mV	451 KΩ	1mV
± 10 VDC	0.03% of rdg + 3mV	0.12% of rdg + 4mV	451 KΩ	1mV
± 25 VDC	0.03% of rdg + 3mV	0.12% of rdg + 4mV	451 KΩ	10mV
± 100 VDC	0.3% of rdg + 30mV	0.12% of rdg + 40mV	451 KΩ	0.1V
± 200 VDC	0.3% of rdg + 30mV	0.12% of rdg + 40mV	451 KΩ	0.1V

Temperature Inputs:
Scale: °F or °C
Offset Range: -1999 to 9999 display units.

Thermocouple Inputs:
Input Impedance: 20MΩ
Lead Resisitance Effect: 0.03 µV/Ω
Max Continuous Overvoltage: 30 VDC

INPUT TYPE	RANGE	ACCURACY* (18 to 28 °C)	ACCURACY* (0 to 50 °C)	STANDARD	WIRE COLOR	
					ANSI	BS 1843
T	-200 to 400°C	1.2°C	2.1°C	ITS-90	(+) blue (-) red	(+) white (-) blue
E	-200 to 750°C	1.0°C	2.4°C	ITS-90	(+) purple (-) red	(+) brown (-) blue
J	-200 to 760°C	1.1°C	2.3°C	ITS-90	(+) white (-) red	(+) yellow (-) blue
K	-200 to 1250°C	1.3°C	3.4°C	ITS-90	(+) yellow (-) red	(+) brown (-) blue
R	0 to 1768°C	1.9°C	4.0°C	ITS-90	no standard	(+) white (-) blue
S	0 to 1768°C	1.9°C	4.0°C	ITS-90	no standard	(+) white (-) blue
B	150 to 300°C 300 to 1820°C	3.9°C 2.8°C	5.7°C 4.4°C	ITS-90	no standard	no standard
N	-200 to 1300°C	1.3°C	3.1°C	ITS-90	(+) orange (-) red	(+) orange (-) blue
C (W5/W26)	0 to 2315°C	1.9°C	6.1°C	ASTM E988-90**	no standard	no standard

RTD Inputs:
Type: 3 or 4 wire, 2 wire can be compensated for lead wire resistance
Excitation current: 100 ohm range: 136.5 µA ±10%
10 ohm range: 2.05 mA ±10%
Lead resistance: 100 ohm range: 10 ohm/lead max.
10 ohm range: 3 ohms/lead max.
Max. continuous overload: 30 VDC

INPUT TYPE	RANGE	ACCURACY* (18 to 28 °C)	ACCURACY* (0 to 50 °C)	STANDARD **
100 ohm Pt alpha = .00385	-200 to 850°C	0.4°C	1.6°C	IEC 751
100 ohm Pt alpha = .00392	-200 to 850°C	0.4°C	1.6°C	no official standard
120 ohm Nickel alpha = .00672	-80 to 259°C	0.2°C	0.5°C	no official standard
10 ohm Copper alpha = .00427	-110 to 260°C	0.4°C	0.9°C	no official standard

Resistance Inputs:

INPUT RANGE	ACCURACY * (18 to 28°C)	ACCURACY * (0 to 50°C)	COMPLIANCE	MAX CONT. OVERLOAD	‡ RESOLUTION
100 ohm	0.05% of rdg +0.03 ohm	0.2% of rdg +0.04 ohm	0.175 V	30 V	0.1 ohm
999 ohm	0.05% of rdg +0.3 ohm	0.2% of rdg +0.4 ohm	1.75 V	30 V	1 ohm
9999 ohm	0.05% of rdg +1 ohm	0.2% of rdg +1.5 ohm	17.5 V	30 V	1 ohm

‡ Higher resolution can be achieved via input scaling.

* After 20 min. warm-up, @ 5 samples per second input rate. Accuracy is specified in two ways: Accuracy over an 18 to 28ºC and 15 to 75% RH environment; and Accuracy over a 0 to 50ºC and 0 to 85% RH (non condensing) environment. The specification includes the A/D conversion errors, linearization conformity, and thermocouple ice point compensation. Total system accuracy is the sum of controller and probe errors. Accuracy may be improved by field calibrating the controller readout at the temperature of interest.

** These curves have been corrected to ITS-90.

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7. **EXCITATION POWER**: Jumper selectable
   Transmitter Power: +18 VDC, ± 5% @ 50 mA max.
   Reference Voltage: + 2 VDC, ± 2%
      Compliance: 1KΩ load min (2 mA max)
      Temperature Coefficient: 40 ppm/ºC max.
   Reference Current: 1.05 mADC, ± 2%
      Compliance: 10 KΩ load max.
      Temperature Coefficient: 40 ppm/ºC max.
8. **USER INPUTS**: Two programmable user inputs
   Max. Continuous Input: 30 VDC
   Isolation To Sensor Input Common: Not isolated.
   Logic State: User programmable (UACt) for sink/source (Lo/Hi)

INPUT STATE (USrACt)	LO/SINK	HI/SOURCE
	20KΩ pull-up to +3.3V	20KΩ pull-down
Active	V_{IN} < 1.1 VDC	V_{IN} > 2.2 VDC
Inactive	V_{IN} > 2.2 VDC	V_{IN} < 1.1 VDC

9. **CUSTOM LINEARIZATION**:
   Data Point Pairs: Selectable from 2 to 16
   Display Range: -1999 to 9999
   Decimal Point: 0 to 0.000
10. **MEMORY**: Nonvolatile FRAM memory retains all programmable parameters and display values.
11. **ENVIRONMENTAL CONDITIONS**:
   Operating Temperature Range: 0 to 50 °C
   Storage Temperature Range: -40 to 60 °C
   Vibration to IEC 68-2-6: Operational 5-150 Hz, 2 g
   Shock to IEC 68-2-27: Operational 25 g (10 g relay)
   Operating and Storage Humidity: 0 to 85% max. RH non-condensing
   Altitude: Up to 2000 meters
12. **CERTIFICATIONS AND COMPLIANCES**:
   CE Approved
      EN 61326-1 Immunity to Industrial Locations
      Emission CISPR 11 Class A
      IEC/EN 61010-1
      RoHS Compliant
   UL Listed: File #E179259
   Type 4X Indoor Enclosure rating (Face only)
   IP65 Enclosure rating (Face only)
   IP20 Enclosure rating (Rear of unit)
   Refer to EMC Installation Guidelines section of the bulletin for additional information.
13. **CONNECTIONS**: High compression cage-clamp terminal block
   Wire Strip Length: 0.3" (7.5 mm)
   Wire Gauge Capacity: One 14 AWG (2.55 mm) solid, two 18 AWG (1.02 mm) or four 20 AWG (0.61 mm)
14. **CONSTRUCTION**: This unit is rated NEMA 4X/IP65 for indoor use only. IP20 Touch safe. Installation Category II, Pollution Degree 2. One piece bezel/ case. Flame resistant. Synthetic rubber keypad. Panel gasket and mounting clip included.
15. **WEIGHT**: 8 oz. (226.8 g)

Optional Plug-in Cards

WARNING: Disconnect all power to the unit before installing plug-in cards.

Adding Option Cards

The PAX2C controllers can be fitted with up to three optional plug-in cards. The details for each plug-in card can be reviewed in the specification section below. Only one card from each function type can be installed at a time. The function types include Setpoint/Control (PAXCDS), Communications (PAXCDC), and Analog Output (PAXCDL). The plug-in cards can be installed initially or at a later date.

COMMUNICATION CARDS (PAXCDC)

A variety of communication protocols are available for the PAX2C controller. Only one PAXCDC card can be installed at a time. *Note: For Modbus communications use RS485 Communications Output Card and configure communication (tYPE) parameter for Modbus.*

PAXCDC10 - RS485 Serial (Terminal)
PAXCDC1C - RS485 Serial (Connector)
PAXCDC20 - RS232 Serial (Terminal)
PAXCDC2C - RS232 Serial (Connector)
PAXCDC30 - DeviceNet
PAXCDC50 - Profibus-DP

SERIAL COMMUNICATIONS CARD

Type: RS485 or RS232
Communication Type: RLC Protocol (ASCII), Modbus RTU, and Modbus ASCII
Isolation To Sensor & User Input Commons: 500 Vrms for 1 min. Working Voltage: 50 V. Not Isolated from all other commons.
Data: 7/8 bits
Baud: 1200 to 38,400
Parity: no, odd or even
Bus Address: Selectable 0 to 99 (RLC Protocol), or 1 to 247 (Modbus Protocol), Max. 32 controllers per line (RS485)
Transmit Delay: Selectable for 0 to 0.250 sec (+2 msec min)

DEVICENET™ CARD

Compatibility: Group 2 Server Only, not UCMM capable
Baud Rates: 125 Kbaud, 250 Kbaud, and 500 Kbaud
Bus Interface: Phillips 82C250 or equivalent with MIS wiring protection per DeviceNet™ Volume I Section 10.2.2.
Node Isolation: Bus powered, isolated node
Host Isolation: 500 Vrms for 1 minute (50 V working) between DeviceNet™ and controller input common.

PROFIBUS-DP CARD

Fieldbus Type: Profibus-DP as per EN 50170, implemented with Siemens SPC3 ASIC
Conformance: PNO Certified Profibus-DP Slave Device
Baud Rates: Automatic baud rate detection in the range 9.6 Kbaud to 12 Mbaud
Station Address: 0 to 125, set by rotary switches.
Connection: 9-pin Female D-Sub connector
Network Isolation: 500 Vrms for 1 minute (50 V working) between Profibus network and sensor and user input commons. Not isolated from all other commons.

PROGRAMMING SOFTWARE

Crimson® software is a Windows® based program that allows configuration of the PAX® controller from a PC. Crimson offers standard drop-down menu commands, that make it easy to program the controller. The controller's program can then be saved in a PC file for future use. The Crimson installation file is located on the included flash drive, or it can be downloaded at www.redlion.net

CONTROL/OUTPUT CARDS (PAXCDS)

The PAX2C controller has 4 available control/output plug-in cards. Only one PAXCDS card can be installed at a time. (Logic state of the outputs can be reversed in the programming.) These plug-in cards include:

PAXCDS10 - Dual Relay, FORM-C, Normally open & closed
PAXCDS20 - Quad Relay, FORM-A, Normally open only
PAXCDS30 - Isolated quad sinking NPN open collector
PAXCDS40 - Isolated quad sourcing PNP open collector

DUAL RELAY CARD

Type: Two FORM-C relays
Isolation To Sensor & User Input Commons: 2000 Vrms for 1 min. Working Voltage: 240 Vrms
Contact Rating:
One Relay Energized: 5 amps @ 120/240 VAC or 28 VDC (resistive load).
Total current with both relays energized not to exceed 5 amps
Life Expectancy: 100 K cycles min. at full load rating. External RC snubber extends relay life for operation with inductive loads

QUAD RELAY CARD

Type: Four FORM-A relays
Isolation To Sensor & User Input Commons: 2300 Vrms for 1 min. Working Voltage: 250 Vrms
Contact Rating:
One Relay Energized: 3 amps @ 240 VAC or 30 VDC (resistive load).
Total current with all four relays energized not to exceed 4 amps
Life Expectancy: 100K cycles min. at full load rating. External RC snubber extends relay life for operation with inductive loads

QUAD SINKING OPEN COLLECTOR CARD

Type: Four isolated sinking NPN transistors.
Isolation To Sensor & User Input Commons: 500 Vrms for 1 min. Working Voltage: 50 V. Not Isolated from all other commons.
Rating: 100 mA max @ V_{SAT} = 0.7 V max. V_{MAX} = 30 V

QUAD SOURCING OPEN COLLECTOR CARD

Type: Four isolated sourcing PNP transistors.
Isolation To Sensor & User Input Commons: 500 Vrms for 1 min. Working Voltage: 50 V. Not Isolated from all other commons.
Rating: Internal supply: 18 VDC unregulated, 30 mA max. total
External supply: 30 VDC max., 100 mA max. each output

ALL FOUR SETPOINT CARDS

Response Time: See Update Rates step response specification on page 3; add 6 msec (typical) for relay card

LINEAR DC OUTPUT (PAXCDL)

Either a 0(4)-20 mA or 0-10 V linear DC output is available from the analog output plug-in card. The programmable output low and high scaling can be based on various display values. Reverse slope output is possible by reversing the scaling point positions.

PAXCDL10 - Retransmitted Analog Output Card

ANALOG OUTPUT CARD

Types: 0 to 20 mA, 4 to 20 mA or 0 to 10 VDC
Isolation To Sensor & User Input Commons: 500 Vrms for 1 min. Working Voltage: 50 V. Not Isolated from all other commons.
Accuracy: 0.17% of FS (18 to 28 °C); 0.4% of FS (0 to 50 °C)
Resolution: 1/3500
Compliance: 10 VDC: 10 KΩ load min., 20 mA: 500 Ω load max.
Powered: Self-powered
Step Response: See Update Rates step response specification on page 3.
Update time: See ADC Conversion Rate and Update Time parameter

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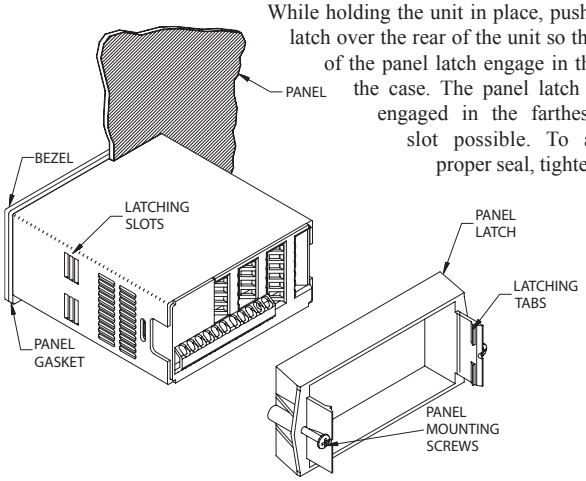
1.0 Installing the Controller

Installation

The PAX2C meets NEMA 4X/IP65 requirements when properly installed. The unit is intended to be mounted into an enclosed panel. Prepare the panel cutout to the dimensions shown. Remove the panel latch from the unit. Slide the panel gasket over the rear of the unit to the back of the bezel. The unit should be installed fully assembled. Insert the unit into the panel cutout.

While holding the unit in place, push the panel latch over the rear of the unit so that the tabs of the panel latch engage in the slots on the case. The panel latch should be engaged in the farthest forward slot possible. To achieve a proper seal, tighten the latch screws evenly until the unit is snug in the panel (Torque to approximately 7 in-lbs [79N-cm]). Do not over-tighten the screws.



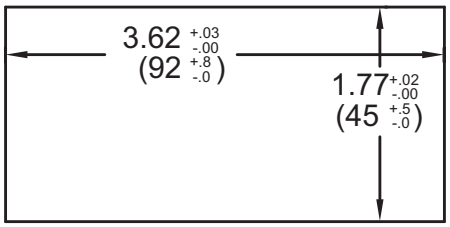
Installation Environment

The unit should be installed in a location that does not exceed the operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.

The bezel should only be cleaned with a soft cloth and neutral soap product. Do NOT use solvents. Continuous exposure to direct sunlight may accelerate the aging process of the bezel.

Do not use tools of any kind (screwdrivers, pens, pencils, etc.) to operate the keypad of the unit.

HORIZONTAL PANEL CUT-OUT

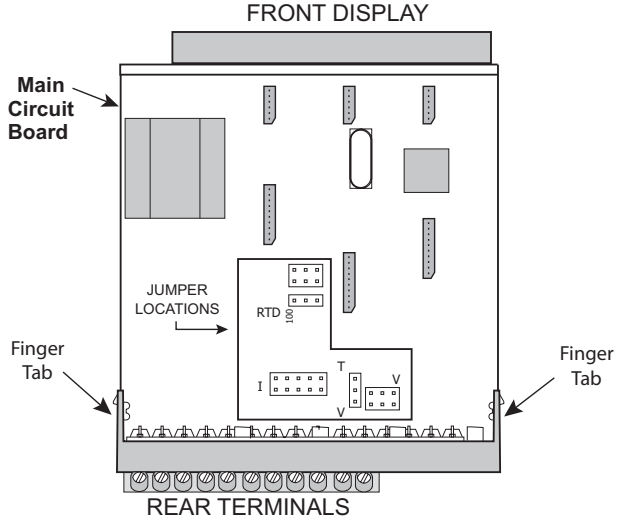


2.0 Setting the Jumpers

The PAX2C controller has four jumpers that must be checked and/or changed prior to applying power. The following Jumper Selection Figures show an enlargement of the jumper area.

To access the jumpers, remove the controller base from the case by firmly squeezing and pulling back on the side rear finger tabs. This should lower the latch below the case slot (which is located just in front of the finger tabs). It is recommended to release the latch on one side, then start the other side latch.

Warning: Exposed line voltage exists on the circuit boards. Remove all power to the controller and load circuits before accessing inside of the controller.



INPUT RANGE JUMPERS

Voltage Input

Two jumpers are used in configuring the controller for voltage/resistance. The first jumper, T/V, must be in the V (voltage) position. The second jumper is used to select the proper voltage input range. (This jumper is also used to select the current input range.) Select a range that is high enough to accommodate the maximum signal input to avoid overloads. For proper operation, the input range selected in programming must match the jumper setting.

Current Input

For current input, only one jumper must be configured to select the current range. This jumper is shared with the voltage input range. To avoid overloads, select the jumper position that is high enough to accommodate the maximum signal input level to be applied.

Note: The position of the T/V jumper does not matter when the controller is in the current input mode.

Temperature Input

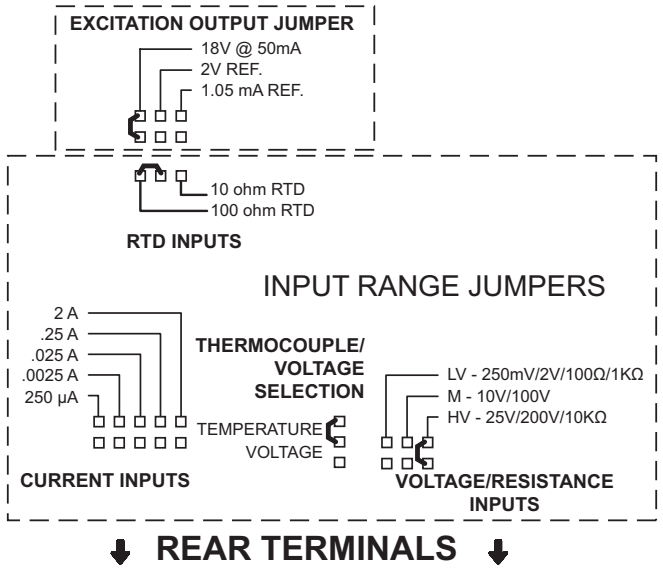
For temperature measurement the T/V jumper must be in the T (temperature) position. For RTD sensors the RTD jumper must also be set.

Resistance Input

Three jumpers are used to configure the resistance input. The T/V jumper must be in the V (voltage) position, and the excitation jumper must be in the 1.05 mA REF position. The voltage/resistance jumper position is determined by the input range.

Excitation Output Jumper

This jumper is used to select the excitation range for the application. If excitation is not being used, it is not necessary to check or move this jumper.



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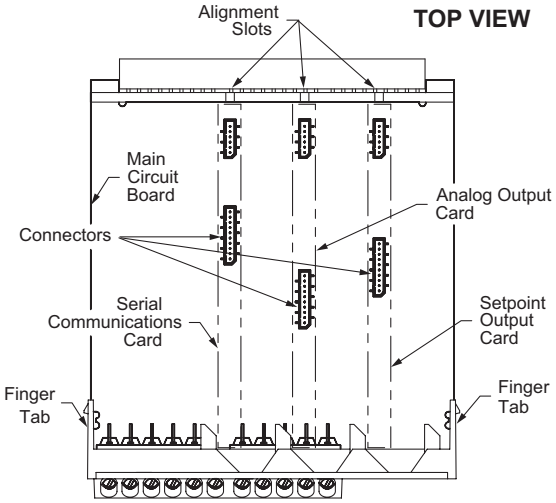
3.0 Installing Plug-In Cards

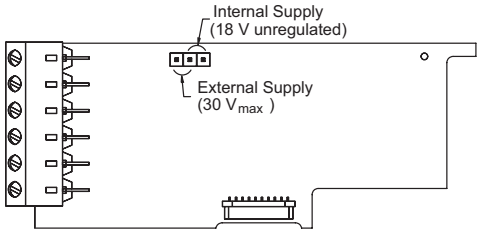
The plug-in cards are separately purchased optional cards that perform specific functions. These cards plug into the main circuit board of the controller. The plug-in cards have many unique functions when used with the PAX2C.

CAUTION: The plug-in card and main circuit board contain static sensitive components. Before handling the cards, discharge static charges from your body by touching a grounded bare metal object. Ideally, handle the cards at a static controlled clean workstation. Also, only handle the cards by the edges. Dirt, oil or other contaminants that may contact the cards can adversely affect circuit operation.



To Install:

1. With the controller removed from the case, locate the plug-in card connector for the card type to be installed. The types are keyed by position with different main circuit board connector locations. When installing the card, hold the controller by the rear terminals and not by the front display board. If installing the Quad sourcing Plug-in Card (PAXCDS40), set the jumper for internal or external supply operation before continuing.



2. Install the plug-in card by aligning the card terminals with the slot bay in the rear cover. Be sure the connector is fully engaged and the tab on the plug-in card rests in the alignment slot on the display board.
3. Slide the controller base back into the case. Be sure the rear cover latches fully into the case.
4. Apply the plug-in card label to the bottom side of the controller in the designated area. Do Not Cover the vents on the top surface of the controller. The surface of the case must be clean for the label to adhere properly.

4.0 Wiring the Controller

WIRING OVERVIEW

Electrical connections are made via screw-clamp terminals located on the back of the controller. All conductors should conform to the controller's voltage and current ratings. All cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that the power supplied to the controller (DC or AC) be protected by a fuse or circuit breaker.

When wiring the controller, compare the numbers embossed on the back of the controller case against those shown in wiring drawings for proper wire position. Strip the wire, leaving approximately 0.3" (7.5 mm) bare lead exposed (stranded wires should be tinned with solder). Insert the lead under the correct screw-clamp terminal and tighten until the wire is secure (Pull wire to verify tightness). Each terminal can accept up to one #14 AWG (2.55 mm) wire, two #18 AWG (1.02 mm), or four #20 AWG (0.61 mm).

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EMC INSTALLATION GUIDELINES

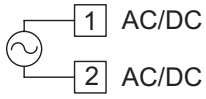
Although Red Lion Controls Products are designed with a high degree of immunity to Electromagnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, source or coupling method into a unit may be different for various installations. Cable length, routing, and shield termination are very important and can mean the difference between a successful or troublesome installation. Listed are some EMI guidelines for a successful installation in an industrial environment.

1. A unit should be mounted in a metal enclosure, which is properly connected to protective earth.
2. Use shielded cables for all Signal and Control inputs. The shield connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield to earth ground (protective earth) at one end where the unit is mounted.
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is over 1 MHz.
3. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors, feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be run through metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter. Also, Signal or Control cables within an enclosure should be routed as far away as possible from contactors, control relays, transformers, and other noisy components.
4. Long cable runs are more susceptible to EMI pickup than short cable runs.
5. In extremely high EMI environments, the use of external EMI suppression devices such as Ferrite Suppression Cores for signal and control cables is effective. The following EMI suppression devices (or equivalent) are recommended:
   Fair-Rite part number 0443167251 (RLC part number FCOR0000)
   Line Filters for input power cables:
   Schaffner # FN2010-1/07 (Red Lion Controls # LFIL0000)
6. To protect relay contacts that control inductive loads and to minimize radiated and conducted noise (EMI), some type of contact protection network is normally installed across the load, the contacts or both. The most effective location is across the load.
   a. Using a snubber, which is a resistor-capacitor (RC) network or metal oxide varistor (MOV) across an AC inductive load is very effective at reducing EMI and increasing relay contact life.
   b. If a DC inductive load (such as a DC relay coil) is controlled by a transistor switch, care must be taken not to exceed the breakdown voltage of the transistor when the load is switched. One of the most effective ways is to place a diode across the inductive load. Most RLC products with solid state outputs have internal zener diode protection. However external diode protection at the load is always a good design practice to limit EMI. Although the use of a snubber or varistor could be used.
   RLC part numbers: Snubber: SNUB0000
   Varistor: ILS11500 or ILS23000
7. Care should be taken when connecting input and output devices to the instrument. When a separate input and output common is provided, they should not be mixed. Therefore a sensor common should NOT be connected to an output common. This would cause EMI on the sensitive input common, which could affect the instrument's operation.

Visit RLC's web site at http://www.redlion.net/Support/InstallationConsiderations.html for more information on EMI guidelines, Safety and CE issues as they relate to Red Lion Controls products.

4.1 POWER WIRING

AC Power



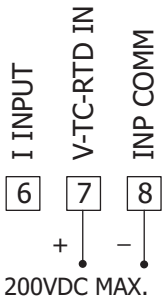
DC Power

The power supplied to the meter shall employ a 15 Amp UL approved circuit breaker for AC input and a 1 Amp, 250 V UL approved fuse for DC input. It shall be easily accessible and marked as a disconnecting device to the installed unit. This device is not directly intended for connection to the mains without a reliable means to reduce transient over-voltages to 1500 V.

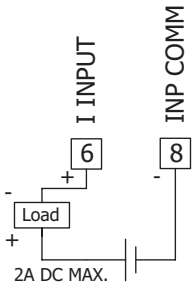
4.2 VOLTAGE/RESISTANCE/CURRENT INPUT SIGNAL WIRING

IMPORTANT: Before connecting signal wires, the Input Range Jumpers and Excitation Jumper should be verified for proper position.

Voltage Signal

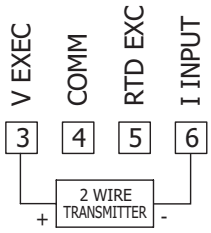


Process/Current Signal (external powered)



Process/Current Signal (2 wire requiring 18V excitation)

Excitation Jumper: 18 V

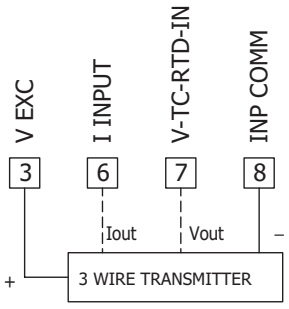


Current Signal (3 wire requiring 18 V excitation)

Terminal 3: +Volt supply
Terminal 6: +ADC (signal)
Terminal 8: -ADC (common)
Excitation Jumper: 18 V

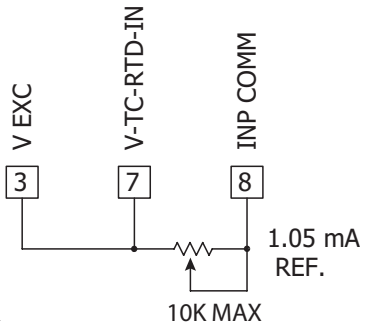
Voltage Signal (3 wire requiring 18 V excitation)

Terminal 3: +Volt supply
Terminal 7: +VDC (signal)
Terminal 8: -VDC (common)
Excitation Jumper: 18 V



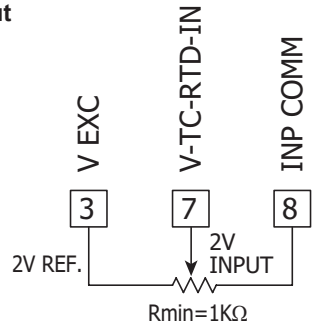
Resistance Signal (2 wire requiring excitation)

Terminal 3: Jumper to terminal 7
Terminal 7: Resistance
Terminal 8: Resistance
Excitation Jumper: 1.05 mA REF.
T/V Jumper: V position
Voltage/Resistance Input Jumper: Set per input signal



Potentiometer Signal as Voltage Input (3 wire requiring excitation)

Terminal 3: High end of pot.
Terminal 7: Wiper
Terminal 8: Low end of pot.
Excitation Jumper: 2 V REF.
T/V Jumper: V
Voltage/Resistance Input Jumper: 2 Volt
Module 1 Input Range: 2 Volt
Note: The Apply signal scaling style should be used because the signal will be in volts.



CAUTION: *Sensor input common is NOT isolated from user input common. In order to preserve the safety of the controller application, the sensor input common must be suitably isolated from hazardous live earth referenced voltages; or input common must be at protective earth ground potential. If not, hazardous live voltage may be present at the User Inputs and User Input Common terminals. Appropriate considerations must then be given to the potential of the user input common with respect to earth common; and the common of the isolated plug-in cards with respect to input common.*

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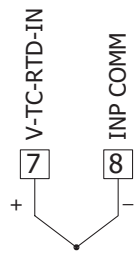
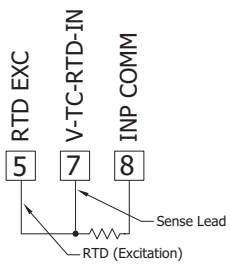
4.3 TEMPERATURE INPUT SIGNAL WIRING

IMPORTANT: Before connecting signal wires, verify the T/V Jumper is in the T position.

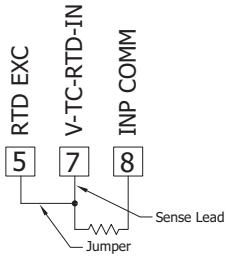
Thermocouple



3-Wire RTD



2-Wire RTD



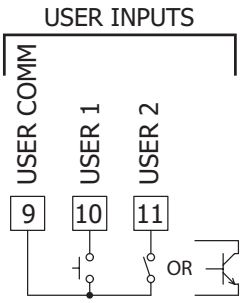
CAUTION*: Sensor input common is NOT isolated from user input common. In order to preserve the safety of the controller application, the sensor input common must be suitably isolated from hazardous live earth referenced voltages; or input common must be at protective earth ground potential. If not, hazardous live voltage may be present at the User Inputs and User Input Common terminals. Appropriate considerations must then be given to the potential of the user input common with respect to earth common; and the common of the isolated plug-in cards with respect to input common.*

4.4 USER INPUT WIRING

If not using User Inputs, then skip this section. User Input terminal does not need to be wired in order to remain in the inactive state.

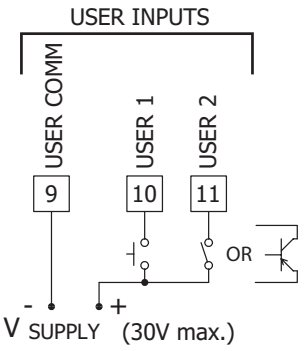
Sinking Logic (UACt Lo)

When the UACt parameter is programmed to Lo, the user inputs of the controller are internally pulled up to +3.3 V with 20 KΩ resistance. The input is active when it is pulled low (<1.1 V).



Sourcing Logic (UACt HI)

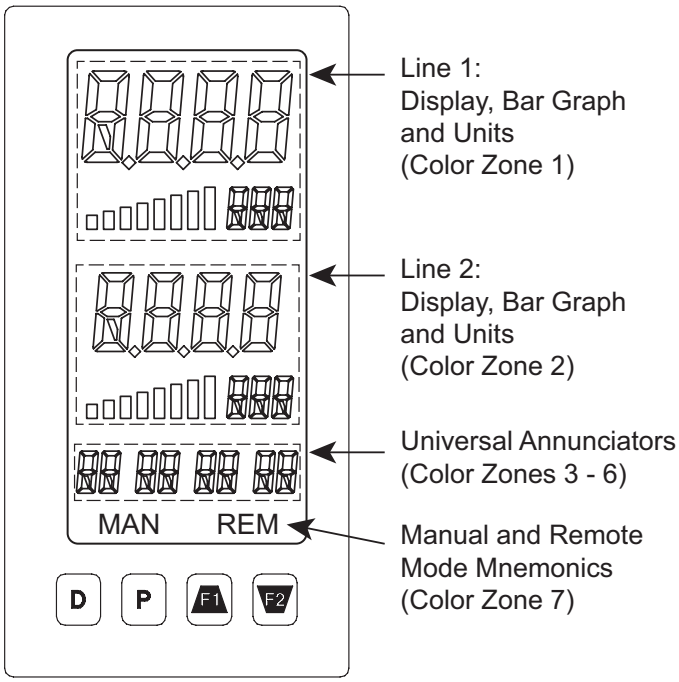
When the UACt parameter is programmed to HI, the user inputs of the controller are internally pulled down to 0 V with 20 KΩ resistance. The input is active when a voltage greater than 2.2 VDC is applied.



4.5 SETPOINT (ALARMS) WIRING
4.6 SERIAL COMMUNICATION WIRING
4.7 ANALOG OUTPUT WIRING

See appropriate plug-in card bulletin for wiring details.

5.0 REVIEWING THE FRONT BUTTONS AND DISPLAY



KEY	DISPLAY MODE OPERATION
D	Index Line 2 through enabled Line 2 display values
P	Enter full programming mode or access the parameter and hidden display loops; Press and hold to skip parameters and go directly to Code or Programming Menu
F1	User programmable Function key 1; hold for 3 seconds for user programmable second function 1*
F2	User programmable Function key 2; hold for 3 seconds for user programmable second function 2*

**Factory setting for F1 and F2 and second function F1/F2 is no mode*

KEY	PROGRAMMING MODE OPERATION
D	Return to the previous menu level (momentary press) Quick exit to Display Mode (press and hold)
P	Access the programming parameter menu, store selected parameter and index to next parameter
F1	Increment selected parameter value; Hold F1 and momentarily press F2 key to increment next decade or D key to increment by 1000's
F2	Decrement selected parameter value; Hold F2 and momentarily press F1 key to decrement next decade or D key to decrement by 1000's

DISPLAY LINE 1

Line 1 consists of a large 4-digit top line display, eight segment bar graph and a three digit units mnemonic: Values such as Input, Max(HI) & Min (LO) may be shown on Line 1. The eight segment bar graph may be mapped to values such as Output Power, Deviation or Setpoints. The three digit units mnemonic characters can be used to indicate which Line 1 display value is shown. Line 1 is a tri-colored display and may be configured to change color based on specified alarm/logic configurations.

DISPLAY LINE 2

Line 2 consists of a 4-digit bottom line display, eight segment bar graph and a three digit units mnemonic. Values such as Setpoints, Output Power, Deviation, PID Parameters/Tuning Status, List A/B Status, and Alarm Values may be shown on the Line 2 display. The eight segment bar graph may be mapped to values such as Output Power, Deviation or Setpoints. The three digit units mnemonic characters can be used to indicate which Line 2 display value is shown. Line 2 is a tri-colored display and may be configured to change color based on specified alarm/logic configurations.

The display loops described in the next section are used to view, reset and modify the selected display values, based on the Line 2 Value Access setting programmed for each available value. See Line 2 parameters in the Display Parameters programming section for configuration details.

Universal Annunciator Zones

The PAX2C has four programmable universal annunciator zones. Each zone has a user-defined two digit annunciator mnemonic to suit a variety of applications. Universal annunciator zones are tri-colored and may be configured to change color based on specified alarm/logic configurations.

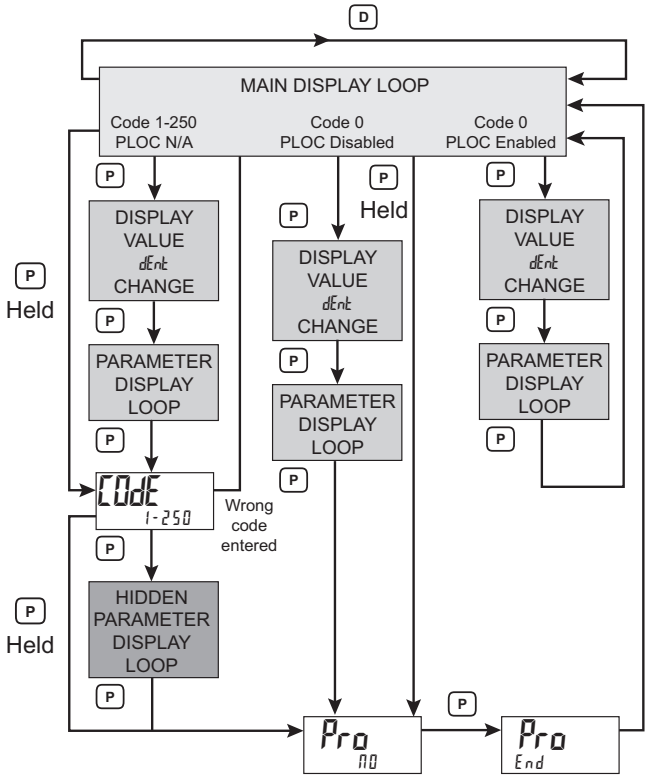
Manual Mnemonic

'MAN' - Flashes when the unit is in manual mode

The Mnemonic zone is tri-colored and may be configured to change color based on specified alarm/logic configurations.

LINE 2 DISPLAY LOOPS

The PAX2C offers three display loops to allow users quick access to needed information.



Full Programming Mode

Main Display Loop

In the Main display loop, the D key is pressed to sequence through the selected Line 2 values. The Line 2 units mnemonics are used to indicate which Line 2 value is currently shown. When in the Main display loop, the Function keys F1 and F2 perform the user functions programmed in the User Input parameter section.

Parameter and Hidden Parameter Display Loops

Display loops provide quick access to selected parameters that can be viewed and modified on Line 2 without having to enter Full Programming mode. These values may include: input, max/min, List A/B selection, output power, PID parameters/control, alarm parameters, setpoint values/selection, and display intensity and contrast settings. To utilize the Parameter or Hidden Parameter display loops, a security code (1-250) must be programmed. (See Programming Security Code in the Display Parameters programming section for details.)

The Parameter display loop is accessed by pressing the **P** key. The selected Parameter display loop values can be viewed and/or changed per the Line 2 Value Access setting programmed for each available value. The Hidden Parameter display loop follows the Parameter display loop, and can only be accessed when the correct security code is entered at the Code prompt. Combining the two parameter loops provides an area for parameters that require general access and/or protected or secure access depending on the application needs.

While in the Parameter and Hidden Parameter loops, pressing the **D** key will return the meter to the Main display loop. To directly access the Code prompt, press and hold the **P** key. This can be done from the Main display loop or at any point during the Parameter display loop. Also, to directly access Full Programming mode while in the Hidden Parameter loop, press and hold the **P** key to bypass any remaining Hidden Parameter loop values.

6.0 PROGRAMMING THE PAX2C

It is recommended that program settings be recorded as programming is performed. A blank Parameter Value Chart is provided at the end of this bulletin.

BASIC/ADVANCED MODE

The PAX2C incorporates two different configuration modes that are user selectable via the Display Configuration Menu:

Basic Mode (bSIC)

When the PAX2C is configured in this mode, a maximum of four alarms are supported and no mapped backlight color changes are available. Default backlight colors are still user selectable.

Advanced Mode (AdUC)

A maximum of sixteen alarms are supported and all backlight color configuration menu parameters are enabled. Select this mode when you require more than four alarms or where display color changes are desired.

PROGRAMMING MODE ENTRY

The Programming Mode is entered by pressing the **P** key. Full Programming Mode will be accessible unless the controller is programmed to use the Parameter loop or Hidden Parameter loop on the Line 2 display. In this case, programming access will be limited by a security code and/or a hardware program lock. (Refer to the previous section for details on Line 2 display loops and limited programming access.) Full Programming Mode permits all parameters to be viewed and modified. In this mode, the front panel keys change to Programming Mode Operations and certain user input functions are disabled.

MODULE ENTRY

The Programming Menu is organized into seven modules. These modules group together parameters that are related in function. The F1 and F2 keys are used to select the desired module. The displayed module is entered by pressing the **P** key.

MODULE MENU

Upon entering a module, a parameter selection sub-menu is provided to choose the specific parameter type for programming. For example, this includes analog and user input under the Input Parameter menu. Use the F1 and F2 keys to select the desired parameter type, and press the **P** key to enter the parameter menu.

PARAMETER MENU

Upon entering the Parameter Menu, the **P** key is pressed to advance to a specific parameter to be changed. After completing the parameter menu, or upon pressing the **D** key, the display returns to the initial entry point for the parameter menu. For each additional press of the **D** key, the display returns to the previous level within the module until exiting the module entirely.

F

SELECTION/VALUE ENTRY

For each parameter, the top line display shows the parameter while the bottom line shows the selections/value for that parameter. The F1 and F2 keys are used to move through the selections/values for the parameter. Pressing the **P** key, stores and activates the displayed selection/value. This also advances the meter to the next parameter.

Numerical Value Entry

If the parameter is programmed for enter (Entr), the F1 and F2 keys are used to change the parameter values in any of the display loops.

The F1 and F2 keys will increment or decrement the parameter value. When the F1 or F2 key is pressed and held, the value automatically scrolls. The longer the key is held the faster the value scrolls.

For large value changes, press and hold the F1 or F2 key. While holding that key, momentarily press the opposite arrow key (F2 or F1) to shift decades (10's 100's, etc), or momentarily press the **D** key and the value scrolls by 1000's as the arrow key is held. Releasing the arrow key removes the decade or 1000's scroll feature. The arrow keys can then be used to make small value changes as described above.

PROGRAMMING MODE EXIT

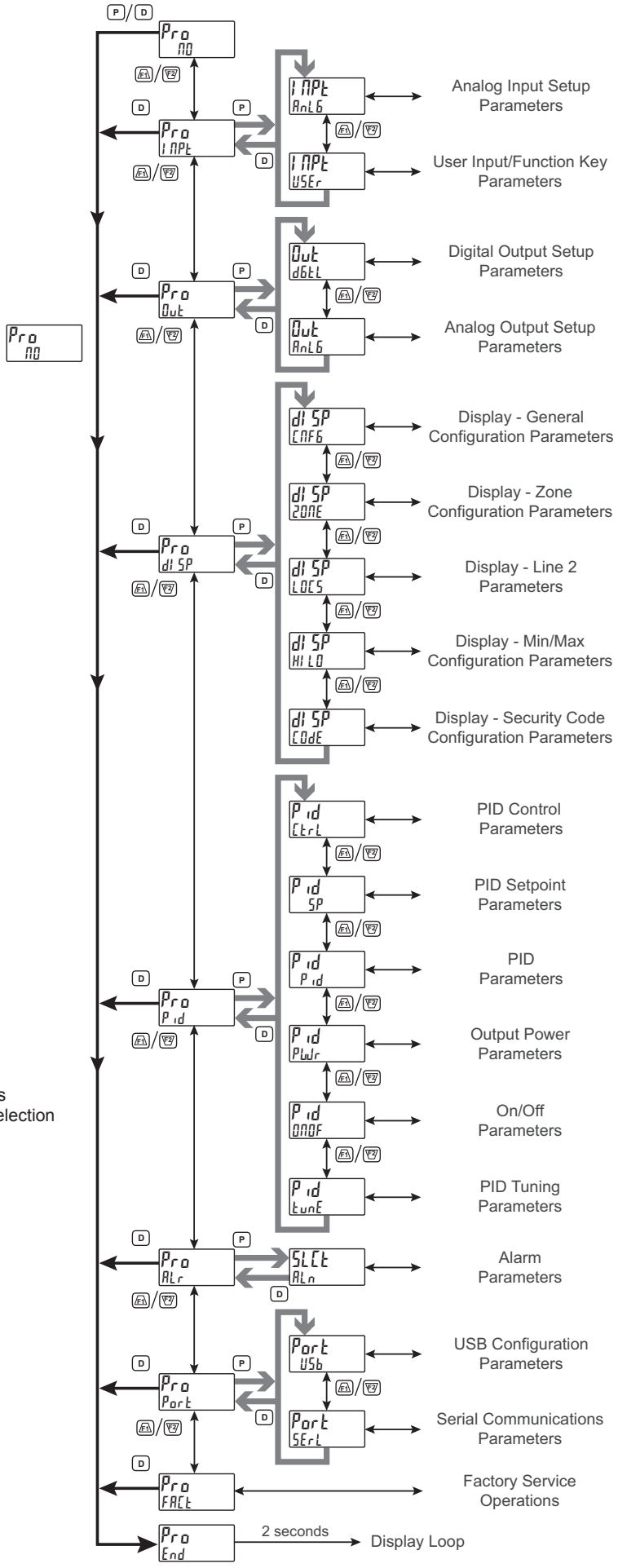
To exit the Programming Mode, press and hold the **D** key (from anywhere in the Programming Mode) or press the **P** key with Pro nO displayed. This will commit stored parameter changes to memory and return the meter to the Display Mode. If a parameter was just changed, the **P** key must be pressed to store the change before pressing the **D** key. (If power loss occurs before returning to the Display Mode, verify recent parameter changes.)

PROGRAMMING TIPS

It is recommended to start with the Input Parameters and proceed through each module in sequence. If lost or confused while programming, press and hold the **D** key to exit programming mode and start over. It is recommended that program settings be recorded as programming is performed. When programming is complete lock out programming with a user input or lock-out code.

Factory Settings may be completely restored in the Factory Service Operations module. This is useful when encountering programming problems.

In Programming Menu:
Top line is green to indicate top level programming modules
Top line is orange to indicate module menu or sub-menu selection
Top line is red to indicate a changeable parameter.

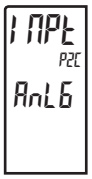


INPUT PARAMETERS (INPt)

INPUT SELECT

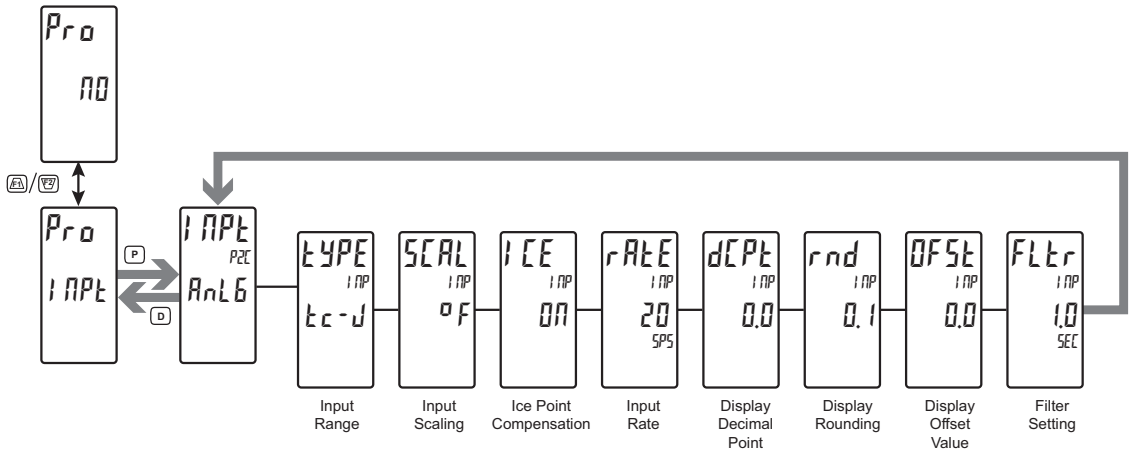
AnLG USEr

Select the Input to be programmed.



ANALOG INPUT PARAMETERS: TEMPERATURE MODE (AnLG)

This section details the programming for the analog input.



TEMPERATURE INPUT TYPE

250 uA	2 V	1K RES	tc-r	r392
25 mA	10 V	10K RES	tc-S	r672
25 mA	25 V	tc-t	tc-b	r427
250 mA	100 V	tc-E	tc-n	
2 A	200 V	tc-J	tc-C	
250 mV	100 RES	tc-K	r385	

Shaded selections indicate the available temperature input types. Select the desired input type.

TEMPERATURE SCALE

oF oC

Select the temperature scale. If changed, those parameters that relate to the temperature scale should be checked.

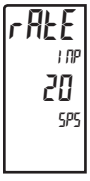
ICE POINT COMPENSATION

For TC Input Range Selection only.

on OFF

This parameter turns the internal ice point compensation on or off. Normally, the ice point compensation is on. If using external compensation, set this parameter to off. In this case, use copper leads from the external compensation point to the meter.

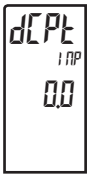
INPUT UPDATE RATE (/SEC)



5 10 20

Select the ADC conversion rate (conversions per second). The selection does not affect the display update rate, however it does affect alarm and analog output response time. The default factory setting of 20 is recommended for most applications. Selecting a fast update rate may cause the display to appear very unstable.

DECIMAL RESOLUTION (Display Units)



0 to 0.0 (temp)
0 to 0.000 (curr/volt/ohm)

Select desired display resolution. The available selections are dependent on the Input Type selected (tYPE).

ROUNDING INCREMENT

1 2 5
10 20 50 100

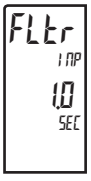
Rounding selections other than one, cause the Input Display to 'round' to the nearest rounding increment selected (ie. rounding of '5' causes 122 to round to 120 and 123 to round to 125). Rounding starts at the least significant digit of the Input Display. Remaining parameter entries (scaling point values, setpoint values, etc.) are not automatically adjusted to this display rounding selection.

DISPLAY OFFSET

-1999 to 9999

The display can be corrected with an offset value. This can be used to compensate for probe errors, errors due to variances in probe placement or adjusting the readout to a reference thermometer.

DIGITAL FILTERING



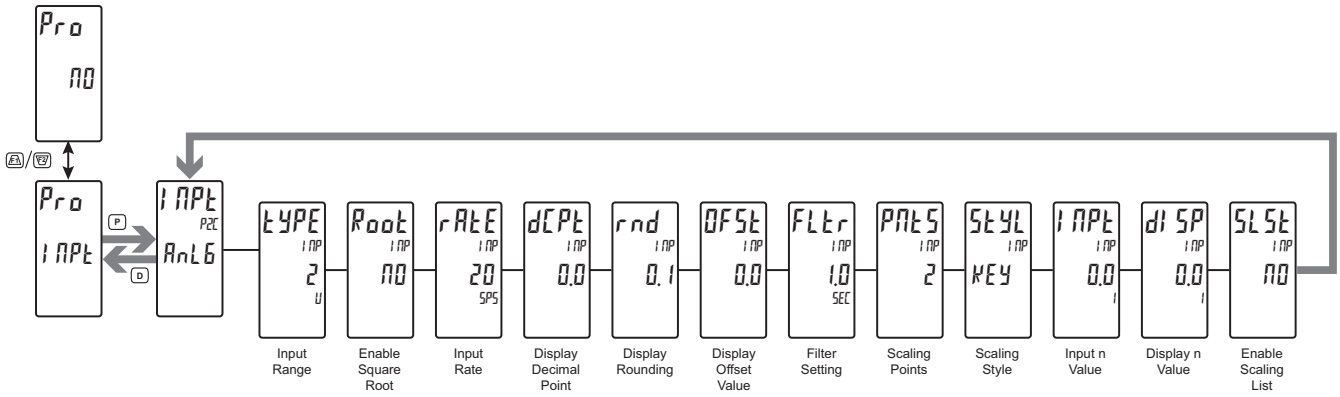
0.0 to 25.0 seconds

The input filter setting is a time constant expressed in tenths of a second. The filter settles to 99% of the final display value within approximately 3 time constants. This is an Adaptive Digital Filter which is designed to steady the Input Display reading. A value of '0' disables filtering.

F

Analog Input Parameters: Process Mode (AnLG)

This section details the programming for the analog input.



PROCESS INPUT TYPE

tYPE
INP
2
U

250 uA	2 U	1K RES	tc-r	r392
25 mA	10 U	10K RES	tc-S	r672
25 mA	25 U	tc-t	tc-b	r427
250 mA	100 U	tc-E	tc-n	
2 A	200 U	tc-J	tc-C	
250 mV	100 RES	tc-K	r385	

Shaded selections indicate the available process input types. Select the desired input type.

SQUARE ROOT

Root
INP
NO

YES NO

This parameter allows the unit to be used in applications in which the measured signal is the square of the PV. This is useful in applications such as the measurement of flow with a differential pressure transducer.

Example: It is necessary to square root linearize the output of a differential pressure transmitter to indicate and control flow. The defining equation is $F = 278\sqrt{\Delta P}$, where ΔP = 0 - 500 PSI, transmitted linearly by a 4 - 20 mA transducer. At full flow rate (ΔP = 500 PSI), the flow is 6216 ft^3/h. The following scaling information is used with the controller:

dEPt = 0 — INPt1 = 400 mA
Root = YES — diSP2 = 6216 ft^3/hr
diSP1 = 0 ft^3/hr — INPt2 = 2000 mA

As a result of the scaling and square root linearization, the following represents the readings at various inputs:

Delta P (PSI)	Transmitter (mA)	Flow (ft^3 /hr)
0.00	4.00	0
15.63	4.50	1099
31.25	5.00	1554
62.50	6.00	2198
125.00	8.00	3108
187.50	10.00	3807
250.00	12.00	4396
312.50	14.00	4914
375.00	16.00	5383
437.50	18.00	5815
500.00	20.00	6216

INPUT UPDATE RATE (/SEC)

rAtE
INP
20
SPS

5 10 20 40

Select the ADC conversion rate (conversions per second). The selection does not affect the display update rate, however it does affect alarm and analog output response time. The default factory setting of 5 is recommended for most applications. Selecting a fast update rate may cause the display to appear very unstable.

DECIMAL RESOLUTION (Display Units)

dEPt
INP
0.0

0 to 0.000 (curr/volt/ohm)
0 to 0.0 (temp)

Select desired display resolution. The available selections are dependent on the Input Type selected (tYPE).

ROUNDING INCREMENT

rnd
INP
0.1

1 2 5
10 20 50 100

Rounding selections other than one, cause the Input Display to 'round' to the nearest rounding increment selected (ie. rounding of '5' causes 122 to round to 120 and 123 to round to 125). Rounding starts at the least significant digit of the Input Display. Remaining parameter entries (scaling point values, setpoint values, etc.) are not automatically adjusted to this display rounding selection.

DISPLAY OFFSET

OFSt
INP
0.0

-1999 to 9999

The display can be corrected with an offset value. This can be used to compensate for sensor errors, errors due to variances in sensor placement or adjusting the readout to a reference source. A value of zero will remove the affects of offset.

DIGITAL FILTERING

FLtr
INP
1.0
SEC

0.0 to 25.0 seconds

The input filter setting is a time constant expressed in tenths of a second. The filter settles to 99% of the final display value within approximately 3 time constants. This is an Adaptive Digital Filter which is designed to steady the Input Display reading. A value of '0' disables filtering.

SCALING POINTS

PntS
INP
2

2 to 16

Linear - Scaling Points (2)

For linear processes, only 2 scaling points are necessary. It is recommended that the 2 scaling points be at opposite ends of the input signal being applied. The points do not have to be the signal limits. Display scaling will be linear between and continue past the entered points up to the limits of the Input Signal Jumper position. Each scaling point has a coordinate-pair consisting of an Input Value (INPt n) and an associated desired Display Value (diSP n).

F

Nonlinear - Scaling Points (Greater than 2)

For non-linear processes, up to 16 scaling points may be used to provide a piece-wise linear approximation. (The greater the number of scaling points used, the greater the conformity accuracy.) The Input Display will be linear between scaling points that are sequential in program order. Each scaling point has a coordinate-pair consisting of an Input Value (*InPt n*) and an associated desired Display Value (*diSP n*). Data from tables or equations, or empirical data could be used to derive the required number of segments and data values for the coordinate pairs. In the Crimson software, several linearization equations are provided to help calculate scaling points.

SCALING STYLE

KEY key-in data
APLY apply signal

If Input Values and corresponding Display Values are known, the Key-in (*KEY*) scaling style can be used. This allows scaling without the presence of the input signal. If Input Values have to be derived from the actual input signal source or simulator, the Apply (*APLY*) scaling style must be used.

INPUT VALUE FOR SCALING POINT 1

- 1999 to 9999

For Key-in (*KEY*), enter the known first Input Value by using the F1 or F2 arrow keys. (The Input Range selection sets up the decimal location for the Input Value). For Apply (*APLY*), the existing programmed value will appear. If this is acceptable, press the **P** key to save and continue to the next parameter. To update/program this value, apply the input signal that corresponds to Scaling Point 1, press F2 key and the actual signal value will be displayed. Then press the **P** key to accept this value and continue to the next parameter.

DISPLAY VALUE FOR SCALING POINT 1

- 1999 to 9999

Enter the first coordinating Display Value by using the arrow keys. This is the same for *KEY* and *APLY* scaling styles. The decimal point follows the *dCPt* selection.

INPUT VALUE FOR SCALING POINT 2

- 1999 to 9999

For Key-in (*KEY*), enter the known second Input Value by using the F1 or F2 arrow keys. For Apply (*APLY*), the existing programmed value will appear. If this is acceptable, press the **P** key to save and continue to the next parameter. To update/program this value, apply the input signal that corresponds to Scaling Point 2, press F2 key and the actual signal value will be displayed. Then press the **P** key to accept this value and continue to the next parameter. (Follow the same procedure if using more than 2 scaling points.)

DISPLAY VALUE FOR SCALING POINT 2

- 1999 to 9999

Enter the second coordinating Display Value by using the F1 or F2 arrow keys. This is the same for *KEY* and *APLY* scaling styles. (Follow the same procedure if using more than 2 scaling points.)

ENABLE SCALE LIST

no yES

When enabled, a second list of scaling points is active in the selected parameter list for List A and List B.

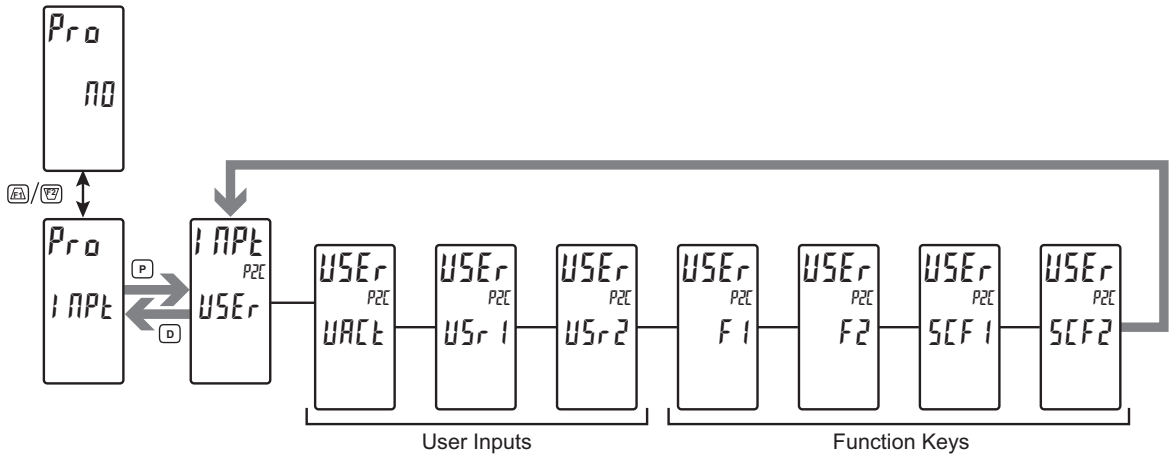
F

USER INPUT/FUNCTION KEY PARAMETERS (USEr)

The two user inputs are individually programmable to perform specific meter control functions. While in the Display Mode or Program Mode, the function is executed the instant the user input transitions to the active state. The front panel function keys, F1 and F2, are also individually programmable to perform specific control functions. While in the Display Mode, the primary function is executed the instant the key is pressed. Holding the function key for three seconds executes a secondary function. It is possible to program a secondary function without a primary function.

In most cases, if more than one user input and/or function key is programmed for the same function, the maintained (level trigger) actions will be performed while at least one of those user inputs or function keys are activated. The momentary (edge trigger) actions will be performed every time any of those user inputs or function keys transition to the active state.

Note: In the following explanations, not all selections are available for both user inputs and front panel function keys. Displays are shown with each selection. Those selections showing both displays are available for both. If a display is not shown, it is not available for that selection. USEr-n will represent both user inputs. Fn will represent both function keys and second function keys.

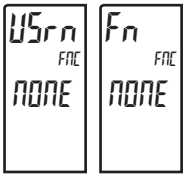


USER INPUT ACTIVE STATE

Lo Hi

Select the desired active state for the User Inputs. Select Lo for sink input, active low. Select Hi for source input, active high.

NO FUNCTION



No function is performed if activated. This is the factory setting for all user inputs and function keys.

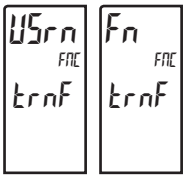
PROGRAMMING MODE LOCK-OUT

Programming Mode is locked-out, as long as activated (maintained action). A security code can be configured to allow programming access during lock-out.

INTEGRAL ACTION LOCK

Integral Action of the PID computation is disabled as long as activated (USr = maintained action; Fn = toggle).

AUTO/MANUAL MODE

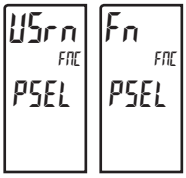


Places the controller in manual (user) mode as long as activated (USr = maintained action; Fn = toggle). The output is "bumpless" when transferring to/from either operating mode.

SETPOINT SELECTION

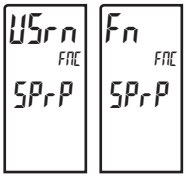
When activated (USr = maintained action; Fn = toggle), the controller uses Setpoint 2 (SP2) as the active setpoint value.

PID PARAMETER SELECTION



When activated (USr = maintained action; Fn = toggle), the controller uses the Alternate P, I, D, and filter values for control. The controller initiates a "bumpless" transfer during each transfer in an effort to minimize any output power fluctuation.

SETPOINT RAMPING DISABLE



When activated (USr = maintained action), setpoint ramping is terminated and unit will operate at the target setpoint. When user input is released, setpoint ramping will resume at the next setpoint change.

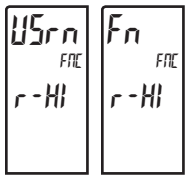
When Function key is pressed (Fn = toggle), setpoint ramping is terminated and unit will operate at the target setpoint. A second press of the function key resumes setpoint ramping at the next setpoint change.

SELECT MAXIMUM DISPLAY

The Maximum display appears on Line 2 as long as activated (maintained). When the user input is released, the previously selected display is returned. The **D** or **P** keys override and disable the active user input. The Maximum continues to function independent of the selected display.

F

RESET MAXIMUM DISPLAY

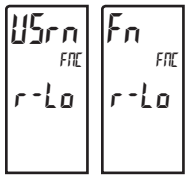


When activated (momentary action), rSEt flashes and the Maximum resets to the present Input Display value. The Maximum function then continues from that value. This selection functions independent of the selected display.

SELECT MINIMUM DISPLAY

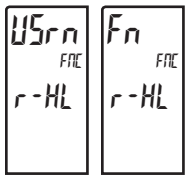
The Minimum display appears on Line 2 as long as activated (maintained). When the user input is released, the previously selected display is returned. The **D** or **P** keys override and disable the active user input. The Minimum continues to function independent of the selected display.

RESET MINIMUM DISPLAY



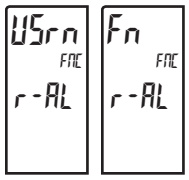
When activated (momentary action), rSEt flashes and the Minimum resets to the present Input Display value. The Minimum function then continues from that value. This selection functions independent of the selected display.

RESET MAXIMUM AND MINIMUM DISPLAY



When activated (momentary action), rSEt flashes and the Maximum and Minimum readings are set to the present Input Display value. The Maximum and Minimum function then continues from that value. This selection functions independent of the selected display.

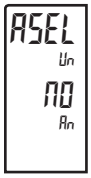
RESET ALARMS



When activated (momentary action), the controller will reset any active alarms that are selected in the User/ Function Alarm Selection Menu (ASEL).

Basic Mode: 4 Alarms Max
Advanced Mode: 16 Alarms Max

ALARM MASK SELECTION

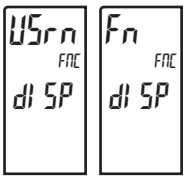


Selects the alarms that will be reset when the User Input/ Function keys are activated. Any alarms configured as "YES" will be reset depending on the alarms configuration. Please see the Alarms section of the manual for more information on the alarm reset operation.

ADJUST DISPLAY INTENSITY

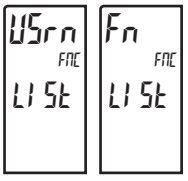
When activated (momentary action), the display intensity changes to the next intensity level.

DISPLAY SELECT



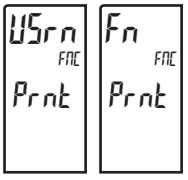
When activated (momentary action), Line 2 advances to the next display that is not locked out from the Display Mode.

SELECT PARAMETER LIST



Two lists of input scaling points and alarm values (including band and deviation) are available. The two lists are named LStA and LStb. If a user input is used to select the list then LStA is selected when the user input is not active and LStb is selected when the user input is active (maintained action). If a front panel key is used to select the list then the list will toggle for each key press (momentary action). The display will only indicate which list is active when the list is changed. To program the values for List-A and List-B, first complete the programming of all the parameters. Exit programming and switch to the other list. Re-enter programming and enter the desired values for the input scaling points, alarms, band, and deviation if used.

PRINT REQUEST



The meter issues a block print through the serial port when activated, and the serial type is set to rLC. The data transmitted during a print request and the serial type is programmed in Module 7. If the user input is still active after the transmission is complete (about 100 msec), an additional transmission occurs. As long as the user input is held active, continuous transmissions occur.

F

OUTPUT PARAMETERS (Out)

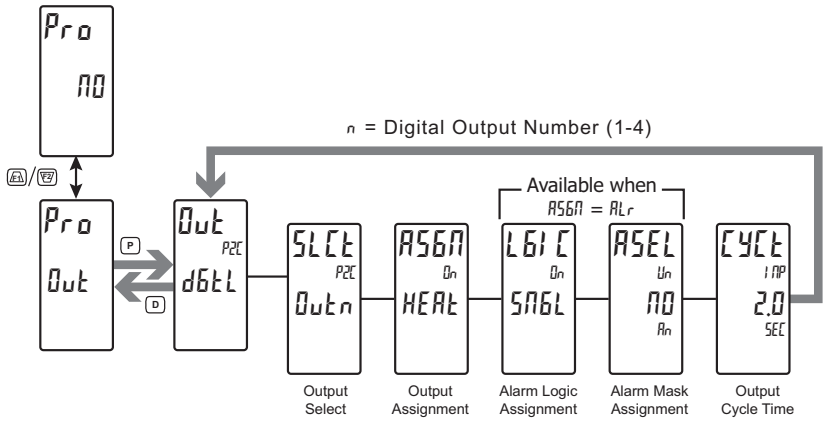
OUTPUT SELECT

dGtL AnLG

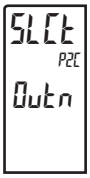
Select the Digital or Analog output to be programmed. The Analog output selection only appears if an analog output and/or digital output plug-in card is installed in the meter. When there is no output card installed, "No Card" will be displayed on the display when trying to enter the Output Configuration.

DIGITAL OUTPUT PARAMETERS (dGtL)

To have digital output capabilities, a digital output Plug-in card needs to be installed into the PAX2C (see Ordering Information). Depending on the output card installed, there will be two or four digital outputs available.



DIGITAL OUTPUT SELECTION



Out1 Out2 Out3 Out4

Selects the digital output to be programmed. The "Outn" in the following parameters will reflect the chosen output number. After the chosen output is completely programmed, the display returns to the Output Select menu. Repeat steps for each output to be programmed. The number of outputs available is digital output card (PAXCDS) dependent (2 or 4).

DIGITAL OUTPUT ASSIGNMENT

NONE HEAt COOL ALr MAN

This selection is used to assign the controller's digital outputs to various internal values or conditions. It is possible to assign the same properties to more than one output.

NONE = Digital Output is disabled
HEAt = Heat Output Power
COOL = Cool Output Power
ALr = Alarm
MAN = Manual Control Mode

ALARM LOGIC MODE

SNGL And Or

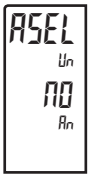
The PAX2C supports three different modes when an output is assigned as an alarm:

SNGL = Any single alarm. Selecting YES to any selection will change other alarm selections to NO.

And = Allows multiple alarms to be mapped to an output using AND Boolean logic. For example: If AL1 and AL2 are active, the output will energize.

Or = Allows multiple alarms to be mapped to an output using OR Boolean logic. For example: If AL1 or AL2 are active, the output will energize.

ALARM MASK ASSIGNMENT



no YES

Selects the alarms to be logically combined per the Alarm Logic Mode selection. Any alarms configured as "YES" will be used in the Boolean logic calculation. If the Alarm Logic Mode is assigned as Single (SNGL), only one alarm may be selected at a time.

Basic Mode: 4 Alarms Max
Advanced Mode: 16 Alarms Max

DIGITAL OUTPUT CYCLE TIME

0.0 to 60.0 seconds

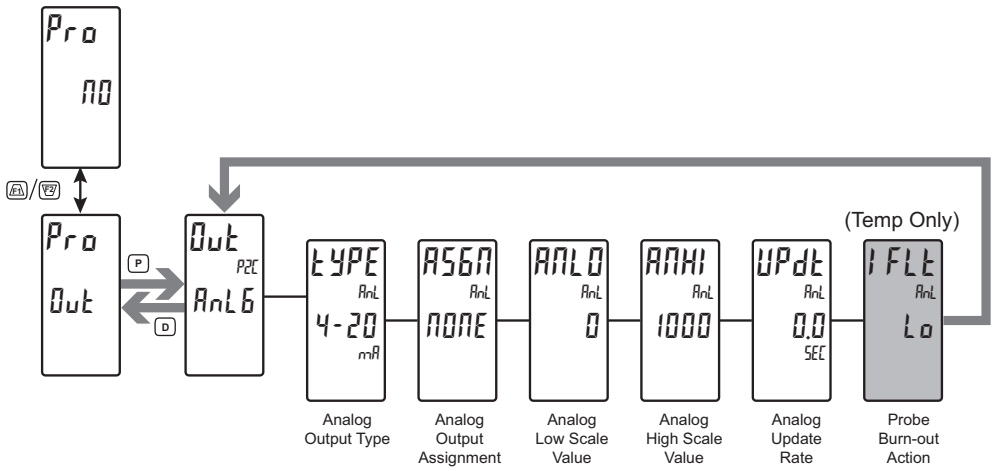
The Cycle Time value is the sum of a time-proportioned output's on and off cycles. With time proportional outputs, the percentage of output power is converted into output on time of the cycle time value eg. if the controller's algorithm calls for 65% power, and has a Cycle Time of 10 seconds, the output will be on for 6.5 seconds and off for 3.5 seconds. A Cycle Time equal to, or less than, one-tenth of the process time constant is recommended.

This parameter is only available when the digital output assignment is configured as HEAt or COOL.

F

ANALOG OUTPUT PARAMETERS (ANLG)

This section is only accessible with the optional PAXCDL Analog card installed (see Ordering Information).



ANALOG OUTPUT TYPE

tYPE AnL 4-20

4-20 0-10 0-20

Enter the analog output type. For 0-20 mA or 4-20 mA use terminals 18 and 19. For 0-10 V use terminals 16 and 17. Only one range can be used at a time.

ANALOG OUTPUT ASSIGNMENT

ASGN AnL NONE

NONE InPt HI LO OP SP dEu

Enter the source for the analog output to retransmit:

- NONE = Manual Mode operation. (See Serial RLC Protocol in the Communications Port module).
- InPt = Input Value
- HI = Maximum Display Value
- LO = Minimum Display Value
- OP = Output Power
- SP = Active Setpoint Value
- dEu = Deviation from the Setpoint value

ANALOG LOW SCALE VALUE

ANLO AnL 0

-1999 to 9999

Enter the Display Value that corresponds to 0 mA (0-20 mA), 4 mA (4-20 mA) or 0 VDC (0-10 VDC).

ANALOG HIGH SCALE VALUE

ANHI AnL 1000

-1999 to 9999

Enter the Display Value that corresponds to 20 mA (0-20 mA) , 20 mA (4-20 mA) or 10 VDC (0-10 VDC).

ANALOG UPDATE TIME

UPdt AnL 0.0 SEC

0.0 to 10.0 seconds

Enter the analog output update rate in seconds. A value of 0.0 allows the meter to update the analog output at the ADC Conversion Rate.

The following programming step is only available when Input Type in the Input Menu is set for a temperature input (TC/RTD).

PROBE BURN-OUT ACTION

I FLt AnL Lo

Lo Hi

Enter the probe burn-out action. In the event of a temperature probe failure, the analog output can be programmed for low or high scale.

F

DISPLAY PARAMETERS (dISP)

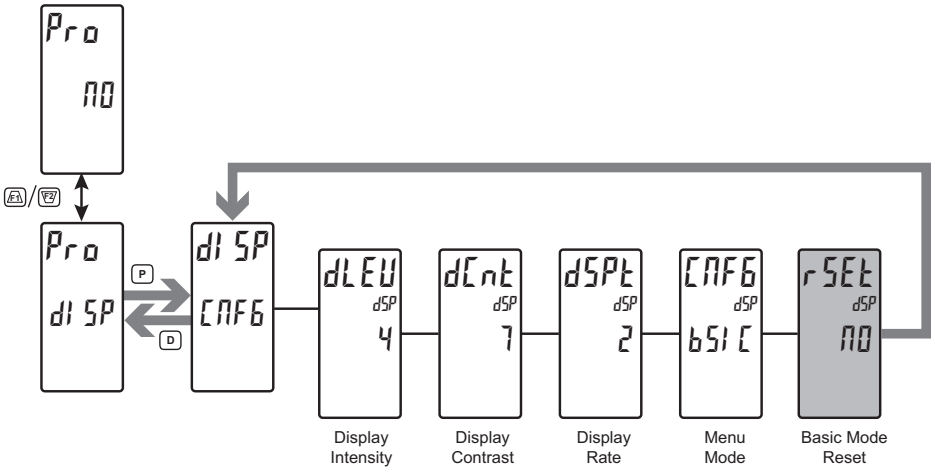
DISPLAY SELECT

dISP
CNFG

CNFG ZONE LOCS HILO CODE

Select the display parameters to be programmed.

DISPLAY PARAMETERS: GENERAL CONFIGURATION (CNFG)



DISPLAY INTENSITY LEVEL

dLEV
dSP
4

0 to 4

Enter the desired Display Intensity Level (0-4) by using the arrow keys. The display will actively dim or brighten as the levels are changed. This parameter can also be accessed in the Display, Parameter or Hidden Loops when enabled.

DISPLAY CONTRAST LEVEL

dCnt
dSP
7

0 to 15

Enter the desired Display Contrast Level (0-15) by using the arrow keys. The display contrast / viewing angle will actively adjust up or down as the levels are changed. This parameter can also be accessed in the Display, Parameter or Hidden Loops when enabled.

DISPLAY UPDATE RATE (/SEC)

dSPt
dSP
2

1 2 5 10 20

This parameter configures the display update rate. It does not affect the response time of the setpoint output or analog output option cards.

OPERATING MODE

CNFG
dSP
bSIC

bSIC AdUC

This parameter configures the unit to operate in Basic or Advanced Mode. Basic mode offers a reduced menu structure geared towards simpler applications that may not require the more advanced features of the PAX2C.

Basic Mode (bSIC):
- Maximum of four alarms
- Configuration of Display Color Zones is limited to a default color (no dynamic changing of zone colors based on mapped parameters)

Advanced Mode(AdUC):
- Maximum of sixteen alarms
- Full configuration on all seven Display Color Zones

The following programming step is only available when switching from Advanced Operating Mode to Basic Operating Mode. The PAX2C Factory default is Basic Operating Mode.

BASIC MODE RESET

rSEt
dSP
NO

NO YES

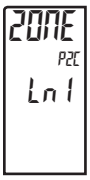
Resets the unit back to Basic Operating Mode factory defaults.

Warning: Any Advanced Operating Mode configuration in the unit that is not supported in Basic Operating Mode will be cleared and reset back to factory defaults.

F

Display Parameters: Zone Select (ZONE)

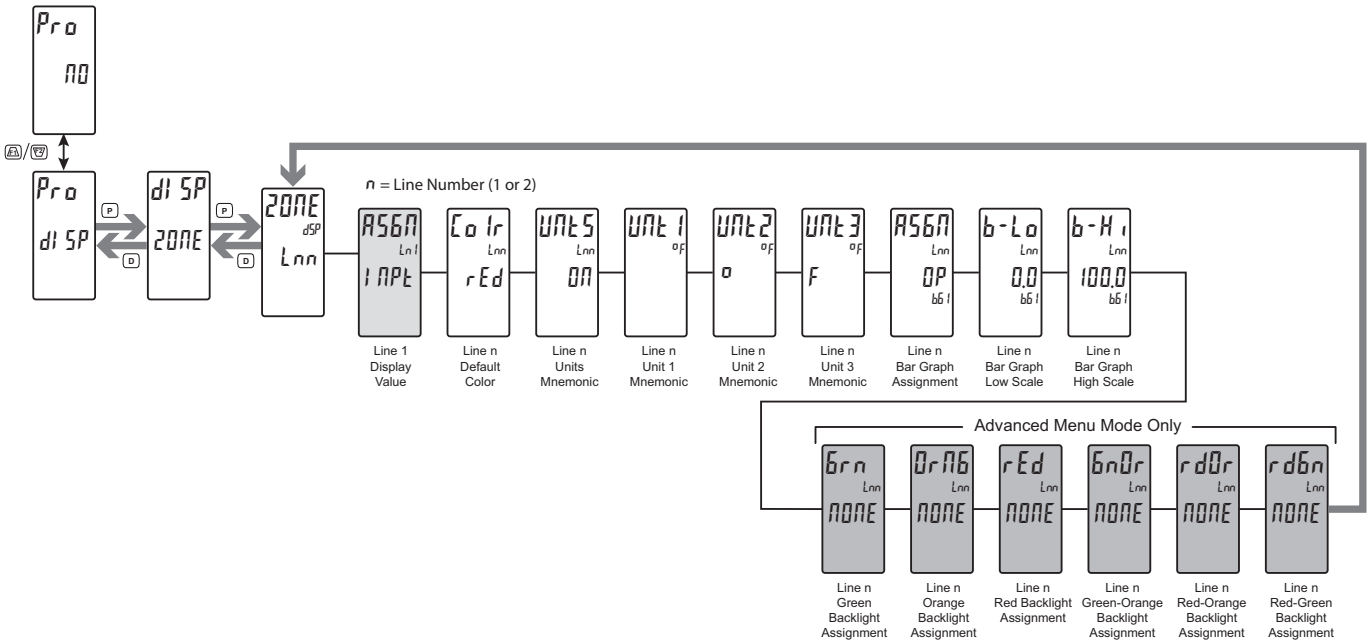
ZONE SELECT



Ln1 Ln2 UAn1 UAn2
UAn3 UAn4 Mn

Select the zone to be programmed.

Display Parameters: Zone Configuration - Line 1 & Line 2 (Ln1 & Ln2)



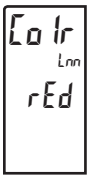
LINE 1 ASSIGNMENT

NONE 1 NPt HI LO

Select the value to be assigned to the primary or top line of the controller display.

- NONE = Line 1 is Disabled
- 1 NPt = Input/Process Value
- HI = Maximum Display Value
- LO = Minimum Display Value

LINE n DISPLAY COLOR



Grn OrNG rEd

Enter the desired Display Line, Bar Graph, and Programmable Units Display color.

- Grn = Green
- OrNG = Orange
- rEd = Red

LINE n UNITS MNEMONIC

OFF On

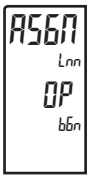
This parameter allows programming of the display mnemonics characters. Three individual characters may be selected from a preprogrammed list.

The characters available for the programmable modes include:

A b C d E F G H I J K L M n O P Q R S t U v W y 2 0 1
2 3 4 5 6 7 8 9 d c E 9 h i m n o 9 r u w - = [ ] r ° _ blank

Two character spaces are required to display this character.

LINE n BAR GRAPH ASSIGNMENT

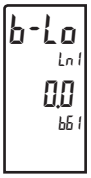


NONE OP dEu SP

Select the parameter to be assigned to Display Line n bar graph.

- NONE = Bar Graph is disabled
- OP = Output Power
- dEu = Deviation from the Setpoint Value
- SP = Active Setpoint

LINE n BAR GRAPH LOW SCALING POINT



-1999 to 9999

Enter the desired Display Line n Bar Graph Low Scaling Point by using the arrow keys.

LINE n BAR GRAPH HIGH SCALING POINT

-1999 to 9999

Enter the desired Display Line n Bar Graph High Scaling Point by using the arrow keys.

F

The following programming steps are only available in the Advanced Operating Mode.

These parameters allow Line n backlights to change color, or alternate between two colors when the mapped parameter is activated. When multiple backlight assignments are programmed for a particular zone, the color priority is defined as follows (from Lowest to Highest): Grn, Org, REd, GnOr, RdOr, RdGn

BACKLIGHT ASSIGNMENT SELECTIONS

NONE = Backlight color change disabled
Out1 = Output 1
Out2 = Output 2
Out3 = Output 3
Out4 = Output 4
ALr = Alarm
MAN = Manual Control Mode

The following two programming steps are only available when the Backlight Assignment is configured as an Alarm (ALr). These steps apply to each of the six different backlight color assignment parameters.

ALARM LOGIC MODE

SNGL And Or

The PAX2C supports three different modes when an output is assigned as an alarm:

SNGL = Any single alarm
And = Allows multiple alarms to be mapped to an output using AND Boolean logic. For example: If AL1 **and** AL2 are active, the output will energize.
Or = Allows multiple alarms to be mapped to an output using OR Boolean logic. For example: If AL1 **or** AL2 are active, the output will energize.

ALARM MASK ASSIGNMENT

NO YES

Selects the alarms to be logically combined per the Alarm Logic Mode selection. Any alarms configured as YES will be used in the Boolean logic calculation. If the Alarm Logic Mode is assigned as Single (SNGL), the last alarm selected as YES will be used.

LINE n GREEN BACKLIGHT ASSIGNMENT

NONE Out1 Out2 Out3 Out4 ALr MAN

Select the parameter to be assigned to Line n Green Backlight.

LINE n ORANGE BACKLIGHT ASSIGNMENT

NONE Out1 Out2 Out3 Out4 ALr MAN

Select the parameter to be assigned to Line n Orange Backlight.

LINE n RED BACKLIGHT ASSIGNMENT

NONE Out1 Out2 Out3 Out4 ALr MAN

Select the parameter to be assigned to Line n Red Backlight.

LINE n GREEN-ORANGE BACKLIGHT ASSIGNMENT

NONE Out1 Out2 Out3 Out4 ALr MAN

Select the parameter to be assigned to Line n Green-Orange Backlight.

LINE n RED-ORANGE BACKLIGHT ASSIGNMENT

NONE Out1 Out2 Out3 Out4 ALr MAN

Select the parameter to be assigned to Line n Red-Orange Backlight.

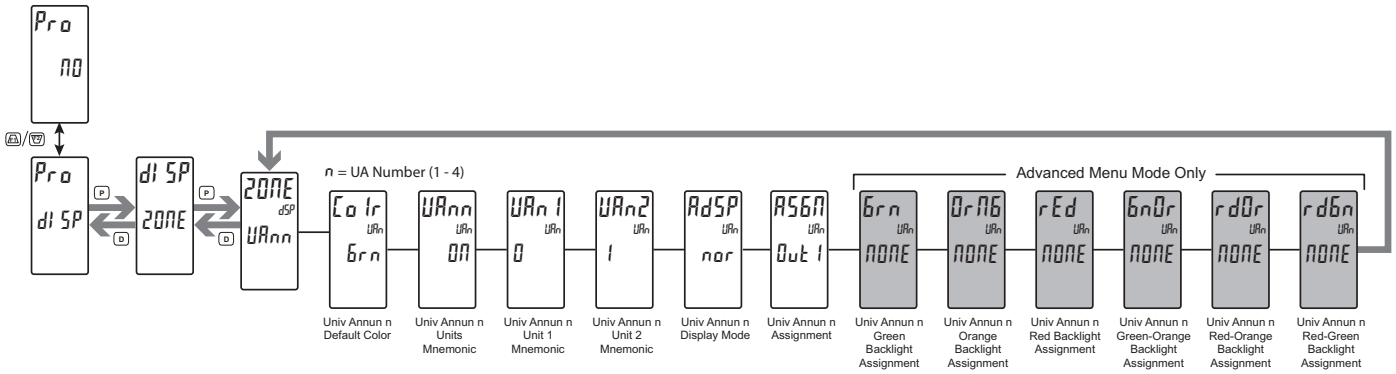
LINE n RED-GREEN BACKLIGHT ASSIGNMENT

NONE Out1 Out2 Out3 Out4 ALr MAN

Select the parameter to be assigned to Line n Red-Green Backlight.

F

DISPLAY PARAMETERS: ZONE CONFIGURATION - UNIVERSAL ANNUNCIATORS 1-4 (UAnn)



UNIVERSAL ANNUNCIATOR n DISPLAY COLOR

Color UAn rEd

Grn OrNG rEd

Enter the desired Universal Annunciator Display color.

Grn = Green
OrNG = Orange
rEd = Red

UNIVERSAL ANNUNCIATOR n UNITS MNEMONIC

UNtS UAn On

OFF On

This parameter allows programming of the display mnemonics characters. Two individual characters may be selected from a preprogrammed list.

The characters available for the programmable modes include:

A b C d E F G H I J K L M n O P Q R S t U v W y Z 0 1
2 3 4 5 6 7 8 9 d c E 9 h i m n o 9 r u w - = [ ] ° _ blank

Two character spaces are required to display this character.

UNIVERSAL ANNUNCIATOR n DISPLAY MODE

AdSP UAn nor

nor rEu FLSh

Enter the desired Universal Annunciator Display Mode. This parameter is available when the Universal Annunciator is in List (LiSt) Mode.

nor = Displays the configured universal annunciator when the mapped parameter is activated (on).
rEu = Displays the configured universal annunciator when the mapped parameter is deactivated (off).
FLSh = Flashes the configured universal annunciator when the mapped parameter is activated (on).

UNIVERSAL ANNUNCIATOR n ASSIGNMENT

ASGn UAn NONE

NONE Out1 Out2 Out3 Out4 ALr MAN

Selects the parameter that enables the Universal Annunciator mnemonic to be displayed. If the mapped parameter is active, the mnemonic is displayed. If the mapped parameter is not active, the mnemonic will be disabled (off).

NONE = Universal Annunciator text is disabled
Out1 = Output 1
Out2 = Output 2
Out3 = Output 3
Out4 = Output 4
ALr = Alarm
MAN = Manual Control Mode

The following programming steps are only available in the Advanced Operating Mode.

These parameters allow Universal Annunciator n backlights to change color, or alternate between two colors when the mapped parameter is activated. When multiple backlight assignments are programmed for a particular zone, the color priority is defined as follows (from Lowest to Highest): Grn, OrG, rEd, GnOr, rdOr, rdGn

BACKLIGHT ASSIGNMENT SELECTIONS

NONE = Backlight color change disabled
Out1 = Output 1
Out2 = Output 2
Out3 = Output 3
Out4 = Output 4
ALr = Alarm
MAN = Manual Control Mode

The following two programming steps are only available when the Backlight Assignment is configured as an Alarm (ALr). These steps apply to each of the six different backlight color assignment parameters.

ALARM LOGIC MODE

LGIC UAn SNGL

SNGL And Or

The PAX2C supports three different modes when an output is assigned as an alarm:

SNGL = Any single alarm
And = Allows multiple alarms to be mapped to an output using AND Boolean logic. For example: If AL1 **and** AL2 are active, the output will energize.
Or = Allows multiple alarms to be mapped to an output using OR Boolean logic. For example: If AL1 **or** AL2 are active, the output will energize.

ALARM MASK ASSIGNMENT

ASEL UAn no An

no YES

Selects the alarms to be logically combined per the Alarm Logic Mode selection. Any alarms configured as YES will be used in the Boolean logic calculation. If the Alarm Logic Mode is assigned as Single (SNGL), the last alarm selected as YES will be used.

F

UNIVERSAL ANNUNCIATOR n GREEN BACKLIGHT ASSIGNMENT

NONE Out1 Out2 Out3 Out4 ALr MAN

Select the parameter to be used to activate the Green backlight on Universal Annunciator n.

UNIVERSAL ANNUNCIATOR n ORANGE BACKLIGHT ASSIGNMENT

NONE Out1 Out2 Out3 Out4 ALr MAN

Select the parameter to be used to activate the Orange backlight on Universal Annunciator n.

UNIVERSAL ANNUNCIATOR n RED BACKLIGHT ASSIGNMENT

NONE Out1 Out2 Out3 Out4 ALr MAN

Select the parameter to be used to activate the Red backlight on Universal Annunciator n.

UNIVERSAL ANNUNCIATOR n GREEN-ORANGE BACKLIGHT ASSIGNMENT

NONE Out1 Out2 Out3 Out4 ALr MAN

Select the parameter to be used to activate the Green-Orange backlight on Universal Annunciator n.

UNIVERSAL ANNUNCIATOR n RED-ORANGE BACKLIGHT ASSIGNMENT

NONE Out1 Out2 Out3 Out4 ALr MAN

Select the parameter to be used to activate the Red-Orange backlight on Universal Annunciator n.

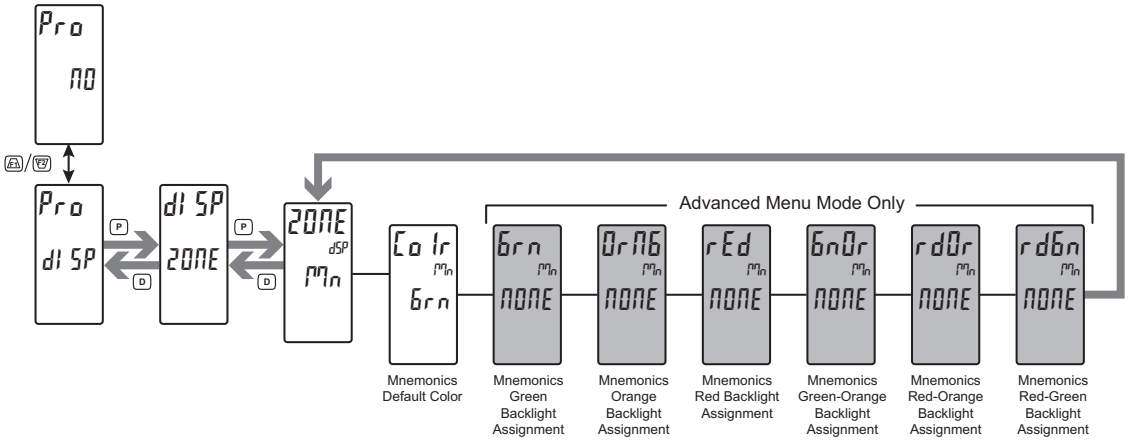
UNIVERSAL ANNUNCIATOR n RED-GREEN BACKLIGHT ASSIGNMENT

NONE Out1 Out2 Out3 Out4 ALr MAN

Select the parameter to be used to activate the Red-Green backlight on Universal Annunciator n.

F

DISPLAY PARAMETERS: ZONE CONFIGURATION - MNEMONICS (mn)



MNEMONICS DISPLAY COLOR

Color
USn
rEd

Grn OrNG rEd

Enter the desired Mnemonics Display color.

Grn = Green
OrNG = Orange
rEd = Red

The following programming steps are only available in the Advanced Operating Mode.

These parameters allow the mnemonic backlights to change color, or alternate between two colors when the mapped parameter is activated. When multiple backlight assignments are programmed for a particular zone, the color priority is defined as follows (from Lowest to Highest): Grn, OrG, rEd, GnOr, rdOr, rdGn

BACKLIGHT ASSIGNMENT SELECTIONS

NONE = Backlight color change disabled
Out 1 = Output 1
Out2 = Output 2
Out3 = Output 3
Out4 = Output 4
ALr = Alarm
MAN = Manual Control Mode

The following two programming steps are only available when the Backlight Assignment is configured as an Alarm (Alr). These steps apply to each of the six different backlight color assignment parameters.

ALARM LOGIC MODE

LGIC
USn
SNGL

SNGL And Or

The PAX2C supports three different modes when an output is assigned as an alarm:

SNGL = Any single alarm
And = Allows multiple alarms to be mapped to an output using AND Boolean logic. For example: If AL1 **and** AL2 are active, the output will energize.
Or = Allows multiple alarms to be mapped to an output using OR Boolean logic. For example: If AL1 **or** AL2 are active, the output will energize.

ALARM MASK ASSIGNMENT

ASEL
USn
no
An

no YES

Selects the alarms to be logically combined per the Alarm Logic Mode selection. Any alarms configured as YES will be used in the Boolean logic calculation. If the Alarm Logic Mode is assigned as Single (SNGL), only one alarm may be selected at a time.

MNEMONICS GREEN BACKLIGHT ASSIGNMENT

Grn
mn
NONE

NONE Out 1 Out2 Out3 Out4 ALr MAN

Select the parameter to be used to activate the mnemonic Green backlight.

MNEMONICS ORANGE BACKLIGHT ASSIGNMENT

OrNG
mn
NONE

NONE Out 1 Out2 Out3 Out4 ALr MAN

Select the parameter to be used to activate the mnemonic Orange backlight.

MNEMONICS RED BACKLIGHT ASSIGNMENT

rEd
mn
NONE

NONE Out 1 Out2 Out3 Out4 ALr MAN

Select the parameter to be used to activate the mnemonic Red backlight.

MNEMONICS GREEN-ORANGE BACKLIGHT ASSIGNMENT

GnOr
mn
NONE

NONE Out 1 Out2 Out3 Out4 ALr MAN

Select the parameter to be used to activate the mnemonic Green-Orange backlight.

MNEMONICS RED-ORANGE BACKLIGHT ASSIGNMENT

rdOr
mn
NONE

NONE Out 1 Out2 Out3 Out4 ALr MAN

Select the parameter to be used to activate the mnemonic Red-Orange backlight.

MNEMONICS RED-GREEN BACKLIGHT ASSIGNMENT

rdGn
USn
NONE

NONE Out 1 Out2 Out3 Out4 ALr MAN

Select the parameter to be used to activate the mnemonic Red-Green backlight.

F

DISPLAY PARAMETERS: LINE 2 PARAMETERS (LOCS)

This section details programming for the Line 2 (Bottom Line) Display. Various Input, Display, PID, Alarm, and Function Parameters can be shown on the Line 2 display. The display loops described below are used to view, reset and modify the selected display values, based on the Line 2 Value Access setting programmed for each available value.

Main Display Loop

In the Main display loop, the selected values can be consecutively read on Line 2 by pressing the **D** key. The lower 3-character units mnemonic indicates which Line 2 value is currently shown. When in the Main display loop, the Function keys F1 and F2 perform the User functions programmed in the User Input program section.

Parameter Display Loop and Hidden Parameter Loop

These display loops provide quick access to selected parameters that can be viewed and modified on Line 2 without having to enter Full Programming Mode. To utilize the Hidden Parameter display loop, a security code (1-250) must be programmed. (See Security Code Configuration at the end of this section.)The Parameter display loop is accessed by pressing the **P** key. The selected Parameter display loop values can be viewed and/or changed per the Line 2 Value Access setting programmed for each available value. The Hidden Parameter loop follows the Parameter display loop, and can only be accessed when the correct security code is entered at the Code prompt.

Line 2 Value Access Configuration

Line 2 values can be made accessible in either the Main (**D** key), Parameter (**P** key) or Hidden (**P** key following code entry) display loops. When the List parameter is configured for an Ent setting, a List assignment submenu will follow. Refer to Input module, User sub-menu section for a description of the function. Each parameter must be configured for one of the following settings. Not all settings are available for each parameter, as shown in the Parameter Value Access table.

SELECTION	DESCRIPTION
LOC	Not viewed on Line 2 Display (Factory Default Setting).
drEd	View in Main display loop. Cannot change or reset.
dEnt	View and change in Main display loop.
PrEd	View in Parameter display loop. Cannot change or reset.
PEnt	View and change in Parameter display loop.
HrEd	View in Hidden display loop. Cannot change or reset.
HEnt	View and change in Hidden display loop.

LINE 2 PARAMETER VALUE ACCESS

DISPLAY	DESCRIPTION	NOT VIEWED	MENU DISPLAY LOOP (D KEY)		PARAMETER DISPLAY LOOP (P KEY)		HIDDEN LOOP	
		LOC	drEd	dEnt	PrEd	PEnt	HrEd	HEnt
INPt	Input	x	x		x		x	
HI	Max Value	x	x	x	x	x	x	x
LO	Min Value	x	x	x	x	x	x	x
dLEV	Display Intensity Level	x	x	x	x	x	x	x
dCnt	Display Contrast Level	x	x	x	x	x	x	x
SP	Actual Setpoint Value	x	x	x	x	x	x	x
SP1	Setpoint 1 Value	x	x	x	x	x	x	x
SP2	Setpoint 2 Value	x	x	x	x	x	x	x
OP	Output Power (must be in manual mode to edit)	x	x	x	x	x	x	x
dEv	Deviation	x	x		x		x	
SPrP	Setpoint Ramping	x	x	x	x	x	x	x
Pid ACt	Actual PID Values: P, I & D	x	x	x	x	x	x	x
Pid Pr1	Primary PID Values: P, I & D	x	x	x	x	x	x	x
Pid ALt	Alternate PID Values: P, I & D	x	x	x	x	x	x	x
ALn	Alarm Values: Basic Mode (1-4), Advanced Mode (1-16)	x	x	x	x	x	x	x
bdn	Band/Deviation	x	x	x	x	x	x	x
SPSL	Setpoint Selection	x	x	x	x	x	x	x
SPrP	Setpoint Ramping	x	x	x	x	x	x	x
ILOC	Integral Lock	x	x	x	x	x	x	x
trnF	Manual/Auto Control Mode	x	x	x	x	x	x	x
PSEL	PID Parameter Selection	x	x	x	x	x	x	x
tunE	Tuning Enable	x	x	x	x	x	x	x
r-HI	Reset Maximum Value	x		x		x		x
r-Lo	Reset Minimum Value	x		x		x		x
r-HL	Reset Max and Min Values	x		x		x		x
r-AL	Reset Alarms	x		x		x		x
LISt	Parameter List A/B Access	x	x	x	x	x	x	x
Prnt	Print Request	x		x		x		x

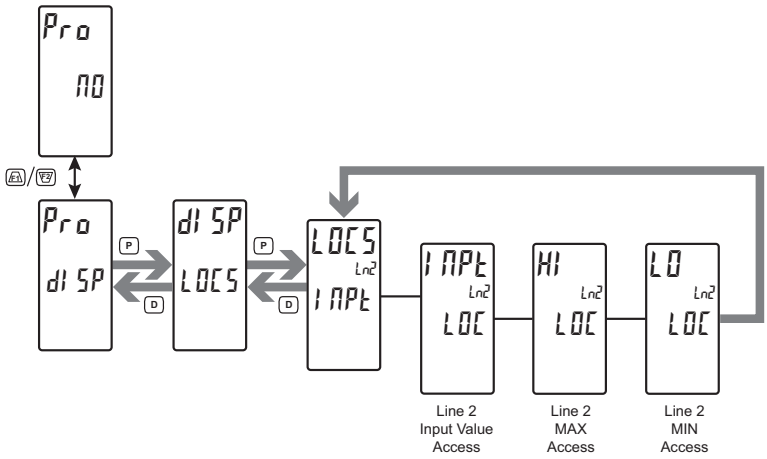
F

LINE 2 VALUE ACCESS PARAMETER SELECTION

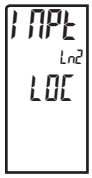
INPt dISP Pid ALr FNCt

Select the display parameters to be displayed.

DISPLAY PARAMETERS: LINE 2 PARAMETER VALUE ACCESS - INPUT (INPt)



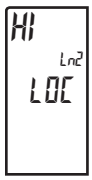
LINE 2 INPUT ACCESS



LOC drEd PrEd HrEd

Displays the controller process input reading on Line 2.

LINE 2 MAX ACCESS



LOC drEd dEnt PrEd PEnt HrEd HEnt

When configured for dEnt, PEnt or HEnt, the Max Display value can be reset using a front keypad sequence. To reset, push the **P** key while viewing the Hi value on Line 2. The display will show rHI no. Press the F1 key to select YES and then press **P** key. The display will indicate rSEt and then return to the Hi value parameter.

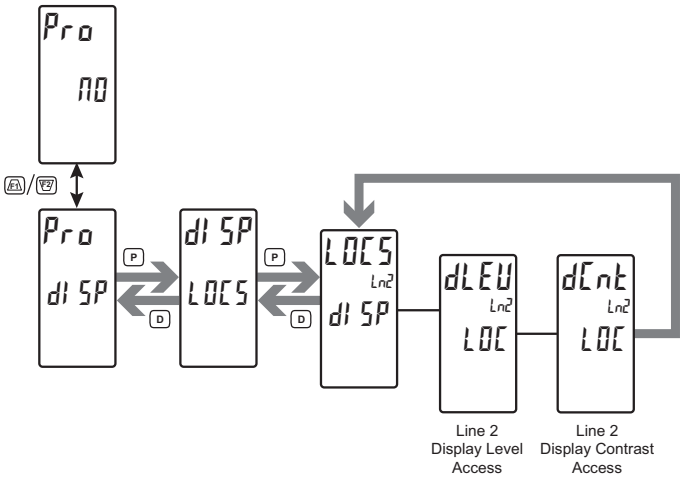
LINE 2 MIN ACCESS

LOC drEd dEnt PrEd PEnt HrEd HEnt

When configured for dEnt, PEnt or HEnt, the Min Display value can be reset using a front keypad sequence. To reset, push the **P** key while viewing the Lo value on Line 2. The display will show rLo no. Press the F1 key to select YES and then press **P** key. The display will indicate rSEt and then return to the Lo value parameter.

F

DISPLAY PARAMETERS: LINE 2 PARAMETER VALUE ACCESS - DISPLAY (diSP)



LINE 2 DISPLAY INTENSITY LEVEL

dLEU Ln2 LOC

LOC drEd dEnt PrEd PEnt HrEd HEnt

When configured for dEnt, PEnt or HEnt, the display intensity can be adjusted in the selected display loop by using the F1 and F2 keys while viewing dLEU.

LINE 2 DISPLAY CONTRAST LEVEL

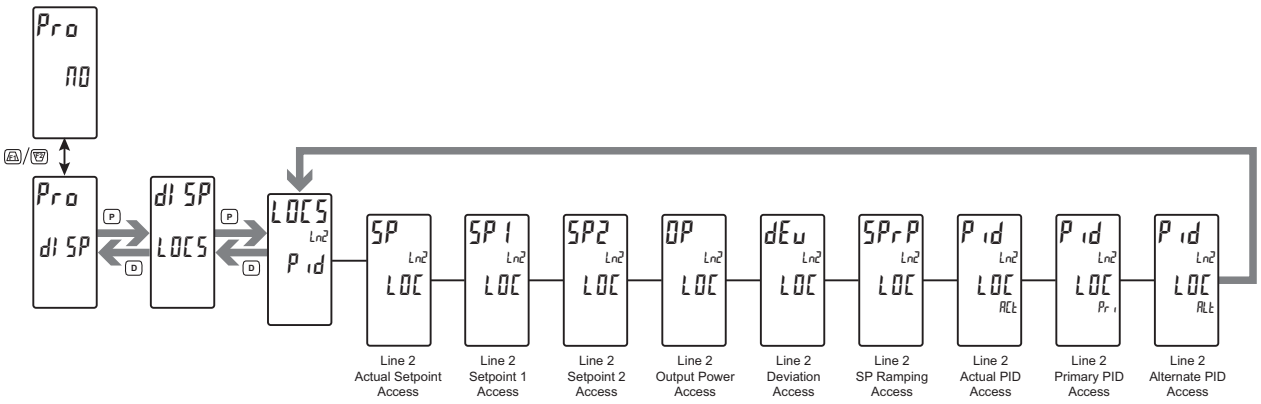
dCnt Ln2 LOC

LOC drEd dEnt PrEd PEnt HrEd HEnt

When configured for dEnt, PEnt or HEnt, the display contrast can be adjusted in the selected display loop by using the F1 and F2 keys while viewing dCnt.

F

DISPLAY PARAMETERS: LINE 2 PARAMETER VALUE ACCESS - PID (Pid)



LINE 2 ACTIVE SETPOINT VALUE

LOC drEd dEnt PrEd PEnt HrEd HEnt

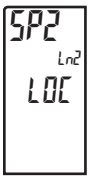
When configured for dEnt, PEnt or HEnt, the active setpoint value can be adjusted in the selected display loop by using the F1 and F2 keys while viewing SP. When configured for d-ENt, the P key must be pressed to select the item prior to changing the value.

LINE 2 SETPOINT 1 VALUE

LOC drEd dEnt PrEd PEnt HrEd HEnt

When configured for dEnt, PEnt or HEnt, the Setpoint 1 value can be adjusted in the selected display loop by using the F1 and F2 keys while viewing SP1. When configured for dEnt, the **P** key must be pressed to select the item prior to changing the value.

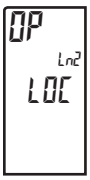
LINE 2 SETPOINT 2 VALUE



LOC drEd dEnt PrEd PEnt HrEd HEnt

When configured for dEnt, PEnt or HEnt, the Setpoint 2 value can be adjusted in the selected display loop by using the F1 and F2 keys while viewing SP2. When configured for dEnt, the **P** key must be pressed to select the item prior to changing the value.

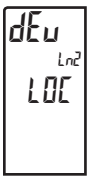
LINE 2 OUTPUT POWER VALUE



LOC drEd dEnt PrEd PEnt HrEd HEnt

Displays the Output Power value on Line 2 in the selected display loop. In manual mode, the value can be adjusted in the selected display loop by using the F1 and F2 keys. When configured for dEnt, the **P** key must be pressed to select the item prior to changing the value.

LINE 2 DEVIATION VALUE



LOC drEd PrEd HrEd

Displays the difference between Temp/Process and the Actual Setpoint value on Line 2 in the selected display loop.

LINE 2 SETPOINT RAMPING VALUE

LOC drEd dEnt PrEd PEnt HrEd HEnt

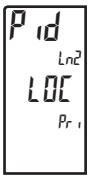
When configured for dEnt, PEnt or HEnt, the Setpoint Ramping value can be adjusted in the selected display loop by using the F1 and F2 keys while viewing SPrP. When configured for dEnt, the **P** key must be pressed to select the item prior to changing the value.

LINE 2 ACTUAL PID VALUES

LOC drEd dEnt PrEd PEnt HrEd HEnt

When configured for dEnt, PEnt or HEnt, the Actual PID values (P, I & D) can be adjusted in the selected display loop by using the F1 and F2 keys while viewing the selected parameter. When configured for dEnt, the **P** key must be pressed to select the item prior to changing the value.

LINE 2 PRIMARY PID VALUES



LOC drEd dEnt PrEd PEnt HrEd HEnt

When configured for dEnt, PEnt or HEnt, the Primary PID values (P, I & D) can be adjusted in the selected display loop by using the F1 and F2 keys while viewing the selected parameter. When configured for dEnt, the **P** key must be pressed to select the item prior to changing the value.

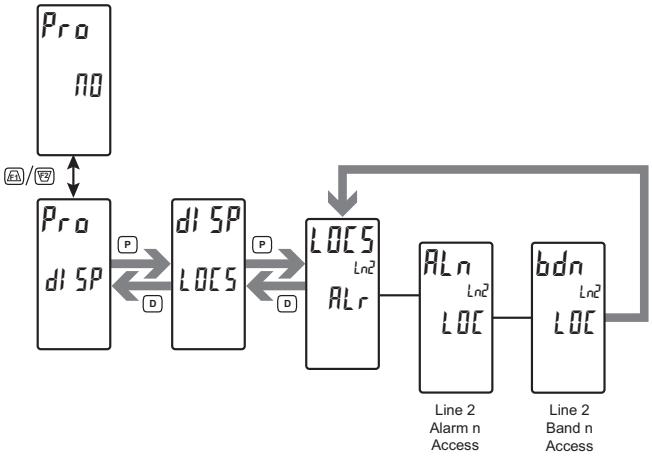
LINE 2 ALTERNATE PID VALUES

LOC drEd dEnt PrEd PEnt HrEd HEnt

When configured for dEnt, PEnt or HEnt, the Alternate PID values (P, I & D) can be adjusted in the selected display loop by using the F1 and F2 keys while viewing the selected parameter. When configured for dEnt, the **P** key must be pressed to select the item prior to changing the value.

F

Display Parameters: Line 2 Parameter Value Access - Alarms (ALr)



LINE 2 ALARM ACCESS

LOC drEd dEnt PrEd PEnt HrEd HEnt

When configured for dEnt, PEnt or HEnt, the Alarm n value can be adjusted in the selected display loop by using the F1 and F2 keys while viewing ALn. When configured for dEnt, the **P** key must be pressed to select the item prior to changing the value.

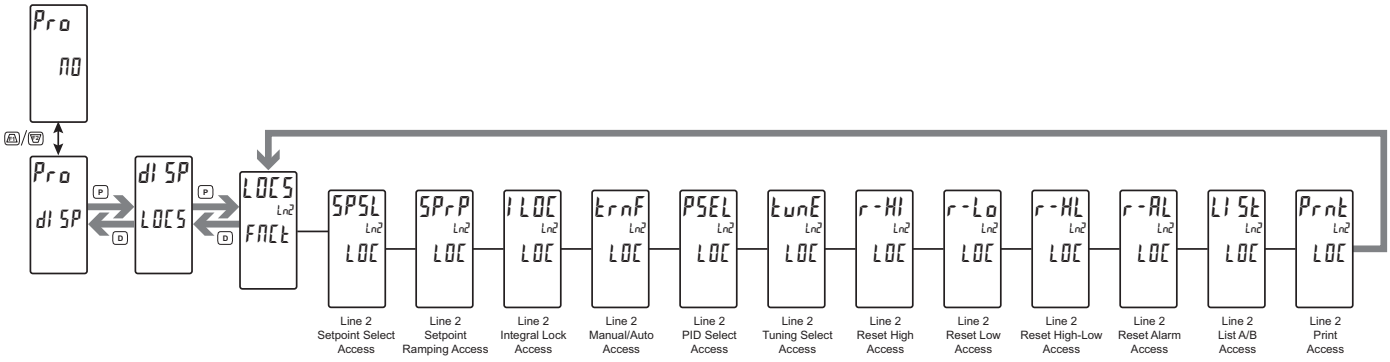
LINE 2 BAND/DEVIATION ACCESS

LOC drEd dEnt PrEd PEnt HrEd HEnt

When configured for dEnt, PEnt or HEnt, the Band/Deviation n value can be adjusted in the selected display loop by using the F1 and F2 keys while viewing bdn. When configured for dEnt, the **P** key must be pressed to select the item prior to changing the value.

Basic Mode: 4 alarms max
Advanced Mode: 16 alarms max

Display Parameters: Line 2 User Function Access - Functions (Fnct)



F

LINE 2 USER FUNCTION ACCESSIBLE ITEMS

The following list of User functions can be made available in the Display (dEnt), Parameter (PEnt) or Hidden (HEnt) display loops. The more critical and frequently used Functions should be first assigned to the User Inputs and User Function keys. If more functions are needed than what can be obtained with User Inputs, this feature will provide a means to provide that access. Please refer to the USER INPUT / FUNCTION KEY PARAMETERS (USEr) section for a detailed description of the available functions.

SPSL	ILOC	PSEL	r-HI	r-HL	LiSt*
SPrP	trnF	tunE	r-Lo	r-AL	Prnt

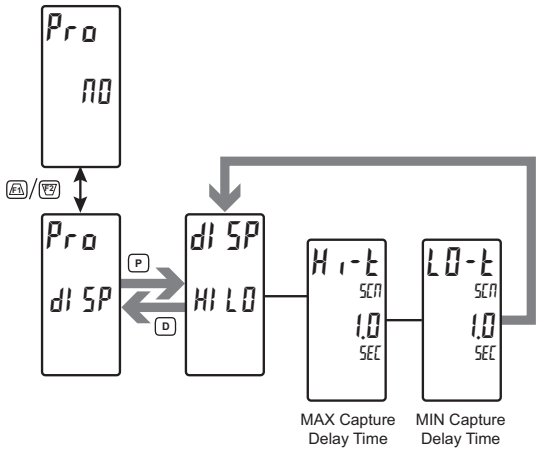
* Also available as a read-only item in the Display (drEd), Parameter (PrEd) or Hidden (HrEd) Display loops.

LINE 2 PARAMETER LIST A/B ACCESS

LOC drEd dEnt PrEd PEnt HrEd HEnt

When configured for dEnt, PEnt or HEnt, the Parameter list can be selected using a front keypad sequence. To select, push the **P** key while viewing LiSt x". "x" will begin to flash, press the F1 key to select "A" or "b" and then press **P** key. The selected Parameter List will become active and the display will advance to the next available item or menu loop. See User Functions "Select Parameter List" for a description of the list function. The Line 2 Parameter List provides a means of setting or viewing the active parameter list.

Display Parameters: Display Min/Max Configuration (HI LO)



MAX CAPTURE DELAY TIME

HI-t SCN 1.0 SEC

0.0 to 25.0 seconds

When the Input Display is above the present MAX value for the entered delay time, the controller will capture that display value as the new MAX reading. A delay time helps to avoid false captures of sudden short spikes.

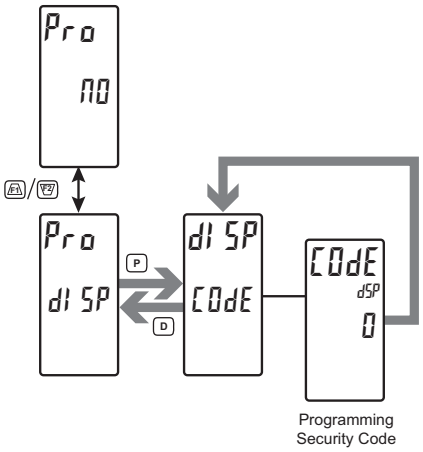
MIN CAPTURE DELAY TIME

LO-t SCN 1.0 SEC

0.0 to 25.0 seconds

When the Input Display is below the present MIN value for the entered delay time, the controller will capture that display value as the new MIN reading. A delay time helps to avoid false captures of sudden short spikes.

Display Parameters: Security Code Configuration (CodE)



PROGRAMMING SECURITY CODE

CodE dSP 0

0 to 250

The Security Code determines the programming mode and the accessibility of programming parameters. This code can be used along with the Program Mode Lock-out (PLOC) in the User Input Function parameter (Input [User] module).

To activate the Hidden Parameter display loop, a security code (1-250) must be entered. If a "0" security code is programmed, Full Programming Mode is available following the Parameter Loop. Pressing the **P** key takes you into, and is used to step through the Parameter Loop. Two modes are available. Full Programming mode allows all parameters to be viewed and modified. Parameter display loop mode provides access to those selected parameters that can be viewed and/or modified without entering the Full Programming mode.

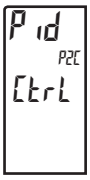
The following chart indicates the levels of access based on various CodE and User Input PLOC settings.

SECURITY CODE	USER INPUT CONFIGURED	USER INPUT STATE	HIDDEN AND FULL PROGRAMMING MODE ACCESS
>0	PLOC or Not Active	Any State	After Parameter Display Loop with correct code # at CodE prompt.
0	PLOC	Active	No Access
0	PLOC or Not Active	Not Active	Access after Parameter Display Loop

F

PID Parameters (Pid)

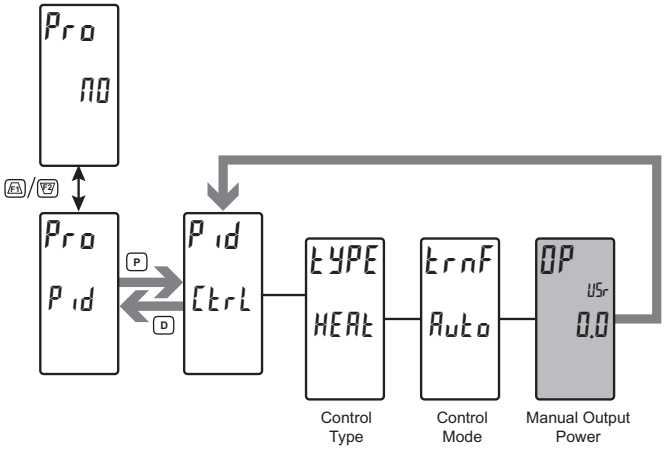
PID PARAMETER MENU SELECTION



CtrL SP Pid PWr ONOF tunE

Select the PID parameter menu to be programmed.

PID Parameters: Control Parameters (CtrL)



PID CONTROL TYPE

HEAt COOL botH

Select the type of PID control desired. When programmed for Heating action (reverse), the output power decreases when the Process Value is above the setpoint value. When programmed for Cooling (direct), the output power will increase if the Process value is above the Setpoint Value.

PID CONTROL MODE

Auto MAN

Select Automatic or Manual Operation. In Automatic (Auto) mode (closed loop; On/Off, or PID Control), the controller calculates the required output to reach and maintain setpoint, and acts accordingly. In manual mode (MAN), the calculated PID algorithm heat and cool output percentages are not used to control the controller outputs. The unit is instead placed into an open loop mode where the control does not work from a setpoint or process feedback.

The following programming step is only available when PID Control Mode is set to Manual Mode (MAN).

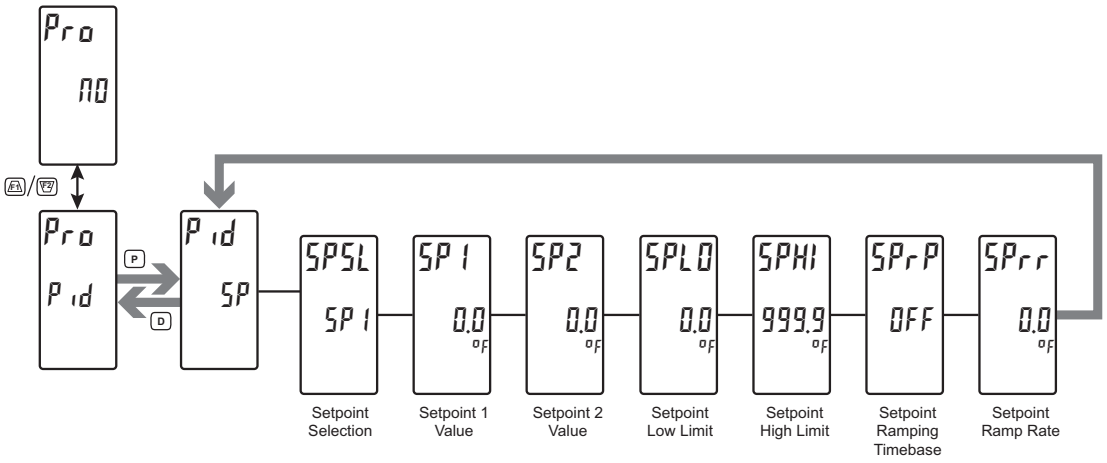
OUTPUT POWER

-100.0 to 100.0 %

Manual Output Power is the level the PID module will assume in manual mode.

F

PID Parameters: Setpoint Parameters (SP)



SETPOINT SELECTION

SPSL
SP1

SP1 SP2

Select the desired Setpoint Value (SP1 or SP2) to use as the control point. The SP Select function can also be configured in the Display Parameter LOCS Menu (PId LOCS) or a User Input or Function Key can be assigned to the Setpoint Select Function.

SETPOINT 1 VALUE

SP1
0.0
°F

-1999 to 9999

One of the two values that may be selected as the target setpoint of the process.

SETPOINT 2 VALUE

SP2
0.0
°F

-1999 to 9999

One of the two values that may be selected as the target setpoint of the process.

SETPOINT LOW LIMIT

SPLO
0.0
°F

-1999 to 9999

Select the desired Setpoint Low Limit value. This value should be selected so that the controller setpoint value cannot be set outside the safe operating range of the process.

SETPOINT HIGH LIMIT

SPHI
999.9
°F

-1999 to 9999

Select the desired Setpoint High Limit value. This value should be selected so that the controller setpoint value cannot be set outside the safe operating range of the process.

SETPOINT RAMPING TIMEBASE

SPrP
OFF

OFF SEC MIN hour

Select the desired unit of time for ramping of the process:

OFF = Off
SEC = Seconds
MIN = Minutes
hour = Hours

SETPOINT RAMP RATE

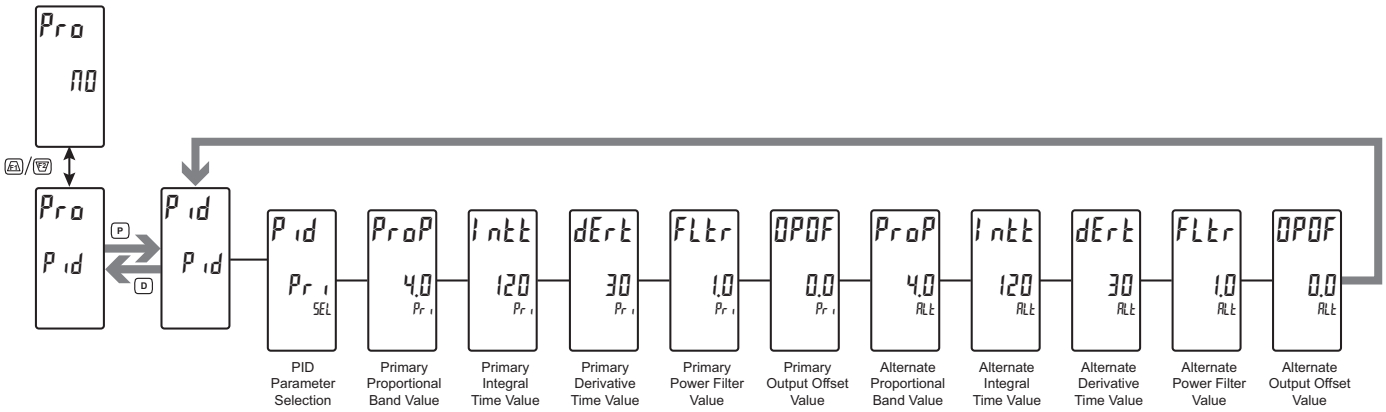
SPrr
0.0
°F

0 to 9999

The Ramp Rate property is used to reduce sudden shock to a process during setpoint changes and system startup, a setpoint ramp rate can be used to increase or decrease the Target Setpoint at a controlled rate. The value is entered in units/time. A value of 0 disables setpoint ramping. If the Setpoint Ramp Rate is a non-zero value, and the Actual Setpoint is changed or the controller is powered up, the controller sets the Target Setpoint to the current process measurement, and uses that value as its setpoint. It then adjusts the Target Setpoint according to the setpoint Ramp Rate. When the Target Setpoint reaches the Actual Setpoint, the controller resumes use of the Actual Setpoint value. (In a properly designed and functioning system, the process will have followed the Target Setpoint value to the Actual Setpoint value.)

F

PID Parameters: PID Parameters (Pid)



PID PARAMETER SELECTION

Pr1 ALt

Select the desired set of PID Values (Primary or Alternate) that will be used in the PID calculation. The PID Parameter Selection function can also be configured in the Display Parameter LOCS Menu (Pid LOCS) or a User Input or Function Key can be assigned to the PID Parameter Selection Function.

PRIMARY/ALTERNATE PROPORTIONAL BAND

0 to 999.9 %

The Proportional Band property, entered as a percentage of the full input range, is the amount of input change required to vary the output full scale. For temperature inputs, the input range is fixed per the entered thermocouple or RTD type. For process inputs, the input range is the difference between the Process at 0%, and Process at 100% values. The Proportional Band is adjustable from 0.0% to 999.9%, and should be set to a value that provides the best response to a process disturbance while minimizing overshoot. A Proportional Band of 0.0% forces the controller into On/Off Control with its characteristic cycling at setpoint. The optimal value may be established by invoking Auto-tune.

PRIMARY/ALTERNATE INTEGRAL TIME

0 to 65000 seconds

The Integral Time is the time in seconds that it takes the integral action to equal the proportional action, during a constant process error. As long as the error exists, integral action is repeated each Integral Time. The higher the value, the slower the response. The optimal value may be established by invoking autotune.

PRIMARY/ALTERNATE DERIVATIVE TIME

0 to 9999 seconds

The Derivative Time is the seconds per repeat that the controller looks ahead at the ramping error to see what the proportional contribution will be and then matches that value every Derivative Time. As long as the ramping error exists, the derivative contribution is repeated every derivative time. Increasing the value helps to stabilize the response. Too high of a value, coupled with noisy signal processes, may cause the output to fluctuate too greatly, yielding poor control. Setting the time to zero disables derivative action. The optimal Derivative Time may be established by invoking auto-tune.

PRIMARY/ALTERNATE POWER FILTER

0 to 60.0 seconds

The Power Filter is a time constant, entered in seconds, that dampens the calculated output power. Increasing the value increases the dampening effect. Generally, a Power Filter in the range of one-twentieth to one-fiftieth of the controller's integral time (or process time constant) is effective. Values longer than these may cause controller instability due to the added lag effect.

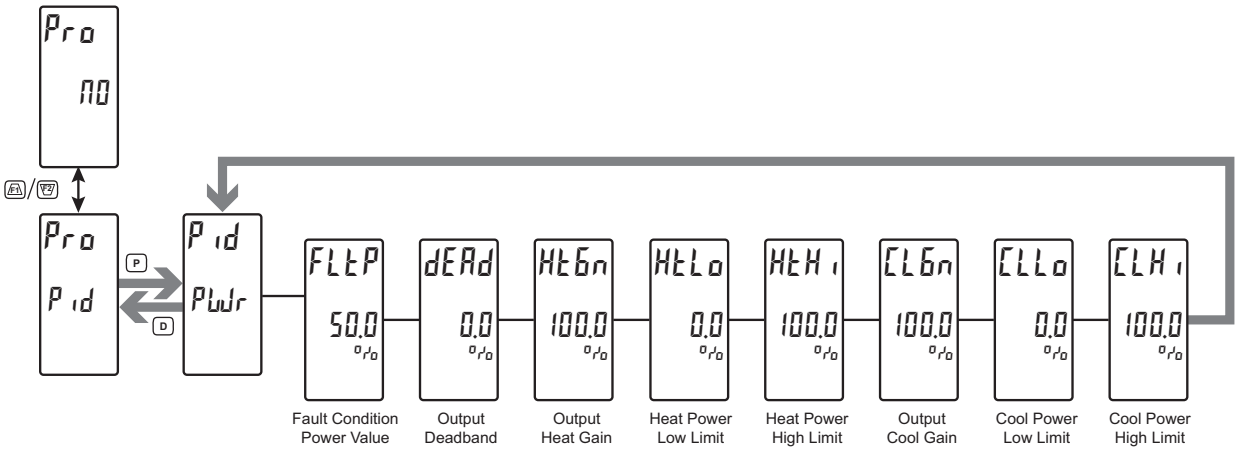
PRIMARY/ALTERNATE OUTPUT OFFSET

-100.0 to 100.0

This value effectively shifts the zero output point of the module's output power calculation. This feature is most commonly used in proportional-only applications to remove steady-state error.

F

PID Parameters: Output Power Parameters (Pwdr)



FAULT CONDITION POWER VALUE

- 199.9 to 200.0 %

Enter the desired control output value for the controller to assume in the event that the input sensor fails. You may enter values in excess of 100% and -100% to overcome limitations caused by Power Transfer Values, such as Gains and Offsets, that would otherwise limit the output to less than their maximums.

OUTPUT DEADBAND

- 100.0 to 100.0 %

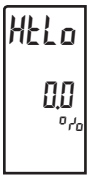
The Output Deadband property defines the area in which both the heating and cooling outputs are inactive, known as deadband, or the area in which they will both be active, known as overlap. A positive value results in a deadband, while a negative value results in an overlap.

OUTPUT HEAT GAIN

0 to 500.0 %

The Output Heat Gain defines the gain of the heating output relative to the gain established by the Proportional Band. A value of 100% causes the heat gain to mimic the gain determined by the proportional band. A value less than 100% can be used in applications in which the heater is oversized, while a value greater than 100% can be used when the heater is undersized. For the majority of applications the default value of 100% is adequate, and adjustments should only be made if the process requires it.

HEAT POWER LOW AND HIGH LIMITS



0 to 200.0 %

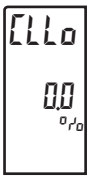
The Heat Low Limit and Heat High Limit properties may be used to limit controller power due to process disturbances or setpoint changes. Enter the safe output power limits for the process. You may enter values in excess of 100% to overcome limitations caused by power transfer values, such as gains and offsets, which would otherwise limit the output to less than their maximums.

OUTPUT COOL GAIN

0 to 500.0 %

The Output Cool Gain defines the gain of the cooling output relative to the gain established by the Proportional Band. A value of 100% causes the cool gain to mimic the gain determined by the proportional band. A value less than 100% can be used in applications in which the cooling device is oversized, while a value greater than 100% can be used when the cooling device is undersized. For the majority of applications the default value of 100% is adequate, and adjustments should only be made if the process requires it.

COOL POWER LOW AND HIGH LIMITS

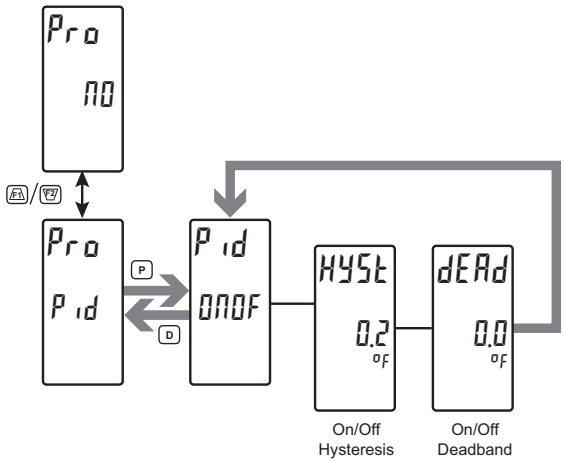


0 to 200.0 %

The Cool Low Limit and Cool High Limit properties may be used to limit controller power due to process disturbances or setpoint changes. Enter the safe output power limits for the process. You may enter values in excess of –100% to overcome limitations caused by power transfer values, such as gains and offsets, which would otherwise limit the output to less than their maximums.

F

PID Parameters: On/Off Parameters (ONOF)



ON/OFF HYSTERESIS

HYSt 0.2

0 to 50.0 units

The On/Off Hysteresis property is used to eliminate output chatter by separating the on and off points of the output(s) when performing on/off control. The hysteresis value is centered around the setpoint, that is, the transition points of the output will be offset above and below the setpoint by half of the On/Off Hysteresis value. This value effects outputs programmed for Heat or Cool. During auto-tune, the controller cycles the process through 4 on/off cycles, so it is important to set the On-Off Hysteresis to an appropriate value before initializing auto-tune.

ON/OFF DEADBAND

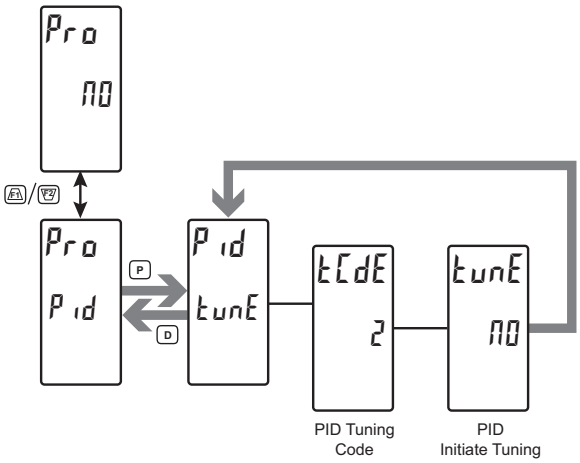
dEAd 0.0

-199.9 to 999.9 units

The On-Off Deadband property provides a means of offsetting the on-points of heat and cool outputs programmed for on/off operation. This results in a deadband if the value is positive, and overlap if the value is negative. When determining the actual transition points of the outputs, the On/Off Hysteresis value must also be taken into consideration.

F

PID Parameters: PID Tuning Parameters (tunE)



PID TUNING CODE

tCdE
2

0 to 4

The Tune Response property is used to ensure that an auto-tune yields the optimal P, I, and D values for various applications. A setting of Very Aggressive (0) results in a PID set that will reach setpoint as fast as possible, with no concern for overshoot, while a setting of Very Conservative sacrifices speed in order to prevent overshoot. Note: If the Tune Response property is changed, auto-tune needs to be reinitiated for the changes to affect the PID settings. See the PID Tuning Explanations Section for more information.

0 = Very Aggressive
1 = Aggressive
2 = Default
3 = Conservative
4 = Very Conservative

PID INITIATE TUNING

tunE
no

no yes

The PID Initiate Tuning is used to initiate an auto-tune sequence. Auto-tune may be used to establish the optimal P, I, D, and Power Filter values for a particular process. See the PID Tuning Explanations Section for more information

F

Alarm Parameters (ALr)

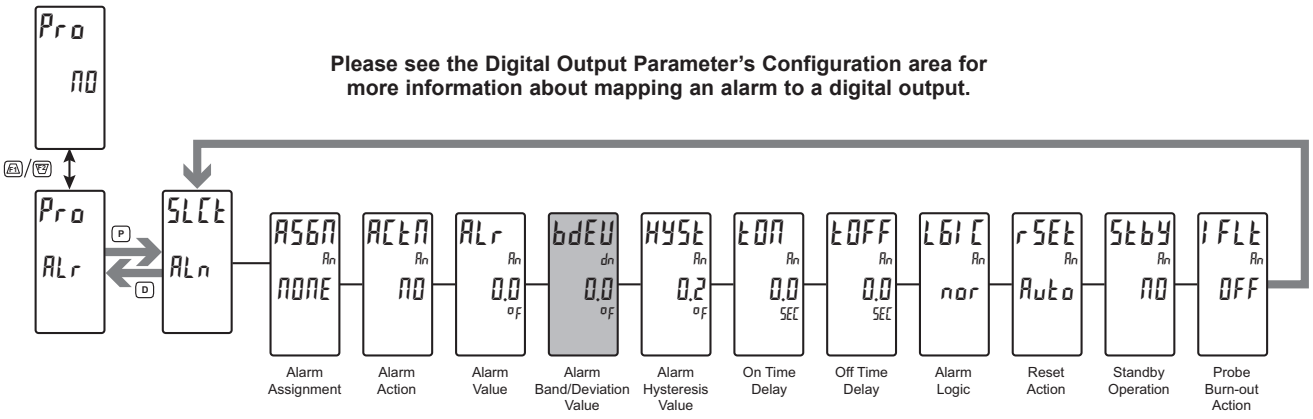
ALARM PARAMETER MENU SELECTION

SLCt
P2C
AL 1

AL 1 AL 2 AL 3 AL 4 } Basic Mode
AL 5 through AL 16 } Advanced Mode

Select the Alarm parameter to be programmed.

ALARM PARAMETERS (ALn)



Please see the Digital Output Parameter's Configuration area for more information about mapping an alarm to a digital output.

ALARM ASSIGNMENT

none PU

Selects the parameter to be used to trigger the Alarm.

- none = No Alarm Assignment (alarm disabled)
- PU = Input Process Value

ALARM ACTION

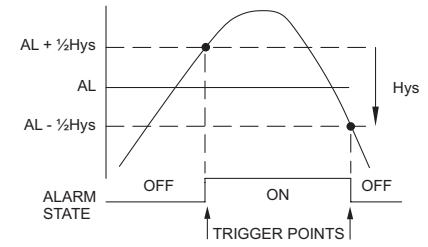
no AbHI AbLO AUHI AULO
dEHI dELO bAnd bdIn

Enter the action for the selected alarm. See Alarm Figures for a visual detail of each action.

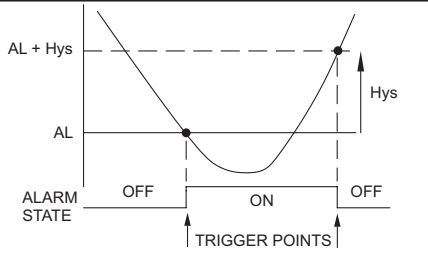
- no = No Alarm Action
- AbHI = Absolute high, with balanced hysteresis
- AbLO = Absolute low, with balanced hysteresis
- AUHI = Absolute high, with unbalanced hysteresis
- AULO = Absolute low, with unbalanced hysteresis
- dEHI = deviation high, with unbalanced hysteresis
- dELO = deviation low, with unbalanced hysteresis
- bAnd = Outside band, with unbalanced hysteresis
- bdIn = Inside band, with unbalanced hysteresis

Setpoint Alarm Figures

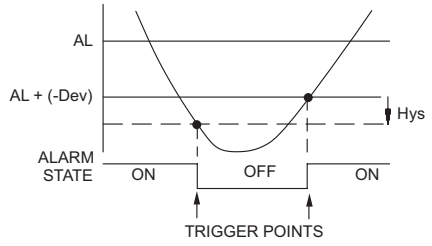
With reverse logic rEv, the below alarm states are opposite.



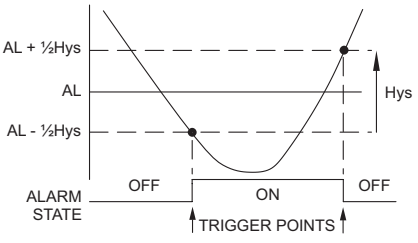
Absolute High Acting (Balanced Hys) = AbHI



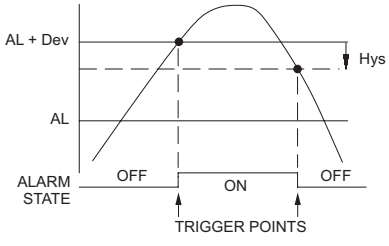
Absolute Low Acting (Unbalanced Hys) = AULO



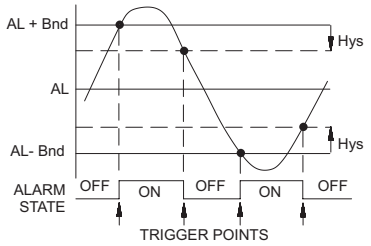
Deviation High Acting (Dev < 0) = dEHI



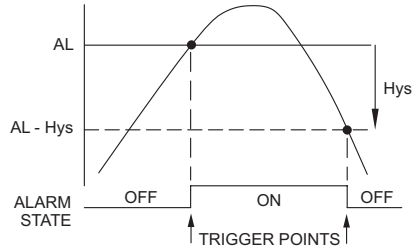
Absolute Low Acting (Balanced Hys) = AbLO



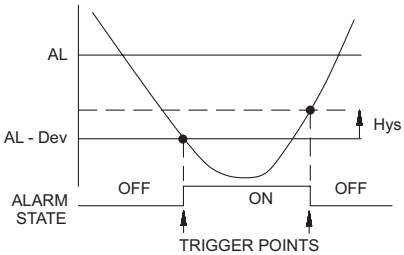
Deviation High Acting (Dev > 0) = dEHI



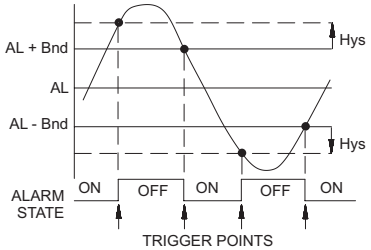
Band Outside Acting = bAnd



Absolute High Acting (Unbalanced Hys) = AUHI



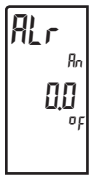
Deviation Low Acting (Dev > 0) = dELO



Band Inside Acting = bdIn

F

ALARM VALUE



- 1999 to 9999

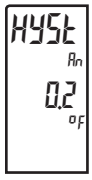
Enter desired alarm value. Alarm values can also be entered when the alarm is programmed as dEnt, PEnt or HEnt. The decimal point position is determined by the Decimal Resolution setting in the Analog Input Parameter Menu.

BAND/DEVIATION VALUE

- 1999 to 9999

This parameter is only available in band and deviation alarm actions. Enter desired alarm band or deviation value. When the Alarm Action is programmed for Band, this value can only be a positive value.

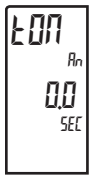
HYSTERESIS VALUE



1 to 9999

Enter desired hysteresis value. See Alarm Figures for visual indication or representation of how alarm actions (balanced and unbalanced) are affected by the hysteresis. When the alarm is a control output, usually balanced hysteresis is used. For alarm applications, usually unbalanced hysteresis is used. For unbalanced hysteresis modes, the hysteresis functions on the low side for high acting alarms and functions on the high side for low acting alarms. Note: Hysteresis eliminates output chatter at the switch point, while on/off time delay can be used to prevent false triggering during process transient events.

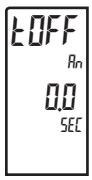
ON TIME DELAY



0 to 9999 seconds

Enter the time value in seconds that the alarm is delayed from turning on after the trigger point is reached. A value of 0.0 allows the controller to update the alarm status per the response time listed in the Specifications. When the output logic is rEu, this becomes off time delay. Any time accumulated at power-off resets during power-up.

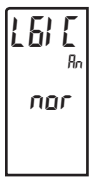
OFF TIME DELAY



0 to 9999 seconds

Enter the time value in seconds that the alarm is delayed from turning off after the trigger point is reached. A value of 0.0 allows the controller to update the alarm status per the response time listed in the Specifications. When the output logic is rEu, this becomes on time delay. Any time accumulated at power-off resets during power-up.

ALARM LOGIC



nor rEu

Enter the logic of the alarm. The nor logic leaves the alarm operation as normal. The rEu logic reverses the alarm logic. In rEu, the alarm states in the Alarm Figures are reversed.

RESET ACTION

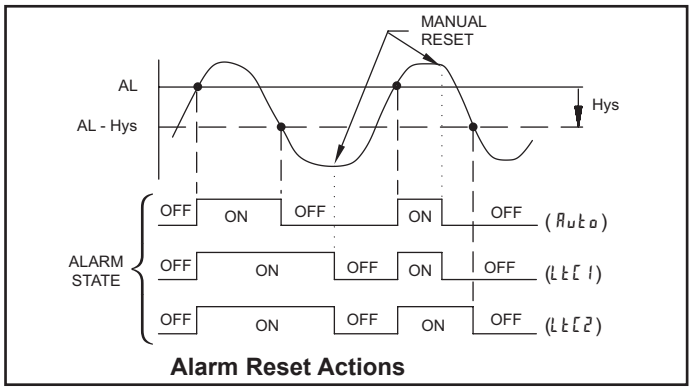
Auto LtC1 LtC2

Enter the reset action of the alarm.

Auto = Automatic action; This action allows the alarm to automatically reset off at the trigger points per the Alarm Action shown in Alarm Figures. The "on" alarm may be manually reset (off) immediately by a front panel function key or user input. The alarm remains reset off until the trigger point is crossed again.

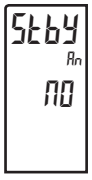
LtC1 = Latch with immediate reset action; This action latches the alarm on at the trigger point per the Alarm Action shown in Alarm Figures. Latch means that the alarm can only be turned off by front panel function key or user input manual reset, serial reset command or controller power cycle. When the user input or function key is activated (momentary or maintained), the corresponding "on" alarm is reset immediately and remains off until the trigger point is crossed again. Any alarms that are latched at power down will be reset.

LtC2 = Latch with delay reset action; This action latches the alarm on at the trigger point per the Alarm Action shown in Alarm Figures. Latch means that the alarm can only be turned off by front panel function key or user input manual reset, serial reset command or controller power cycle. When the user input or function key is activated (momentary or maintained), the controller delays the event until the corresponding "on" alarm crosses the trigger off point. Any alarms that are latched at power down will be reset.



Alarm Reset Actions

ALARM STANDBY OPERATION



no YES

When YES, the alarm is disabled (after a power up) until the trigger point is crossed. After the alarm trigger is reached, the alarm operates normally per the Alarm Action and Reset Mode.

The following programming step is only available when Input Type in the Input Menu is set for a temperature input (TC/RTD).

BURN-OUT ACTION

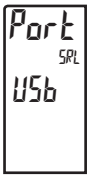
OFF ON

Enter the probe burn-out action. In the event of a temperature probe failure (TC open; RTD open or short), the alarm output can be programmed to be on or off.

F

PORT PARAMETERS (Port)

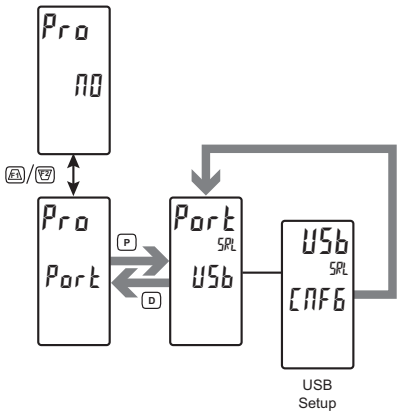
PORT PARAMETER MENU SELECTION



USb SErL

Select the Communication Port Mode.

USB PORT PARAMETERS (USb)



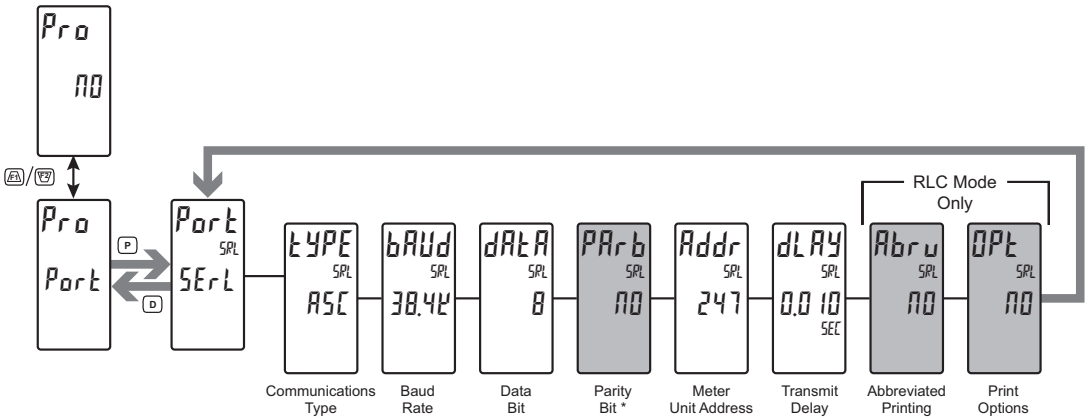
USB SETUP

CNFG SErL

CNFG = Configures USB with settings required to operate with Crimson configuration software. This will automatically internally configure the PAX2C USB port to use Modbus RTU protocol, 38400 baud, 8 bits, and unit address of 247. The serial port settings in the Serial Parameters (SErL) will not change, or show this.

SErL = Configures USB to utilize serial settings and protocol as configured in the Serial Parameters.

SERIAL PORT PARAMETERS (SErL)



COMMUNICATIONS TYPE

ASC = Modbus ASCII
rLC = RLC Protocol (ASCII)
rtu = Modbus RTU

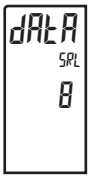
Select the desired communications protocol. Modbus is preferred as it provides access to all meter values and parameters. Since the Modbus protocol is included within the PAX2C, the PAX Modbus option card, PAXCDC4, should not be used. The PAXCDC1 (RS485), or PAXCDC2 (RS232) card should be used instead.

BAUD RATE

1200 2400 4800 9600 19.2k 38.4k

Set the baud rate to match the other serial communications equipment on the serial link. Normally, the baud rate is set to the highest value that all the serial equipment are capable of transmitting and receiving.

DATA BIT



7 8

Select either 7 or 8 bit data word lengths. Set the word length to match the other serial communications equipment on the serial link.

PARITY BIT *

no EVEN Odd

Set the parity bit to match that of the other serial communications equipment on the serial link. The meter ignores the parity when receiving data and sets the parity bit for outgoing data. If no parity is selected with 7 bit word length, an additional stop bit is used to force the frame size to 10 bits.

* Available when Data Bit = 7.

F

METER UNIT ADDRESS

0 to 99 = RLC Protocol
1 to 247 = Modbus

Select a Unit Address that does not match an address number of any other equipment on the serial link.

TRANSMIT DELAY

0.000 to 0.250 seconds

Following a transmit value ("*" terminator) or Modbus command, the PAX2C will wait this minimum amount of time in seconds before issuing a serial response.

The following programming steps are only available when Communications Type(tYPE) is programmed for rLC.

ABBREVIATED PRINTING

NO YES

Select NO for full print or Command T transmissions (meter address, mnemonics and parameter data) or YES for abbreviated print transmissions (parameter data only). This will affect all the parameters selected in the print options. If the meter address is 00, the address will not be sent during a full transmission.

PRINT OPTIONS

NO YES

YES - Enters the sub-menu to select the meter parameters to appear during a print request. For each parameter in the sub-menu, select YES for that parameter information to be sent during a print request or NO for that parameter information not to be sent. A print request is sometimes referred to as a block print because more than one parameter information (meter address, mnemonics and parameter data) can be sent to a printer or computer as a block.

DISPLAY	DESCRIPTION	FACTORY SETTING	MNEMONIC
INPt	Signal Input	YES	INP
SP	*Setpoint	NO	SET
SPrr	Setpoint Ramp Rate	NO	RMP
OP	Output Power	NO	PWR
ProP	*Proportional Band	NO	PBD
Int	*Integral Time	NO	INT
dEr	*Derivative Time	NO	DER
ALr	Alarm Status (1-4)	NO	ALR
AL1	*Alarm Value 1	NO	AL1
AL2	*Alarm Value 2	NO	AL2
AL3	*Alarm Value 3	NO	AL3
AL4	*Alarm Value 4	NO	AL4
CtrL	Control Parameters	NO	CTL

* Active values

F

SERIAL COMMUNICATIONS

The PAX2 supports serial communications using the optional serial communication cards or via the USB programming port located on the side of the unit. When USB is being used (connected), the serial communication card is disabled. When using the standard RS232 and RS485 PAX option cards, the PAX2 supports both the RLC protocol and also supports Modbus communications. The PAX Modbus option card should not be used with the PAX2, as the PAX2 internal Modbus protocol supports complete unit configuration, and is much more responsive.

USB

The USB programming port is primarily intended to be used to configure the PAX2 with the Crimson programming software. It can also be used as a virtual serial communications port following installation of the PAX2 USB drivers that are supplied with the Crimson software. When the USB port is being used, i.e. the USB cable is connected between PAX2 and PC, all serial communications with the serial option card (if used) is disabled.

USB Cable type required: USB A to Mini-B (not supplied)

PAX2 CONFIGURATION USING CRIMSON AND USB

1. Install Crimson software.
2. Supply power to PAX2.
3. Insure USB Setup in USB Port Parameters is set to CNFG (factory default setting).
4. Attach USB cable (USB A to Mini-B) between PC and PAX2.
5. Create a new file (File, New) or open an existing PAX2 database within Crimson.
6. Configure Crimson Link options (Link, Options) to the PC port which the USB cable is attached (in Step 4).

SERIAL MODBUS COMMUNICATIONS

Modbus Communications requires that the Serial Communications Type Parameter (TYPE) be set to Modbus RTU (rtu) or Modbus ASCII (ASC).

PAX2 CONFIGURATION USING CRIMSON AND SERIAL COMMUNICATIONS CARD

1. Install Crimson software.
2. Install RS232 or RS485 card and connect communications cable from PAX2 to PC.
3. Supply power to PAX2.
4. Configure serial parameters as Modbus RTU (rtu), 38,400 baud, address 247.
5. Create a new file (File, New) or open an existing PAX2 database within Crimson.
6. Configure Crimson 2 Link options (Link, Options) to the serial port which the communication cable is attached (in step 2).

SUPPORTED FUNCTION CODES

FC03: Read Holding Registers

1. Up to 64 registers can be requested at one time.
2. HEX <8000> is returned for non-used registers.

FC04: Read Input Registers

1. Up to 64 registers can be requested at one time.
2. Block starting point can not exceed register boundaries.
3. HEX <8000> is returned in registers beyond the boundaries.
4. Input registers are a mirror of Holding registers.

FC06: Preset Single Register

1. HEX <8001> is echoed back when attempting to write to a read only register.
2. If the write value exceeds the register limit (see Register Table), then that register value changes to its high or low limit. It is also returned in the response.

FC16: Preset Multiple Registers

1. No response is given with an attempt to write to more than 64 registers at a time.
2. Block starting point cannot exceed the read and write boundaries (40001-41711).
3. If a multiple write includes read only registers, then only the write registers will change.
4. If the write value exceeds the register limit (see Register Table), then that register value changes to its high or low limit.

FC08: Diagnostics

The following is sent upon FC08 request:

Module Address, 08 (FC code), 04 (byte count), “Total Comms” 2 byte count, “Total Good Comms” 2 byte count, checksum of the string

“Total Comms” is the total number of messages received that were addressed to the PAX2. “Total Good Comms” is the total messages received by the PAX2 with good address, parity and checksum. Both counters are reset to 0 upon response to FC08 and at power-up.

FC17: Report Slave ID

The following is sent upon FC17 request:

RLC-PX2C ab<0100h><40h><40h><10h>
a = SP Card, “0”-No SP, “2” or “4” SP
b = Linear Card “0” = None, “1” = Yes
<0100> Software Version Number (1.00)
<20h>Max Register Reads (64)
<20h>Max Register Writes (64)
<10h> Number Guid/Scratch Pad Regs (16)

SUPPORTED EXCEPTION CODES

01: Illegal Function

Issued whenever the requested function is not implemented in the meter.

02: Illegal Data Address

Issued whenever an attempt is made to access a single register that does not exist (outside the implemented space) or to access a block of registers that falls completely outside the implemented space.

03: Illegal Data Value

Issued when an attempt is made to read or write more registers than the meter can handle in one request.

07: Negative Acknowledge

Issued when a write to a register is attempted with an invalid string length.

PAX2C FREQUENTLY USED MODBUS REGISTERS

Only frequently used registers are shown below. The entire Modbus Register Table can be found at www.redlion.net and on the included flash drive.
Values less than 65,535 will be in (LO word). Values greater than 65,535 will continue into (Hi word). Negative values are represented by two's complement of the combined (Hi word) and (LO word).
Note 1: The PAX2C should not be powered down while parameters are being changed. Doing so may corrupt the non-volatile memory resulting in checksum errors.

REGISTER ADDRESS	REGISTER NAME	LOW LIMIT	HIGH LIMIT	FACTORY SETTING	ACCESS	COMMENTS
	FREQUENTLY USED REGISTERS					
40001	Process Value	N/A	N/A	N/A	Read	1 = 1 Display Unit
40002	Maximum Value	-1999	9999	N/A	Read	1 = 1 Display Unit
40003	Minimum Value	-1999	9999	N/A	Read	1 = 1 Display Unit
40004	Active Setpoint Value	-1999	9999	0	Read/Write	1 = 1 Display Unit
40005	Setpoint 1 Value	-1999	9999	0	Read/Write	1 = 1 Display Unit
40006	Setpoint 2 Value	-1999	9999	0	Read/Write	1 = 1 Display Unit
40007	Setpoint Deviation	N/A	N/A	N/A	Read Only	
40008	Output Power	-1000	1000	N/A	Read/Write	Output Power: Heat/Cool; * writable only in manual mode; 1 = 0.1%
40009	Active Proportional Band	0	9999	40	Read/Write	1 = 0.1 Display Unit
40010	Active Integral Time	0	65000	120	Read/Write	1 = 1 Display Unit
40011	Active Derivative Time	0	9999	30	Read/Write	1 = 0.1 Display Unit
40012	Active Power Filter	0	600	10	Read/Write	1 = 1 Display Unit
40013	Auto-Tune Code	0	4	2	Read/Write	0 = Very Aggressive, 1 = Aggressive, 2 = Default, 3 = Conservative, 4 = Very Conservative
40014	Auto-Tune Request	0	1	0	Read/Write	0 = Off, 1 = Invoke Auto-Tune
40015	Auto-Tune Phase	0	4	0	Read	0 = Off, 4 = Last Phase of Auto-Tune
40016	Auto-Tune Done	0	1	0	Read	1 = Successful Auto-Tune since last power cycle.
40017	Auto-Tune Fail	0	1	0	Read/Write	
40018	Control Mode	0	1	0	Read/Write	0 = Automatic, 1 = Manual Mode
40019	Setpoint Selection	0	1	0	Read/Write	0 = Setpoint 1, 1 = Setpoint 2
40020	Remote/Local Setpoint Selection	0	1	0	Read/Write	0 = Local, 1 = Remote
40021	PID Parameter Selection	0	1	0	Read/Write	0 = Primary PID Values, 1 = Alternate PID Values
40022	Disable Integral Action	0	1	0	Read/Write	0 = Enabled, 1 = Disabled
40023	Disable Setpoint Ramping	0	1	0	Read/Write	0 = Enabled, 1 = Disabled
40024	Setpoint Ramping In Process	0	1	0	Read/Write	0 = Off, 1 = In Process
40025	Setpoint Ramp Rate Value	-1999	9999	0	Read/Write	1 = 1 Display Unit
40026	Alarm (1-16) Status Register	0	65535	0	Read	Bit 15 = A16, Bit 0 = A1
40027	Input Range Alarm	0	1	0	Read	
40028	User Input Status	0	2	0	Read	Bit 1 = User Input 2, Bit 0 = User Input 1
40029	Digital Output Status	0	15	N/A	Read/Write	Status of Digital Outputs. Bit State: 0 = Off, 1 = On Bit 3 = Out1, Bit 2 = Out2, Bit 1 = Out3, Bit 0 = Out4 Outputs can only be activated/reset with this register when the respective bits in the Manual Mode Register (MMR) are set.
40030	Output Manual Mode Register (MMR)	0	31	0	Read/Write	Bit State: 0 = Auto Mode, 1 = Manual Mode Bit 4 = DO1, Bit 3 = DO2, Bit 2 = DO3, Bit 1 = DO4, Bit 0 = Linear Output
40031	Reset Output Register	0	15	0	Read/Write	Bit State: 1 = Reset Output, bit is returned to zero following reset processing; Bit 3 = DO1, Bit 2 = DO2, Bit 1 = DO3, Bit 0 = DO4
40032	Analog Output Register (AOR)	0	4095	0	Read/Write	Functional only if Linear Output is in Manual Mode. (MMR bit 0 = 1) Linear Output Card written to only if Linear Out (MMR bit 0) is set.
40033	Active Alarm 1 Value	-1999	9999	0	Read/Write	Active List (A or B)
40034	Active Alarm 2 Value	-1999	9999	0	Read/Write	Active List (A or B)
40035	Active Alarm 3 Value	-1999	9999	0	Read/Write	Active List (A or B)
40036	Active Alarm 4 Value	-1999	9999	0	Read/Write	Active List (A or B)
40037	Active Alarm 5 Value	-1999	9999	0	Read/Write	Active List (A or B)
40038	Active Alarm 6 Value	-1999	9999	0	Read/Write	Active List (A or B)
40039	Active Alarm 7 Value	-1999	9999	0	Read/Write	Active List (A or B)
40040	Active Alarm 8 Value	-1999	9999	0	Read/Write	Active List (A or B)
40041	Active Alarm 9 Value	-1999	9999	0	Read/Write	Active List (A or B)
40042	Active Alarm 10 Value	-1999	9999	0	Read/Write	Active List (A or B)
40043	Active Alarm 11 Value	-1999	9999	0	Read/Write	Active List (A or B)
40044	Active Alarm 12 Value	-1999	9999	0	Read/Write	Active List (A or B)
40045	Active Alarm 13 Value	-1999	9999	0	Read/Write	Active List (A or B)
40046	Active Alarm 14 Value	-1999	9999	0	Read/Write	Active List (A or B)
40047	Active Alarm 15 Value	-1999	9999	0	Read/Write	Active List (A or B)
40048	Active Alarm 16 Value	-1999	9999	0	Read/Write	Active List (A or B)
40049	Active Alarm 1 Band/Dev. Value	-1999	9999	0	Read/Write	Active List (A or B). Only for Band or Deviation Alarm Action.
40050	Active Alarm 2 Band/Dev. Value	-1999	9999	0	Read/Write	Active List (A or B). Only for Band or Deviation Alarm Action.

REGISTER ADDRESS	REGISTER NAME	LOW LIMIT	HIGH LIMIT	FACTORY SETTING	ACCESS	COMMENTS
40051	Active Alarm 3 Band/Dev. Value	-1999	9999	0	Read/Write	Active List (A or B). Only for Band or Deviation Alarm Action.
40052	Active Alarm 4 Band/Dev. Value	-1999	9999	0	Read/Write	Active List (A or B). Only for Band or Deviation Alarm Action.
40053	Active Alarm 5 Band/Dev. Value	-1999	9999	0	Read/Write	Active List (A or B). Only for Band or Deviation Alarm Action.
40054	Active Alarm 6 Band/Dev. Value	-1999	9999	0	Read/Write	Active List (A or B). Only for Band or Deviation Alarm Action.
40055	Active Alarm 7 Band/Dev. Value	-1999	9999	0	Read/Write	Active List (A or B). Only for Band or Deviation Alarm Action.
40056	Active Alarm 8 Band/Dev. Value	-1999	9999	0	Read/Write	Active List (A or B). Only for Band or Deviation Alarm Action.
40057	Active Alarm 9 Band/Dev. Value	-1999	9999	0	Read/Write	Active List (A or B). Only for Band or Deviation Alarm Action.
40058	Active Alarm 10 Band/Dev. Value	-1999	9999	0	Read/Write	Active List (A or B). Only for Band or Deviation Alarm Action.
40059	Active Alarm 11 Band/Dev. Value	-1999	9999	0	Read/Write	Active List (A or B). Only for Band or Deviation Alarm Action.
40060	Active Alarm 12 Band/Dev. Value	-1999	9999	0	Read/Write	Active List (A or B). Only for Band or Deviation Alarm Action.
40061	Active Alarm 13 Band/Dev. Value	-1999	9999	0	Read/Write	Active List (A or B). Only for Band or Deviation Alarm Action.
40062	Active Alarm 14 Band/Dev. Value	-1999	9999	0	Read/Write	Active List (A or B). Only for Band or Deviation Alarm Action.
40063	Active Alarm 15 Band/Dev. Value	-1999	9999	0	Read/Write	Active List (A or B). Only for Band or Deviation Alarm Action.
40064	Active Alarm 16 Band/Dev. Value	-1999	9999	0	Read/Write	Active List (A or B). Only for Band or Deviation Alarm Action.

SERIAL RLC PROTOCOL COMMUNICATIONS

RLC Communications requires the Serial Communications Type Parameter (tYPE) be set to "rLC".

SENDING SERIAL COMMANDS AND DATA TO THE METER

When sending commands to the meter, a string containing at least one command character must be constructed. A command string consists of a command character, a value identifier, numerical data (if writing data to the meter) followed by a command terminator character * or $.

Command Chart

COMMAND	DESCRIPTION	NOTES
N	Node (Meter) Address Specifier	Address a specific meter. Must be followed by a two digit node address. Not required when address = 00.
T	Transmit Value (read)	Read a register from the meter. Must be followed by register ID character
V	Value Change (write)	Write to register of the meter. Must be followed by register ID character and numeric data.
R	Reset	Reset a register or output. Must be followed by register ID character.
P	Block Print Request	Initiates a block print output. Registers are defined in programming.
*, $	Terminator	Signifies end of transmission

Command String Construction

The command string must be constructed in a specific sequence. The meter does not respond with an error message to invalid commands. The following procedure details construction of a command string:

1. The first characters consist of the Node Address Specifier (N) followed by a 2 character address number. The address number of the meter is programmable. If the node address is 0, this command and the node address itself may be omitted. This is the only command that may be used in conjunction with other commands.
2. After the optional address specifier, the next character is the command character.
3. The next character is the Register ID. This identifies the register that the command affects. The P command does not require a Register ID character. It prints according to the selections made in print options.
4. If constructing a value change command (writing data), the numeric data is sent next.
5. All command strings must be terminated with the string termination characters *, or $. The meter does not begin processing the command string until this character is received. See Timing Diagram figure for differences between terminating characters.

Register Identification Chart

ID	VALUE DESCRIPTION	MNEMONIC	APPLICABLE COMMANDS/COMMENTS
A	Signal Input	INP	T, P
B	Active Setpoint	SET	T, V, P
C	Setpoint Ramp Rate	RMP	T, V, P
D	Output Power	PWR	T, V, P (V only in manual mode)
E	Proportional Band	PBD	T, V, P
F	Integral Time	INT	T, V, P
G	Derivative Time	DER	T, V, P
H	Alarm Status (1-4)	ALR	T, R, P
I	Alarm Value 1	AL1	T, V, R, P (Reset command resets Alarm Outputs)
J	Alarm Value 2	AL2	
K	Alarm Value 3	AL3	
L	Alarm Value 4	AL4	
M	Control Parameters	CTL	T, V, P
O	Auto/Manual Register	MMR	T, V
Q	Analog Output Register	AOR	T, V
S	Digital Output Register	DOR	T, V

Command String Examples:

1. Node address = 17, Write 350 to Alarm 1.
   String: N17VI350$
2. Node address = 5, Read Input value.
   String: N5TA*
3. Node address = 0, Reset Alarm 4 output.
   String: RL*

Sending Numeric Data

Numeric data sent to the controller must be limited to 4 digits (-1999 to 9999). Leading zeros are ignored. Negative numbers must have a minus sign. The controller ignores any decimal point and conforms the number to the scaled resolution. (For example: the meter's scaled decimal point position = 0.0 and 25 is written to a register. The value of the register is now 2.5.

Note: Since the controller does not issue a reply to value change commands, follow with a transmit value command for readback verification.

F

RECEIVING DATA FROM THE CONTROLLER

Data is transmitted by the controller in response to either a transmit command (T), a print block command (P) or User Function print request. The response from the controller is either a full field transmission or an abbreviated transmission. The controller response mode is selected via the Abru parameter in the Serial Port Parameters.

Full Field Transmission (Address, Mnemonic, Numeric data)

Byte	Description
1, 2	2 byte Node Address field [00-99]
3	<SP> (Space)
4-6	3 byte Register Mnemonic field
7-18	2 byte data field, 10 bytes for number, one byte for sign, one byte for decimal point
19	<CR> carriage return
20	<LF> line feed
21	<SP>* (Space)
22	<CR>* carriage return
23	<LF>* line feed

** These characters only appear in the last line of a block print.*

The first two characters transmitted are the node address, unless the node address assigned = 0, in which case spaces are substituted. A space follows the node address field. The next three characters are the register mnemonic.

The numeric data is transmitted next. The numeric field is 12 characters long (to accommodate the 10 digit totalizer), with the decimal point position floating within the data field. Negative values have a leading minus sign. The data field is right justified with leading spaces.

The end of the response string is terminated with a carriage return <CR> and <LF>. When block print is finished, an extra <SP><CR> <LF> is used to provide separation between the blocks.

Abbreviated Transmission (Numeric data only)

Byte	Description
1-12	12 byte data field, 10 bytes for number, one byte for sign, one byte for decimal point
13	<CR> carriage return
14	<LF> line feed
15	<SP>* (Space)
16	<CR>* carriage return
17	<LF>* line feed

** These characters only appear in the last line of a block print.*

Controller Response Examples:

1. Node address = 17, full field response, Input = 875
   17 INP 875 <CR><LF>
2. Node address = 0, full field response, Alarm 2 = -250.5
   SP2 -250.5<CR><LF>
3. Node address = 0, abbreviated response, Alarm 2 = 250, last line of block print
   250<CR><LF><SP><CR><LF>

Auto/Manual Mode Register (MMR) ID: O

This register sets the controlling mode for the outputs. In Auto Mode (0) the controller controls the digital outputs and analog output. In Manual Mode (1) the outputs are defined by the registers DOR and AOR. When transferring from auto mode to manual mode, the controller holds the last output value (until the register is changed by a write). Each output may be independently changed to auto or manual. In a write command string (VO), any character besides 0 or 1 in a field will not change the corresponding output mode.

O abcde
- e = Analog Output
- d = DO4
- c = DO3
- b = DO2
- a = DO1

Example: VO00011* places DO4 and Analog in manual.

Analog Output Register (AOR) ID: Q

This register stores the present signal value of the analog output. The range of values of this register is 0 to 4095, which corresponds to the analog output range per the following chart:

Register Value	Output Signal*		
	0-20 mA	4-20 mA	0-10 V
0	0.00	4.00	0.000
1	0.005	4.004	0.0025
2047	10.000	12.000	5.000
4094	19.995	19.996	9.9975
4095	20.000	20.000	10.000

**Due to the absolute accuracy rating and resolution of the output card, the actual output signal may differ 0.15% FS from the table values. The output signal corresponds to the range selected (0-20 mA, 4-20 mA or 0-10 V).*

Writing to this register (VQ) while the analog output is in the Manual Mode causes the output signal level to update immediately to the value sent. While in the Automatic Mode, this register may be written to, but it has no effect until the analog output is placed in the manual mode. When in the Automatic Mode, the controller controls the analog output signal level. Reading from this register (TQ) will show the present value of the analog output signal.

Example: VQ2047 will result in an output of 10.000 mA, 12.000 mA or 5.000V depending on the range selected.

Digital Output Register (DOR) ID: S

This register stores the states of the setpoint outputs. Reading from this register (TS) will show the present state of all the digital outputs. A "0" in the setpoint location means the output is off and a "1" means the output is on.

S abcd
- d = DO4
- c = DO3
- b = DO2
- a = DO1

In Automatic Mode, the controller controls the digital output state. In Manual Mode, writing to this register (VS) will change the output state. Sending any character besides 0 or 1 in a field or if the corresponding output was not first in manual mode, the corresponding output value will not change. (It is not necessary to send least significant 0s.)

Example: VS10* will result in output 1 on and output 2 off.

F

COMMAND RESPONSE TIME

The controller can only receive data or transmit data at any one time (half-duplex operation). When sending commands and data to the controller, a delay must be imposed before sending another command. This allows enough time for the controller to process the command and prepare for the next command.

At the start of the time interval t_1, the computer program prints or writes the string to the com port, thus initiating a transmission. During t_1, the command characters are under transmission and at the end of this period, the command terminating character (*) is received by the controller. The time duration of t_1 is dependent on the number of characters and baud rate of the channel.

$$t_1 = (10 * \#\text{ of characters}) / \text{baud rate}$$

At the start of time interval t_2, the controller starts the interpretation of the command and when complete, performs the command function. This time interval t_2 varies from 2 msec to 15 msec. If no response from the controller is expected, the controller is ready to accept another command.

If the controller is to reply with data, the time interval t_2 is controlled by the use of the command terminating character and the (Serial Transmit Delay parameter (dLAY)). The standard command line terminating character is "*". This terminating character results in a response time window of the Serial Transmit Delay time (dLAY) plus 15 msec. maximum. The dLAY parameter should be programmed to a value that allows sufficient time for the release of the sending driver on the RS485 bus. Terminating the command line with "$" results in a response time window (t_2) of 2 msec minimum and 15 msec maximum. The response time of this terminating character requires that sending drivers release within 2 msec after the terminating character is received.

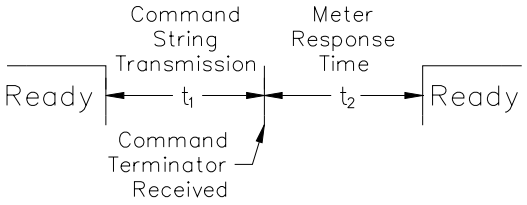
At the beginning of time interval t_3, the controller responds with the first character of the reply. As with t_1, the time duration of t_3 is dependent on the number of characters and baud rate of the channel.

$$t_3 = (10 * \#\text{ of characters}) / \text{baud rate.}$$

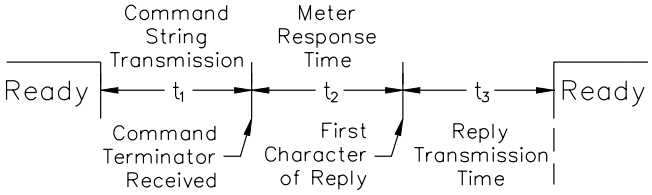
At the end of t_3, the controller is ready to receive the next command. The maximum serial throughput of the controller is limited to the sum of the times t_1, t_2 and t_3.

Timing Diagrams

NO REPLY FROM CONTROLLER



RESPONSE FROM CONTROLLER



COMMUNICATION FORMAT

Data is transferred from the controller through a serial communication channel. In serial communications, the voltage is switched between a high and low level at a predetermined rate (baud rate) using ASCII encoding. The receiving device reads the voltage levels at the same intervals and then translates the switched levels back to a character.

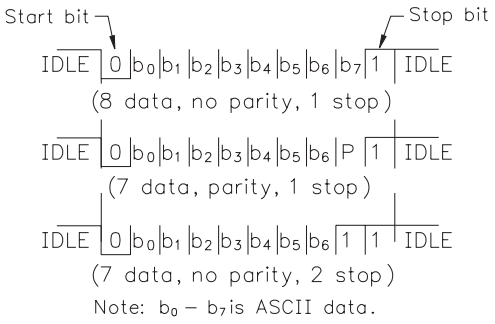
The voltage level conventions depend on the interface standard. The table lists the voltage levels for each standard.

LOGIC	INTERFACE STATE	RS232*	RS485*
1	mark (idle)	TXD,RXD; -3 to -15 V	a-b < -200 mV
0	space (active)	TXD,RXD; +3 to +15 V	a-b > +200 mV
* Voltage levels at the Receiver			

Data is transmitted one byte at a time with a variable idle period between characters (0 to ∞). Each ASCII character is "framed" with a beginning start bit, an optional parity bit and one or more ending stop bits. The data format and baud rate must match that of other equipment in order for communication to take place. The figures list the data formats employed by the controller.

Start bit and Data bits

Data transmission always begins with the start bit. The start bit signals the receiving device to prepare for reception of data. One bit period later, the least significant bit of the ASCII encoded character is transmitted, followed by the remaining data bits. The receiving device then reads each bit position as they are transmitted. Since the sending and receiving devices operate at the same transmission speed (baud rate), the data is read without timing errors.



Character Frame Figure

Parity bit

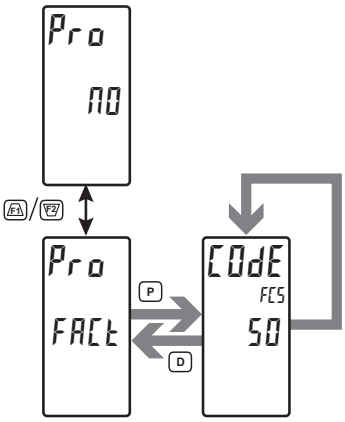
After the data bits, the parity bit is sent. The transmitter sets the parity bit to a zero or a one, so that the total number of ones contained in the transmission (including the parity bit) is either even or odd. This bit is used by the receiver to detect errors that may occur to an odd number of bits in the transmission. However, a single parity bit cannot detect errors that may occur to an even number of bits. Given this limitation, the parity bit is often ignored by the receiving device. The PAX controller ignores the parity bit of incoming data and sets the parity bit to odd, even or none (mark parity) for outgoing data.

Stop bit

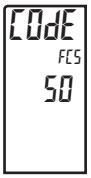
The last character transmitted is the stop bit. The stop bit provides a single bit period pause to allow the receiver to prepare to re-synchronize to the start of a new transmission (start bit of next byte). The receiver then continuously looks for the occurrence of the start bit. If 7 data bits and no parity is selected, then 2 stop bits are sent from the PAX controller.

F

FACTORY SERVICE OPERATIONS (FACt)



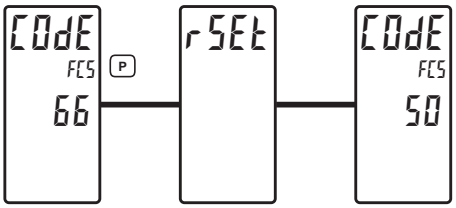
FACTORY SERVICE CODE



0 to 250

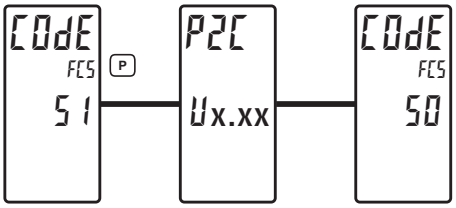
Enter the Service Code for the desired operation.

RESTORE FACTORY DEFAULTS



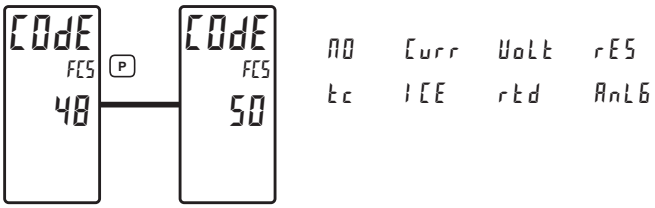
Use the F1 and F2 keys to display CodE 66 and press **P**. The controller will flash rSEt and then return to CodE 50. This will overwrite all user settings with the factory settings.

MODEL AND CODE VERSION



The controller will briefly display the model (P2C) on Line 1, and the current firmware version (UEr x.xx) on Line 2, and then return to CodE 50.

CONTROLLER CALIBRATION



The controller has been fully calibrated at the factory. Scaling to convert the input signal to a desired display value is performed in Input Parameters. If the controller appears to be indicating incorrectly or inaccurately, refer to Troubleshooting before attempting to calibrate the controller. When recalibration is required (generally every 2 years), it should only be performed by qualified technicians using appropriate equipment. Calibration does not change any user programmed parameters. However, it will affect the accuracy of the input signal and the values previously stored using the Apply (APLY) Scaling Style.

Preparation for Current, Volt, and Ohm Input Calibration

Warning: Input Calibration of this controller requires a signal source capable of producing a signal greater than or equal to the range being calibrated with an accuracy of 0.01% or better.

Before starting, verify that the Input Range, T/V, and Excitation Jumper is set for the range to be calibrated. Verify that the precision signal source is connected and ready. Allow a 30 minute warm-up period before calibrating the controller. Selecting nO at any calibration step, will cause the unit to maintain the existing calibration parameters for that step. Selecting YES and pressing the **P** key will cause the unit to store new calibration settings for the range selected. Pressing **D** at any time will exit programming mode, but any range that has been calibrated will maintain the new settings.

Current, Volt and Ohm Calibration Procedure

1. After entering CodE 48, select the input signal type (Curr, VoLt, rES) to be calibrated.
2. Press the **P** key until the desired range along with ZEr is displayed in the Line 2 units mnemonic.
3. Apply the zero input limit of the range indicated on Line 1 of the controller.
4. Press F1 to select YES.
5. Press **P**. Display will indicate ---- on Line 2 as the unit reads and stores the new calibration parameter.
6. Display will indicate the desired range along with FUL in the Line 2 units mnemonic
7. Apply the signal level indicated on Line 1 of the controller.
8. Press F1 to select YES.
9. Press **P**. Display will indicate ---- on Line 2 as the unit reads and stores the new calibration parameter.
10. Repeat Preparation and Calibration Procedure for each Input Range to be calibrated.

F

Preparation for TC calibration

TC calibration parameters will affect RTD calibration. If using an RTD, it is recommended that the RTD calibration be performed after completing the TC calibration.

Warning: TC Input Calibration of this controller requires a signal source capable of producing a 60 mV signal with an accuracy of 0.01% or better.

Before starting, verify the T/V jumper is in the T position. Verify the precision signal source is connected and ready. Allow a 30 minute warm-up period before calibrating the controller. Selecting NO at any calibration step, will cause the unit to maintain the existing calibration parameters for that step. Selecting YES and pressing **P** key will cause the unit to store new calibration settings for the range selected. Pressing **D** at any time will exit programming mode, but any range that has been calibrated will maintain the new settings.

TC Calibration Procedure

1. After entering CodE 48, select the tc.
2. Press the **P** key. Display will indicate 60mV with ZER displayed in the Line 2 units mnemonic.
3. Apply 0 mV to input.
4. Press F1 to select YES.
5. Press **P**. Display will indicate ---- on Line 2 as the unit reads and stores the new calibration parameter.
6. Display will indicate 60mV with FUL displayed in the Line 2 units mnemonic.
7. Apply 60 mV to input.
8. Press F1 to select YES.
9. Press **P**. Display will indicate ---- on Line 2 as the unit reads and stores the new calibration parameter.
10. TC Calibration complete.

Preparation for RTD Input Calibration

RTD calibration is dependent on TC calibration parameters. Therefore, the TC calibration should be performed prior to attempting the RTD calibration.

Warning: RTD Input Calibration of this controller requires a signal source capable of producing a 300 ohm resistance with an accuracy of 0.01% or better.

Before starting, verify that the T/V Jumper is in the T position. Verify the RTD jumper is in the proper range. Verify the precision signal source is connected and ready. Allow a 30 minute warm-up period before calibrating the controller. Selecting NO at any calibration step, will cause the unit to maintain the existing calibration parameters for that step. Selecting YES and pressing **P** key will cause the unit to store new calibration settings for the range selected. Pressing **D** at any time will exit programming mode, but any range that has been calibrated will maintain the new settings.

RTD Calibration Procedure

1. After entering Code 48, select rtd.
2. Press the **P** key until the desired range along with 0 is displayed in the Line 2 units mnemonic.
3. Apply zero ohms to the input of the controller.
4. Press F1 to select YES.
5. Press **P**. Display will indicate ---- on Line 2 as the unit reads and stores the new calibration parameter.
6. Display will indicate the desired range along with a value in the upper right corner, in ohms, to be applied in the next step in the Line 2 units mnemonic of the controller.
7. Apply the signal level, in ohms, as indicated by the Line 2 units mnemonic on the controller.
8. Press F1 to select YES.
9. Press **P**. Display will indicate ---- on Line 2 as the unit reads and stores the new calibration parameter.
10. Repeat Preparation and Calibration Procedure for each Input Range to be calibrated.

Ice Point Calibration Procedure

1. Remove all option cards.
2. Verify ambient temperature of controller environment is between 20°C and 30°C.
3. Set T/V jumper in the T position.
4. Connect a thermocouple with an accuracy of 1°C or better to the controller.
5. In the Analog Input Parameters, verify Input Type (tYPE) is set to the type of thermocouple connected in step 4, Temperature Scale (SCAL) is °C, Ice Point Compensation (iCE) is turned ON, Decimal Resolution (dCPt) is 0.0, Rounding Increment (rnd) is 0.1 and Display Offset (OFSt) is set to 0.
6. Place the thermocouple in close thermal contact to a reference thermometer probe. (Use a reference thermometer with an accuracy of 0.25% °C or better.) The two probes should be shielded from air movement and allowed sufficient time to equalize in temperature. (A calibration bath could be used in place of the thermometer.)
7. If a difference exits between PAX2C display and reference thermometer, continue calibration.
8. Note the PAX2C display reading as the "Display Mode" reading to be used in Step 12.
9. Enter the Factory Service Operations, select CodE 48 and press **P**.
10. Select iCE and press **P**.
11. Display will indicate the Existing ICE Point Value.
12. Calculate a new ICE Point Value using: Existing ICE Point Value + (reference temperature – Display Mode reading). All values are in °C.
13. Using F1 and F2 change Existing ICE Point Value to indicate the new ICE Point Value calculated in Step 12.
14. Press **P** and return to Display Mode. Verify the Display Mode reading (with 0 Display Offset) matches the reference temperature. If not, repeat steps 8 thru 14.

Preparation for Analog Output Card Calibration

Warning: Calibration of this controller requires an external meter with an accuracy of 0.005% or better.

Before starting, verify that the precision voltmeter (voltage output) or current meter (current output) is connected and ready. Perform the following procedure.

1. After entering CodE 48, select AnLG.
2. Using the chart below, step through the five selections to be calibrated. At each prompt, use the PAX2C F1 and F2 keys to adjust the external meter display to match the selection being calibrated. When the external reading matches, or if the particular range is not in need of calibration, press the **P** key to advance to the next range.

PAX2C DISPLAY	EXTERNAL METER	ACTION
00 mA	0.00 mA	F1 and F2 to adjust External Meter
40 mA	4.00 mA	F1 and F2 to adjust External Meter
20.0 mA	20.00 mA	F1 and F2 to adjust External Meter
00 U	0.00 V	F1 and F2 to adjust External Meter
10.0 U	10.00 V	F1 and F2 to adjust External Meter

3. Calibration Complete.

F

OPERATION OVERVIEW

CONTROLLER POWER-UP

Upon applying power, the controller delays control action and temperature indication for several seconds to perform several self-diagnostic tests and display basic controller information. Initially, the controller illuminates both displays and all annunciators to verify that all display elements are functioning. The controller then displays the unit model type on the top display as well as the current firmware revision number on the bottom display. The controller then checks for correct internal operation and displays an error message (E-XX) if an internal fault is detected (see Troubleshooting for further information). Upon completion of this sequence, the controller begins control action by displaying the temperature/process value and updating the output(s) based on the PID control calculation.

PROCESS START-UP

After starting the process, the controller's PID settings must be initially "tuned" to the process for optimum control. Minimal tuning consists of adjusting the Proportional Band, Integral Time, and Derivative Time parameters to achieve the optimum response to a process disturbance. The controller can be tuned once, but must be re-tuned if the process has been changed significantly. Several options exist for tuning these parameters:

A) Use the controller's built-in Auto-Tune feature (see Auto-Tune).

B) Use a manual tuning technique (see Manual Tuning).

C) Use a third party tuning software package (generally expensive and not always precise).

D) Use values based on control loop experience, calculated values or values from a similar process.

If the controller is a replacement, the PID settings from the unit being replaced may be used as good initial values. Be sure to consider any differences in the units and the PID settings when replacing. The PID settings may be fine tuned by using the techniques outlined in the PID Control section. After tuning the controller to the process, it is important to power the load and the controller at the same time for best start-up response.

CONTROLLER POWER-DOWN

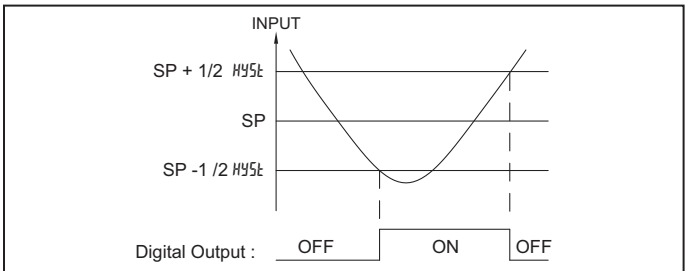
At power down, all parameters and control modes are saved to provide a quick and predictable process response on the next power-up. When powering down the process, it is important to power down the controller at the same time. This prevents the reset action of the controller from shifting the proportional band while the temperature/process value is dropping and prevents excessive overshoot on the next process start-up.

CONTROL MODE EXPLANATIONS

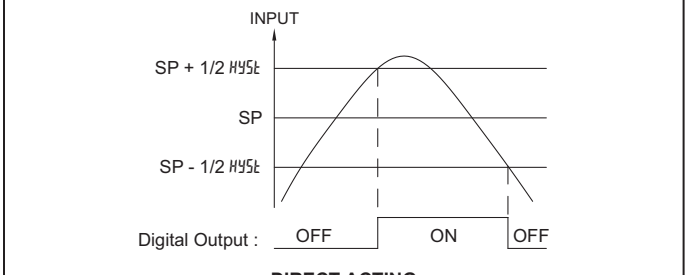
ON/OFF CONTROL

The controller operates in On/Off Control when the Proportional Band is set to 0.0%. In this control mode, the process will constantly oscillate around the setpoint value. The On/Off Control Hysteresis (balanced around the setpoint) can be used to eliminate output chatter. The Output Assignment can be set for heating (reverse - output on when below the setpoint) or for cooling(direct - output on when above the setpoint) applications.

ON/OFF CONTROL - FIGURES



REVERSE ACTING

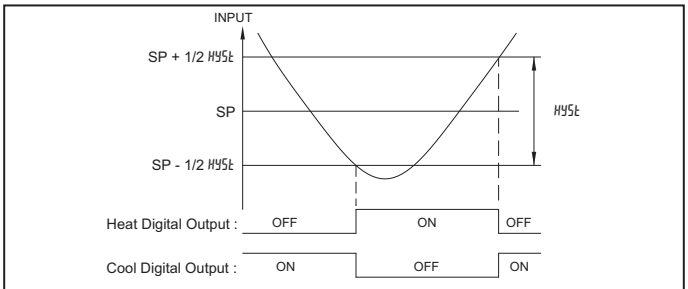


DIRECT ACTING

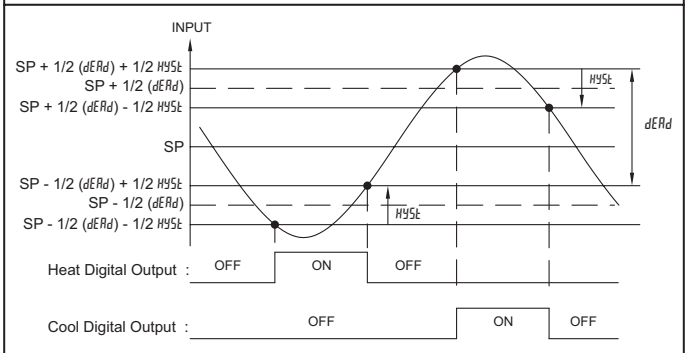
Note: HYST in the On/Off Control Figures is a user defined value in the PID Configuration Parameters.

For heat and cool systems, one Digital Output is assigned as HEAT (reverse) and another Digital Output is assigned as COOL (direct). The Proportional Band is set to 0.0 and the Relative Gain in Cooling to 0.0. The Deadband in Cooling sets the amount of operational deadband or overlap between the outputs. The setpoint and the On/Off Control Hysteresis applies to both O1 and O2 outputs. The hysteresis is balanced in relationship to the setpoint and deadband value.

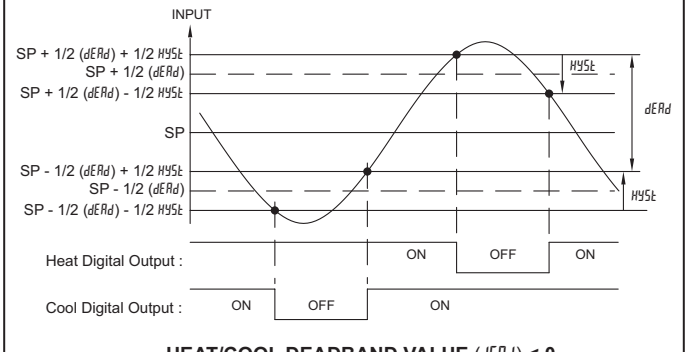
ON/OFF CONTROL - HEAT/COOL OUTPUT FIGURES



HEAT/COOL DEADBAND VALUE (dERd) = 0



HEAT/COOL DEADBAND VALUE (dERd) > 0



HEAT/COOL DEADBAND VALUE (dERd) < 0

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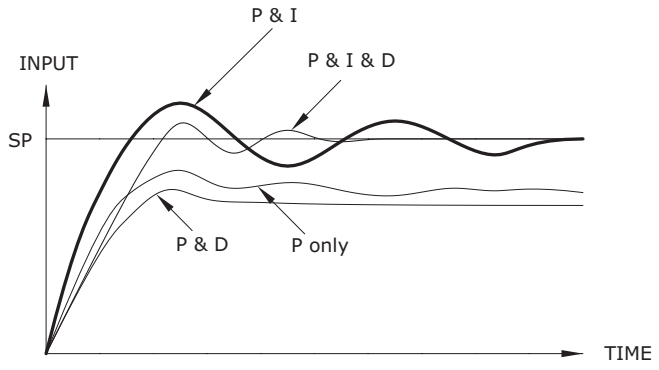
PID CONTROL

In PID Control, the controller processes the input and then calculates a control output power value by use of a specialized Proportional Band, IntegralTime, and Derivative Time control algorithm. The system is controlled with the new output power value to keep the process at the setpoint. The Control Action for PID Control can be set to reverse for heating (output on when below the setpoint) or direct for cooling (output on when above the setpoint) applications.For heat and cool systems, the heat and cool outputs are both used. The PID parameters can be established by using Auto-Tune, or they can be Manually tuned to the process.

TYPICAL PID RESPONSE CURVE



TIME PROPORTIONAL PID CONTROL

In Time Proportional applications, the output power is converted into output On time using the Cycle Time. For example, with a four second cycle time and 75% power, the output will be on for three seconds (4 × 0.75) and off for one second.

The cycle time should be no greater than 1/10 of the natural period of oscillation for the process. The natural period is the time it takes for one complete oscillation when the process is in a continuously oscillating state.

LINEAR PID CONTROL

In Linear PID Control applications, the Analog Output Assignment ANAS is set to % Output Power, OP. The Analog Low Scaling, ANLO , is set to 0.0 and the Analog High Scaling, ANHI , is set to 100.0. The Analog Output will then be proportional to the PID calculated % output power for Heat or Cooling per the Control Action OPAC. For example, with 0 VDC to 10 VDC (scaled 0 to 100%) and 75% power, the analog output will be 7.5 VDC.

MANUAL CONTROL MODE

In Manual Control Mode, the controller operates as an open loop system (does not use the setpoint or process feedback). The user adjusts the percentage of power through the % Power display to control the output power. Manual operation provides 0 to 100% power to the HEAT output and -100 to 0% power to the COOL output. The Low and High Output Power limits are ignored when the controller is in Manual.

MODE TRANSFER

When transferring the controller mode between Automatic and Manual, the controlling outputs remain constant, exercising true “bumpless” transfer. When transferring from Manual to Automatic, the power initially remains steady, but Integral Action corrects (if necessary) the closed loop power demand at a rate proportional to the Integral Time.

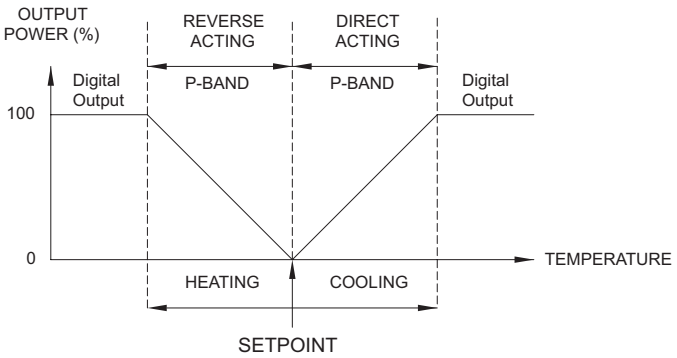
AUTOMATIC CONTROL MODE

In Automatic Control Mode, the percentage of output power is automatically determined by PID or On/Off calculations based on the setpoint and process feedback.

PID CONTROL

PROPORTIONAL BAND

Proportional band is defined as the “band” of temperature the process changes to cause the percent output power to change from 0% to 100%. The band may or may not be centered about the setpoint value depending upon the steady state requirements of the process. The band is shifted by manual offset or integral action (automatic reset) to maintain zero error. Proportional band is expressed as percent of input sensor range.



Example: Thermocouple type T with a temperature range of 600°C is used and is indicated in degrees Celsius with a proportional band of 5%. This yields a band of 600°C X 5% = 30°C.

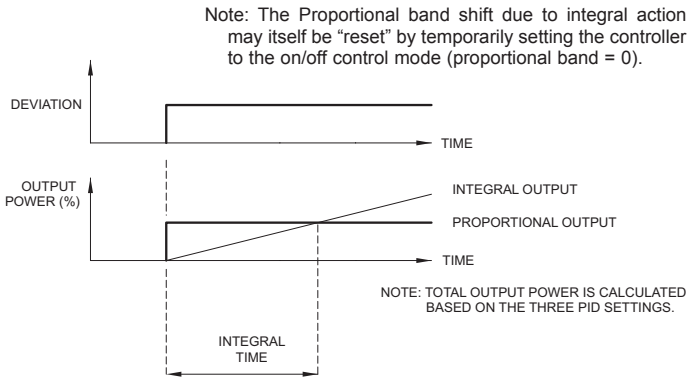
The proportional band should be set to obtain the best response to a disturbance while minimizing overshoot. Low proportional band settings (high gain) result in quick controller response at expense of stability and increased overshoot. Settings that are excessively low produce continuous oscillations at setpoint. High proportional band settings (low gain) result in a sluggish response with long periods of process “droop”. A proportional band of 0.0% forces the controller into ON/OFF control mode with its characteristic cycling at setpoint (See ON/OFF Control for more information).

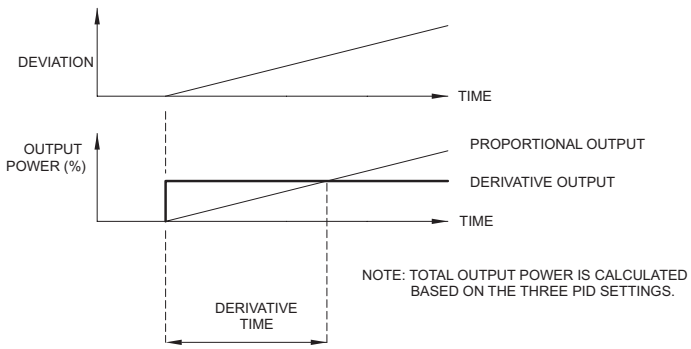
INTEGRAL TIME

Integral time is defined as the time, in seconds, in which the output due to integral action alone equals the output due to proportional action with a constant process error. As long as a constant error exists, integral action repeats the proportional action every integral time. Integral action shifts the center point position of the proportional band to eliminate error in the steady state. The units of integral time are seconds per repeat.

Integral action (also known as “automatic reset”) changes the output power to bring the process to setpoint. Integral times that are too fast (small times) do not allow the process to respond to the new output value. This causes over compensation and leads to an unstable process with excessive overshoot. Integral times that are too slow (large times) cause a slow response to steady state errors. Integral action may be disabled by setting the time to zero. If time is set to zero, the previous integral output power value is maintained.

If integral action is disabled, manual reset is available by modifying the output power offset (OPOF initially set to zero) to eliminate steady state errors. This parameter appears in unprotected parameter mode when integral time is set to zero. The controller has the feature to prevent integral action when operating outside the proportional band. This prevents “reset wind-up”.





DERIVATIVE TIME

Derivative time is defined as the time, in seconds, in which the output due to proportional action alone equals the output due to derivative action with a ramping process error. As long as a ramping error exists, the derivative action is "repeated" by proportional action every derivative time. The units of derivative time are seconds per repeat.

Derivative action is used to shorten the process response time and helps to stabilize the process by providing an output based on the rate of change of the process. In effect, derivative action anticipates where the process is headed and changes the output before it actually "arrives". Increasing the derivative time helps to stabilize the response, but too much derivative time coupled with noisy signal processes, may cause the output to fluctuate too greatly, yielding poor control. None or too little derivative action usually results in decreased stability with higher overshoots. No derivative action usually requires a wider proportional and slower integral times to maintain the same degree of stability as with derivative action. Derivative action is disabled by setting the time to zero.

PRIMARY/ALTERNATE PID VALUES

The PAX2C incorporates two different groups of PID parameters in memory. These are designated as the Primary (Pr 1) and Alternate (ALt) PID values. It is possible to toggle between these values using the PID Selection parameter which is available in the PID configuration menu. This functionality (PSEL) is also available via the user inputs, function keys or Line 2 user function.

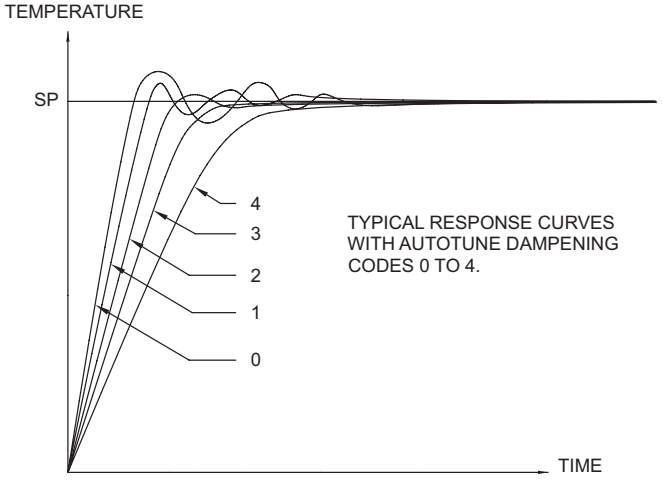
The Active PID parameters reflect the PID values that are selected via the PSEL parameter. If a change is made to an active PID value, such as a user change or after an Auto-tune, the values will automatically be copied into the Primary or Alternate group depending on which group is selected by the PSEL parameter.

PID TUNING EXPLANATIONS

AUTO-TUNE

Auto-Tune is a user-initiated function where the controller automatically determines the Proportional Band, Integral Time, Derivative Time, Digital Filter, Control Ouput Dampening Time, and Relative Gain (Heat/Cool) values based upon the process characteristics. The Auto-Tune operation cycles the controlling output(s) at a control point three-quarters of the distance between the present process value and the setpoint. The nature of these oscillations determines the settings for the controller's parameters.

Prior to initiating Auto-Tune, it is important that the controller and system be verified. (This can be accomplished in On/Off Control or Manual Control Mode.) If there is a wiring, system or controller problem, Auto-Tune may give incorrect tuning or may never finish. Auto-Tune may be initiated at start-up, from setpoint or at any other process point. However, insure normal process conditions (example: minimize unusual external load disturbances) as they will have an effect on the PID calculations.



AUTO-TUNING CODE FIGURE

INITIATE AUTO-TUNE

Below are the parameters and factory settings that affect Auto-Tune calculations. If changes are needed, then they must be made before starting Auto-Tune. Please note that it is necessary to configure the input and control outputs prior to initiating auto-tune.

DISPLAY	PARAMETER	FACTORY SETTING	MENU
FLtr	Digital Filtering	1.0	INPt
CHYS	On/Off Control Hysteresis	2 (Temperature Mode) 0.2 (Process Mode)	Pid
tCod	Auto-Tune Code	2	Pid
dEAd	Deadband	0.0	Pid
tUNE	Auto-Tune Access	LOC	Pid

1. Enter the Setpoint value via the PID Menu or via the Display, Parameter or Hidden Menu Loop Menu (if enabled).
2. Initiate Auto-Tune by changing Auto-Tune tUNE to YES via the PID Menu or via the Display, Parameter or Hidden Menu Loop Menu (if enabled).

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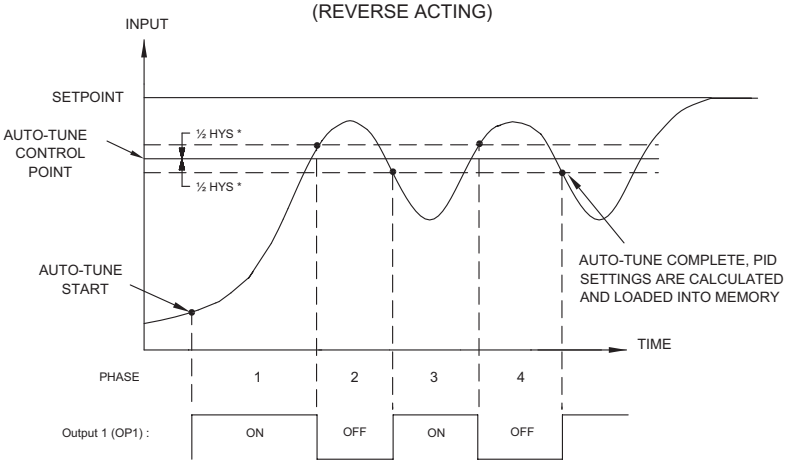
AUTO-TUNE PROGRESS

The controller will oscillate the controlling output(s) for four phases. The bottom display will flash the phase number. Parameter viewing is permitted during Auto-Tune. The time to complete the Auto-Tune cycles is process dependent. The controller should automatically stop Auto-Tune and store the calculated values when the four phases are complete. If the controller remains in Auto-Tune unusually long, there may be a process problem. Auto-Tune may be stopped by entering no in Auto-Tune Start tUNE.

AUTO-TUNE OPERATION
(REVERSE ACTING)



* - On/Off Control Hysteresis

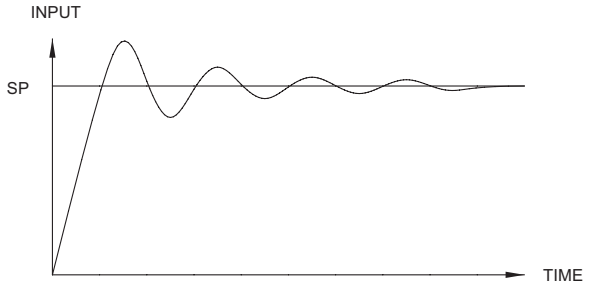
PID ADJUSTMENTS

In some applications, it may be necessary to fine tune the Auto-Tune calculated PID parameters. To do this, a chart recorder or data logging device is needed to provide a visual means of analyzing the process. Compare the actual process response to the PID response figures with a step change to the process. Make changes to the PID parameters in no more than 20% increments from the starting value and allow the process sufficient time to stabilize before evaluating the effects of the new parameter settings.

In some unusual cases, the Auto-Tune function may not yield acceptable control results or induced oscillations may cause system problems. In these applications, Manual Tuning is an alternative.

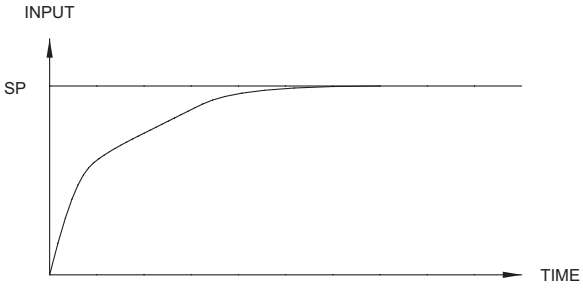
PROCESS RESPONSE EXTREMES

OVERSHOOT AND OSCILLATIONS



TO DAMPEN RESPONSE:
- INCREASE PROPORTIONAL BAND.
- INCREASE INTEGRAL TIME.
- USE SETPOINT RAMPING.
- USE OUTPUT POWER LIMITS.
- RE-INVOKE AUTO-TUNE WITH A HIGHER AUTO-TUNE CODE.
- INCREASE DERIVATIVE TIME.

SLOW RESPONSE



TO QUICKEN RESPONSE:
- DECREASE PROPORTIONAL BAND.
- DECREASE INTEGRAL TIME.
- INCREASE OR DEFEAT SETPOINT RAMPING.
- EXTEND OUTPUT POWER LIMITS.
- RE-INVOKE AUTO-TUNE WITH A LOWER AUTO-TUNE CODE.
- DECREASE DERIVATIVE TIME.

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MANUAL TUNING

A chart recorder or data logging device is necessary to measure the time between process cycles. This procedure is an alternative to the controller's Auto-Tune function. It will not provide acceptable results if system problems exist.

1. Set the Proportional Band (PrOP) to 10.0% for temperature models (Temperature) and 100.0% for process models (Voltage/Current).
2. Set both the Integral Time (Int) and Derivative Time (dEr) to 0 seconds.
3. Set the active PID Power Filter (FLtr) in the PID Menu to 0 seconds.
4. Set the Output Cycle Time (CYCt) in the Digital Output Menu to no higher than one-tenth of the process time constant (when applicable).
5. Place the controller into Manual Control Mode (MAN) via the trnF parameter in the PID Menu and adjust the % Power to drive the process value to the Setpoint value. Allow the process to stabilize after setting the % Power.
6. Place the controller in Automatic (Auto) Control Mode via the trnF parameter in the PID Menu. If the process will not stabilize and starts to oscillate, set the Proportional Band two times higher and go back to Step 5.
7. If the process is stable, decrease Proportional Band setting by two times and change the Setpoint value a small amount to excite the process. Continue with this step until the process oscillates in a continuous nature.
8. Fix the Proportional Band to three times the setting that caused the oscillation in Step 7.
9. Set the Integral Time to two times the period of the oscillation.
10. Set the Derivative Time to 1/8 (0.125) of the Integral Time.
11. Set the Output Dampening Time to 1/40 (0.025) the period of the oscillation.

TROUBLESHOOTING GUIDE

PROBLEM	REMEDIES
No Display At Power-Up	Check power level and power connections
No Display After Power-Up	Check dLEU and dCnt program settings in the Display menu.
Program Locked-Out	Check for Active User Input, programmed for PLOC. Deactivate User Input.
	Enter proper access code at CodE 0 prompt.
No Line 1 Display	Check program settings for Line 1 Display Assignment.
No Line 2 Display	Check program settings for Line 2 Value Access. Confirm at least one Line 2 Parameter Value is enabled in Main Display Loop.
No Programmable Units Display	Check program settings for Line 1/2 Units Mnemonic(s).
Incorrect Process Display Value	Check Input Jumper Setting, Input Level, and Input Connections.
	Verify Input Menu settings.
	Contact factory
Display of OLOL, ULUL, Short, OPEN, or "- - - -"	See General Controller Specifications, Display Messages.
Modules or Parameters Not Accessible	Check for corresponding plug-in option card.
	Verify parameter is valid in regard to previous program settings.
Error Code: EtEY	Keypad is active at power up. Check for depressed or stuck keypad. Press any key to clear Error Code.
Error Code: EPAr Error Code: EdYn	Parameter Data Checksum Error. Press any key to clear Error Code, verify all program settings and cycle power. Contact factory if Error Code returns at next power-up.
Error Code: EPro	Parameter Data Validation Error. Press any key to clear Error Code, verify all program settings and cycle power. Contact factory if Error Code returns at next power-up.
Error Code: ECAL	Calibration Data Validation Error. Contact factory.
Error Code: EL in	Linear Output Card Data Validation Error. Press any key to clear Error Code and cycle power. If Error Code returns at next power-up, replace Linear Option Card or contact factory.

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MODEL TCU - TEMPERATURE CONTROL UNIT

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IND. CONT. EQ.
51EB

- *100 msec SAMPLING PERIOD WITH 0.15% ACCURACY*
- *ON DEMAND AUTO-TUNING OF PID CONTROL SETTINGS*
- *DUAL LED DISPLAYS FOR SIMULTANEOUS INDICATION OF TEMPERATURE AND SETPOINT, SECOND ANALOG INPUT OR HEATER CURRENT*
- *ACCEPTS 10 DIFFERENT TYPES OF SENSOR INPUTS (Thermocouple or RTD)*
- *SELF-DIAGNOSTICS*
- *FULL PID CONTROL WITH REDUCED OVERSHOOT*
- *OPTIONAL RS485 SERIAL COMMUNICATIONS INTERFACE*
- *OPTIONAL DUAL ALARM OUTPUTS (USES OUTPUT MODULES)*
- *OPTIONAL COOLING OUTPUT (USES OUTPUT MODULE)*
- *OPTIONAL LINEAR 4 to 20 mA or 0 to 10 VDC OUTPUT FOR CONTROL OR TEMPERATURE RE-TRANSMISSION*
- *OPTIONAL HEATER CURRENT MONITOR AND BREAK ALARM*
- *OPTIONAL MOTORIZED VALVE POSITION CONTROL AND VALVE FAIL ALARM*
- *OPTIONAL SECOND ANALOG INPUT FOR REMOTE SETPOINT AND CASCADE CONTROL*
- *OPTIONAL TYPE 4X/IP65 SEALED FRONT BEZEL*
- *STATUS INDICATORS FOR OUTPUTS AND CONTROL MODES*
- *PROGRAMMABLE USER INPUT (DIGITAL) FOR ADDED FLEXIBILITY*
- *SENSOR ERROR COMPENSATION (Slope and Offset) AND BREAK DETECTION*
- *MANUAL/AUTOMATIC AND LOCAL/REMOTE SETPOINT CONTROL MODES*
- *SETPOINT RAMPING FOR PROCESS STARTUP*
- *PARAMETER SECURITY VIA PROGRAMMABLE LOCKOUTS*
- *FIELD REPLACEABLE AND INTERCHANGEABLE OUTPUT MODULES (Relay, Logic/SSR Drive and Triac)*

DESCRIPTION

The TCU Controller accepts signals from a variety of temperature sensors *(thermocouple or RTD elements)*, precisely displays the process temperature, and provides an accurate output control signal *(time proportional or linear)* to maintain a process at the desired control point. A comprehensive set of easy to use steps allows the controller to solve various application requirements.

The controller can operate in the PID control mode for both heating and cooling, with on-demand auto-tune, which will establish the tuning constants. The PID tuning constants may be fine-tuned by the operator at any time and then locked out from further modification. The controller employs a unique overshoot suppression feature, which allows the quickest response without excessive overshoot. The unit can be transferred to operate in the manual mode, providing the operator with direct control of the output. The controller may also be programmed to operate in the ON/OFF control mode with adjustable hysteresis.

Dual 4-digit displays allow viewing of the process temperature and setpoint simultaneously. Front panel indicators inform the operator of the controller and output status. Replaceable and interchangeable output modules *(relay, SSR drive, or triac)* can be installed for the main control output, alarm output(s) and cooling output.

Optional dual alarms can be configured to activate according to a variety of actions (Absolute HI or LO, Deviation HI or LO, Band IN or OUT, Heater Break and Valve Fail Detect) with adjustable hysteresis. A standby feature suppresses the output during power-up until the temperature stabilizes outside the alarm region. An optional secondary output is available *(for processes that require cooling)* which provides increased control accuracy and response.

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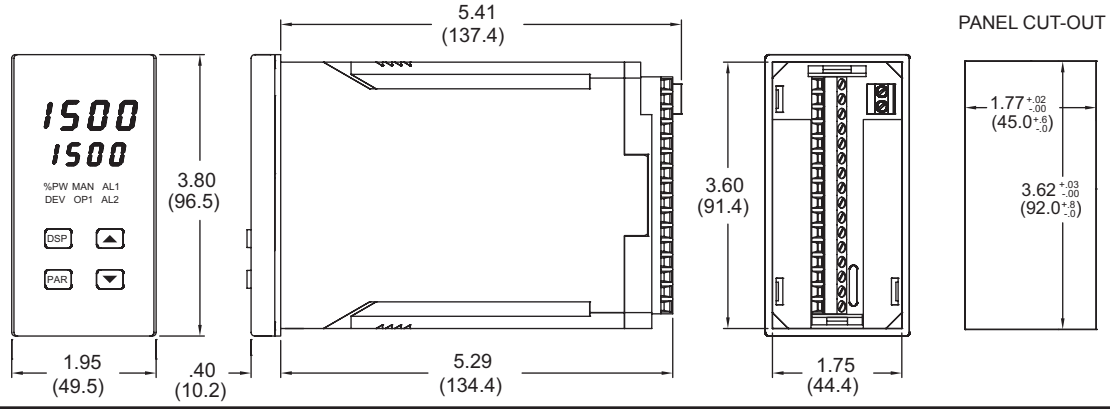
DIMENSIONS In inches (mm)

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 5.5" (140) H x 2.1" (53.4) W.



DESCRIPTION (Cont'd)

OPTIONS

A linear 4 to 20 mA or 0 to 10 VDC output signal is available to interface with actuators, chart recorders, indicators, or other controllers. The output signal can be digitally scaled and selected to transmit one of the following: % output power, process temperature value, process temperature value deviation or setpoint value. For Linear DC control applications, the adjustable output demand dampening, output deadband and output update time parameters expand the versatility of the TCU with final control devices.

The optional Heater Current Monitor serves as a digital ammeter for heater current monitoring. Current transformer accessory (CT005001), is required. An alarm event output can be programmed to signal when the heater or heater control devices have failed, before damage to process material occurs. The Heater Break alarm triggers under two conditions:

1) The main output (OP1) is "on" and the heater current is below the heater current alarm value, indicating an aged or failed heater.
2) Output (OP1) is "off" and the heater current is more than 10% of the alarm value, indicating a shorted heater control device or other problem.

The optional Motorized Valve Positioner directly controls the position of a valve by the use of twin outputs *(open and close)* to control the direction of motor rotation. The motor position defines the opening position of the valve. Two control modes are possible: position control, which makes use of the slidewire feedback signal supplied with the positioner and velocity control, in which no slidewire feedback signal is used. Parameters are provided to adjust the operation of the valve. These include:

Valve activity hysteresis
Valve update time
Variable control dampening
Slidewire signal fail action
Adjustable valve position limits.

The valve positioner TCU achieves tight process control, yet minimizes unnecessary valve activity. An alarm event output or display alarm can be programmed under loss of slidewire feedback or under valve fail detection.

The optional Second Analog Input (0-20 mA DC) can be configured as a remote setpoint signal or as a secondary process signal. Configuration of the second analog input as a remote setpoint signal allows ratio control, master setpoint/multiple slave operation, and the ability to cascade the TCU with another controller (external cascade). Configuration of the second input as a secondary process signal allows operation as a two-process cascade controller within a single unit (internal cascade). In either control mode, parameters are provided to scale, configure, communicate and monitor the activity of both analog inputs. A square law linearizer function can be used to linearize signals derived from flow transmitters.

The optional RS485 multidrop serial communication interface provides two-way communication between a TCU unit and other compatible equipment such as a printer, a programmable controller, or a host computer. In multipoint applications the address number of each unit on the line can be programmed from 0-99. Up to thirty-two units can be installed on a single pair of wires. The Setpoint value, % Output Power, Setpoint Ramp Rate, etc. can be interrogated or changed by sending the proper command code via serial communications. Alarm output*(s)* may also be reset via the serial communications interface option.

An optional Type 4X/IP65 rated bezel is available for wash down and/or dirty environments, when properly installed. Modern surface-mount technology, extensive testing, plus high immunity to noise interference makes the controller extremely reliable in industrial environments.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the manual or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Do not use the TCU to directly command motors, valves, or other actuators not equipped with safeguards. To do so, can be potentially harmful to persons or equipment in the event of a fault to the unit. An independent and redundant temperature limit indicator with alarm outputs is strongly recommended. The indicators should have input sensors and AC power feeds independent from other equipment.

SPECIFICATIONS

1. **DISPLAY**: Dual 4-digit
   Upper Temperature Display: 0.4" (10.2 mm) high red LED
   Lower Auxiliary Display: 0.3" (7.6 mm) high green LED
   Display Messages (Model dependent):
   "OLOL" - Appears when measurement exceeds + sensor range.
   "ULUL" - Appears when measurement exceeds - sensor range.
   "OPEN" - Appears when open sensor is detected.
   "SHrt" - Appears when shorted sensor is detected *(RTD only)*
   "...." - Appears when display values exceed + display range.
   "-..." - Appears when display values exceed - display range.
   "SLid" - Appears when loss of slidewire signal is detected.
   "VALV" - Appears when valve actuator error is detected.
2. **POWER**: Switch selectable for 115/230 VAC (+10%, -15%) no observable line variation effect, 48 to 62 Hz, 10 VA
3. **ANNUNCIATORS**:
   LED Backlight Status Indicators (Model dependent):
   %PW - Lower auxiliary display shows power output in (%).
   DEV - Lower auxiliary display shows deviation *(error)* from temperature setpoint.
   OP1 - Main control output is active.
   AL1 - Alarm #1 is active.
   AL2 - Alarm #2 is active *(for Dual Alarm Option)*.
   OP2 - Cooling output is active *(for Cooling Option)*.
   OPN - Valve positioner OPEN output is active *(for Valve Positioner option)*.
   CLS - Valve positioner CLOSE output is active *(for Valve Positioner option)*.
   CUR - Lower auxiliary display shows heater current *(for Heater Current Monitor option)*.
   SEC - Lower auxiliary display shows second analog input *(For Second Analog Input option)*.
   MAN - Flashing: Controller is in manual mode.
   REM - ON: controller is in remote setpoint mode *(Second Analog Input option)*.
   - OFF: controller is in local setpoint mode *(Second Analog Input option)*.
   - Flashing: controller is in Manual control mode *(Second Analog Input optional)*.
4. **CONTROLS**: Four front panel push buttons for modifying and setup of controller functions and one external input for parameter lockout or other functions.
5. **MAIN SENSOR INPUT**:
   Sample Period: 100 msec
   Response Time: 300 msec *(to within 99% of final value w/step input; typically, response is limited to response time of probe)*
   Failed Sensor Response:
   Main Control Output(s): Programmable preset output
   Display: "OPEN"
   Alarms: Upscale drive
   DC Linear: Programmable preset output
   Normal Mode Rejection: 40 dB @ 50/60 Hz *(improves with increased digital filtering.*
   Common Mode Rejection: 100 dB, DC to 60 Hz
   Protection: Input overload 120 VAC for 30 seconds.
6. **THERMOCOUPLE**:
   Types: T, E, J, K, R, S, B, N, Linear mV
   Input Impedance: 20 M Ω all types
   Lead resistance effect: 20 µV/350 Ω
   Cold junction compensation: Less than ±1°C error over 0 - 50°C ambient temperature range. Disabled for Linear mV type.
   Resolution: 1°C/F all types, or 0.1°C/F for T, E, J, K, and N only.
7. **RTD**: 2, 3 or 4 wire, 100 Ω platinum, alpha = 0.00385 (DIN 43760), alpha = 0.003916
   Excitation: 0.175 mA
   Resolution: 1 or 0.1 degree
   Lead Resistance: 7 Ω maximum
8. **RANGE AND ACCURACY**:
   Errors include NIST conformity and A/D conversion errors at 23°C after 20 min. warm-up. Thermocouple errors include cold junction effect. Errors are expressed as ±percent of reading and ± 3/4 LSD unless otherwise noted.

TC TYPE	RANGE	ACCURACY	WIRE COLOR (ANSI)
T	-200 to +400°C -328 to +752°F	0.20% + 1.5°C 0.20% + 2.7°F	blue
E	-200 to 750°C -328 to +1382°F	0.20% + 1.5°C 0.20% + 2.7°F	violet
J	-200 to +760°C -328 to +1400°F	0.15% + 1.5°C 0.15% + 2.7°F	white
K	-200 to +1250°C -328 to +2282°F	0.20% + 1.5°C 0.20% + 2.7°F	yellow
R	0 to +1768°C +32 to +3214°F	0.15% + 2.5°C 0.15% + 4.5°F	black
S	0 to +1768°C +32 to +3214°F	0.15% + 2.5°C 0.15% + 4.5°F	black
B	+200 to +1820°C +300 to +3308°F	0.15% + 2.5°C 0.15% + 4.5°F	grey
N	-200 to +1300°C -328 to +2372°F	0.20% + 1.5°C 0.20% + 2.5°F	orange
mV	-5.00 to 56.00	0.15% + 1 LSD	—
RTD (385)	-200 to +600°C -328 to +1100°F	0.10% + 0.5°C 0.10% + 0.9°F	—
RTD (392)	-160 to +600°C -256 to +1100°F	0.10% + 0.5°C 0.10% + 0.9°F	—
OHMS	1.0 to 320.0	0.15% + 1 LSD	—

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9. **OUTPUT MODULES [Optional] (For All Output Channels)**:
Relay:
Type: Form-C *(Form-A with some models. See Ordering Information.)*
Rating: 5 Amps @ 120/240 VAC or 28 VDC *(resistive load*), 1/8 HP @ 120 VAC *(inductive load)*
Life Expectancy: 100,000 cycles at max. load rating. *(Decreasing load and/or increasing cycle time, increases life expectancy).*
Logic/SSR Drive: Can drive multiple SSR Power Units.
Type: Non-isolated switched DC, 12 VDC typical
Drive: 45 mA max.
Triac:
Type: Isolated, Zero Crossing Detection
Rating:
Voltage: 120/240 VAC
Max. Load Current: 1 Amp @ 35°C
0.75 Amp @ 50°C
Min. Load Current: 10 mA max.
Offstate Leakage Current: 7mA max. @ 60 Hz
Operating Frequency: 20 to 400 Hz
Protection: Internal Transient Snubber, Fused
10. **MAIN CONTROL OUTPUT (Heating or Cooling)**:
Control: PID or ON/OFF
Output: Time proportioning or linear DC
Hardware: Plug-in, replaceable output modules
Cycle time: Programmable
Auto-tune: When selected, sets proportional band, integral time, and derivative time values.
Probe Break Action: Programmable
11 . **COOLING OUTPUT (Optional)**:
Control: PID or ON/OFF
Output: Time proportioning or linear DC
Hardware: Plug-in, replaceable output modules
Cycle time: Programmable
Proportional Gain Adjust: Programmable
Heat/Cool Deadband Overlap: Programmable
12. **LINEAR DC OUTPUT (Optional)**: With digital scale and offset, programmable deadband and update time.
4 to 20 mA:
Resolution: 1 part in 3500 typ.
Accuracy: ±*(0.1% of reading + 25 μA)*
Compliance: 10 V *(500 Ω max. loop impedance)*
0 to 10 VDC:
Resolution: 1 part in 3500 typ.
Accuracy: ±*(0.1% of reading + 35 mV)*
Min. Load Resistance: 10 KΩ *(1 mA max.)*
Source: % output power, setpoint, deviation, or temperature *(Available for heat or cool, but not both.)*
13. **HEATER CURRENT MONITOR (Optional)**:
Type: Single phase, full wave monitoring of load currents controlled by main output (OP1)
Input: 100 mA AC output from current transformer RLC part number CT005001 or any current transformer with 100 mA AC output
Display Scale Range: 1.0 to 999.9 amperes or 100.0%
Input resistance: 5 Ω
Accuracy: 1% of full scale ±1 LSD (10 to 100% of range)
Frequency: 50 to 400 Hz
Alarm mode: Dual acting; heater element fail detect and control device fail detect
Overload: 200 mA *(steady state)*
Min. output "on" time for Heater break alarm detect: 400 msec
14. **MOTORIZED VALVE POSITIONER (Optional)**:
Two Outputs: Valve open and valve close or Linear DC *(optional)*
Hardware: Plug-in, replaceable output modules
Three Inputs: Slidewire feedback, signal fail detect *(Isolated from main input)*
Slidewire Resistance: 100 to 100 KΩ
Slidewire Exciting Voltage: 0.9 VDC
Slidewire Fail Action: programmable
Control Mode: Position mode *(with slidewire)* and velocity mode *(w/o slidewire)*.
Control Deadband: 1% to 25.0% *(position mode)*
0.1 to 25.0 seconds *(velocity mode)*
Update Time: 1 to 250 seconds
Motor Time (open, close): 1 to 9999 seconds
Position Limits: Adjustable 0.0 to 100.0% of valve stroke
Valve Fail Time: Off to 9999 seconds
Alarm mode: Dual acting; loss of slidewire feedback signal and valve fail detection
15. **SECOND ANALOG INPUT**:
Range: 0 to 20 mA (Isolated from main input)
Overload: 100 mA (steady state)
Input Resistance: 10 Ω
Voltage Drop (@ 20 mA): 0.2 V
Accuracy: 0.15% of reading ±10 μA ±1 LSD
Scale Range: -999 to 9999
16. **SERIAL COMMUNICATION**:
Type: RS485 Multi-point, Balanced Interface
Communication Format:
Baud Rate: Programmable from 300 to 9600
Parity: Programmable for odd, even, or no parity
Frame: 1 start bit, 7 data bits, 1 or no parity bit, 1 stop bit
Unit Address: Programmable from 0 to 99, max. of 32 units per line
Transmit Delay: 100 msec min., 200 msec max.
RS485 Common: Isolated from signal input common
Auto Print Time: Off to 9999 seconds between print-outs
17. **USER INPUT (Optional)**: Internally pulled up to +5 VDC.
$V_{IN\ MAX}$ = 5.25 VDC, V_{IL} = 0.85 V_{MAX}; V_{IH} = 3.0 V_{MIN},
Available on all second input (HCM, MVP & ANA) models, and on models with RS485.
Response Time: 100 msec max.
Functions: Program Lock
Integral Action Lock
Auto/Manual Mode Select
Setpoint Ramp Select
Reset Alarms
Print Request
Local/Remote Setpoint Select
18. **ALARMS (Optional)**:
Hardware: Plug-in, replaceable output module
Modes: Absolute high acting
Absolute low acting
Deviation high acting
Deviation low acting
Inside band acting
Heater break
Valve fail
Second Analog Input monitoring
Reset Action: Programmable; automatic or latched
Standby Mode: Programmable; enable or disable
Hysteresis: Programmable
Probe Break Action: Upscale
Annunciator: LED backlight for "AL1", "AL2", *(Alarm #2 not available with cooling output or motorized valve position option.)*
19. **ENVIRONMENTAL CONDITIONS**:
Operating Temperature Range: 0 to 50°C
Storage Temperature Range: -40 to 80°C
Vibration to IEC 68-2-6: Operational 5-150 Hz, 1 g
Shock to IEC 68-2-27: Operational 5 g
Span Drift *(maximum)*: 100 ppm/°C, main input; 150 ppm/°C, second input
Operating and Storage Humidity:
85% max. (non-condensing) from 0 to 50°C
Zero Drift *(maximum)*: 1 μV/°C, main input;2 μA/°C, second input
Altitude: Up to 2000 meters
20. **ISOLATION BREAKDOWN RATINGS**:
All inputs and outputs with respect to AC line: 2300 V
Analog Outputs, Second Analog Input, Heater Current Input or Slidewire Input with respect to main input: 500 V
21. **CERTIFICATIONS AND COMPLIANCES**:
CE Approved
EN 61326-1 Immunity to Industrial Locations
Emission CISPR 11 Class A
EN 61010-1
RoHS Compliant
UL Recognized Component: File #E156876
UL Listed: File #E137808
Type 2 Enclosure rating (Face only) for TCU0
Type 4X/IP65 Enclosure rating (Face only) for TCU1
Refer to EMC Installation Guidelines section of the manual for additional information.
22. **CONNECTION**: Jaw-type terminal block
Wire Range: 12-30 AWG copper wire
Torque: 5-7 inch-lbs (56-79 N-cm)

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23. **CONSTRUCTION**:
Front Panel: Flame and scratch resistant tinted plastic
Case: High impact black plastic. (Mounting collar included)
Type 4X/IP65 model only: Sealed bezel utilizing two captive mounting screws (panel gasket included). This unit is rated for Type 4X/IP65 indoor use. Installation Category II, Pollution Degree 2
24. **WEIGHT**: 1.3 lbs (0.6 kgs)

ACCESSORIES:

External SSR Power Unit:
Switched Voltage Range: 50 to 280 VAC *(Nominal: 240 VAC)*
Load Current: 45 Amps @ 25°C ambient temperature
35 Amps @ 50°C ambient temperature
On State Input: 3 to 32 VDC @ 1500 Ω impedance. *(isolated)*
(Use Logic/SSR drive output module.)
Off State Input: 0.0 to 1.0 VDC
Size: 5.5" (14 cm) L x 4.75" (12 cm) W x 2.62" (6.6 cm) H
Current Transformer:
Current Ratio: 50:0.1 (Amperes)
Accuracy: ±5.0%
Operating Frequency: 50 to 400 Hz
Insulation Class: 0.6 Kv BIL 10 Kv full wave
Terminals: Brass studs No. 8-36, (flat washer, washer, nut)
Weight: 8.0 oz (226 g)
Approvals: UL recognized component

BASIC OPERATION

The TCU controls a process temperature by measuring the temperature via an input probe, then calculating a control output power value by use of a modified PID control algorithm. The unit controls the system with the new output power value to keep the process temperature at setpoint. The PID control algorithm incorporates features which provide for high control accuracy and low temperature overshoot from process disturbances.

FRONT PANEL FEATURES

In the normal operating mode, the unit will display the process temperature in the upper display. One of six other parameters can be viewed in the lower display:

- Setpoint
- % Power Output
- Temperature Deviation
- Heater Current
- Second Input Process Value
- Temperature Symbol (F or C)

The six parameters can be scrolled through by pressing the DSP button. If enabled, the control setpoint or power output (manual mode only) can be directly modified in this mode.

In the normal operating mode, parameters are selected by use of the PAR button and modified by use of the UP and DOWN buttons. Parameters are then entered by the PAR button, which advances the user to the next parameter. Pressing the DSP button immediately returns the controller to the normal operating mode when making a parameter change. The controller's configuration and parameter settings are stored in an internal E^2PROM device.

HARDWARE FEATURES

The fast 100 msec input sampling rate provides quick controller response to a process disturbance, thus providing excellent temperature control. Measurement accuracy of 0.15% or better, provides closer process control conforming to the desired control setpoint value. One model accepts a variety of both thermocouple or RTD temperature probes. The AC input power is switch selectable, allowing the unit to operate from either 115 VAC or 230 VAC. Since the controller is serviceable from the front of the panel, the output modules may be easily changed or replaced without disturbing the wiring behind the panel. No re-programming is required when changing or replacing modules.

The optional Type 4X/IP65 rated model utilizes two bezel securing screws and a neoprene gasket to guarantee a water tight seal, when properly installed. The standard model simply requires pressing a latch to remove the unit.

Low-drift, highly stable circuitry ensures years of reliable and accurate temperature control. The recommended two-year re-calibration interval is easily accomplished via the programming menu.

SETPOINT FEATURES

The controller setpoint can be protected from out of range values by programming the setpoint range limit values. Additionally, safeguards from inadvertent data entry can be programmed.

The setpoint ramp feature ramps the setpoint value at start-up or any time a setpoint change is made, at a user programmable rate. This feature reduces thermal shock to the process and helps to minimize temperature overshoot.The setpoint may also be transmitted by the optional linear DC output for slave control loops.

The second analog input may be configured as a remote setpoint. As such, the controller is easily switched from local/remote setpoint operation via the front panel or user input. Ratio and bias parameters provide on-line scaling of the remote setpoint. Absolute limit values and maximum rate of change of the remote setpoint further enhance controller flexibility.

INPUT FEATURES

A programmable input filter can be used to stabilize readings from a process with varying or oscillating temperature characteristics, helping to provide better temperature control. A programmable temperature shift and slope function can be used to compensate for probe errors or to have multiple TCU units indicate the same nominal temperature.

The programmable User Input can be used to control a variety of functions, such as auto/manual transfer of the controller, reset alarm output(s), etc.

The second analog input has independent scaling parameters to match the units of other processes or transmitters, or to match the controller's range.

OUTPUT FEATURES

Programmable output power limits provide protection for processes where excessive power can cause damage. Automatic sensor probe break detection, for fail-safe operation, causes the controller to default to a programmed output power (upscale or downscale burnout). With adjustable time proportioning-cycle time, and programmable DC linear output, the controller can satisfy a wide variety of output requirements.

Programmable dampening output hysteresis and output update time parameters can dramatically reduce actuator activity without degrading control accuracy.

The RS485 Communication option allows the user to access various controller parameters such as the setpoint, % output power, % proportional band, etc. The controller may be setup to transmit various parameters at a programmable automatic print rate.

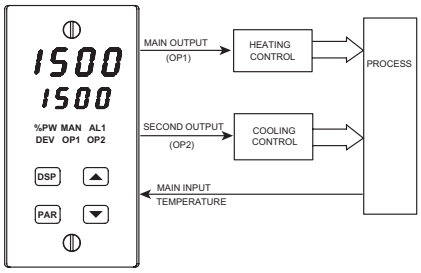
AUTO-TUNE

The TCU has an auto-tune feature which, on demand, automatically determines the PID control parameters for a particular thermal process. After completion of auto-tune, the PID parameters are automatically optimized for that process and loaded into nonvolatile memory. The operator may view and modify the parameters as desired.

Auto-tune may be invoked either at start-up or at setpoint, depending on the process requirements. An auto-tune programmable dampening factor produces various levels of process control and response characteristics.

OPTIONS

HEATING AND COOLING CONTROL

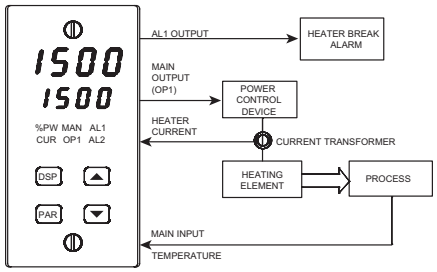


The TCU has dual outputs for providing heating and cooling to those processes that require them. Many extruder applications require both heating and cooling to maintain accurate extruder barrel and die temperatures. The TCU is easily configured for these applications.

Cooling Configuration Parameters

"CYC2"	-	Enter cooling time proportioning cycle time
"GAN2"	-	Enter cooling relative gain
"db-2"	-	Enter heat/cool deadband or overlap

HEATER CURRENT MONITOR

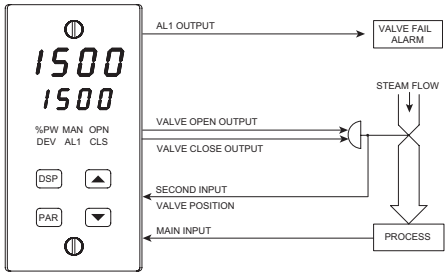


The Heater Current Monitor serves as a heater element fail sentry, so operators can take corrective action before significant process errors occur in the event of a failure. The actual heater current can be viewed in the secondary display and/or a heater break alarm output can be programmed.

Heater Current Monitor Configuration Parameters

"HCur"	-	Enter full scale current of current transformer
ACt1", "ACt2"	-	Program alarm(s) as heater break alarm

MOTORIZED VALVE POSITIONER

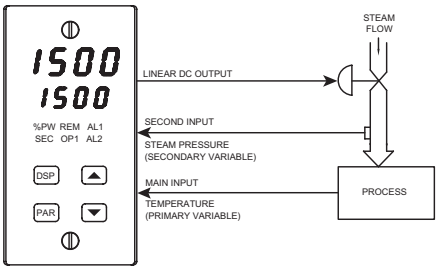


The motorized valve positioner controls the position of a valve directly, by use of "open" and "close" control outputs. The slidewire feedback signals of the valve may optionally be connected to the controller. Alternatively, the controller may be configured for linear input valve control using the 4 to 20 mA DC output.

Motorized Valve Positioner Configuration Parameters

Position mode:	"VPS1"	-	Enter or measure valve closed position
	"VPS2"	-	Enter or measure valve open position
	"VUdt"	-	Enter Valve update time
	"VPdb"	-	Enter valve control deadband
	"VFAL"	-	Enter valve fail detect time
	"Act1"	-	Program alarm as valve fail output
Velocity mode:	"VUdt"	-	Enter Valve update time
	"VOPt"	-	Enter valve open time
	"VCLt"	-	Enter valve close time
	"VONt"	-	Enter valve control deadband *(minimum on time)*

INTERNAL CASCADE



Cascade control allows the process to be divided into two control loops: the primary control loop and the secondary control loop. The secondary loop receives it's setpoint from the primary loop to control an intermediate variable (steam pressure). The control level of the intermediate variable is the input to the primary process. The primary loop (temperature) controller maintains loop regulation by manipulating the setpoint of the secondary controller. The setpoint of the secondary controller, in turn, changes the intermediate variable. The secondary loop can react faster to disturbances of the intermediate variable, thereby minimizing the effects to the primary control loop. Control loops cascaded in such a manner provide greater control quality than would be possible with single loop control. A single TCU can accomplish two-process cascade control.

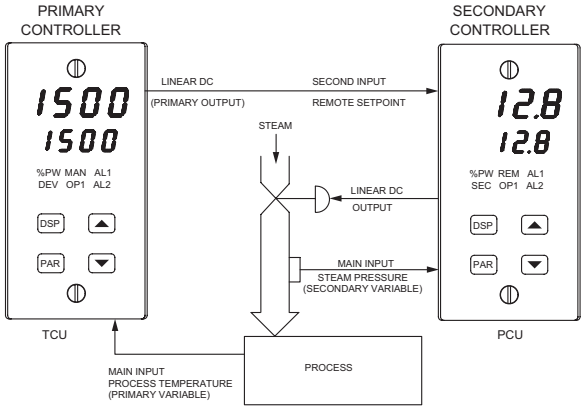
Internal Cascade Configuration Parameters

"OPer"	-	Select cascade mode
"root"	-	Select second input square root linearization
"dPt2"	-	Select second input decimal point
"dSP1"	-	Enter scaling units of second input
"INP1"	-	Enter scaling units of second input
"dSP2"	-	Enter scaling units of second input
"INP2"	-	Enter scaling units of second input
"OPd2"	-	Output dampening of secondary

Internal Cascade Operational Parameters

"SP-2"	-	View secondary setpoint value
"Pb-2"	-	Enter secondary proportional band
"It-2"	-	Enter secondary integral time
"dt-2"	-	Enter secondary derivative time

EXTERNAL CASCADE



Similar to internal cascade control, external cascade control differs by the employment of two controllers, one of which is equipped with a second analog input configured as a remote setpoint. A PCU controls the secondary loop, while a TCU controls the primary loop.

External Cascade Configuration Parameters

"OPEr"	-	Select ratio mode
"root"	-	Select second input square root linearization
"dPt2"	-	Select second input decimal point
"dSP1"	-	Enter scaling units of second input
"INP1"	-	Enter scaling units of second input
"dSP2"	-	Enter scaling units of second input
"INP2"	-	Enter scaling units of second input
"SPtr"	-	Local/Remote select options

External Cascade Operational Parameters

"rtio"	-	Remote setpoint ratio
"bIAS"	-	Remote setpoint bias

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SETPOINT MASTER CONTROL

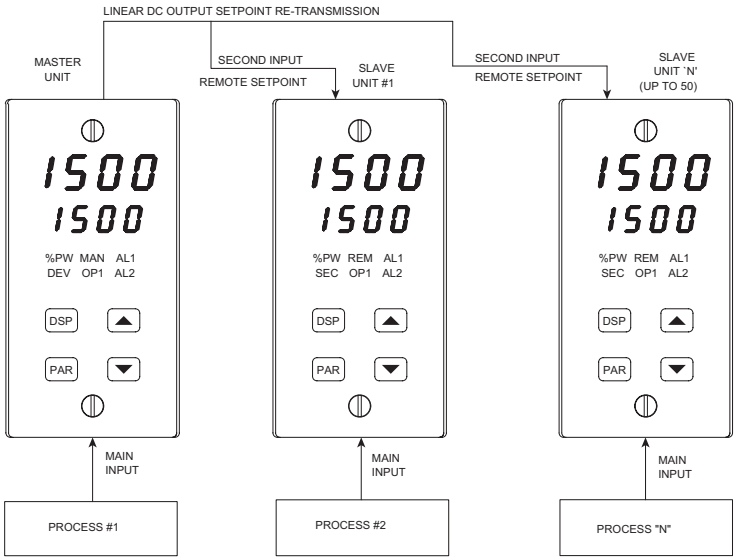
Setpoint Master Control allows automatic setpoint changes to slave controller units (up to 50 units total) from a master TCU controller. The linear DC output of the master is looped with the second analog input of the slave TCU controllers. Each slave unit can have unique remote setpoint ratio and bias values.

Setpoint Slave Configuration Parameters

"OPEr" - Select remote setpoint mode
"root" - Select second input square root Linearization
"dPt2" - Select second input decimal point
"dSP1" - Enter scaling units of second input
"INP1" - Enter scaling units of second input
"dSP2" - Enter scaling units of second input
"INP2" - Enter scaling units of second input
"SPLO" "SPHI" - Limit range of remote setpoint
"SPrP" - Limit rate of change of remote setpoint

Setpoint Slave Operational Parameters

"rtio" - Second input ratio
"bIAS" - Second input bias



CONTROLLER PROGRAMMING

The TCU has been designed to reduce the operator interaction with the controller while still maintaining a high degree of control accuracy and user flexibility. Front Panel Program Disable allows all of the controller's set-ups to be locked-out from further operator intervention after the initial parameter set-up.

The programming of the controller is divided into four sections:
Unprotected Parameter Mode
Configuration Parameter Mode
Protected Parameter Mode
Hidden Function Mode

These four programming modes allow the controller to adapt to any required user-interface level.

UNPROTECTED PARAMETER MODE *

The unprotected parameter mode is accessible when program disable is inactive or when the proper access code number from the protected mode is entered.The configuration parameter modes can be accessed only from this mode.

"SP" - Enter Setpoint
"OP" - Enter output power
"ProP" - Enter proportional band
"Intt" - Enter integral time
"dErt" - Enter derivative time
"rtio" - Enter Remote Setpoint ratio value
"bIAS" - Enter Remote Setpoint bias value
"SP-2" - View internal cascade secondary setpoint demand
"Pb-2" - Enter internal cascade, secondary proportional band
"It-2" - Enter internal cascade, secondary integral time
"dt-2" - Enter internal cascade, secondary derivative time
"AL-1" - Enter value for alarm #1
"AL-2" - Enter value for alarm #2
"CNFP" - Select basic configuration mode
"End" - Return to normal display mode

* *These parameters may not appear due to option configuration or other programming.*

CONFIGURATION PARAMETER MODE

The configuration parameter mode allows the operator to set-up the basic requirements of the controller. It is divided into sections which group together related programming steps, such as inputs, outputs, alarms, etc. Upon completion of each section, the program returns to the configuration selection stage allowing the user to return to the normal display mode.

Configuration 1, Inputs

"tYPE" - Select input probe type
"SCAL" - Select temperature scale
"dCPt" - Select temperature resolution
"FLtr" - Select level of input filtering
"SPAN" - Enter input correction span (slope)
"SHFt" - Enter input correction shift (offset)
"SPLO" - Enter setpoint lower limit
"SPHI" - Enter setpoint higher limit
"SPrP" - Enter setpoint ramp rate
"InPt" - Select user input function *
"HCur" - Enter full scale heater current *

Configuration 2, Outputs

"CYCt" - Enter time proportioning cycle time
"OPAC" - Select control action
"OPLO" - Enter output power low limit
"OPHI" - Enter output power high limit
"OPFL" - Enter probe fail power preset
"OPdP" - Enter output control dampening
"CHYS" - Enter ON/OFF control hysteresis
"tcod" - Select auto-tuning dampening
"ANAS" - Select linear DC output assignment *
"ANLO" - Enter linear DC output low scaling value *
"ANHI" - Enter linear DC output high scaling value *
"ANdb" - Enter linear DC output control deadband *
"ANUt" - Enter linear DC output update time *

Configuration 3, Parameter lock-outs

"SP" - Select degree of setpoint access
"OP" - Select degree of power access
"dEv" - Enable deviation display *
"IN-2" - Enable second input display *
"HCur" - Enable heater current display
"UdSP" - Enable temperature scale display
"CodE" - Enter parameter access code
"PId" - Select degree of PID access
"PId2" - Select degree of secondary PID access *
"rtbS" - Select degree of ratio/bias access *
"AL" - Select degree of alarm access *
"ALrS" - Enable alarm reset access *
"SPSL" - Enable local/remote setpoint selection *
"trnF" - Enable auto/manual mode selection
"tUNE" - Enable auto-tune invocation

Configuration 4, Alarms *

"Act1" - Select operation mode of alarm #1
"rSt1" - Select reset mode of alarm #1
"Stb1" - Enable activation delay of alarm #1
"AL-1" - Enter value for alarm #1
"Act2" - Select operation mode of alarm #2
"rSt2" - Select reset mode of alarm #2
"Stb2" - Enable activation delay of alarm #2
"AL-2" - Enter value for alarm #2
"AHYS" - Enter hysteresis value for both alarms

Configuration 5, Cooling *

"CYC2" - Enter cooling time proportioning cycle time
"GAN2" - Enter cooling relative gain
"db-2" - Enter heat/cool deadband or overlap

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Configuration 6, Serial Communications *

"bAUd" - Select baud rate
"PArb" - Select parity bit
"Addr" - Enter unit address number
"Abrv" - Select abbreviated or full mnemonic transmissions
"PrAt" - Enter automatic print rate
"PoPt" - Select parameters to be included in print-out

Configuration 7, Second Input *

"OPEr" - Select remote setpoint or internal cascade mode
"root" - Select second input square root linearization
"dPt2" - Select second input decimal point
"dSP1" - Enter scaling parameters of second input
"INP1" - Enter scaling parameters of second input
"dSP2" - Enter scaling parameters of second input
"INP2" - Enter scaling parameters of second input
"SPtr" - Enter local/remote select options
"OPd2" - Enter Secondary output control dampening

Configuration 8, Motorized Valve Positioner *

Position mode:
"VPS1" - Enter or measure valve closed position
"VPS2" - Enter or measure valve open position
"VUdt" - Enter valve update time
"VPdb" - Enter valve control deadband
"VFAL" - Enter valve fail detect time

Velocity mode:
"VUdt" - Enter valve update time
"VOPt" - Enter valve open time
"VCLt" - Enter valve close time
"VONt" - Enter valve control deadband *(minimum on time)*

HIDDEN FUNCTION MODE *

The hidden function mode is accessible from the normal operating mode. The four functions in this mode may be locked-out individually in configuration 3 parameter lock-out section.

"SPSL" - Select Local/Remote Setpoint
"trnF" - Transfer between automatic (PID) control and manual control
"tUNE" - Invoke/cancel PID Auto-tune
"ALrS" - Reset latched alarms

PROTECTED PARAMETERS MODE *

The protected parameters mode is enabled when program disable is active. This mode prevents access to the configuration modes without the proper access code number. Only the parameters that are selected in the configuration 3 parameter lock-out section can be accessed.

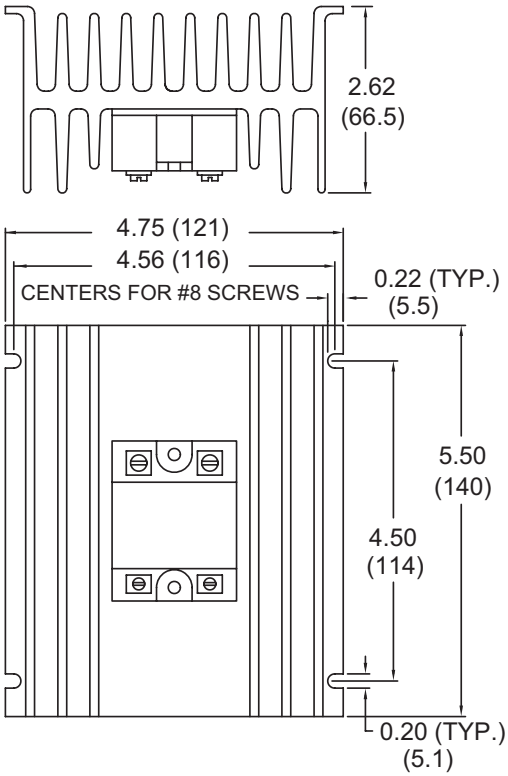
"ProP" - Enter Proportional band
"Intt" - Enter integral time
"dErt" - Enter derivative time
"rtio" - Enter remote setpoint ratio value
"bIAS" - Enter remote setpoint bias value
"SP-2" - Enter internal cascade, secondary setpoint
"Pb-2" - Enter internal cascade, secondary proportional band
"It-2" - Enter internal cascade, secondary integral time
"dt-2" - Enter internal cascade, secondary derivative time
"AL-1" - Enter value for alarm #1
"AL-2" - Enter value for alarm #2
"CodE" - Enter access value to unprotected parameters & configuration parameters

* *These parameters may not appear due to option configuration or other programming.*

ACCESSORY - EXTERNAL RLY50000 SSR POWER UNIT SHOWN

(External DIN Rail mount SSR power units available)

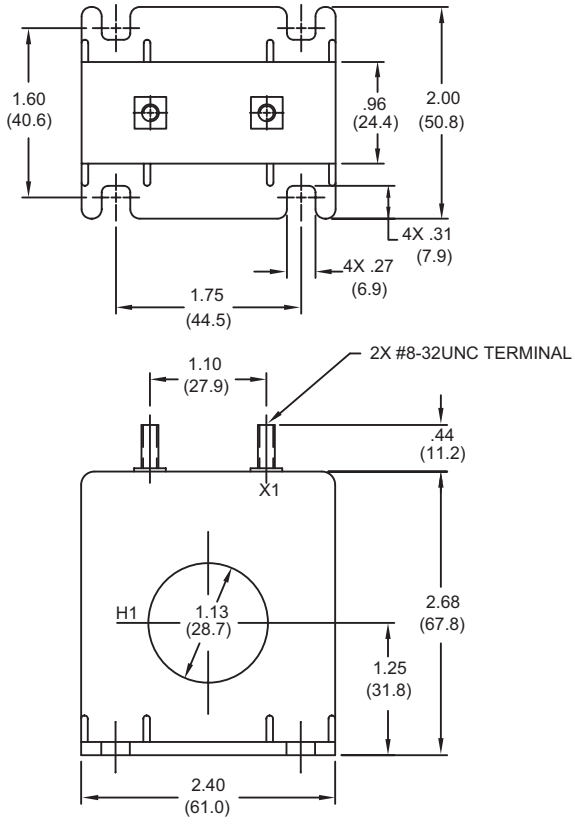
The external SSR Power Unit is used with the Logic/SSR Drive Module (OMD00003) to switch loads up to 240 VAC @ 45 amps, 25°C ambient. The unit is operated by applying a low level DC control signal to the isolated input. The unit features zero cross detection circuits which reduces radiated RFI when switching load currents. With no contacts to wear out, the SSR Power Unit provides virtually limitless operational life. The unit is supplied with an integral heat sink for immediate installation.



ACCESSORY - CT005001 CURRENT TRANSFORMER SHOWN

(Lower current CT available)

The external Current Transformer is used when specifying TCUs equipped with the Heater Current Monitor. The primary current rating is 50 amperes.



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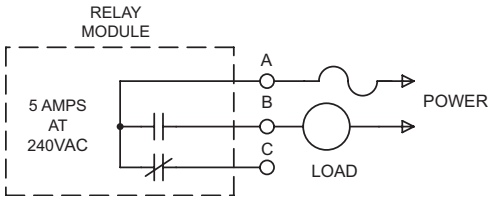
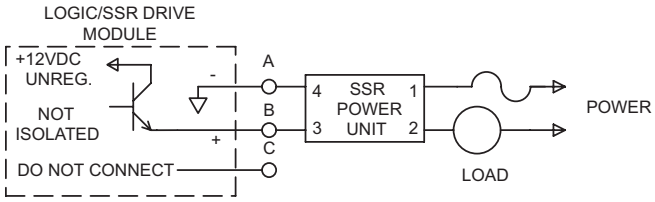
OUTPUT MODULES

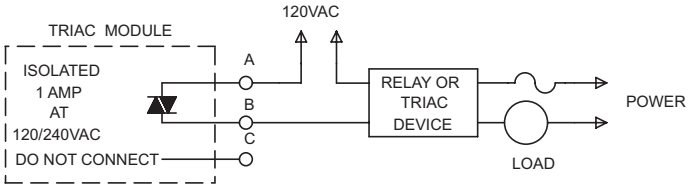
TYPICAL CONNECTIONS



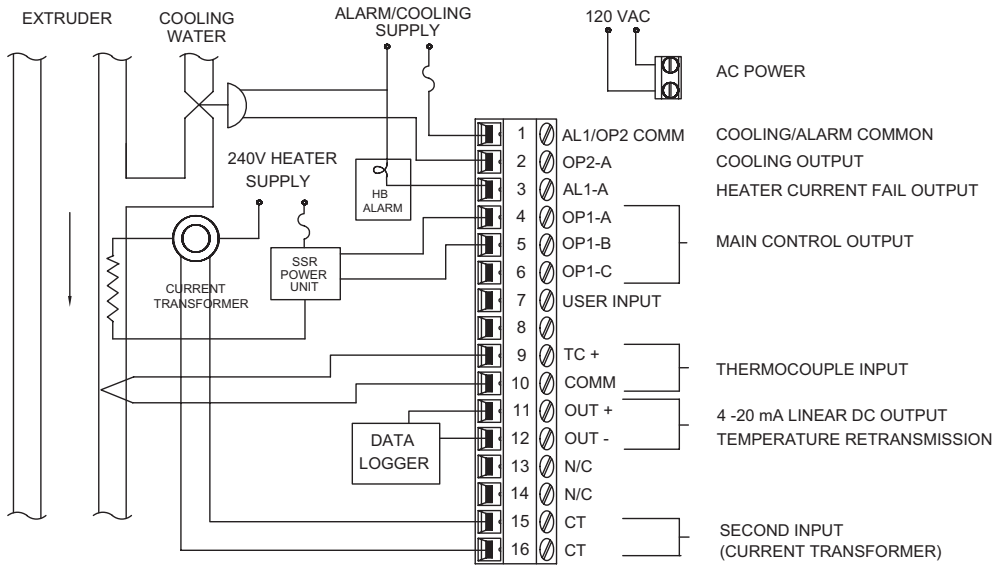
Relay:
Type: Form-C (Form-A with some models. See ordering information.)
Rating: 5 amps @ 120/240 VAC or 28 VDC (resistive load), 1/8 HP @ 120 VAC (inductive).
Life Expectancy: 100,000 cycles at maximum load rating.



(Decreasing load and/or increasing cycle time, increases life expectancy).
Logic/SSR Drive: Can drive multiple SSR Power Units.



Type: Non-isolated switched DC, 12 VDC typical
Drive: 45 mA maximum.
Triac:
Type: Isolated, Zero Crossing Detection
Rating:
Voltage: 120/240 VAC
Max. Load Current: 1 ampere @ 35°C
0.75 ampere @ 50°C
Min. Load Current: 10 mA
Off State Leakage Current: 7 mA max. @ 60 Hz
Operating Frequency: 20 to 400 Hz
Protection: Internal Transient Snubber, Fused



APPLICATION

Several TCU controllers are employed to control the temperature of a plastics extruder. Each TCU controls a heating element and a cooling water solenoid to maintain each extruder zone at a desired temperature. The heater current monitor of the TCU is used for early detection of heater element failure. The linear DC output is used to retransmit the process temperature to a control computer for data logging purposes.

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ORDERING INFORMATION

MODELS WITHOUT SECOND INPUT OPTIONS

Type 4X/IP65 BEZEL	4 to 20 mA ANALOG OUTPUT	0 to 10 VDC ANALOG OUTPUT	ALARM OUTPUTS	COOLING OUTPUT	RS485 COM	PART NUMBER 115/230 VAC
NO	NO	NO	NO	NO	NO	TCU00000
NO	NO	NO	2	NO	NO	TCU00001
NO	NO	NO	1	YES	NO	TCU00002
NO	YES	NO	2	NO	NO	TCU01001
NO	YES	NO	2	NO	YES	TCU01004
NO	YES	NO	1	YES	YES	TCU01005
YES	NO	NO	NO	NO	NO	TCU10000
YES	NO	NO	2	NO	NO	TCU10001
YES	NO	NO	1	YES	NO	TCU10002
YES	YES	NO	2	NO	NO	TCU11001
YES	YES	NO	1	YES	NO	TCU11002
YES	YES	NO	2	NO	YES	TCU11004
YES	YES	NO	1	YES	YES	TCU11005
YES	NO	YES	2	NO	NO	TCU12001
YES	NO	YES	2	NO	YES	TCU12004
YES	NO	YES	1	YES	YES	TCU12005

These models have dual alarm outputs, or single alarm with cooling outputs, with shared common terminals (Form A Type). As a result, these outputs should be fitted with the same type of output module. The main output (OP1) may be fitted with any type of output module.

HEATER CURRENT MONITOR MODELS (HCM)

Type 4X/IP65 BEZEL	4 to 20 mA ANALOG OUTPUT	0 to 10 VDC ANALOG OUTPUT	ALARM OUTPUTS	COOLING OUTPUT	RS485 COM	PART NUMBER
YES	NO	NO	2	NO	YES	TCU10204
YES	YES	NO	2	NO	NO	TCU11208

These models have dual alarm outputs, or single alarm with cooling outputs, with shared common terminals (Form A Type). As a result, these outputs should be fitted with the same type of output module. The main output (OP1) may be fitted with any type of output module.

SECOND ANALOG INPUT MODELS (ANA)

Type 4X/IP65 BEZEL	4 to 20 mA ANALOG OUTPUT	0 to 10 VDC ANALOG OUTPUT	ALARM OUTPUTS	COOLING OUTPUT	RS485 COM	PART NUMBER
YES	NO	NO	2	NO	YES	TCU10104
YES	YES	NO	2	NO	NO	TCU11108
YES	NO	YES	2	NO	NO	TCU12108

These models have dual alarm outputs, or single alarm with cooling outputs, with shared common terminals (Form A Type). As a result, these outputs should be fitted with the same type of output module. The main output (OP1) may be fitted with any type of output module.

MOTORIZED VALVE POSITIONER MODELS (MVP)

Type 4X/IP65 BEZEL	4 to 20 mA ANALOG OUTPUT	0 to 10 VDC ANALOG OUTPUT	ALARM OUTPUTS	COOLING OUTPUT	RS485 COM	PART NUMBER
YES	NO	NO	1	NO	YES	TCU10307
YES	YES	NO	1	NO	NO	TCU11306
YES	NO	YES	1	NO	NO	TCU12306

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ACCESSORIES

DESCRIPTION	PART NUMBER
Relay Module	OMD00000
Triac Module	OMD00001
Logic/SSR Drive Module	OMD00003
45 A Single Phase Panel Mount SSR	RLY50000
25 A Single Phase DIN Rail Mount SSR	RLY60000
40 A Single Phase DIN Rail Mount SSR	RLY6A000
25 A Three Phase DIN Rail Mount SSR	RLY70000
50:0.1 Ampere Current Transformer	CT005001
40:0.1 Ampere Current Transformer	CT004001

Note: Output Modules are NOT supplied with the controller. When specifying the controller, be sure to purchase the appropriate output module for the Main Control Output and if necessary, the alarm output(s), the cooling output, and valve positioner outputs. The controller can be fitted with any combination of output modules.

The Logic/SSR Drive Module is a switched DC source, intended to drive the DC input of an SSR power unit. It should never be connected to line voltage.

All output modules are packaged separately and must be installed by the user.

MODEL TSC - TEMPERATURE SETPOINT CONTROLLER

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51EB

- *SETPOINT PROGRAM CONTROLLER FOR TIME VS. TEMPERATURE (RAMP/SOAK) AND SPECIAL BATCH/RECIPE APPLICATIONS*
- *ADVANCED PROGRAM PROFILING IN A 1/8 DIN PACKAGE*
- *ON-LINE MONITORING AND CONTROL OF PROGRAM STATUS, TIME, AND SETPOINT VALUE (Program Run, Pause, Stop, Advance, Modify Time, & Setpoint Value)*
- *AUTOMATIC PROGRAM DELAY FOR PROFILE CONFORMITY, PLUS PROGRAM LINKING, REPEATING AND AUTO POWER-ON FUNCTIONS FOR ENHANCED CAPABILITY*
- *DUAL EVENT OUTPUTS FOR TIMED ACTIVATION OF PROCESS EQUIPMENT SUCH AS STIRRERS, FANS, HEATERS, ETC. (Uses Alarm Output Channels)*
- *FOUR SETPOINT & PID PARAMETER SETS FOR QUICK RECALL OF SETPOINTS AND/OR GAIN VALUES DURING BATCH OR PROCESS CHANGEOVER*
- *PROGRAMMABLE USER INPUT FOR CONTROLLER AND SETPOINT PROGRAM CONTROL*
- *100 MSEC SAMPLING PERIOD WITH 0.15% ACCURACY*
- *ON DEMAND AUTO-TUNING OF PID CONTROL SETTINGS*
- *DUAL LED DISPLAYS FOR SIMULTANEOUS INDICATION OF TEMPERATURE AND SETPOINT OR TEMPERATURE AND PROFILE STATUS*
- *ACCEPTS ANY ONE OF 10 DIFFERENT TYPES OF SENSOR INPUTS (Thermocouple or RTD)*
- *FIELD REPLACEABLE AND INTERCHANGEABLE OUTPUT MODULES (Relay, Logic/SSR drive, and Triac)*
- *OPTIONAL DUAL ALARM OUTPUTS (Uses Output Modules)*
- *OPTIONAL COOLING OUTPUT (Uses Output Module)*
- *OPTIONAL LINEAR 4 to 20 mA or 0 to 10 VDC OUTPUT FOR CONTROL OR TEMPERATURE RE-TRANSMISSION*
- *OPTIONAL RS485 SERIAL COMMUNICATIONS INTERFACE*
- *OPTIONAL TYPE 4X/IP65 SEALED FRONT BEZEL*

DESCRIPTION

The TSC is a setpoint controller suitable for time vs. temperature, process control applications. The TSC accepts signals from a variety of temperature sensors (thermocouple and RTD elements), precisely displays the process temperature, and provides an accurate output control signal (time proportional or linear) to maintain a process at the desired control point. A comprehensive set of easy to use steps allows the controller to satisfy various applications. The user input can be programmed to perform a variety of controller functions.

Dual 4-digit displays allow viewing of the measured temperature value and setpoint or temperature and profile status simultaneously. Front panel indicators inform the operator of controller status and output states. Replaceable output modules (Relay, logic/SSR drive or Triac) can be fitted to the main control output, alarm output(s) or timed event output(s), and cooling output.

The TSC has been designed to simplify the set-up and operation of a controlled setpoint profile program. The setpoint program is easily entered and controlled through the front panel. Full display capabilities keep the operator informed of the process temperature, profile status, output states, and setpoint value.

The controller can operate in the standard PID control mode for both heating or cooling with on-demand auto-tune which establishes the PID gain set. The PID gain set can be fine tuned by the operator at any time or may be locked from further modification. The unit can be transferred to the manual control mode providing the operator with direct control of the output.

The TSC features four programs or profile recipes, each with up to eight ramp/soak segments, which can be easily stored and executed at any time. Longer profiles can be achieved by linking one or more profiles together, creating a single profile of up to 32 ramp/soak segments. Temperature profile conformity is assured during either soak (hold) phases or both ramp and hold phases by an adjustable error band parameter. The program repeat function cycles the profile either continuously or a set number of times. Power-on options automatically re-start, stop, or resume a running profile. The profile can be controlled via the front panel buttons, the user input, or the optional serial communications port.

Four control points, each having a setpoint and PID parameter set, are available for instant front panel implementation during batch changeover, or

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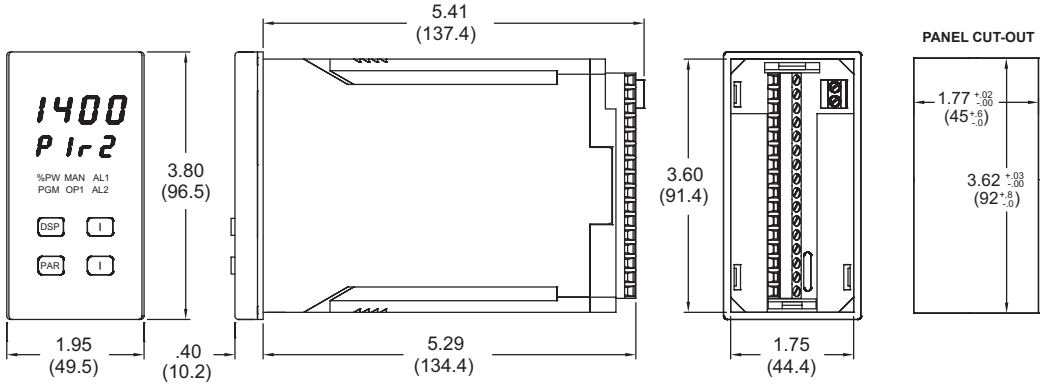
DIMENSIONS In inches (mm)

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 5.5" (140) H x 2.1" (53.4) W.



DESCRIPTION (Cont'd)

other process conditions. A control point may have its PID gain set values disabled when implementing the control point.

The optional RS485 multidrop serial communications interface provides the capability of two-way communication between a TSC unit and other compatible equipment such as a printer, a programmable controller, or a host computer. In multipoint applications the address number of each unit on the line can be programmed from 0-99. Up to thirty-two units can be installed on a single pair of wires. The Setpoint value, % Output Power, Setpoint Ramp Rate, etc. can be interrogated or changed by sending the proper command code via serial communications. Alarm output(s) may also be reset via the serial communications interface option.

Optional alarm output(s) may be configured to operate as a timed event output or as a standard alarm output. As an alarm output it may be configured to activate according to a variety of actions (Absolute HI or LO, Deviation HI or LO, or Band IN or OUT) with adjustable hysteresis. Also, a standby feature suppresses the output(s) on power-up until the temperature stabilizes outside the alarm region. Timed event output(s) allow the controller to activate other equipment while a programmed profile is running. Each profile can define up to 16 event states (phases), for each output(s).

An optional secondary output is available for processes that require cooling which provides increased control accuracy and response.

The optional linear 4 to 20 mA or 0 to 10 VDC output signal is available to interface with final actuators, chart recorders, indicators, or other controllers. The output signal can be digitally scaled and selected to transmit one of the following:

% Output Power
Measurement Value
Measurement Value Deviation
Setpoint Value

An optional Type 4X/IP65 rated bezel is available for washdown and/or dirty environments, when properly installed. Modern surface-mount technology, extensive testing, plus high immunity to noise interference, makes the controller extremely reliable in industrial environments.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the manual or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Do not use the TSC to directly command motors, valves, or other actuators not equipped with safeguards. To do so, can be potentially harmful to persons or equipment in the event of a fault to the unit. An independent and redundant temperature limit indicator with alarm outputs is strongly recommended. The indicators should have input sensors and AC power feeds independent from other equipment.

SPECIFICATIONS

1. **DISPLAY:** Dual 4-digit
   Upper Temperature Display: 0.4" (10.2 mm) Red LED
   Lower Auxiliary Display: 0.3" (7.6 mm) Green LED
   Display Messages:
   "OLOL" - Appears when measurement exceeds + sensor range.
   "ULUL" - Appears when measurement exceeds - sensor range.
   "OPEN" - Appears when open sensor is detected.
   "SHrt" - Appears when shorted sensor is detected *(RTD only)*.
   "...." - Appears when display value exceeds + display range.
   "-..." - Appears when display value exceeds - display range.
2. **POWER:** Switch selectable for 115/230 VAC (+10%, -15%) no observable line variation effect, 48-62 Hz, 10 VA.
3. **ANNUNCIATORS:**
   6 LED Backlight Status Indicators:
   %PW - Lower auxiliary display shows power output in (%).
   PGM - Lower auxiliary display shows profile status or profile time remaining.
   MAN - Controller is in manual mode.
   OP1 - Main control output is active.
   AL1 - Alarm #1 is active.
   AL2 - Alarm #2 is active *(for Dual Alarm Option)*
   OP2 - Cooling output is active *(for Cooling Option)*.
4. **CONTROLS:** Four front panel push buttons for setup and modification of controller functions and one external input.
5. **SETPOINT PROFILE:**
   Profiles: 4
   Segments Per Profile: 8 ramp/hold segments *(linkable to 32 segments)*.
   Ramp Rate: 0.1 to 999.9 degrees/minute or no ramp.
   Hold Time: Off or from 0.1 to 999.9 minutes, can be extended to 500 hours by linking.
   Error Band Conformity: Off or from 1 to 9999 degrees deviation, + value for hold phases, - value for both ramp and hold phases.
   Power-On Modes: Stop, auto-start, or profile resume.
   Start Mode: Ramps from process temperature.
   Program Auto Cycle: 1 to 249, or continuous.
   Event Outputs: 2, time activated with profile [uses Alarm output(s)].
   Control: Front panel buttons, user input, or RS485 communications.
6. **CONTROL POINTS:**
   Setpoints: 4
   PID gain sets: 4
   Control: Front panel buttons or user input.
7. **SENSOR INPUT:**
   Sample Period: 100 msec
   Response Time: 300 msec *(to within 99% of final value w/step input; typically, response is limited to response time of probe)*.
   Failed Sensor Response:
   Main Control Output(s): Programmable preset output.
   Display: "OPEN".
   Alarms: Upscale drive.
   DC Linear: Programmable preset output.
   Normal Mode Rejection: 40 db @ 50/60 Hz *(improves with increased digital filtering)*.
   Common Mode Rejection: 100 db, DC to 50/60 Hz.
   Protection: Input overload voltage; 240 VAC @ 30 sec max.
8. **THERMOCOUPLE:**
   Types: T, E, J, K, R, S, B, N or Linear mV.
   Input Impedance: 20 MΩ, all types.
   Lead Resistance Effect: 20 µV/350 Ω.
   Cold Junction Compensation: Less than ±1°C error over 0-50°C ambient temperature range. Disabled for linear mV type.
   Resolution: 1°C/F all types, or 0.1°C/F for T, E, J, K, and N only.
9. **RTD:** 2, 3 or 4 wire, 100 Ω platinum, alpha = 0.00385 (DIN 43760), alpha = 0.003916
   Excitation: 0.175 mA
   Resolution: 1 or 0.1 degree
   Lead Resistance: 7 Ω max.
10. **RANGE AND ACCURACY:**
    Errors include NIST conformity and A/D conversion errors at 23°C after 20 minutes warm-up. Thermocouple errors include cold junction effect. Errors are expressed as ±(% of reading) and ±3/4 LSD unless otherwise noted.

TC TYPE	RANGE	ACCURACY	WIRE COLOR (ANSI)
T	-200 to +400°C -328 to +752°F	0.20% + 1.5°C 0.20% + 2.7°F	blue
E	-200 to 750°C -328 to +1382°F	0.20% + 1.5°C 0.20% + 2.7°F	violet
J	-200 to +760°C -328 to +1400°F	0.15% + 1.5°C 0.15% + 2.7°F	white
K	-200 to +1250°C -328 to +2282°F	0.20% + 1.5°C 0.20% + 2.7°F	yellow
R	0 to +1768°C +32 to +3214°F	0.15% + 2.5°C 0.15% + 4.5°F	black
S	0 to +1768°C +32 to +3214°F	0.15% + 2.5°C 0.15% + 4.5°F	black
B	+200 to +1820°C +300 to +3300°F	0.15% + 2.5°C 0.15% + 4.5°F	grey
N	-200 to +1300°C -328 to +2372°F	0.20% + 1.5°C 0.20% + 2.5°F	orange
mV	-5.00 to 56.00	0.15% + 1 LSD	—
RTD (385)	-200 to +600°C -328 to +1100°F	0.10% + 0.5°C 0.10% + 0.9°F	—
RTD (392)	-200 to +600°C -328 to +1100°F	0.10% + 0.5°C 0.10% + 0.9°F	—
OHMS	1.0 to 320.0	0.15% + 1 LSD	—

11. **OUTPUT MODULES [Optional] (For All Output Channels):**
    Relay:
    Type: Form-C *(Form-A with RS485 option)*
    Rating: 5 Amps @ 120/240 VAC or 28 VDC *(resistive load)*, 1/8 HP @ 120 VAC *(inductive load)*.
    Life Expectancy: 100,000 cycles at max. rating.*(Decreasing load and/or increasing cycle time, increases life expectancy)*.
    Logic/SSR Drive: Can drive multiple SSR Power Units.
    Type: Non-isolated switched DC, 12 VDC typical.
    Drive: 45 mA max.
    Triac:
    Type: Isolated, Zero Crossing Detection.
    Ratings:
    Voltage: 120/240 VAC
    Max Load Current: 1 AMP @ 35°C
    0.75 AMP @ 50°C
    Min Load Current: 10 mA
    Off State Leakage Current: 7 mA max. @ 60 Hz
    Operating Frequency: 20 to 500 Hz
    Protection: Internal Transient Snubber, Fused.

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SPECIFICATIONS (Cont'd)

12. **MAIN CONTROL OUTPUT (Heating or Cooling):**
Control: PID or ON/OFF.
Output: Time proportioning or linear DC.
Hardware: Plug-in, replaceable output modules.
Cycle time: Programmable.
Auto-tune: When performed, sets proportional band, integral time, and derivative time values.
Probe Break Action: Programmable.
13. **COOLING OUTPUT (Optional):**
Control: PID or ON/OFF.
Output: Time proportioning or linear DC
Hardware: Plug-in, replaceable output modules.
Cycle time: Programmable.
Proportional Gain Adjust: Programmable.
Heat/Cool DeadBand: Programmable.
14. **LINEAR DC DRIVE (Optional):** With digital scale and offset, programmable deadband and update time.
4 to 20 mA:
Resolution: 1 part in 3500 typ.
Accuracy: *±(0.1% of reading + 25 µA)*.
Compliance: 10 V *(500 Ω max. loop impedance)*.
0 to 10 VDC:
Resolution: 1 part in 3500 typ.
Accuracy: *±(0.1% of reading + 35 mV)*.
Min. Load Resistance: 10 KΩ *(1 mA max.)*
Source: % output power, setpoint, deviation, or temperature. (Available for heat or cool, but not both.)
15. **ALARMS (Optional):**
Hardware: Plug-in, replaceable output module.
Modes: Absolute high acting
Absolute low acting
Deviation high acting
Deviation low acting
Inside band acting
Outside band acting
Timed event output(s)
Reset Action: Programmable; automatic or latched.
Delay: Programmable; enable or disable.
Hysteresis: Programmable.
Probe Break Action: Upscale.
Annunciator: LED backlight for "AL1", "AL2", (Alarm #2 not available with cooling output).
16. **SERIAL COMMUNICATIONS (Optional):**
Type: RS485 Multi-point, Balanced Interface.
Communication Format:
Baud Rate: Programmable from 300-9600.
Parity: Programmable for odd, even, or no parity.
Frame: 1 start bit, 7 data bits, 1 or no parity bit, 1 stop bit.
Unit Address: Programmable from 0-99, max. of 32 units per line.
Transmit Delay: 100 msec min., 200 msec max.
RS485 Common: Isolated from signal input common.
Auto Print Time: Off to 9999 seconds between print-outs.
17. **USER INPUT:** V_{IN} max = 5.25 VDC, V_{IL} = 0.85 V_{MAX}; V_{IH} = 2.0 V_{MIN}, Response time 100 msec max.
Functions:

Program Lock	Print Request
Integral Action Lock	Load Control Point
Auto/Manual Transfer	Run/Hold Profile 1
Setpoint Ramp Select	Run/Stop Profile 1
Reset Alarms	

18. **ENVIRONMENTAL CONDITIONS:**
Operating Temperature: 0 to 50°C
Storage Temperature: -40 to 80°C
Vibration to IEC 68-2-6: Operational 5-150 Hz, 1 g
Shock to IEC 68-2-27: Operational 5 g
Operating and Storage Humidity: 85% max. (non-condensing) from 0°C to 50°C.
Span Drift: ≤ 100 ppm/°C
Zero Drift: ≤ 1 µ V/°C
Altitude: Up to 2000 meters
19. **CERTIFICATIONS AND COMPLIANCES:**
CE Approved
EN 61326-1 Immunity to Industrial Locations
Emission CISPR 11 Class A
EN 61010-1
RoHS Compliant
UL Recognized Component: File #E156876
UL Listed: File #E137808
Type 2 Enclosure rating (Face only) for TSC0
Type 4X/IP65 Enclosure rating (Face only) for TSC1
Refer to EMC Installation Guidelines section of the manual for additional information.
20. **CONNECTION:** Jaw-type terminal block.
21. **CONSTRUCTION:**
Front Panel: Flame and scratch resistant tinted plastic.
Case: High impact black plastic. (Mounting collar included).
Type 4X/IP65 model only: Sealed bezel utilizing 2 captive mounting screws (panel gasket included).This unit is rated for Type 4X/IP65 indoor use. Installation Category II, Pollution Degree 2.
22. **WEIGHT:** 1.3 lbs. (0.6 kgs)

BASIC OPERATION

The TSC controls the temperature profile of a system by measuring the temperature via an input probe, compares the actual temperature to the setpoint profile in progress, and calculates the new output power value by use of a modified PID control algorithm. The unit controls the system with the new output power value so the process temperature conforms to the programmed profile. The PID control algorithm incorporates features which provide minimum overshoot and excellent temperature control accuracy for a process.

FRONT PANEL FEATURES

In the normal display mode, the unit will display the process temperature in the upper display. One of five other parameters may be selected for viewing in the lower display:

Target Setpoint	Profile Phase Time Remaining
% Output Power	Temperature Symbol (F/C)
Profile Status	

The program profile status display indicates the active profile number with the current ramp or hold phase of the profile. The profile can be started, stopped, advanced, etc. from the front panel when the profile status display is viewed, if not locked from access.

The phase time remaining display, shows the time remaining in a ramp or hold phase and, if not locked from access, may be changed on-line to effect temporary changes to the program. Additionally, the target setpoint and % output power (manual mode only) may also be changed on-line or locked from operator access.

From the normal operating mode, parameters are selected by use of the PAR button and modified by use of the UP and DOWN buttons. Parameters are then entered by the PAR button, which advances the user to the next parameter. Pressing the DSP button immediately returns the controller to the normal operating mode from any parameter module. The controller configuration and parameter settings are stored in an internal E^2PROM device.

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CONFIGURATION MODE

The configuration modules serve to provide the basic set-ups required by the controller. It is divided into sections which group together related programming steps, such as inputs, outputs, alarms, etc. Upon completion of each section, the program returns to the configuration selection stage, which allows the user to return to the normal display mode, or advance to a later configuration stage.

Configuration 1, Inputs

- "tYPE" - Select input probe type
- "SCAL" - Select temperature scale
- "dCPt" - Select temperature resolution
- "FLtr" - Select degree of input filtering
- "SPAN" - Enter input correction span (slope)
- "SHFt" - Enter input correction shift (offset)
- "SPLO" - Enter setpoint lower limit
- "SPHI" - Enter setpoint higher limit
- "SPrP" - Enter setpoint ramp rate
- "InPt" - Select user input function

Configuration 2, Outputs

- "CYCt" - Enter time proportioning cycle time
- "OPAC" - Select control action
- "OPLO" - Enter output power low limit
- "OPHI" - Enter output power high limit
- "OPFL" - Enter probe fail power preset
- "CHYS" - Enter ON/OF control hysteresis
- "tcod" - Select auto-tuning damping
- "ANAS" - Select linear DC output assignment *
- "ANLO" - Enter linear DC low scaling value *
- "ANHI" - Enter linear DC high scaling value *

Configuration 3, Parameter lock-outs

- "SP" - Select degree of setpoint access
- "OP" - Select degree of power access
- "P-CS" - Select degree of profile status access
- "P-tr" - Select degree of phase time remaining access
- "UdSP" - Enable temperature units display
- "CodE" - Enter parameter access code
- "Pid" - Select degree of PID access
- "AL" - Select degree of alarm access *
- "ALrS" - Enable manual reset of alarms *
- "CPAC" - Enable control point access
- "PrAC" - Enable ramp/hold program access
- "trnF" - Enable automatic/manual transfer
- "tUNE" - Enable auto-tune invocation

Configuration 4, Alarms *

- "Act 1" - Select operation mode of alarm #1
- "rSt1" - Select reset mode of alarm #1
- "Stb1" - Enable activation delay of alarm #1
- "AL-1" - Enter value for alarm #1
- "Act2" - Select operation mode of alarm #2
- "rSt2" - Select reset mode of alarm #2
- "Stb2" - Enable activation delay of alarm #2
- "AL-2" - Enter value for alarm #2
- "AHYS" - Enter hysteresis value for both alarms

Configuration 5,.Cooling *

- "CYC2" - Enter cooling time proportioning cycle time
- "GAN2" - Enter cooling relative gain
- "db-2" - Enter heat/cool deadband or overlap

Configuration 6, Serial Communications *

- "bAUd" - Select baud rate
- "PArb" - Select parity bit
- "Addr" - Enter unit address number
- "Abrv" - Select abbreviated or full mnemonic transmissions
- "PrAt" - Enter automatic print rate
- "PoPt" - Select parameters to be included in print-out

Configuration 7, Control Points

- "CSEt" - Select control point number for set-up 1, 2, 3, & 4
- "SP-x" - Enter setpoint value for selected control point
- "Pid" - Select if PID gain set to be loaded with setpoint
- "PB-x" - Enter proportional band for selected control point *
- "It-x" - Enter integral time for selected control point *
- "dt-x" - Enter derivative time for selected control point *

Configuration 8, Profiles

- "PSEt" - Select profile or event output for set-up 1, 2, 3, or 4
- "PnCC" - Enter program-repeat cycle count for selected profile
- "PnLn" - Select link option for selected profile
- "PnEb" - Enter error band for temperature conformity for selected profile
- "PnPC" - Enter power-down resume status for selected profile
- "Pnr1" - Enter ramp rate 1 for selected profile *
- "PnL1" - Enter setpoint level 1 for selected profile *
- "PnH1" - Enter hold time 1 for selected profile *
- . . .
- "Pnr8" - Enter ramp rate 8 for selected profile *
- "PnL8" - Enter setpoint level 8 for selected profile *
- "PnH8" - Enter hold time 8 for selected profile *
- "Pn 1" - Select event outputs at phase 1 for selected profile *
- . . .
- "Pn16" - Select event outputs at phase 16 for selected profile *

Configuration 9, Factory Service Operations

(Detailed in the operator's manual)

* These parameters may not appear due to option configuration or other programming

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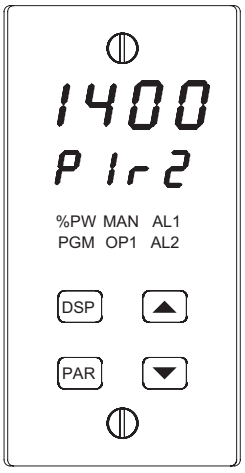
HARDWARE FEATURES

The fast 100 msec input sampling rate provides quick controller response to a process disturbance for excellent temperature control. Measurement accuracy of 0.15% provides closer process control conforming to the desired control setpoint value.

The unit accepts a variety of both thermocouple or RTD temperature probes. The A.C. input power is switch selectable, allowing the unit to operate from either 115 VAC or 230 VAC. Since the controller is serviceable from the front of the panel, the output modules may be easily changed or replaced without disturbing the wiring behind the panel and NO re-programming is required. The standard model simply requires pressing a latch to remove the unit. The Type 4X/IP65 rated model utilizes two panel securing screws and a neoprene gasket to guarantee a water tight seal, when properly installed.

Low-drift, highly stable circuit design ensures years of reliable and accurate temperature control. The recommended two year re-calibration interval is easily accomplished via the programming menu.

Type 4X/IP65 BEZEL



SETPOINT FEATURES

The controller's setpoint can be protected from out of range values, by programming the setpoint range limit values. Additionally, safeguards from inadvertent data entry can also be programmed.

The setpoint ramp feature ramps the setpoint value at start-up or any time a setpoint change is made, at a user programmable rate, independent of a programmed profile. This feature reduces thermal shock to the process and also helps to minimize temperature overshoot.

The active setpoint, which can be a running profile, may also be transmitted by the linear DC output for slave control loops.

Four control points are available which can be implemented at any time. Each control point is programmed independently, with each having a setpoint and a PID gain set value. With gain value changes, the output power control signal will not "bump" resulting in a smooth control transition.

INPUT FEATURES

A programmable input filter can be used to stabilize readings from a process with varying or oscillating temperature characteristics, helping to provide better temperature control.

A programmable temperature shift and slope function can be used to compensate for probe errors or to have multiple TSC units indicate the same nominal temperature.

A programmable User Input is available to control a variety of controller functions, such as profile control, auto/manual transfer, serial communication print requests, etc.

OUTPUT FEATURES

Programmable output power limits provide protection for processes where too much power can cause damage. Automatic sensor probe break detection, for fail-safe operation, causes the controller to default to a programmed output power *(upscale or downscale burnout)*. With adjustable time proportioning-cycle time and programmable D.C. Linear output, the controller can satisfy a wide variety of output requirements.

During execution of a profile, two independent, timed event outputs are available to control or signal other equipment. The event outputs use the alarm channels.

The RS485 Communication option allows the user to access various controller parameters such as the setpoint, % output power, % proportional band, etc. The controller may be setup to transmit various parameters at a programmable automatic print rate.

AUTO-TUNE

The model TSC has an auto-tune feature which, on demand, automatically determines the PID control parameters for a particular thermal process. After completion of auto-tune, the PID parameters are automatically optimized for that process and loaded into nonvolatile memory. The operator may view and modify the parameters as desired.

Auto-tune may be invoked at start-up, while ramping, or at setpoint, depending on the process requirements. A programmable auto-tune damping factor produces various levels of process control and response characteristics.

PROFILE PROGRAMMING

Profiles are programmed independently of each other and are separate from the configuration of other controller parameters. Each profile has parameters for error band (profile conformity), linking, auto-start and program repeat cycles. Profiles may be altered during execution, so changes take effect as the programmed profile advances.

CONTROLLER PROGRAMMING

The model TSC has been designed to reduce the operator interaction with the controller while still maintaining a high degree of control accuracy and user flexibility. Front panel program disable allows all of the controller's set-ups to be locked-out from further operator intervention after the initial parameter set-up.

The programming of the controller is divided into four sections:

Hidden Mode
Protected Mode
Unprotected Mode
Configuration Mode

These four programming modes allow the controller to adapt to any required user-interface level.

UNPROTECTED PARAMETER MODE

The unprotected mode is accessible when program disable is inactive or when the proper access code number from the protected mode is entered. Only from this mode can the configuration modes be accessed.

"SP"	-	Enter setpoint *
"OPOF"	-	Enter %output power offset *
"OP"	-	Enter output power *
"ProP"	-	Enter proportional band
"Intt"	-	Enter integral time *
"dErt"	-	Enter derivative time *
"AL-1"	-	Enter value for alarm #1 *
"AL-2"	-	Enter value for alarm #2 *
"CNFP"	-	Select basic configuration module
"End"	-	Return to normal display mode

PROTECTED PARAMETER MODE *

The protected mode is accessible when program disable is active, also this mode prevents access to the configuration modes without the proper access code number. Only the parameters that are selected in the configuration 3 parameter lock-outs section can be accessed.

"ProP"	-	Enter proportional band
"Intt"	-	Enter integral time
"dErt"	-	Enter derivative time
"AL-1"	-	Enter value for alarm #1
"AL-2"	-	Enter value for alarm #2
"CodE"	-	Enter access value to unprotected mode
"End"	-	Return to normal display mode

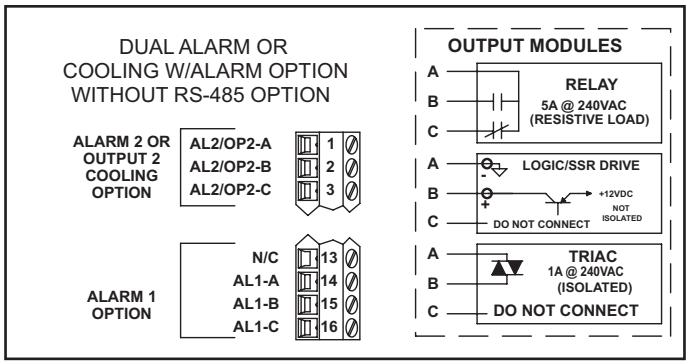
HIDDEN FUNCTIONS MODE *

The hidden mode is accessible from the normal operating mode by holding the PAR button for 3 seconds. The five functions in this mode may be locked-out individually in configuration 3 parameter lock-outs section.

" CP"	-	Load control point x
"Prun"	-	Control ramp/hold profile state
"trnF"	-	Transfer between automatic (PID) control and Manual control
"tUNE"	-	Invoke/Cancel PID auto-tune
"ALrS"	-	Reset latched alarms

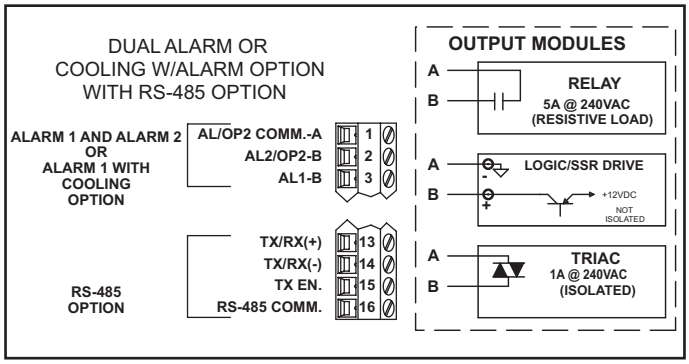
OUTPUT VARIATIONS WITHOUT RS485 OPTION

The Dual Alarm or the Cooling with Alarm output, without the RS485 option, has independent outputs. Therefore, the cooling output and/or alarm output*(s)* can be installed with any combination of output modules.



OUTPUT VARIATIONS WITH RS485 OPTION

The Dual Alarm or the Cooling with Alarm output, with RS485 option, does not have independent outputs. In this case, the cooling output and/or alarm output*(s)* must have the same type of output modules installed since they share the common terminal.



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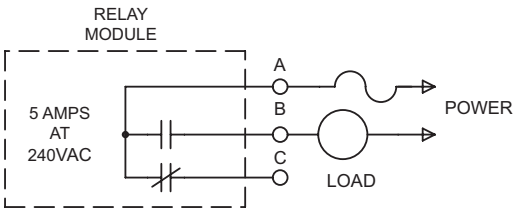
* *These parameters may not appear due to option configuration or other programming*

OUTPUT MODULES

Units equipped with RS485 option must have the Dual Alarm or Cooling w/ alarm options fitted with the same type of output modules. The controller's main output (OP1) can be fitted with any output module. Output modules are shipped separately and must be installed by the user.

TYPICAL CONNECTIONS

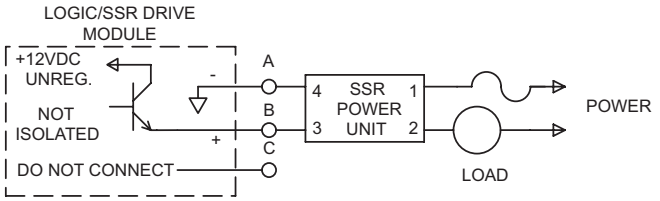


Relay:

Type: Form -C (Form-A with RS485 option only)

Rating: 5 Amps @ 120/240 VAC or 28 VDC (resistive load), 1/8 HP @ 120 VAC (inductive).

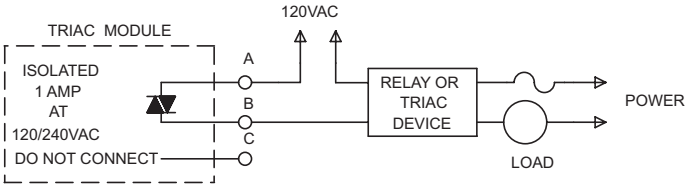
Life Expectancy:100,000 cycles at maximum load rating.
(Decreasing load and/or increasing cycle time, increases life expectancy).



Logic/SSR Drive: can drive multiple SSR Power Units.

Type: Non-isolated switched DC, 12 VDC typical.

Drive: 45 mA max.



Triac:

Type: Isolated, Zero Crossing Detection.

Rating:

Voltage: 120/240 VAC.

Max. Load Current: 1 Amp @ 35°C
0.75 Amp @ 50°C

Min. Load Current: 10 mA

Off State Leakage Current: 7 mA max. @ 60 Hz

Operating Frequency: 20 to 500 Hz.

Protection: Internal Transient Snubber, Fused.

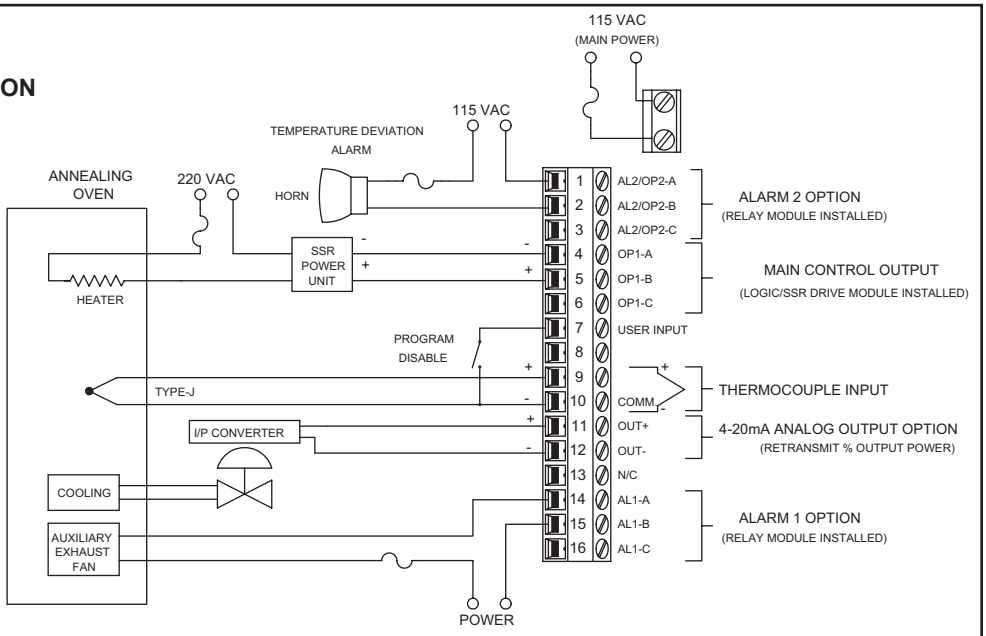
APPLICATION

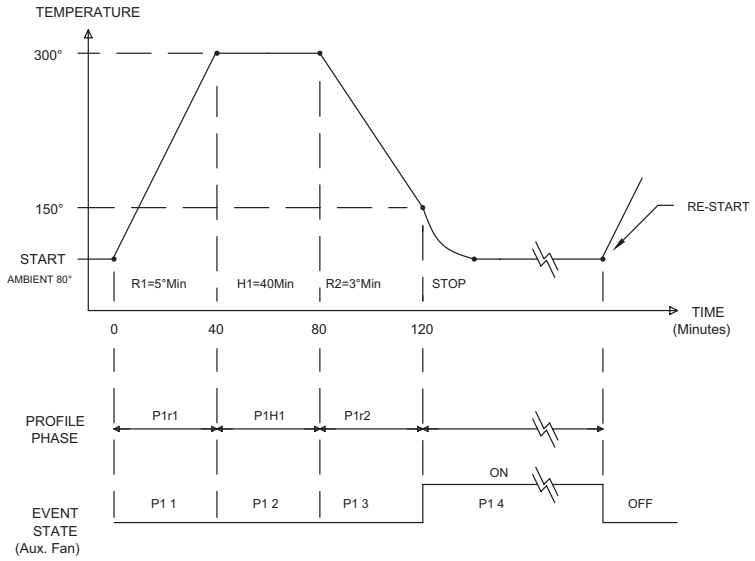
TSC GLASS TEMPERING APPLICATION

A manufacturer of glass items needs to anneal *(temper)* their products to reduce the brittleness of the glass structure. The tempering process requires the glass to be heated and subsequently cooled at a controlled rate to change the structure of the glass. Different tempering profiles are required for different types of glass products.

A TSC is employed to control the temperature profile of the annealing oven. Four different temperature profiles are stored in the controller. The 4 to 20 mA analog output option is utilized to cool the annealing oven during the cool down ramp phases. An event output is used to quickly cool the oven at the end of the batch run *(alarm 1)*. Alarm 2 is used to signal the operator whenever the temperature is outside the prescribed program profile.

Note: Units equipped with the RS485 option have different terminal designators. See "Output Variations with or without the RS485 Option".





The programming for this profile is as follows:

Parameter	Value	Description
"P1r1"	5.0	Ramp from ambient temp. during heat phase at 5.0°/min.
"P1L1"	300	Target setpoint level 300°
"P1H1"	40.0	Heat at 300° for 40.0 minutes
"P1r2"	3.0	Ramp down 3.0°/min. during cooling phase
"P1L2"	150	Target Setpoint is 150°
"P1H2"	0.0	Do not hold at 150° *(used as "phantom" hold time for triggering event output for auxiliary cooling)*
"P1r3"	-0.1	End Program
"P1 1"	1F2F	Turn off output 1 *(output 2 is alarm)*
"P1 2"	1F2F	Keep off output 1
"P1 3"	1F2F	Keep off output 1
"P1 4"	1N2F	Turn on output 1 for Auxiliary Exhaust Fan

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ORDERING INFORMATION

MODEL NO	DESCRIPTION	Type 4X/IP65 BEZEL	4 to 20 mA ANALOG OUTPUT	0 to 10 VDC ANALOG OUTPUT	ALARM OUTPUTS	COOLING OUTPUT	RS485 COM	PART NUMBER
TSC	Temperature Setpoint Controller	NO	YES	NO	2	NO	NO	TSC01001
		YES	YES	NO	2	NO	NO	TSC11001
		YES	YES	NO	1	YES	NO	TSC11002
		YES	YES	NO	2	NO	YES	TSC11004
		YES	YES	NO	1	YES	YES	TSC11005
		YES	NO	YES	2	NO	YES	TSC12004
		YES	NO	YES	1	YES	YES	TSC12005
	Relay Module							OMD00000
	Triac Module							OMD00001
	Logic/SSR Drive Module							OMD00003
PMK5	Panel Mount Adapter Kit (1/4 DIN to 1/8 DIN)							PMK50000
RLY	45 A Single Phase Panel Mount SSR							RLY50000
	25 A Single Phase DIN Rail Mount SSR							RLY60000
	40 A Single Phase DIN Rail Mount SSR							RLY6A000
	25 A Three Phase DIN Rail Mount SSR							RLY70000
These models have dual alarm outputs, or single alarm with secondary outputs, with shared common terminals (Form A Type). As a result, these outputs should be fitted with the same type of output module. The main output (OP1) may be fitted with any type of output								

Note: Output Modules are NOT supplied with the controller. When specifying the controller, be sure to purchase the appropriate output module for the Main Control Output and if necessary, the alarm output(s) and cooling output. The controller can be fitted with any combination of output modules that do not have the RS485 option.

The Logic/SSR Drive Module is a switched DC source, intended to drive the DC input of an SSR power unit. It should never be connected to a line voltage.

All modules are shipped separately and must be installed by the user.

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MODEL P16 - 1/16 DIN PROCESS CONTROLLER

This is a brief overview of the P16. For complete specifications and programming information, see the **T16/P16 Temperature/Process Controller Bulletin** starting on **page 519**.

- *PID CONTROL WITH REDUCED OVERSHOOT*
- *ACCEPTS 0-10 V AND 0/4-20 mA SIGNALS*
- *ON DEMAND AUTO-TUNING OF PID SETTINGS*
- *DC ANALOG OUTPUT (OPTIONAL)*
- *USER PROGRAMMABLE FUNCTION BUTTON*
- *PC OR FRONT PANEL PROGRAMMING*
- *PC CONFIGURABLE WITH TP16KIT*

UL Recognized Component, File #E156876

INPUT SPECIFICATIONS

1. **SENSOR INPUT**:
   Sample Period: 100 msec (10 Hz rate)
   Step Response Time: 300 msec typical, 400 msec max to within 99% of final value with step input.
   Failed Sensor Response:
   Main Control Output(s): Programmable preset output
   Display: "OPEN"
   Alarms: Upscale drive
   Analog Output: Upscale drive when assigned to retransmitted input.
   Normal Mode Rejection: >40 dB @ 50/60 Hz
   Common Mode Rejection: >120 dB, DC to 60 Hz
   Overvoltage Protection: 120 VAC @ 15 sec max
4. **SIGNAL INPUT**: (P16 only)
   * Accuracies are expressed as ± percentages over 0 to 50 °C ambient range after 20 minute warm-up.

INPUT RANGE	ACCURACY *	IMPEDANCE	MAX CONTINUOUS OVERLOAD	RESOLUTION
10 VDC (-1 to 11)	0.30 % of reading +0.03V	1 MΩ	50 V	10 mV
20 mA DC (-2 to 22)	0.30 % of reading +0.04mA	10 Ω	100 mA	10 µA

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MODEL P48 - 1/16 DIN PROCESS CONTROLLER

- *PID CONTROL WITH REDUCED OVERSHOOT*
- *ACCEPTS 0 to 10 VDC or 0/4 to 20 mA DC INPUTS*
- *OPTIONAL TWO LINEAR DC OUTPUTS (0 to 10 V, 0/4 to 20 mA)*
- *OPTIONAL DUAL ALARM OUTPUTS*
- *OPTIONAL REMOTE SETPOINT INPUT (0/4 to 20 mA)*
- *OPTIONAL RS485 SERIAL COMMUNICATIONS*
- *SECOND SETPOINT SETTING*
- *SETPOINT RAMPING FOR PROCESS STARTUP*
- *PROGRAMMABLE USER INPUT (Digital) FOR ADDED FLEXIBILITY*
- *PARAMETER SECURITY VIA PROGRAMMABLE LOCKOUTS*
- *MANUAL/AUTOMATIC CONTROL MODES*
- *ON DEMAND AUTO-TUNING OF PID CONTROL SETTINGS*
- *DUAL LED DISPLAYS FOR SIMULTANEOUS INDICATION OF PROCESS AND SETPOINT*

- *STATUS INDICATORS FOR OUTPUTS AND CONTROL MODES*
- *PC SOFTWARE AVAILABLE FOR CONTROLLER CONFIGURATION*
- *NEMA 4X/IP65 BEZEL*

UL Recognized Component, File # E156876

DESCRIPTION

The P48 Controller accepts either a 0 to 10 VDC or a 0/4 to 20 mA DC signal, precisely displays the input process signal according to the programmable scaling points, and provides an accurate output control signal *(time proportional or linear DC)* to maintain the process at the desired control point. The controller's comprehensive yet simple programming allows it to meet a wide variety of application requirements.

In the PID control mode the controller operates with on-demand auto-tune, which will establish the tuning constants. The PID tuning constants may be fine-tuned by the operator at any time and then locked out from further modification. The controller employs a unique overshoot suppression feature, which allows the quickest response without excessive overshoot. The unit can be transferred to operate in the manual mode, providing the operator with direct control of the output. The controller may also operate in the ON/OFF control mode with adjustable hysteresis. a second setpoint is available to allow quick selection of a different setpoint setting.

Dual 4-digit displays allow viewing of the process and setpoint simultaneously. Front panel indicators inform the operator of the controller and output status. On some models, the main control output and the alarm outputs are field replaceable.

Optional alarm(s) can be configured to activate according to a variety of actions (Absolute HI or LO, Deviation HI or LO, and Band IN or OUT) with adjustable hysteresis. A standby feature suppresses the alarm during power-up until the process stabilizes outside the alarm region. The second alarm can be configured as a secondary PID output (heat/cool applications).

Optional Main Linear DC output (10 V or 20 mA) can be used for control or process re-transmission purposes. Programmable output update time reduces valve or actuator activity. The output range can be scaled independent of the input range.

Optional Second Linear DC output (10 V or 20 mA) provides an independent process re-transmission, while the main Linear DC output is being used for control. The output range can be scaled independent of the input range.

Optional Remote Setpoint input (0/4 to 20 mA) allows for cascade control loops; and allows for remotely driven setpoint signal from computers or other similar equipment. Straightforward end point scaling with independent filtering and local/remote transfer option expand the controller's flexibility.

The optional RS485 serial communication interface provides two-way communication between a P48 and other compatible equipment such as a printer, PLC, HMI, or a host computer. In multipoint applications (up to thirty-two), the address number of each P48 on the line can be programmed separately from 0 to 99. Data from the P48 can be interrogated or changed, and alarm output(s) may be reset by sending the proper command code via serial communications. PC software, SFCRM, allows for easy configuration of controller parameters. These settings can be saved to disk for later use or used for multi-controller down loading. On-line help is provided within the software.

The unit is constructed of a lightweight, high impact plastic case with a tinted front panel. The front panel meets NEMA 4X/IP65 specifications when properly installed. Multiple units can be stacked horizontally or vertically. Modern surface-mount technology, extensive testing, plus high immunity to noise interference makes the controller extremely reliable in industrial environments.

CAUTION: Risk of Danger. Read complete instructions prior to installation and operation of the unit.

CAUTION: Risk of electric shock.

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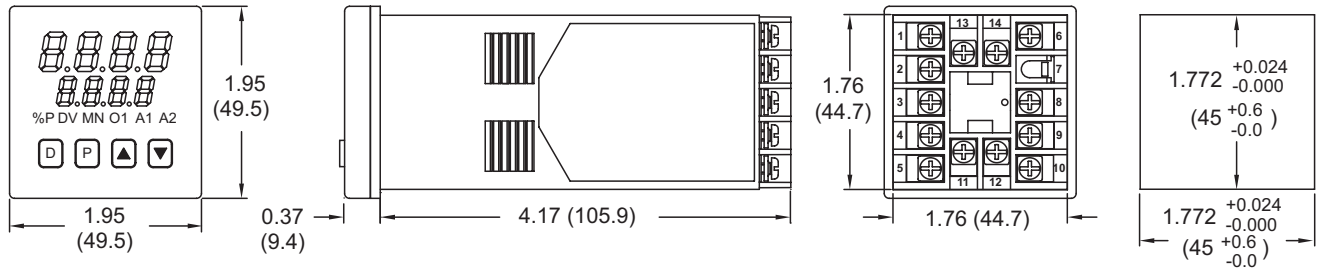
DIMENSIONS In inches (mm)



SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the manual or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Do not use the P48 to directly command motors, valves, or other actuators not equipped with safeguards. To do so can be potentially harmful to persons or equipment in the event of a fault to the controller. An independent and redundant process limit indicator with alarm outputs is strongly recommended.

SPECIFICATIONS

1. **DISPLAY:** Dual 4-digit
   Upper Process Display: 0.4" (10.2 mm) high red LED
   Lower Auxiliary Display: 0.3" (7.6 mm) high green LED
   Display Messages:
   "OLOL" - Appears when measurement exceeds + input range.
   "ULUL" - Appears when measurement exceeds - input range.
   "SENS" - Appears when measurement exceeds controller limits.
   "..." - Appears when display values exceed + display range.
   "-.." - Appears when display values exceed - display range.
   LED Status Annunciators:
   %P - Lower auxiliary display shows power output in (%).
   MN - Flashing: Controller is in manual mode.
   On: Local Setpoint (Remote Setpoint option)
   Off: Remote Setpoint
   DV - Lower auxiliary display shows deviation *(error)* from setpoint.
   O1 - Main control output is active.
   A1 - Alarm #1 is active *(for A1 option)*.
   A2 - Alarm #2 is active OR
   - Secondary output (02) is active.
2. **POWER:**
   AC Versions: 85 VAC min. to 250 VAC max., 50 to 60 Hz, 8 VA max.
   DC Versions:
   DC Power: 18 to 36 VDC; 7 W
   AC Power: 24 VAC ±10%; 50 to 60 Hz, 9 VA
3. **CONTROLS:** Four front panel push buttons for modification and setup of controller functions and one external user input for parameter lockout or other functions.
4. **MEMORY:** Nonvolatile E^2 PROM retains all programmable parameters and values.
5. **RANGE AND ACCURACY:**

INPUT RANGE	ACCURACY * (18 to 28°C)	ACCURACY * (0 to 50°C)	IMPEDANCE	MAX CONTINUOUS OVERLOAD	RESOLUTION
10 VDC (-1 to 11)	0.10% of reading +0.02 V	0.30% of reading +0.03 V	1 M ohm	300 V	10 mV
20 mA DC (-2 to 22)	0.10% of reading +0.03 mA	0.30% of reading +0.04 mA	10 ohm	100 mA	10 µA

   * Accuracies are expressed as ± percentages after 20 minutes warm-up. The controller's accuracy is specified in two ways: accuracy over an 18 to 28°C range at 10 to 75% RH environment; and accuracy over a 0 to 50°C range at 0 to 85% RH (non-condensing) environment. Accuracy over the wide sensor range reflects the coefficient of the internal circuitry.
6. **MAIN SIGNAL INPUT:**
   Sample Period: 100 msec
   Response Time: Less than 300 msec typ., 400 msec max. *(to within 99% of final value w/step input; typically, response is limited to response time of sensor)*
   Normal Mode Rejection: 40 dB @ 50/60 Hz (improves with increased digital filtering.)
   Common Mode Rejection: Greater than 120 dB, DC to 60 Hz
   Protection: Input overload 120 VAC max. for 15 sec. max.
7. **USER INPUT:** Internally pulled up to +5 VDC (1 MΩ).
   $V_{IN\ MAX}$ = 5.25 VDC; V_{IL} = 0.85 V max.; V_{IH} = 3.65 V min.;
   I_{OFF} = 1µA max.
   Response Time: 120 msec max.
   Functions:
   Program Lock
   Auto/Manual Mode Select
   Reset Alarms
   Local/Remote Setpoint Select
   Integral Action Lock
   Setpoint Ramp Enable
   Setpoint 1/Setpoint 2 Select
   Serial block print
8. **CONTROL AND ALARM OUTPUTS:**
   Relay outputs with Form A contacts:
   Contact Rating: 3 A @ 250 VAC or 30 VDC (resistive load)
   1/10 HP @ 120 VAC (inductive load)
   Life Expectancy: 100,000 cycles at max. load rating.
   (Decreasing load and/or increasing cycle time, increases life expectancy.)
9. **MAIN CONTROL:**
   Control: PID or ON/OFF
   Output: Time proportioning or Linear DC
   Cycle time: Programmable
   Auto-tune: When selected, sets proportional band, integral time, and derivative time values.
10. **ALARMS:** 1 or 2 alarms (optional)
    Modes:
    Absolute high acting
    Deviation high acting
    Inside band acting
    Absolute low acting
    Deviation low acting
    Outside band acting
    Reset Action: Programmable; automatic or latched
    Standby Mode: Programmable; enable or disable
    Hysteresis: Programmable
    Annunciator: LED backlight for "A1", "A2"
11. **SECONDARY OUTPUT:** Software selectable (overrides alarm 2)
    Control: PID or ON/OFF
    Output: Time Proportioning
    Cycle time: Programmable
    Proportional Gain Adjust: Programmable
    Deadband /Overlap: Programmable
12. **MAIN AND SECOND LINEAR DC OUTPUT:** (optional)
    Main: Control or re-transmission, programmable update rate from 0.1 sec to 250 sec
    Second: Re-transmission only, fixed update rate of 0.1 sec

OUTPUT ** RANGE	ACCURACY * (18 to 28°C)	ACCURACY * (0 to 50°C)	COMPLIANCE	RESOLUTION
0 to 10 V	0.10% of FS + 1/2 LSD	0.30% of FS + 1/2 LSD	10k ohm min.	1/3500
0 to 20 mA	0.10% of FS + 1/2 LSD	0.30% of FS + 1/2 LSD	500 ohm max.	1/3500
4 to 20 mA	0.10% of FS + 1/2 LSD	0.30% of FS + 1/2 LSD	500 ohm max.	1/2800

    * Accuracies are expressed as ± percentages after 20 minutes warm-up. Output accuracy is specified in two ways: Accuracy over an 18 to 28°C range at 10 to 75% RH environment; and accuracy over a 0 to 50°C range at 0 to 85% RH (non-condensing) environment. Accuracy over the wide sensor range reflects the coeffecient of the internal circuitry.
    ** Outputs are independently jumper selectable for either 10 V or 20 mA. The output range may be field calibrated to yield approximately 10% overrange and a small underrange (negative) signal.
13. **REMOTE SETPOINT INPUT:** (optional)
    Input type: 0/4 to 20 mA
    Input Resistance: 10Ω
    Overrange: -5% to 105%
    Overload: 100 mA (continuous)
    Scale Range: -999 to 9999
    Resolution: 1 part in 10,000.
    Accuracy:
    At 25° C: ±(0.1 % of full scale +½ LSD)
    Over 0 to 50°C range: ±(0.2% of full scale +½ LSD)
    Reading Rate: 10/sec.
    Setpoint Filtering: Programmable Digital
    Setpoint Ramping: Programmable, 1 to 9999 units/minute.
14. **SERIAL COMMUNICATIONS:** (optional)
    Type: RS485 multipoint, balanced interface
    Baud Rate: 300 to 9600
    Data Format: 7O1, 7E1, 7N2, 8N1
    Node Address: 0 to 99, max of 32 units per line
    Transmit Delay: 2 to 100 msec or 100 to 200 msec
    Data Encoding: ASCII
    Isolation w.r.t Main Input Common: 500 Vrms for 1 min. (50 V working)
    Not isolated w.r.t. Remote Setpoint or Analog Output common
    Note: RS485 and the Analog Output commons are not internally isolated within the controller. The terminating equipment of these outputs must not share the same common (ie. earth ground).
15. **ENVIRONMENTAL CONDITIONS:**
    Operating Range: 0 to 50°C
    Storage Range: -40 to 80°C
    Operating and Storage Humidity:
    85% max. relative humidity (non-condensing) from 0°C to 50°C.
    Vibration According to IEC 68-2-6: Operational 5 to 150 Hz, in X, Y, Z direction for 1.5 hours, 2 g.
    Shock According to IEC 68-2-27: Operational 20 g (10 g relay), 11 msec in 3 directions.
    Altitude: Up to 2000 meters

16. **ISOLATION BREAKDOWN RATINGS:**
AC line with respect to all Inputs and outputs: 250 V working (2300 V for 1 minute).
Main input with respect to Analog Outputs and Remote Setpoint Input: 50 V working (2300 V for 1 minute).
All other inputs and outputs with respect to relay contacts: 2000 VAC
Not isolated between Analog Output and Remote Setpoint commons.
17. **CERTIFICATIONS AND COMPLIANCES:**
SAFETY
UL Recognized Component, File #E156876, UL873, CSA 22.2 No. 24
Recognized to U.S. and Canadian requirements under the Component Recognition Program of Underwriters Laboratories, Inc.
Type 4X Enclosure rating (Face only), UL50
IEC 61010-1, EN 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1.
IP65 Enclosure rating (Face only), IEC 529
ELECTROMAGNETIC COMPATIBILITY

Immunity to EN 50082-2		
Electrostatic discharge	EN 61000-4-2	Level 2; 4 Kv contact Level 3; 8 Kv air
Electromagnetic RF fields	EN 61000-4-3	Level 3; 10 V/m [1] 80 MHz - 1 GHz
Fast transients (burst)	EN 61000-4-4	Level 4; 2 Kv I/O Level 3; 2 Kv power
RF conducted interference	EN 61000-4-6	Level 3; 10 V/rms [2] 150 KHz - 80 MHz
Power frequency magnetic fields	EN 61000-4-8	Level 4; 30 A/m
Simulation of cordless telephones	ENV 50204	Level 3; 10 V/m 900 MHz ± 5 MHz 200 Hz, 50% duty cycle
Emissions to EN 50081-2		
RF interference	EN 55011	Enclosure class A Power mains class A

Notes:
1. No loss of performance during EMI disturbance at 10 V/m.
Unit is panel mounted in a metal enclosure (Buckeye SM7013-0 or equivalent) that provides at least 20 dB shielding effectiveness. Metal panel is connected to earth ground.
Power Line and I/O cables routed in metal conduit connected to earth ground.
2. Self-recoverable loss of performance during EMI disturbance at 10 Vrms: Analog output may deviate during EMI disturbance.
For operation without loss of performance:
Install power line filter, RLC#LFIL0000 or equivalent.
OR
Install 2 ferrite cores, RLC#FCOR0000 or equivalent, to AC lines at unit for frequencies above 5 MHz.
I/O cables routed in metal conduit connected to earth ground.
Refer to the EMC Installation Guidelines section of the manual for additional information.
18. **CONNECTION:** Wire clamping screw terminals
19. **CONSTRUCTION:** Black plastic alloy case and collar style panel latch. Panel latch can be installed for vertical or horizontal instrument stacking. One piece tinted plastic bezel. Bezel assembly with circuit boards can be removed from the case to change the output board without removing the case from the panel or disconnecting wiring. Unit meets NEMA 4X/IP65 requirements for indoor use, when properly installed. Installation Category II, Pollution Degree 2.
20. **WEIGHT:** 0.38 lbs (0.17 kgs)

BASIC OPERATION

The P48 controls a process by receiving a linear DC signal representing the process value, then calculating a control output power value by use of a modified PID control algorithm. The unit controls the system with the new output power value to keep the process at setpoint. The PID control algorithm incorporates features which provide for high control accuracy and low overshoot from process disturbances.

FRONT PANEL FEATURES

In the normal operating mode, the unit displays the process value in the upper display. One of the following parameters can be viewed in the lower display:

- Setpoint
- % Power Output
- Process Deviation
- Blank Display

The user scrolls through these parameters by pressing the D button. If enabled, the control setpoint or power output (manual mode only) can be directly modified in this mode.

In the normal operating mode, parameters are selected by use of the P button and modified by use of the UP and DOWN buttons. Parameters are then entered by the P button, which advances the user to the next parameter. Pressing the D button immediately returns the controller to the normal operating mode without changing the currently selected parameter.

HARDWARE FEATURES

A fast 100 msec input sampling rate provides quick controller response to a process disturbance, thus providing excellent process control. Measurement accuracy of 0.1% or better, provides close process control conforming to the desired control setpoint value.

Low-drift, highly stable circuitry ensures years of reliable and accurate process control. The recommended two year re-calibration interval is easily accomplished via the programming menu.

REMOTE SETPOINT INPUT

The remote setpoint input facilitates the use of a remote signal to drive the controller's setpoint. The remote signal can be scaled independent to that of the controller's range. The controller's response to local/remote setpoint transfers can be programmed. Also, the remote signal is filtered by use of an adaptive filter. With this filter, relatively large filtering time constants can be used without suffering from long settling times. The time constant and filter disable band are programmable. Additionally, the remote signal can also be velocity limited (or ramped) to slow the controller's response to changes in setpoint. This results in a steady control response with no overshoot.

LINEAR DC ANALOG OUTPUTS

The Main Linear DC output has independent scaling, programmable output update time and filter (damping) time. These parameters permit flexibility in process configuration. The output can be set for 0 to 10 V, 0 to 20 mA or 4 to 20 mA ranges and can be configured for control or for re-transmission of input or setpoint values.

A Second Linear DC output is dedicated for the re-transmission of the process input signal. The output can be scaled and converted independent of the input signal and Main Linear DC output. This output is isolated from the input.

SETPOINT FEATURES

The controller setpoint can be protected from out of range values by programming the setpoint range limit values. Additionally, safeguards from inadvertent data entry can be programmed.

A second setpoint can be selected by the user input and/or through the front panel.

The setpoint ramp feature can be used to control the setpoint value at start-up or any time a setpoint change is made, at a user programmable rate. This feature reduces shock to the process and helps to minimize overshoot.

INPUT FEATURES

A programmable input filter can be used to stabilize readings from a process with varying or oscillating process characteristics, helping to provide better control.

The programmable user input can be used to control a variety of functions, such as auto/manual transfer of the controller, reset alarm output*(s)*, etc.

OUTPUT FEATURES

Programmable output power limits provide protection for processes where excessive power can cause damage. Programmable output cycle time, output hysteresis, and dampening can reduce output activity without degrading control accuracy. The main outputs can operate in PID, ON/OFF, or manual control modes.

CONTROL AND ALARM OUTPUTS

In addition to the Linear DC output, there are up to three relay outputs available. Relay outputs can switch user applied AC or DC voltages for control or alarm purposes.

AUTO-TUNE

The P48 has an auto-tune feature which, on demand, automatically determines the PID control parameters for a particular process. After completion of auto-tune, the PID parameters are automatically optimized for that process and loaded into non-volatile memory. The operator may view and modify the parameters as desired.

Auto-tune may be invoked either at start-up or at setpoint, depending on the process requirements. An auto-tune programmable dampening factor produces various levels of process control and response characteristics.

RS485 SERIAL COMMUNICATIONS

The RS485 communications option allows the connection of up to 32 devices on a single pair of wires with a distance of up to 4,000 feet and a maximum baud rate of 9600. Since the same pair of wires are used for both transmit and receive, only one way communication is possible at any given time. The controller has a programmable response time to allow the host device adequate time to release the communication line for a transmission.

Selected parameters from the P48 can be interrogated or changed, and alarm output(s) may be reset by sending the proper command code via serial communications. It is also possible to invoke Auto-tune through the serial port. Serial communications used with SFCRM software allows for easy controller parameter configuration by computer.

DUAL TIME PROPORTIONAL SYSTEMS

The P48 is available with dual time proportional outputs. The dual outputs can be used for level or heat/cool applications. The A2 output can be configured for Secondary (cool) control. This allows for dual PID control or ON/OFF control with unbalanced hysteresis.

CONTROLLER PROGRAMMING

Front Panel Program Disable allows all of the controller's set-ups to be locked-out from further operator intervention after the initial set-up.

The following four programming modes allow the controller to adapt to any required user-interface level:

Unprotected Parameter Mode
Protected Parameter Mode
Hidden Function Mode
Configuration Parameter Mode

UNPROTECTED PARAMETER MODE *

The Unprotected Parameter Mode is accessible from the Normal Display mode when program disable is inactive or when the proper access code number from the Protected Parameter Mode is entered. The Configuration Parameter Modes can be accessed only from this mode.

"SP"	- Enter setpoint
"OP"	- Enter output power
"ProP"	- Enter proportional band
"Intt"	- Enter integral time
"dErt"	- Enter derivative time
"AL-1"	- Enter value for alarm #1
"AL-2"	- Enter value for alarm #2
"CNFP"	- Select configuration access point
"End"	- Return to normal display mode

PROTECTED PARAMETERS MODE *

The Protected Parameters Mode is enabled when program disable is active. This mode prevents access to the configuration modes without the proper access code number. Only the parameters that are enabled in the Configuration 3 parameter (lock-out section) can be accessed.

"ProP"	- Enter proportional band
"Intt"	- Enter integral time
"dErt"	- Enter derivative time
"AL-1"	- Enter value for alarm #1
"AL-2"	- Enter value for alarm #2
"CodE"	- Enter value to access unprotected parameters and configuration parameters

HIDDEN FUNCTION MODE *

The Hidden Function Mode is accessible from the Normal Display Mode. The functions in this mode may be locked-out individually in Configuration 3 parameter (lock-out section).

"SPSL"	- Select local (SP1 or SP2) or remote setpoint
"trnF"	- Transfer between automatic (PID) control and manual control
"tUNE"	- Invoke/cancel PID Auto-tune
"ALrS"	- Reset latched alarms

CONFIGURATION PARAMETER MODE

The Configuration Parameter Mode allows the operator to set-up the basic requirements of the controller. It is divided into sections which group together related programming steps, such as inputs, outputs, alarms, etc. Upon completion of each section, the program returns to the Configuration Access Point allowing the user to return to the Normal Display Mode.

Configuration 1, Inputs (1-IN)

"tYPE"	- Select input signal type
"dCPt"	- Select scaled display decimal point position
"rnd"	- Enter rounding increment and trailing zeros for scaled display
"FLtr"	- Select level of input filtering
"dSP1", "InP1", "dSP2", "InP2"	- Scale main input
"SPLO"	- Enter setpoint lower limit
"SPHI"	- Enter setpoint higher limit
"SPrP"	- Enter setpoint ramp rate
"InPt"	- Select user input function

Configuration 2, Outputs (2-OP) *

"CYCt"	- Enter time proportioning cycle time
"OPAC"	- Select output control action
"OPLO"	- Enter output power low limit
"OPHI"	- Enter output power high limit
"OPdP"	- Enter output control dampening
"CHYS"	- Enter ON/OFF control hysteresis
"tcOd"	- Select auto-tuning dampening
"ANtP"	- Main Linear DC analog output range
"ANAS"	- Main Linear DC analog output source
"ANut"	- Main Linear DC analog output update time
"ANLO"	- Main Linear DC analog output scaling low
"ANHI"	- Main Linear DC analog output scaling high

Configuration 3, Parameter Lock-Outs (3-LC) *

"SP"	- Select setpoint access level
"OP"	- Select power access level
"dEv"	- Enable deviation display
"bdSP"	- Enable blank display
"CodE"	- Enter parameter access code
"PId"	- Select PID access level
"AL"	- Select alarm access level
"ALrS"	- Enable alarm reset access
"SPSL"	- Enable local/remote selection
"trnF"	- Enable auto/manual mode selection
"tUNE"	- Enable auto-tune invocation

Configuration 4, Alarms (4-AL) *

"ACt1"	- Select operation mode of alarm #1, or select main output
"rSt1"	- Select reset mode of alarm #1
"Stb1"	- Enable activation delay of alarm #1
"AL-1"	- Enter value for alarm #1
"ACt2"	- Select operation mode of alarm #2, or select second output
"rSt2"	- Select reset mode of alarm #2
"Stb2"	- Enable activation delay of alarm #2
"AL-2"	- Enter value for alarm #2
"AHYS"	- Enter hysteresis value for both alarms

Configuration 5, Second Output (5-O2) *

"CYC2"	- Enter time proportioning cycle time
"GAN2"	- Enter relative gain
"db-2"	- Enter deadband or overlap

Configuration 6, Serial Communications (6-SC) *

"bAUd"	- Select baud rate
"ConF"	- Select character frame format
"Addr"	- Enter address
"Abrv"	- Select abbreviated or full transmission
"PoPt"	- Select print options

Configuration 7, Remote Setpoint Input (7-N2) *

"dSP1"	- Enter remote setpoint display scaling value #1
"INP1"	- Enter remote setpoint process scaling value #1
"dSP2"	- Enter remote setpoint display scaling value #2
"INP2"	- Enter remote setpoint process scaling value #2
"FLtr"	- Enter remote setpoint filter time constant
"bAnd"	- Enter remote setpoint filter disable band
"trnF"	- Select Local/Remote setpoint transfer response

Configuration 8, Second Linear DC Analog Output (8-A2) *

"A2tP"	- Second linear DC analog range
"A2LO"	- Second linear DC analog scaling low
"A2HI"	- Second linear DC analog scaling high

Configuration 9, Factory Service Operations (9-FS)

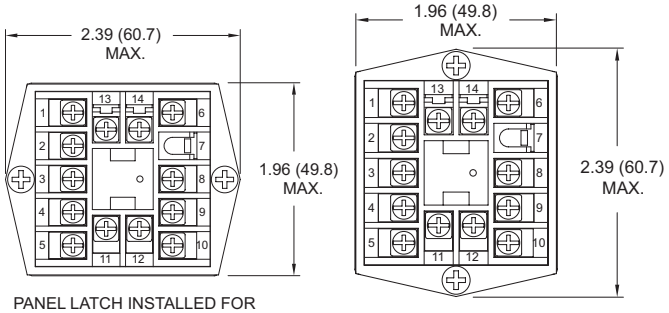
"Code 48"	- Calibrate Instrument
"Code 66"	- Reset parameters to factory setting

* *These parameters may not appear due to option configuration or other programming.*

MULTIPLE UNIT STACKING

The P48 is designed for close spacing of multiple units. Units can be stacked either horizontally or vertically. For vertical stacking, install the panel latch with the screws to the sides of the unit. For horizontal stacking, the panel latch screws should be at the top and bottom of the unit. The minimum spacing from center line to center line of units is 1.96" (49.8 mm). This spacing is the same for vertical or horizontal stacking.

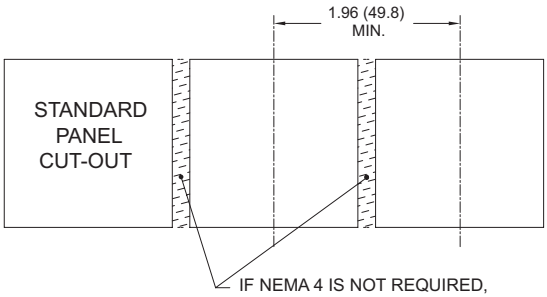
Note: When stacking units, provide adequate panel ventilation to ensure that the maximum operating temperature range is not exceeded.



PANEL LATCH INSTALLED FOR VERTICAL UNIT STACKING

PANEL LATCH INSTALLED FOR HORIZONTAL UNIT STACKING

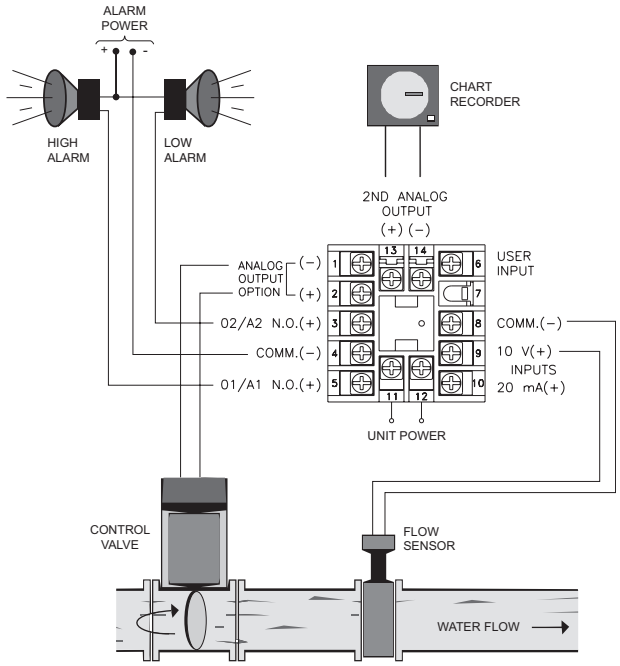
PANEL CUT-OUT SPACING FOR MULTIPLE UNIT STACKING. HORIZONTAL ARRANGEMENT SHOWN.



APPLICATION

WATER PROCESSING APPLICATION

A city water company needs to maintain a steady flow of water for their customer needs. They have an existing 0 to 10 VDC flow transmitter to measure the water flow. They need to control the water flow, have a high and low alarm, and keep a recorded chart of the flow for later reference. The Main Linear DC output of the P48 can be used to control the position of water output values per the desired flow setpoint value. The P48 relay outputs can be programmed to give a high flow alarm and a low flow alarm. With the Second Linear DC output model, the flow measurement to the P48 can be converted from 0-10 V to 4-20 mA and retransmitted to a 4-20 mA chart recorder.



(Terminal assignments are model number dependent.)

ORDERING INFORMATION

Options and Output Boards are factory configured per the part number specified. Part numbers without replacement output boards listed must be returned to the factory for output board replacement.

DEDICATED MAIN CONTROL O1 OUTPUT	MAIN CONTROL O1 or A1(ALARM 1)*	DEDICATED ALARM 1 A1 OUTPUT	A2 (ALARM 2) OR O2 (SECONDARY)*	REMOTE SETPOINT INPUT @	RS485 @	MAIN ANALOG OUTPUT** @	SECOND ANALOG OUTPUT** @	REPLACEMENT OUTPUT BOARD	PART NUMBERS	
									18-36 VDC/24 VAC	85 to 250 VAC
						YES		NA	P4800011	P4800001
Relay								RBD48100	P4810010	P4810000
	Relay		Relay			YES		NA	P4810111	P4810101
	Relay		Relay	YES		YES		NA	P4810115	P4810105
	Relay		Relay		YES	YES		NA	P4810117	P4810107
	Relay		Relay			YES	YES	NA	P481011A	P481010A
Relay		Relay	Relay					RBD48111	P4811110	P4811100
Relay		Relay	Relay		YES			RBD48111	P4811112	P4811102

* This output is programmable as either Control (PID) or as an Alarm.
** These part numbers are jumper and program selectable for either a current or a voltage Linear DC output.
@ These part numbers are equipped with a second setpoint.

Option Boards are installed at the factory for the appropriate models. These boards are only needed for field replacement.

ACCESSORIES

MODEL NO.	DESCRIPTION	PART NUMBERS
SFCRM	Crimson 2 PC Configuration Softwware for Windows 98, ME, 2000 and XP (for RS485 models)	SFCRM
ICM4	RS232/RS485 Serial Converter Module	ICM40030
ICM5	Three Way Isolated RS232/RS485 Serial Converter Module	ICM50000

*Crimson Software is available for download from http://www.redlion.net

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MODEL PCU - PROCESS CONTROL UNIT

c UL US LISTED
IND. CONT. EQ.
51EB

- *100 MSEC SAMPLING PERIOD WITH 0.15% ACCURACY*
- *ON DEMAND AUTO-TUNING OF PID CONTROL SETTINGS*
- *DUAL LED DISPLAYS FOR SIMULTANEOUS INDICATION OF PROCESS VALUE AND SETPOINT OR SECOND ANALOG INPUT*
- *ACCEPTS EITHER 0 to 10 VDC OR 0 to 20 mA DC INPUTS*
- *SELF-DIAGNOSTICS*
- *FULL PID CONTROL WITH REDUCED OVERSHOOT*
- *OPTIONAL RS485 SERIAL COMMUNICATIONS INTERFACE*
- *OPTIONAL DUAL ALARM OUTPUTS (USES OUTPUT MODULES)*
- *OPTIONAL SECONDARY OUTPUT (USES OUTPUT MODULE)*
- *OPTIONAL LINEAR 4 to 20 mA OR 0 to 10 VDC OUTPUT FOR CONTROL OR PROCESS VALUE RE-TRANSMISSION*
- *OPTIONAL MOTORIZED VALVE POSITION CONTROL AND VALVE FAIL ALARM*
- *OPTIONAL SECOND ANALOG INPUT FOR REMOTE SETPOINT AND CASCADE CONTROL*
- *OPTIONAL TYPE 4X/IP65 SEALED FRONT BEZEL*
- *STATUS INDICATORS FOR OUTPUTS AND CONTROL MODES*
- *PROGRAMMABLE USER INPUT (DIGITAL) FOR ADDED FLEXIBILITY*
- *MANUAL/AUTOMATIC AND LOCAL/REMOTE SETPOINT CONTROL MODES*
- *SETPOINT RAMPING FOR PROCESS STARTUP*
- *PARAMETER SECURITY VIA PROGRAMMABLE LOCKOUTS*
- *FIELD REPLACEABLE AND INTERCHANGEABLE OUTPUT MODULES (Relay, Logic/SSR Drive and Triac)*

DESCRIPTION

The PCU Controller accepts either 0 to 10 VDC or a 0 to 20 mA DC input signal, precisely scales the process signal according to programmable scaling points, and provides an accurate output control signal *(time proportional, linear, or valve position)* to maintain a process at the desired control point. A comprehensive set of easy to use program instructions allows the controller to solve various applications.

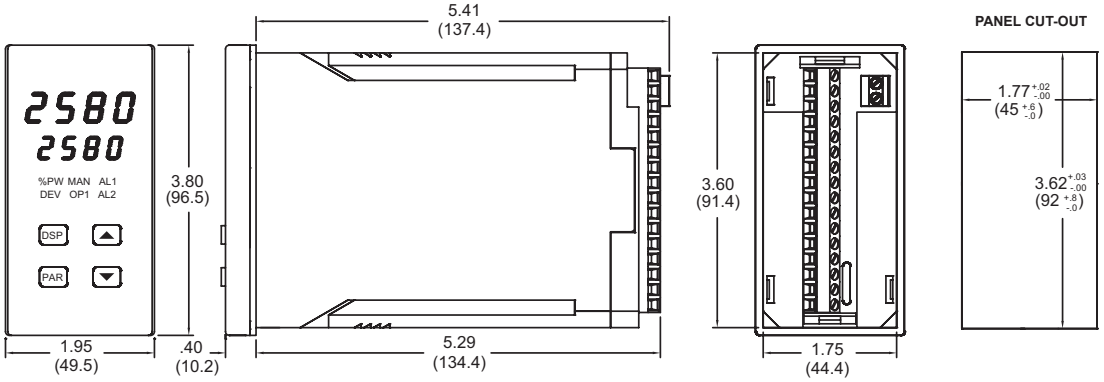
The controller can operate in the PID control mode for both the main output and optional secondary output, with on-demand auto-tune, that establishes the tuning constants. The PID tuning constants may be fine-tuned by the operator at any time and then locked-out from further modification. The controller employs a unique overshoot suppression feature, which allows the quickest response without excessive overshoot. The unit can be transferred to operate in the manual mode, providing the operator with direct control of the output. The controller may also be programmed to operate in the ON/OFF control mode with adjustable hysteresis.

Dual 4-digit displays allow viewing of the process value and setpoint simultaneously. Front panel indicators inform the operator of the controller and output status. Replaceable and interchangeable output modules *(Relay, Logic/SSR Drive, or Triac)* can be installed for the main control output, alarm output(s) and secondary output.

F

DIMENSIONS In inches (mm)

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 5.5" (140) H x 2.1" (53.4) W.



OPTIONS

Optional dual alarms can be configured to activate according to a variety of actions (Absolute HI or LO, Deviation HI or LO, Band IN or OUT and Valve Fail Detect) with adjustable hysteresis. A standby feature suppresses the output during power-up until the process stabilizes outside the alarm region. An optional secondary output is available *(for processes that require cooling)* that provides increased control accuracy and response.

A linear 4 to 20 mA or 0 to 10 VDC output signal is available to interface with actuators, chart recorders, indicators, or other controllers. The output signal can be digitally scaled and selected to transmit one of the following: % output power, measurement value, process measurement value deviation or setpoint value. Valve Positioner and Second Analog Input Models have the adjustable output demand dampening, output deadband and output update time parameters to expand the versatility of the PCU to control devices.

The optional Motorized Valve Positioner directly controls the position of a valve by the use of twin outputs (open and close) to control the direction of motor rotation. The motor position defines the opening position of the valve. Two control modes are possible: position control, that makes use of the slidewire feedback signal supplied with the positioner and velocity control, in which no slidewire feedback signal is used. Parameters are provided to adjust the operation of the valve. These include:

- Valve activity hysteresis
- Valve update time
- Variable control dampening
- Slidewire signal fail action
- Adjustable valve position limits

The Valve Positioner PCU achieves tight process control, yet minimizes unnecessary valve activity. An alarm event output or display alarm can be programmed under loss of slidewire feedback or under valve fail detection.

The optional Second Analog Input (0 to 20 mA DC) can be configured as a remote setpoint signal or as a secondary process signal. Configuration of the second analog input as a remote setpoint signal allows ratio control, master setpoint/multiple slave operation, and the ability to cascade the PCU with another controller (external cascade). Configuration of the second input as a secondary process signal allows operation as a two-process cascade controller within a single unit (internal cascade). In either control mode, parameters are provided to scale, configure, communicate and monitor the activity of both analog inputs. A square law linearizer function can be used to linearize signals derived from flow transmitters.

The optional RS485 multidrop serial communication interface provides two-way communication between a PCU unit and other compatible equipment such as a printer, a programmable controller, or a host computer. In multipoint applications the address number of each unit on the line can be programmed from zero to ninety-nine. Up to thirty-two units can be installed on a single pair of wires. The Setpoint value, % Output Power, Setpoint Ramp Rate, etc. can be interrogated or changed by sending the proper command code via serial communications. Alarm output(s) may also be reset via the serial communications interface option.

An optional Type 4X/IP65 rated bezel is available for wash down and/or dirty environments, when properly installed. Modern surface-mount technology, extensive testing, plus high immunity to noise interference makes the controller extremely reliable in industrial environments.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the manual or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Do not use the PCU to directly command motors, valves, or other actuators not equipped with safeguards. To do so, can be potentially harmful to persons or equipment in the event of a fault to the unit. An independent and redundant limit indicator with alarm outputs is strongly recommended. The indicators should have input sensors and AC power feeds independent from other equipment.

SPECIFICATIONS

1. **DISPLAY**: Dual 4-digit
   Upper Process Display: 0.4" (10.2 mm) high red LED
   Lower Auxiliary Display: 0.3" (7.6 mm) high green LED
   Display Messages (Model dependent):
   "OLOL" - Appears when measurement exceeds +105% input range.
   "ULUL" - Appears when measurement exceeds -5% input range.
   "SENS" - Appears when measurement exceeds "OLOL" & "ULUL" range.
   "...." - Appears when display values exceed + display range.
   "-..." - Appears when display values exceed - display range.
   "SLid" - Appears when loss of slidewire signal is detected.
   "VALV" - Appears when valve actuator error is detected.
2. **POWER**: Switch selectable 115/230 VAC (+10%, -15%) no observable line variation effect, 48 to 62 Hz, 10 VA.
3. **ANNUNCIATORS**:
   LED Backlight Status Indicators (Model dependent):
   %PW - Lower auxiliary display shows power output in (%).
   DEV - Lower auxiliary display shows deviation *(error)* from process setpoint.
   OP1 - Main control output is active.
   AL1 - Alarm #1 is active.
   AL2 - Alarm #2 is active *(for Dual Alarm Option)*.
   OP2 - Secondary output is active *(for Secondary Output Option)*.
   OPN - Valve positioner OPEN output is active *(for Valve Positioner Option)*.
   CLS - Valve positioner CLOSE output is active *(for Valve Positioner Option)*.
   SEC - Lower auxiliary display shows second analog input *(for Second Analog Input Option)*.
   MAN - Flashing: Controller is in Manual control mode.
   REM - ON: controller is in remote setpoint mode *(Second Analog Input Option)*.
   - OFF: controller is in local setpoint mode *(Second Analog Input Option)*.
   - Flashing: controller is in Manual control mode *(Second Analog Input Optional)*.
4. **CONTROLS**: Four front panel push buttons for modifying and setup of controller functions and one external input for parameter lockout or other functions.
5. **SIGNAL INPUT**:
   Sample Period: 100 msec typ.
   Response Time: 300 msec typ. *(to within 99% of final value w/step input)*
   Signal Overdrive Threshold:
   10 V Range: 13 V typ.
   20 mA Range: 26 mA typ.
   Signal Overdrive Response:
   Main Control Output: Programmable preset output
   Display: "SENS"
   Alarms: Upscale drive
   DC Linear: Programmable preset output
   Normal Mode Rejection: 40 dB typ. @ 50/60 Hz *(improves with increased digital filtering)*.
   Common Mode Rejection: 100 dB typ., DC to 60 Hz
   Protection: Input overload 120 VAC for 30 seconds.
   Range And Accuracy:

SIGNAL RANGE	ACCURACY (% OF UNSCALED READING)	MAXIMUM INPUT	INPUT IMPEDANCE	RESOLUTION
0 to 10 VDC	±(0.15% + 3 mV)	300 VDC	1M Ω	10 mV
0 to 20 mADC	±(0.15% + 6 µA)	200 mADC	10 Ω	10 µA

6. **OUTPUT MODULES [Optional] (For All Output Channels)**:
   Relay:
   Type: Form-C *(Form-A with some models. See Ordering Information.)*
   Rating: 5 Amps @ 120/240 VAC or 28 VDC *(resistive load)*, 1/8 HP @ 120 VAC *(inductive load)* max.
   Life Expectancy: 100,000 cycles at max. load rating. *(Decreasing load and/or increasing cycle time, increases life expectancy).*
   Logic/SSR Drive: Can drive multiple SSR Power Units.
   Type: Non-isolated switched DC, 12 VDC typ.
   Drive: 45 mA max.
   Triac:
   Type: Isolated, Zero Crossing Detection
   Rating:
   Voltage: 120/240 VAC
   Max. Load Current: 1 Amp @ 35°C
   0.75 Amp @ 50°C
   Min. Load Current: 10 mA
   Off State Leakage Current: 7 mA max. @ 60 Hz
   Operating Frequency: 20 to 400 Hz
   Protection: Internal Transient Snubber, Fused
7. **MAIN CONTROL OUTPUT**:
   Control: PID or ON/OFF
   Output: Time proportioning or linear DC
   Hardware: Plug-in, replaceable output modules
   Cycle time: Programmable
   Auto-tune: When selected, sets proportional band, integral time, and derivative time values.
   Signal Overdrive Action: Programmable

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SPECIFICATIONS (Cont'd)

8. **SECONDARY OUTPUT (Optional)**:
   Control: PID or ON/OFF
   Output: Time proportioning or linear DC
   Hardware: Plug-in, replaceable output modules
   Cycle time: Programmable
   Proportional Gain Adjust: Programmable
   Deadband Overlap: Programmable
9. **LINEAR DC OUTPUT (Optional)**: With digital scale and offset, programmable deadband and update time.
   4 to 20 mA:
      Resolution: 1 part in 3500 typ.
      Accuracy: ±*(0.1% of reading + 25 µA)*
      Compliance: 10 V *(500 Ω max. loop impedance)*
   0 to 10 VDC:
      Resolution: 1 part in 3500 typ.
      Accuracy: ±*(0.1% of reading + 35 mV)*
      Min. Load Resistance: 10 KΩ *(1 mA max.)*
   Source: % output power, setpoint, deviation, or process value *(Available for OP1 or OP2, but not both.)*
10. **MOTORIZED VALVE POSITIONER (Optional)**:
   Two Outputs: Valve open and valve close or Linear DC *(optional)*
   Hardware: Plug-in, replaceable output modules
   Three Inputs: Slidewire feedback, signal fail detect *(Isolated from main input)*
   Slidewire Resistance: 100 Ω to 100 KΩ
   Slidewire Exciting Voltage: 0.9 VDC typ.
   Slidewire Fail Action: programmable
   Control Mode: Position mode *(with slidewire)* and velocity mode *(w/o slidewire)*.
   Control Deadband: 1% to 25.0% (position mode)
      0.1 to 25.0 seconds (velocity mode)
   Update Time: 1 to 250 seconds
   Motor Time (open, close): 1 to 9999 seconds
   Position Limits: Adjustable 0.0 to 100.0% of valve stroke
   Valve Fail Time: Off to 9999 seconds
   Alarm mode: Dual acting; loss of slidewire feedback signal and valve fail detection
11. **SECOND ANALOG INPUT**:
   Range: 0 to 20 mA (Isolated from main input)
   Overload: 100 mA_{MIN} (steady state)
   Input Resistance: 10 Ω typ.
   Voltage Drop (@ 20 mA): 0.2 V typ.
   Accuracy: 0.15% of reading ±10 µA ±1 LSD
   Scale Range: -999 to 9999
12. **SERIAL COMMUNICATION**:
   Type: RS485 Multi-point, Balanced Interface
   Communication Format:
      Baud Rate: Programmable from 300 to 9600
      Parity: Programmable for odd, even, or no parity
      Frame: 1 start bit, 7 data bits, 1 or no parity bit, 1 stop bit
      Unit Address: Programmable from 0 to 99, max. of 32 units per line
   Transmit Delay: 100 msec min., 200 msec max.
   RS485 Common: Isolated from signal input common
   Auto Print Time: Off to 9999 seconds between print-outs
13. **USER INPUT (Optional)**: Internally pulled up to +5 VDC.
   V_{IN} = 5.25 VDC_{MAX}, V_{IL} = 0.85 V_{MAX}; V_{IH} = 3.0 V_{MIN},
   Available on all second input (MVP & ANA) models, and on models with RS485.
   Response Time: 100 msec max.
   Functions: Program Lock
      Integral Action Lock
      Auto/Manual Mode Select
      Setpoint Ramp Select
      Reset Alarms
      Print Request
      Local/Remote Setpoint Select
14. **ALARMS (Optional)**:
   Hardware: Plug-in, replaceable output module
   Modes: Absolute high acting
      Absolute low acting
      Deviation high acting
      Deviation low acting
      Inside band acting
      Outside band acting
      Valve fail
      Second Analog Input monitoring
   Reset Action: Programmable; automatic or latched
   Standby Mode: Programmable; enable or disable
   Hysteresis: Programmable
   Signal Overdrive Action: Upscale
   Annunciator: LED backlight for "AL1", "AL2", *(Alarm #2 not available with secondary output or motorized valve position option.)*
15. **ENVIRONMENTAL CONDITIONS**:
   Operating Temperature Range: 0 to 50°C
   Storage Temperature Range: -40 to 80°C
   Vibration to IEC 68-2-6: Operational 5-150 Hz, 1 g
   Shock to IEC 68-2-27: Operational 5 g
   Span Drift *(maximum)*: 100 ppm/°C, main input; 150 ppm/°C, second input
   Zero Drift *(maximum)*:
      4 to 20 mA DC Range: 0.5 µA/°C
      0 to 10 VDC Range: 0.2 mV/°C
      Second Input: 2 µA/°C
   Relative Humidity: Less than 85% RH (non-condensing)
   Altitude: Up to 2000 meters
16. **ISOLATION BREAKDOWN RATINGS**:
   All inputs and outputs with respect to AC line: 2300 V_{MIN}
   Analog Outputs, Second Analog Input or Slidewire Input with respect to main input: 500 V_{MIN}
17. **CERTIFICATIONS AND COMPLIANCES**:
   CE Approved
      EN 61326-1 Immunity to Industrial Locations
      Emission CISPR 11 Class A
      EN 61010-1
      RoHS Compliant
   UL Recognized Component: File #E156876
   UL Listed: File #E137808
   Type 2 Enclosure rating (Face only) for PCU0
   Type 4X/IP65 Enclosure rating (Face only) for PCU1
   Refer to EMC Installation Guidelines section of the manual for additional information.
18. **CONNECTION**: Jaw-type terminal block
   Wire Range: 12-30 AWG copper wire
   Torque: 5-7 inch-lbs (56-79 N-cm)
19. **CONSTRUCTION**:
   Front Panel: Flame and scratch resistant tinted plastic
   Case: High impact black plastic. (Mounting collar included)
   Type 4X/IP65 model only: Sealed bezel utilizing two captive mounting screws (panel gasket included) This unit is rated for Type 4X/IP65 indoor use. Installation Category II, Pollution Degree 2
20. **WEIGHT**: 1.3 lbs (0.6 kgs)

BASIC OPERATION

The PCU controls a process by measuring the input signal and then calculating a control output power value by use of a modified PID control algorithm. The unit controls the system with the new output power value to keep the process at setpoint. The PID control algorithm incorporates features that provide for high control accuracy and low overshoot from process disturbances.

FRONT PANEL FEATURES

In the normal operating mode, the unit displays the scaled process value in the upper display. One of four other parameters can be viewed in the lower display:

- Setpoint
- % Power Output
- Deviation
- Second Input Process Value

The parameters can be scrolled through by pressing the DSP button. If enabled, the control setpoint or power output (manual mode only) can be directly modified in this mode.

In the normal operating mode, parameters are selected by use of the PAR button and modified by use of the UP and DOWN buttons. Parameters are then entered by the PAR button, which advances the user to the next parameter. Pressing the DSP button immediately returns the controller to the normal operating mode when making a parameter change. The controller's configuration and parameter settings are stored in an internal E^2PROM device.

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HARDWARE FEATURES

The fast 100 msec input sampling rate provides quick controller response to a process disturbance, thus providing excellent process control. Measurement accuracy of 0.15% or better, provides closer process control conforming to the desired control setpoint value. The unit accepts either a 0 to 10 VDC or a 0 to 20 mA DC input signal. The AC input power is switch selectable, allowing the unit to operate from either 115 VAC or 230 VAC. Since the controller is serviceable from the front of the panel, the output modules may be easily changed or replaced without disturbing the wiring behind the panel. No re-programming is required when changing or replacing modules.

The optional Type 4X/IP65 rated model utilizes two bezel securing screws and a neoprene gasket to guarantee a water tight seal, when properly installed. The standard model simply requires pressing a latch to remove the unit.

Low-drift, highly stable circuitry ensures years of reliable and accurate process control. The recommended two-year re-calibration interval is easily accomplished via the programming menu.

SETPOINT FEATURES

The controller setpoint can be protected from out of range values by programming the setpoint range limit values. Additionally, safeguards from inadvertent data entry can be programmed.

The setpoint ramp feature ramps the setpoint value at start-up or any time a setpoint change is made, at a user programmable rate. This feature reduces shock to the process and helps to minimize overshoot. The setpoint may also be transmitted by the optional linear DC output for slave control loops.

The second analog input may be configured as a remote setpoint. As such, the controller is easily switched from local/remote setpoint operation via the front panel or user input. Ratio and bias parameters provide on-line scaling of the remote setpoint. Absolute limit values and maximum rate of change of the remote setpoint further enhance controller flexibility.

INPUT FEATURES

A programmable input filter can be used to stabilize readings from a process with varying or oscillating characteristics, helping to provide better process control. Programmable scaling points allow the controller to display in any engineering unit; flow, level, pressure, etc. Scaling points are used in conjunction with the programmable rounding increment to stabilize a jittery or otherwise hard to read process signal for better indication.

The programmable User Input can be used to control a variety of functions, such as auto/manual transfer of the controller, reset alarm output(s), etc.

The second analog input has independent scaling parameters to match the units of other processes or transmitters, or to match the controller's range.

OUTPUT FEATURES

Programmable output power limits provide protection for processes where excessive power can cause damage. Automatic signal overdrive detection, for fail-safe operation, causes the controller to default to a programmed output power (upscale or downscale burnout). With adjustable time proportioning cycle time, and programmable DC linear output, the controller can satisfy a wide variety of output requirements.

Programmable dampening output hysteresis and output update time parameters can dramatically reduce actuator activity without degrading control accuracy.

The RS485 Communication option allows the user to access various controller parameters such as the setpoint, % output power, % proportional band, etc. The controller may be set up to transmit various parameters at a programmable automatic print rate.

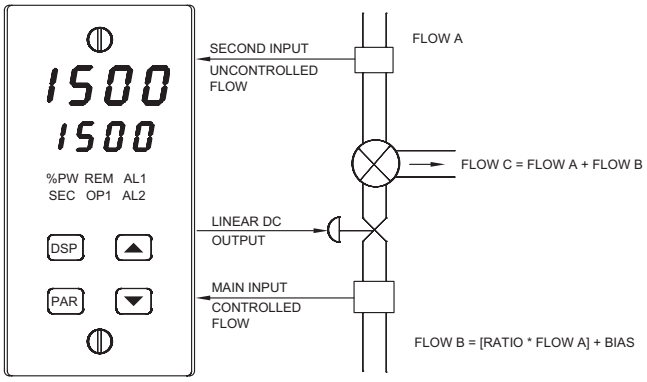
AUTO-TUNE

The PCU has an auto-tune feature that, on demand, automatically determines the PID control parameters for a particular process. After completion of auto-tune, the PID parameters are automatically optimized for that process and loaded into nonvolatile memory. The operator may view and modify the parameters as desired.

Auto-tune may be invoked either at start-up or at setpoint, depending on the process requirements. An auto-tune programmable dampening factor produces various levels of process control and response characteristics.

OPTIONS

RATIO CONTROL



The PCU configured for ratio operation controls a process as a ratio of another process or to another variable. Ratio control is commonly used for flow applications, however, any two process variables can be controlled in a ratio mode.

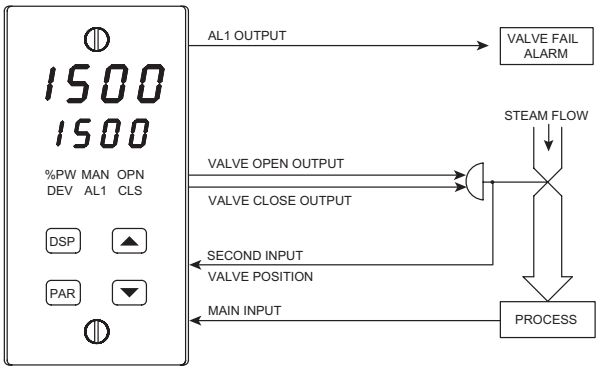
Ratio Control Configuration Parameters

"OPEr"	-	Select ratio mode
"root"	-	Select second input square root linearization
"dPt2"	-	Select second input decimal point
"dSP1"	-	Enter scaling units of second input
"INP1"		
"dSP2"		
"INP2"		
"SPtr"	-	Local/Remote Select options
"InPt"	-	Program User Input for Local/Remote Setpoint selection

Ratio Control Operational Parameters

"rtio"	-	Remote setpoint ratio
"bIAS"	-	Remote setpoint bias

MOTORIZED VALVE POSITIONER



The motorized valve positioner controls the position of a valve directly, by use of *"open"* and *"close"* control outputs. The slidewire feedback signals of the valve may optionally be connected to the controller. Alternatively, the controller may be configured for linear input valve control using the 4 to 20 mA DC output.

Motorized Valve Positioner Configuration Parameters

Position mode:	"VPS1"	-	Enter or measure valve closed position
	"VPS2"	-	Enter or measure valve open position
	"VUdt"	-	Enter Valve update time
	"VPdb"	-	Enter valve control deadband
	"VFAL"	-	Enter valve fail detect time
	"Act1"	-	Program alarm as valve fail output
Velocity mode:	"VUdt"	-	Enter Valve update time
	"VOPt"	-	Enter valve open time
	"VCLt"	-	Enter valve close time
	"VOnt"	-	Enter valve control deadband *(minimum on time)*

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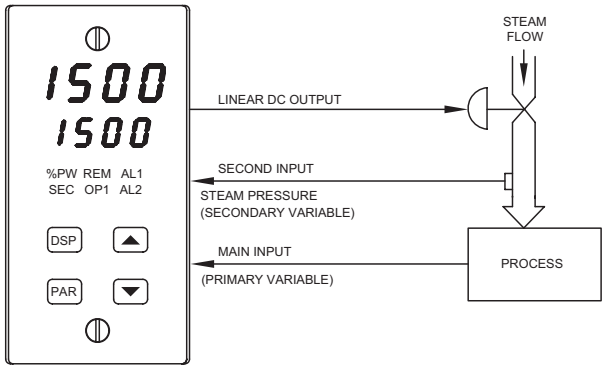
INTERNAL CASCADE



Cascade control allows the process to be divided into two control loops: the primary control loop and the secondary control loop. The secondary loop receives its setpoint from the primary loop to control an intermediate variable (steam pressure). The control level of the intermediate variable is the input to the primary process. The primary loop (main input) controller maintains loop regulation by manipulating the setpoint of the secondary controller. The setpoint of the secondary controller, in turn, changes the intermediate variable. The secondary loop can react faster to disturbances of the intermediate variable, thereby minimizing the effects to the primary control loop. Control loops cascaded in such a manner provide greater control quality than would be possible with single loop control. A single PCU can accomplish two-process cascade control.

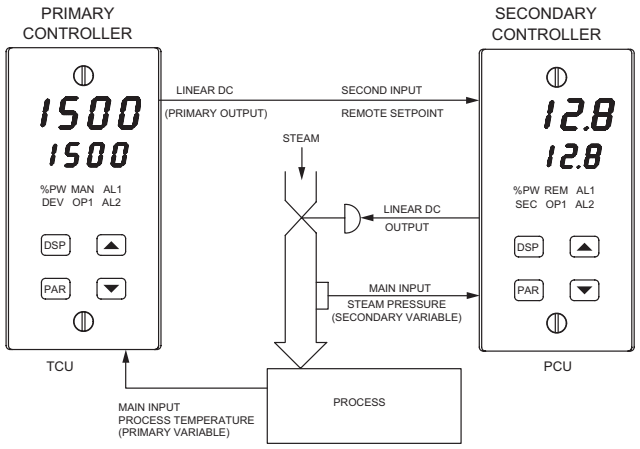
Internal Cascade Configuration Parameters

"OPEr"	-	Select cascade mode
"root"	-	Select second input square root linearization
"dPt2"	-	Select second input decimal point
"dSP1", "INP1", "dSP2", "INP2"	-	Enter scaling units of second input
"OPd2"	-	Output dampening of secondary

Internal Cascade Operational Parameters

"SP-2"	-	View secondary setpoint value
"Pb-2"	-	Enter secondary proportional band
"It-2"	-	Enter secondary integral time
"dt-2"	-	Enter secondary derivative time

EXTERNAL CASCADE



Similar to internal cascade control, external cascade control differs by the employment of two controllers, one of which is equipped with a second analog input configured as a remote setpoint. A PCU controls the secondary loop, while a TCU controls the primary loop.

External Cascade Configuration Parameters

"OPEr"	-	Select ratio mode
"root"	-	Select second input square root linearization
"dPt2"	-	Select second input decimal point
"dSP1", "INP1", "dSP2", "INP2"	-	Enter scaling units of second input
"SPtr"	-	Local/Remote select options

External Cascade Operational Parameters

"rtio"	-	Remote setpoint ratio
"bIAS"	-	Remote setpoint bias

SETPOINT MASTER CONTROL

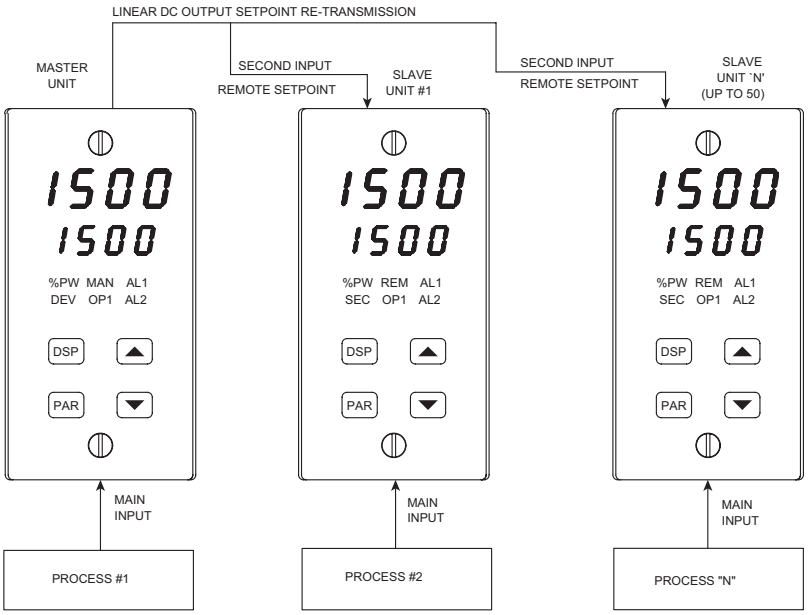
Setpoint Master Control allows automatic setpoint changes to slave controller units (up to 50 units total) from a master PCU controller. The linear DC output of the master is looped with the second analog input of the slave PCU controllers. Each slave unit can have unique remote setpoint ratio and bias values.

Setpoint Slave Configuration Parameters

"OPEr"	-	Select remote setpoint mode
"root"	-	Select second input square root linearization
"dPt2"	-	Select second input decimal point
"dSP1", "INP1", "dSP2", "INP2"	-	Enter scaling units of second input
"SPLO", "SPHI"	-	Limit range of remote setpoint
"SPrP"	-	Limit rate of change of remote setpoint

Setpoint Slave Operational Parameters

"rtio"	-	Second input ratio
"bIAS"	-	Second input bias



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CONTROLLER PROGRAMMING

The PCU has been designed to reduce the operator interaction with the controller while still maintaining a high degree of control accuracy and user flexibility. Front Panel Program Disable allows all of the controller's set-ups to be locked-out from further operator intervention after the initial parameter set-up.

The programming of the controller is divided into four sections:

Unprotected Parameter Mode
Configuration Parameter Mode
Protected Parameter Mode
Hidden Function Mode

These four programming modes allow the controller to adapt to any required user-interface level.

UNPROTECTED PARAMETER MODE *

The unprotected parameter mode is accessible when program disable is inactive or when the proper access code number from the protected mode is entered. The configuration parameter modes can be accessed only from this mode.

"SP" - Enter Setpoint
"OP" - Enter output power
"Prop" - Enter proportional band
"Intt" - Enter integral time
"dErt" - Enter derivative time
"rtio" - Enter Remote Setpoint ratio value
"bIAS" - Enter Remote Setpoint bias value
"SP-2" - View internal cascade secondary setpoint demand
"Pb-2" - Enter internal cascade, secondary proportional band
"It-2" - Enter internal cascade, secondary integral time
"dt-2" - Enter internal cascade, secondary derivative time
"AL-1" - Enter value for alarm #1
"AL-2" - Enter value for alarm #2
"CNFP" - Select basic configuration mode
"End" - Return to normal display mode

CONFIGURATION PARAMETER MODE

The configuration parameter mode allows the operator to set up the basic requirements of the controller. It is divided into sections which group together related programming steps, such as inputs, outputs, alarms, etc. Upon completion of each section, the program returns to the configuration selection stage allowing the user to return to the normal display mode.

Configuration 1, Inputs

"tYPE" - Select input signal type
"root" - Select square root linearization of main input *
"dCPt" - Select scaled display decimal point position
"rnd" - Enter rounding increment and trailing zeroes for scaled display
"FLtr" - Select level of input filtering
"dSP1", "INP1", "dSP2", "INP2" - Scale main input
"SPLO" - Enter setpoint lower limit
"SPHI" - Enter setpoint higher limit
"SPrP" - Enter setpoint ramp rate
"InPt" - Select user input function *

Configuration 2, Outputs

"CYCt" - Enter time proportioning cycle time
"OPAC" - Select control action
"OPLO" - Enter output power low limit
"OPHI" - Enter output power high limit
"OPFL" - Enter signal overdrive power preset
"OPdP" - Enter output control dampening
"CHYS" - Enter ON/OFF control hysteresis
"tcod" - Select auto-tuning dampening
"ANAS" - Select linear DC output assignment *
"ANLO" - Enter linear DC output low scaling value *
"ANHI" - Enter linear DC output high scaling value *
"ANdb" - Enter linear DC output control deadband *
"ANUt" - Enter linear DC output update time *

Configuration 3, Parameter lock-outs

"SP" - Select degree of setpoint access
"OP" - Select degree of power access
"dEv" - Enable deviation display *
"IN-2" - Enable second input display *
"bdSP" - Enable blank display
"CodE" - Enter parameter access code
"PId" - Select degree of PID access
"PId2" - Select degree of secondary PID access *
"rtbS" - Select degree of ratio/bias access *
"AL" - Select degree of alarm access *
"ALrS" - Enable alarm reset access *
"SPSL" - Enable local/remote setpoint selection *
"trnF" - Enable auto/manual mode selection
"tUNE" - Enable auto-tune invocation

Configuration 4, Alarms *

"Act1" - Select operation mode of alarm #1
"rSt1" - Select reset mode of alarm #1
"Stb1" - Enable activation delay of alarm #1
"AL-1" - Enter value for alarm #1
"Act2" - Select operation mode of alarm #2
"rSt2" - Select reset mode of alarm #2
"Stb2" - Enable activation delay of alarm #2
"AL-2" - Enter value for alarm #2
"AHYS" - Enter hysteresis value for both alarms

Configuration 5, Secondary Output *

"CYC2" - Enter time proportioning cycle time
"GAN2" - Enter relative gain
"db-2" - Enter deadband or overlap

Configuration 6, Serial Communications *

"bAUd" - Select baud rate
"PArb" - Select parity bit
"Addr" - Enter unit address number
"Abrv" - Select abbreviated or full mnemonic transmissions
"PrAt" - Enter automatic print rate
"PoPt" - Select parameters to be included in print-out

Configuration 7, Second Input *

"OPEr" - Select remote setpoint or internal cascade mode
"root" - Select second input square root linearization
"dPt2" - Select second input decimal point
"dSP1", "INP1", "dSP2", "INP2" - Entering scaling parameters of second input
"SPtr" - Enter local/remote select options
"OPd2" - Enter Secondary output control dampening

Configuration 8, Motorized Valve Positioner *

Position mode:
"VPS1" - Enter or measure valve closed position
"VPS2" - Enter or measure valve open position
"VUdt" - Enter valve update time
"VPdb" - Enter valve control deadband
"VFAL" - Enter valve fail detect time

Velocity mode:
"VUdt" - Enter valve update time
"VOPt" - Enter valve open time
"VCLt" - Enter valve close time
"VOnt" - Enter valve control deadband *(minimum on time)*

HIDDEN FUNCTION MODE *

The hidden function mode is accessible from the normal operating mode. The four functions in this mode may be locked-out individually in configuration 3 parameter lock-out section.

"SPSL" - Select Local/Remote Setpoint
"trnF" - Transfer between automatic (PID) control and manual control
"tUNE" - Invoke/cancel PID Auto-tune
"ALrS" - Reset latched alarms

* *These parameters may not appear due to option configuration or other programming.*

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PROTECTED PARAMETERS MODE *

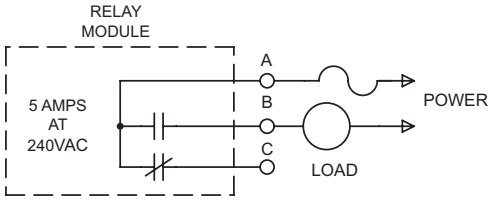
The protected parameters mode is enabled when program disable is active. This mode prevents access to the configuration modes without the proper access code number. Only the parameters that are selected in the configuration 3 parameter lock-out section can be accessed.

"ProP" - Enter Proportional band
"Intt" - Enter integral time
"dErt" - Enter derivative time
"rtio" - Enter remote setpoint ratio value
"bIAS" - Enter remote setpoint bias value
"SP-2" - Enter internal cascade, secondary setpoint
"Pb-2" - Enter internal cascade, secondary proportional band
"It-2" - Enter internal cascade, secondary integral time
"dt-2" - Enter internal cascade, secondary derivative time
"AL-1" - Enter value for alarm #1
"AL-2" - Enter value for alarm #2
"CodE" - Enter access value to unprotected parameters & configuration parameters

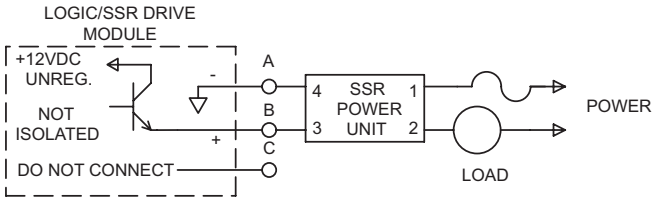
* *These parameters may not appear due to option configuration or other programming.*

OUTPUT MODULES

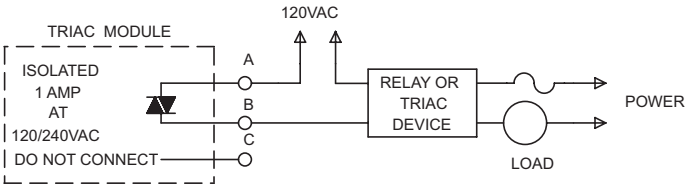
TYPICAL CONNECTIONS



Relay:
Type: Form-C (Form-A with some models. See ordering information.)
Rating: 5 amps @ 120/240 VAC or 28 VDC (resistive load), 1/8 HP @ 120 VAC (inductive) maximum.
Life Expectancy: 100,000 cycles at maximum load rating.
(Decreasing load and/or increasing cycle time, increases life expectancy).



Logic/SSR Drive: Can drive multiple SSR Power Units.
Type: Non-isolated switched DC, 12 VDC typical
Drive: 45 mA maximum.



Triac:
Type: Isolated, Zero Crossing Detection
Rating:
Voltage: 120/240 VAC
Max. Load Current: 1 ampere @ 35°C
0.75 ampere @ 50°C
Min. Load Current: 10 mA
Off State Leakage Current: 7 mA max. @ 60 Hz
Operating Frequency: 20 to 400 Hz
Protection: Internal Transient Snubber, Fused

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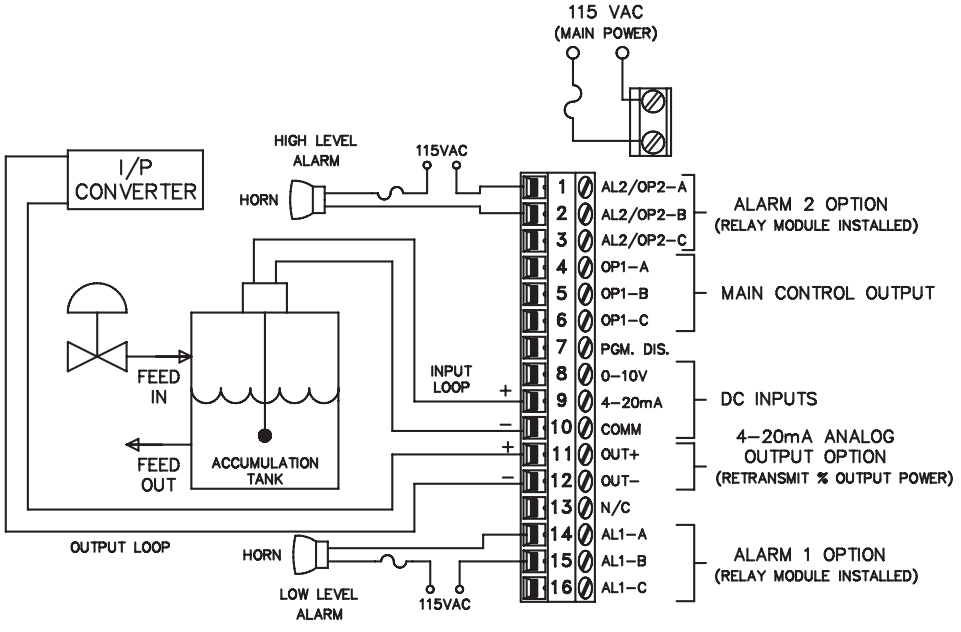

APPLICATION

A chemical company would like to maintain the level of an acid solution tank to insure constant availability for their process. They have chosen a PCU controller which has a continuous level probe with a 4 to 20 mA output proportional to tank level, connected to the input terminals. The tank is filled by controlling the position of a proportional control valve. The control valve is controlled by a 3 to 15 PSI air signal.

The PCU uses the level control input as its feedback. The 4 to 20 mA input signal is scaled so that 4 mA equals 0% and 20 mA equals 100%.

The 4 to 20 mA output of the PCU is taken to an I/P converter to convert the 4 to 20 mA output to a 3 to 15 PSI signal for the control valve. The relay outputs of the PCU are used for high and low level alarms.

ORDERING INFORMATION

MODELS WITHOUT SECOND INPUT OPTIONS

Type 4X/IP65 BEZEL	4 to 20 mA ANALOG OUTPUT	0 to 10 VDC ANALOG OUTPUT	ALARM OUTPUTS	COOLING OUTPUT	RS485 COM	PART NUMBER
NO	YES	NO	NO	NO	NO	PCU01000
NO	YES	NO	2	NO	NO	PCU01001
YES	NO	NO	NO	NO	NO	PCU10000
YES	NO	NO	2	NO	NO	PCU10001
YES	NO	NO	1	YES	NO	PCU10002
YES	YES	NO	NO	NO	NO	PCU11000
YES	YES	NO	2	NO	NO	PCU11001
YES	YES	NO	1	YES	NO	PCU11002
YES	YES	NO	2	NO	YES	PCU11004
YES	YES	NO	1	YES	YES	PCU11005
YES	NO	YES	2	NO	NO	PCU12001
YES	NO	YES	2	NO	YES	PCU12004
YES	NO	YES	1	YES	YES	PCU12005

These models have dual alarm outputs, or single alarm with secondary outputs, with shared common terminals (Form A Type). As a result, these outputs should be fitted with the same type of output module. The main output (OP1) may be fitted with any type of output module.

SECOND ANALOG INPUT MODELS (RSP)

Type 4X/IP65 BEZEL	4 to 20 mA ANALOG OUTPUT	0 to 10 VDC ANALOG OUTPUT	ALARM OUTPUTS	COOLING OUTPUT	RS485 COM	PART NUMBER
YES	NO	NO	2	NO	YES	PCU10104
YES	YES	NO	2	NO	NO	PCU11108
YES	NO	YES	2	NO	NO	PCU12108

These models have dual alarm outputs, or single alarm with secondary outputs, with shared common terminals (Form A Type). As a result, these outputs should be fitted with the same type of output module. The main output (OP1) may be fitted with any type of output module.

MOTORIZED VALVE POSITIONER MODELS (MVP)

Type 4X/IP65 BEZEL	4 to 20 mA ANALOG OUTPUT	0 to 10 VDC ANALOG OUTPUT	ALARM OUTPUTS	COOLING OUTPUT	RS485 COM	PART NUMBER
YES	NO	NO	1	NO	YES	PCU10307
YES	YES	NO	1	NO	NO	PCU11306
YES	NO	YES	1	NO	NO	PCU12306

ACCESSORIES

DESCRIPTION	PART NUMBER
Relay Module	OMD00000
Triac Module	OMD00001
Logic/SSR Drive Module	OMD00003
45 A Single Phase Panel Mount SSR	RLY50000
25 A Single Phase DIN Rail Mount SSR	RLY60000
40 A Single Phase DIN Rail Mount SSR	RLY6A000
25 A Three Phase DIN Rail Mount SSR	RLY70000

Note: Output Modules are NOT supplied with the controller. When specifying the controller, be sure to purchase the appropriate output module for the Main Control Output and if necessary, the alarm output(s), the secondary output, and valve positioner outputs.

The Logic/SSR Drive Module is a switched DC source, intended to drive the DC input of an SSR power unit. It should never be connected to line voltage.

All modules are packaged separately and must be installed by the user.

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MODEL PSC - PROCESS SETPOINT CONTROLLER

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- *SETPOINT PROGRAM CONTROLLER FOR TIME VS. PROCESS (RAMP/SOAK) AND SPECIAL BATCH/RECIPE APPLICATIONS*
- *ADVANCED PROGRAM PROFILING IN A 1/8 DIN PACKAGE*
- *ON-LINE MONITORING AND CONTROL OF PROGRAM STATUS, TIME, AND SETPOINT VALUE (Profile Run, Pause, Stop, Advance, Modify Time, & Setpoint Value)*
- *AUTOMATIC PROGRAM DELAY FOR PROFILE CONFORMITY, PLUS PROGRAM LINKING, REPEATING AND AUTO POWER-ON FUNCTIONS FOR ENHANCED CAPABILITY*
- *DUAL EVENT OUTPUTS FOR TIMED ACTIVATION OF PROCESS EQUIPMENT SUCH AS STIRRERS, FANS, HEATERS, ETC. (Uses Alarm Output Channels)*
- *FOUR SETPOINT & PID PARAMETER SETS FOR QUICK RECALL OF SETPOINTS AND/OR GAIN VALUES DURING BATCH OR PROCESS CHANGEOVER*
- *PROGRAMMABLE USER INPUT FOR CONTROLLER AND SETPOINT PROGRAM CONTROL*
- *100 MSEC SAMPLING PERIOD WITH 0.15% ACCURACY*
- *ON DEMAND AUTO-TUNING OF PID CONTROL SETTINGS*
- *DUAL LED DISPLAYS FOR SIMULTANEOUS INDICATION OF PROCESS AND SETPOINT OR PROCESS AND PROFILE STATUS*
- *ACCEPTS EITHER 0 to 10 VDC OR 4 to 20 mA DC INPUT SIGNAL*
- *FIELD REPLACEABLE AND INTERCHANGEABLE OUTPUT MODULES (Relay, Logic/SSR drive, and Triac)*
- *OPTIONAL DUAL ALARM OUTPUTS (Uses Output Modules)*
- *OPTIONAL SECONDARY OUTPUT (Uses Output Module)*
- *OPTIONAL LINEAR 4 to 20 mA OR 0 to 10 VDC OUTPUT FOR CONTROL OR PROCESS RE-TRANSMISSION*
- *OPTIONAL RS485 SERIAL COMMUNICATIONS INTERFACE*
- *OPTIONAL TYPE 4X/IP65 SEALED FRONT BEZEL*

DESCRIPTION

The PSC is a setpoint controller suitable for time vs. process control applications. The PSC Controller accepts either a 0 to 10 VDC or a 4 to 20 mA DC input signal, precisely scales the process signal, according to programmable scaling points, and provides an accurate output control signal (time proportional or linear) to maintain a process at the desired control point. A comprehensive set of easy to use steps allows the controller to satisfy various applications. The user input can be programmed to perform a variety of controller functions.

Dual 4-digit displays allow viewing of the measured process value and setpoint or the process and profile status simultaneously. Front panel indicators inform the operator of controller status and output states. Replaceable output modules (Relay, logic/SSR drive or Triac) can be fitted to the main control output, alarm output(s) or timed event output(s), and secondary output.

The PSC has been designed to simplify the set-up and operation of a controlled setpoint profile program. The setpoint program is easily entered and controlled through the front panel. Full display capabilities keep the operator informed of the process value, profile status, output states, and setpoint value.

The controller can operate in the standard PID control mode for both Output 1 and Output 2 with on-demand auto-tune which establishes the PID gain set. The PID gain set can be fine tuned by the operator at any time or may be locked from further modification. The unit can be transferred to the manual control mode providing the operator with direct control of the output.

The PSC features four programs or profile recipes, each with up to eight ramp/soak segments, which can be easily stored and executed at any time. Longer profiles can be achieved by linking one or more profiles together, creating a single profile of up to 32 ramp/soak segments. Process profile conformity is assured during either soak (hold) phases or both ramp and hold phases by an adjustable error band parameter. The program repeat function cycles the profile either continuously or a set number of times. Power-on options automatically re-start, stop, or resume a running profile. The profile can be controlled via the front panel buttons, the user input, or the optional serial communications port.

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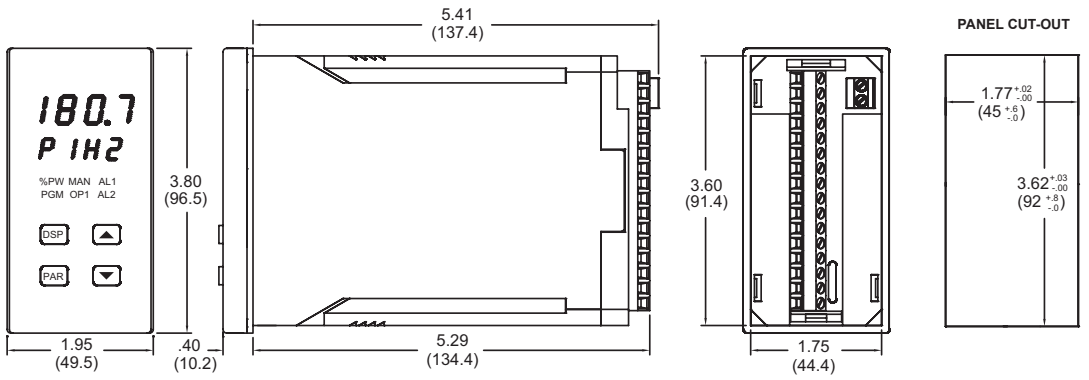
DIMENSIONS In inches (mm)

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 5.5" (140) H x 2.1" (53.4) W.



DESCRIPTION (Cont'd)

Four control points, each having a setpoint and PID parameter set, are available for instant front panel implementation during batch changeover, or other process conditions. A control point may have its PID gain set values disabled when implementing the control point.

The optional RS485 multidrop serial communications interface provides the capability of two-way communication between a PSC unit and other compatible equipment such as a printer, a programmable controller, or a host computer. In multipoint applications the address number of each unit on the line can be programmed from 0 to 99. Up to thirty-two units can be installed on a single pair of wires. The Setpoint value, % Output Power, Setpoint Ramp Rate, etc. can be interrogated or changed by sending the proper command code via serial communications. Alarm output*(s)* may also be reset via the serial communications interface option.

Optional alarm output*(s)* may be configured to operate as a timed event output or as a standard alarm output. As an alarm output it may be configured to activate according to a variety of actions (Absolute HI or LO, Deviation HI or LO, or Band IN or OUT) with adjustable hysteresis. Also, a standby feature suppresses the output*(s)* on power-up until the process stabilizes outside the alarm region. Timed event output*(s)* allow the controller to activate other equipment while a programmed profile is running. Each profile can define up to 16 event states (phases), for each output*(s)*.

An optional secondary output is available for processes that require cooling which provides increased control accuracy and response.

The optional linear 4 to 20 mA or 0 to 10 VDC output signal is available to interface with final actuators, chart recorders, indicators, or other controllers. The output signal can be digitally scaled and selected to transmit one of the following:

% Output Power
Measurement Value
Measurement Value Deviation
Setpoint Value

An optional Type 4X/IP65 rated bezel is available for washdown and/or dirty environments, when properly installed. Modern surface-mount technology, extensive testing, plus high immunity to noise interference, makes the controller extremely reliable in industrial environments.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the manual or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Do not use the PSC to directly command motors, valves, or other actuators not equipped with safeguards. To do so, can be potentially harmful to persons or equipment in the event of a fault to the unit. An independent and redundant process limit indicator with alarm outputs is strongly recommended. The indicators should have input sensors and AC power feeds independent from other equipment.

SPECIFICATIONS

1. **DISPLAY:** Dual 4-digit
   Upper Process Display: 0.4" (10.2 mm) Red LED
   Lower Auxiliary Display: 0.3" (7.6 mm) Green LED
   Display Messages:
   "OLOL" - Appears when measurement exceeds +105% of input range.
   "ULUL" - Appears when measurement exceeds -5% of input range.
   "SENS" - Appears when measurement exceeds "OLOL" & "ULUL" range.
   "...." - Appears when display value exceeds + display range.
   "-..." - Appears when display value exceeds - display range.
2. **POWER**: Switch selectable 115/230 VAC (+10%, -15%) no observable line variation effect, 48 to 62 Hz, 10 VA.
3. **ANNUNCIATORS:**
   6 LED Backlight Status Indicators:
   %PW - Lower auxiliary display shows power output in (%).
   PGM - Lower auxiliary display shows profile status or profile time remaining.
   MAN - Controller is in manual mode.
   OP1 - Main control output is active.
   AL1 - Alarm #1 is active.
   AL2 - Alarm #2 is active *(for Dual Alarm Option)*.
   OP2 - Secondary output is active *(for Secondary Option)*.
4. **CONTROLS:** Four front panel push buttons for modifying and setup of controller functions and one external input.
5. **SETPOINT PROFILE:**
   Profiles: 4
   Segments Per Profile: 8 ramp/hold segments (linkable to 32 segments).
   Ramp Rate: 0.1 to 999.9 units/minute or no ramp.
   Hold Time: Off or from 0.1 to 999.9 minutes, can be extended to 500 hours by linking.
   Error Band Conformity: Off or from 1 to 9999 units deviation, + value for hold phases, - value for both ramp and hold phases.
   Power-On Modes: Stop, auto-start, or profile resume.
   Start Mode: Ramps from process value.
   Program Auto Cycle: 1 to 249, or continuous.
   Event Outputs: 2, time activated with profile [uses Alarm output(s)].
   Control: Front panel buttons, user input, or RS485 communications.
6. **CONTROL POINTS:**
   Setpoints: 4
   PID gain sets: 4
   Control: Front panel buttons or user input.
7. **SIGNAL INPUT:**
   Sample Period: 100 msec
   Response Time: 300 msec (to within 99% of final value w/step input).
   Signal Overdrive Threshold:
   10 V Range: 13 V
   20 mA Range: 26 mA
   Signal Overdrive Response:
   Main Control Output: Programmable preset output.
   Display: "SENS"
   DC Linear: Programmable preset output.
   Normal Mode Rejection: 40 db @ 50/60 Hz (improves with increased digital filtering).
   Common Mode Rejection: 100 db, DC to 50/60 Hz.
8. **RANGE AND ACCURACY:**

Signal Range	Accuracy (% of Unscaled Reading)	Max. Input	Input Impedance	Resolution
0 to 10 VDC	±(0.15% + 3 mV)	300 VDC	1M Ω	10 mV
0 to 20 mADC	±(0.15% + 6 µA)	200 mADC	10 Ω	10 µA

9. **OUTPUT MODULES (For All Output Channels):**
   (Optional - Must be ordered separately)
   Relay:
   Type: Form-C *(Form-A with RS485 option)*
   Rating: 5 Amps @ 120/240 VAC or 28 VDC *(resistive load)*, 1/8 HP @ 120 VAC *(inductive load)*.
   Life Expectancy: 100,000 cycles at max. rating. (Decreasing load and/or increasing cycle time, increases life expectancy).
   Logic/SSR Drive: Can drive multiple SSR Power Units.
   Type: Non-isolated switched DC, 12 VDC typical
   Drive: 45 mA max.
   Triac:
   Type: Isolated, Zero Crossing Detection.
   Ratings: Voltage: 120/240 VAC
   Max Load Current: 1 AMP @ 35°C
   0.75 AMP @ 50°C
   Min Load Current: 10 mA
   Off State Leakage Current: 7 mA max. @ 60 Hz
   Operating Frequency: 20 to 500 Hz
   Protection: Internal Transient Snubber, Fused.
10. **MAIN CONTROL OUTPUT:**
    Control: PID or ON/OFF.
    Output: Time proportioning or linear DC.
    Hardware: Plug-in, replaceable output modules.
    Cycle time: Programmable.
    Auto-tune: When performed, sets proportional band, integral time, and derivative time values.
    Probe Break Action: Programmable.
11. **SECONDARY OUTPUT (Optional):**
    Control: PID or ON/OFF.
    Output: Time proportioning or linear DC
    Hardware: Plug-in, replaceable output modules.
    Cycle time: Programmable.
    Proportional Gain Adjust: Programmable.
    DeadBand Overlap: Programmable.
12. **LINEAR DC DRIVE (Optional):** With digital scale and offset, programmable deadband and update time.
    4 to 20 mA:
    Resolution: 1 part in 3500 typ.
    Accuracy: *±(0.1% of reading + 25 µA)*.
    Compliance: 10 V *(500 Ω max. loop impedance)*.
    0 to 10 VDC:
    Resolution: 1 part in 3500 typ.
    Accuracy: *±(0.1% of reading + 35 mV)*.
    Min. Load Resistance: 10 K Ω (1 mA max.)
    Source: % output power, setpoint, deviation, or process value.
    (Available for OP1 or OP2, but not both.)

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SPECIFICATIONS (Cont'd)

13. **ALARMS (Optional):**
Hardware: Plug-in, replaceable output module.
Modes: Absolute high acting
Absolute low acting
Deviation high acting
Deviation low acting
Inside band acting
Outside band acting
Timed event output(s)
Reset Action: Programmable; automatic or latched.
Delay: Programmable; enable or disable.
Hysteresis: Programmable.
Annunciator: LED backlight for "AL1", "AL2", *(Alarm #2 not available with secondary output)*.

14. **SERIAL COMMUNICATIONS (Optional):**
Type: RS485 Multi-point, Balanced Interface.
Communication Format:
Baud Rate: Programmable from 300 to 9600.
Parity: Programmable for odd, even, or no parity.
Frame: 1 start bit, 7 data bits, 1 or no parity bit, 1 stop bit.
Unit Address: Programmable from 0-99, max. of 32 units per line.
Transmit Delay: 100 msec min., 200 msec max.
RS485 Common: Isolated from signal input common.
Auto Print Time: Off to 9999 seconds between print-outs.

15. **USER INPUT:** $V_{IN\ MAX}$ = 5.25 VDC, V_{IL} = 0.85 V_{MAX}; V_{IH} = 2.0 V_{MIN}
Response time: 100 msec max.
Functions:

Program Lock	Print Request
Integral Action Lock	Load Control Point
Auto/Manual Transfer	Run/Hold Profile 1
Setpoint Ramp Select	Run/Stop Profile 1
Reset Alarms	

16. **ENVIRONMENTAL CONDITIONS:**
Operating Temperature Range: 0° to 50°C
Storage Temperature Range: -40° to 80°C
Vibration to IEC 68-2-6: Operational 5-150 Hz, 1 g
Shock to IEC 68-2-27: Operational 5 g
Span Drift: 90 ppm/°C
Zero Drift: 0 to 10 VDC Range - 0.2 mV/°C
4 to 20 mA DC Range - 0.5 µA/°C
Relative Humidity: Less than 85% RH (non-condensing)
Altitude: Up to 2000 meters

17. **CERTIFICATIONS AND COMPLIANCES:**
CE Approved
EN 61326-1 Immunity to Industrial Locations
Emission CISPR 11 Class A
EN 61010-1
RoHS Compliant
UL Recognized Component: File #E156876
UL Listed: File #E137808
Type 2 Enclosure rating (Face only) for PSC0
Type 4X/IP65 Enclosure rating (Face only) for PSC1
Refer to EMC Installation Guidelines section of the manual for additional information.

18. **CONNECTION:** Jaw-type terminal block.

19. **CONSTRUCTION:**
Front Panel: Flame and scratch resistant tinted plastic.
Case: High impact black plastic. (Mounting collar included).
Type 4X/IP65 model only: Sealed bezel utilizing 2 captive mounting screws (panel gasket included). This unit is rated for Type 4X/IP65 indoor use. Installation Category II, Pollution Degree 2.

20. **WEIGHT:** 1.3 lbs. (0.6 kgs)

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BASIC OPERATION

The PSC controls the process profile of a system by measuring the input signal, comparing it to the setpoint value of the profile in progress, and calculates the new output power value by use of a modified PID control algorithm. The unit controls the system with the new output power value so the process value conforms to the profile. The PID control algorithm incorporates features which provide high control accuracy and low disturbance overshoot.

FRONT PANEL FEATURES

In the normal display mode, the unit will display the scaled process value in the upper display. One of five other parameters may be selected for viewing in the lower display:

Target setpoint
% Output Power
Profile Status
Profile phase time remaining
Blank the lower display.

The profile status display indicates the active program number with the current ramp or hold phase of the program. The profile can be started, stopped, advanced, etc., from the front panel when the profile status display is viewed, if not locked from access.

The phase time remaining display, shows the time remaining in a ramp or hold phase and, if not locked from access, may be changed on-line to effect temporary changes to the profile. Additionally, the target setpoint and % output power (manual mode only) may also be changed on-line or locked from operator access.

From the normal operating mode, parameters are selected by use of the PAR button and modified by use of the UP and DOWN buttons. Parameters are then entered by the PAR button, which advances the user to the next parameter. Pressing the DSP button immediately returns the controller to the normal operating mode from any parameter module. The controller configuration and parameter settings are stored in an internal E^2PROM device.

HARDWARE FEATURES

The fast 100 msec input sampling rate provides quick controller response to a process disturbance for excellent process control. Measurement accuracy of 0.15% provides closer process control conforming to the desired control setpoint value.

The unit will accept either a 0 to 10 VDC or a 4 to 20 mADC input signal. The A.C. input power is switch selectable, allowing the unit to operate from either 115 VAC or 230 VAC. Since the controller is serviceable from the front of the panel, the output modules may be easily changed or replaced without disturbing the wiring behind the panel and NO re-programming is required. The standard model simply requires pressing a latch to remove the unit. The Type 4X/IP65 rated model utilizes two panel securing screws and a neoprene gasket to guarantee a water tight seal, when properly installed.

Low-drift, highly stable circuit design ensures years of reliable and accurate process control. The recommended two year re-calibration interval is easily accomplished via the programming menu.

Type 4X/IP65 BEZEL

CONFIGURATION MODE

The configuration modules serve to provide the basic set-ups required by the controller. It is divided into sections which group together related programming steps, such as inputs, outputs, alarms, etc. Upon completion of each section, the program returns to the configuration selection stage, which allows the user to return to the normal display mode, or advance to a later configuration stage.

Configuration 1, Inputs

- "tYPE" - Select current or voltage
- "dCPt" - Select scaled display decimal point position
- "rnd" - Enter rounding increment and trailing zeros for scaled display
- "FLtr" - Select degree of input filtering
- "dSP1" - Enter display reading for scaling point #1
- "INP1" - Key-in or apply signal level for scaling point #1
- "dSP2" - Enter display reading for scaling point #2
- "INP2" - Key-in or apply signal level for scaling point #2
- "SPLO" - Enter setpoint lower limit
- "SPHI" - Enter setpoint higher limit
- "SPrP" - Enter setpoint ramp rate
- "InPt" - Select user input function

Configuration 2, Outputs

- "CYCt" -. Enter time proportioning cycle time
- "OPAC" -. Select control action
- "OPLO" -. Enter output power low limit
- "OPHI" -. Enter output power high limit
- "OPFL" -. Enter signal overdrive power preset
- "CHYS" -. Enter ON/OFF control hysteresis
- "tcod" -. Select auto-tuning damping
- "ANAS" -. Select linear DC output assignment ∗
- "ANLO" -. Enter linear DC low scaling value ∗
- "ANHI" -. Enter linear DC high scaling value ∗

Configuration 3, Parameter lock-outs

- "SP" - Select degree of setpoint access
- "OP" - Select degree of power access
- "P-CS" - Select degree of profile status access
- "P-tr" - Select degree of phase time remaining access
- "bdSP" - Enable blank display
- "CodE" - Enter parameter access code
- "PId" - Select degree of PID access
- "AL" - Select degree of alarm access ∗
- "ALrS" - Enable manual reset of alarms ∗
- "CPAC" - Enable control point access
- "PrAC" - Enable ramp/hold program access
- "trnF" - Enable automatic/manual transfer
- "tUNE" - Enable auto-tune invocation

∗ *These parameters may not appear due to option configuration or other programming.*

Configuration 4, Alarms ∗

- "Act 1" - Select operation mode of alarm #1
- "rSt1" - Select reset mode of alarm #1
- "Stb1" - Enable activation delay of alarm #1
- "AL-1" - Enter value for alarm #1
- "Act2" - Select operation mode of alarm #2
- "rSt2" - Select reset mode of alarm #2
- "Stb2" - Enable activation delay of alarm #2
- "AL-2" - Enter value for alarm #2
- "AHYS" - Enter hysteresis value for both alarms

Configuration 5, Secondary Output ∗

- "CYC2" - Enter time proportioning cycle time
- "GAN2" - Enter relative gain
- "db-2" - Enter deadband or overlap

Configuration 6, Serial Communications ∗

- "bAUd" - Select baud rate
- "PArb" - Select parity bit
- "Addr" - Enter unit address number
- "Abrv" - Select abbreviated or full mnemonic transmissions
- "PrAt" - Enter automatic print rate
- "PoPt" - Select parameters to be included in print-out

Configuration 7, Control Points

- "CSEt" - Select control point number for set-up 1, 2, 3, & 4
- "SP-x" - Enter setpoint value for selected control point
- "PID" - Select if PID gain set to be loaded with setpoint
- "PB-x" - Enter proportional band for selected control point ∗
- "It-x" - Enter integral time for selected control point ∗
- "dt-x" - Enter derivative time for selected control point ∗

Configuration 8, Profiles

- "PSEt" - Select profile or event output for set-up 1, 2, 3, or 4
- "PnCC" - Enter program-repeat cycle count for selected profile
- "PnLN" - Select link option for selected profile
- "PnSt" - Enter power-down resume status for selected profile
- "PnEb" - Enter error band for process conformity for selected profile
- "Pnr1" - Enter ramp rate 1 for selected profile ∗
- "PnL1" - Enter setpoint level 1 for selected profile ∗
- "PnH1" - Enter hold time 1 for selected profile ∗
- . -
- . -
- "Pnr8" - Enter ramp rate 8 for selected profile ∗
- "PnL8" - Enter setpoint level 8 for selected profile ∗
- "PnH8" - Enter hold time 8 for selected profile ∗
- "Pn 1" - Select event outputs at phase 1 for selected profile ∗
- . -
- . -
- "Pn16" - Select event outputs at phase 16 for selected profile ∗

Configuration 9, Factory Service Operations

(Detailed in the operator's manual)

SETPOINT FEATURES

The controller's setpoint can be protected from out of range values, by programming the setpoint range limit values. Additionally, safeguards from inadvertent data entry can also be programmed.

The setpoint ramp feature ramps the setpoint value at start-up or any time a setpoint change is made, at a user programmable rate, independent of a programmed profile. This feature reduces shock to the process and also helps to minimize overshoot.

The active setpoint, which can be a running profile, may also be transmitted by the linear DC output for slave control loops.

Four control points are available which can be implemented at any time. Each control point is programmed independently, with each having a setpoint and a PID gain set value. With gain value changes, the output power control signal will not "bump" resulting in a smooth control transition.

INPUT FEATURES

A programmable input filter can be used to stabilize readings from a process with varying or oscillating characteristics, helping to provide better process control.

Scaling points allow the controller to display in any engineering unit; flow, level, pressure temperature, etc. Scaling points are used in conjunction with the programmable rounding increment to stabilize a jittery or otherwise hard to read process signal for better indication.

A programmable User Input is available to control a variety of controller functions, such as profile control, auto/manual transfer, serial communication print requests, etc.

OUTPUT FEATURES

Programmable output power limits provide protection for processes where too much power can cause damage. Automatic signal overdrive detection can be used to define the state of the output channels, when this situation occurs. With adjustable time proportioning-cycle time and programmable D.C. Linear output, the controller can satisfy a wide variety of output requirements.

During execution of a profile, two independent timed event outputs are available to control or signal other equipment. The event outputs use the alarm channels.

The RS485 Communication option allows the user to access various controller parameters such as the setpoint, % output power, % proportional band, etc. The controller may be setup to transmit various parameters at a programmable automatic print rate.

AUTO-TUNE

The model PSC has an auto-tune feature which, on demand, automatically determines the PID control parameters for a particular process. After completion of auto-tune, the PID parameters are automatically optimized for that process and loaded into nonvolatile memory. The operator may view and modify the parameters as desired.

Auto-tune may be invoked at start-up, while ramping, or at setpoint, depending on the process requirements. A programmable auto-tune damping factor produces various levels of process control and response characteristics.

PROFILE PROGRAMMING

Profiles are programmed independently of each other and are separate from the configuration of other controller parameters. Each profile has parameters for error band (profile conformity), linking, auto-start and program repeat cycles. Profiles may be altered during execution, so changes take effect as the profile advances.

CONTROLLER PROGRAMMING

The model PSC has been designed to reduce the operator interaction with the controller while still maintaining a high degree of control accuracy and user flexibility. Front panel program disable allows all of the controller's set-ups to be locked-out from further operator intervention after the initial parameter set-up.

The programming of the controller is divided into four sections:

Hidden Mode
Protected Mode
Unprotected Mode
Configuration Mode

These four programming modes allow the controller to adapt to any required user-interface level.

UNPROTECTED PARAMETER MODE

The unprotected mode is accessible when program disable is inactive or when the proper access code number from the protected mode is entered. Only from this mode can the configuration modes be accessed.

"SP" - Enter setpoint ∗
"OPOF" - Enter %output power offset ∗
"OP" - Enter output power ∗
"ProP" - Enter proportional band
"Intt" - Enter integral time ∗
"dErt" - Enter derivative time ∗
"AL-1" - Enter value for alarm #1 ∗
"AL-2" - Enter value for alarm #2 ∗
"CNFP" - Select basic configuration module
"End" - Return to normal display mode

PROTECTED PARAMETER MODE ∗

The protected mode is accessible when program disable is active, also this mode prevents access to the configuration modes without the proper access code number. Only the parameters that are selected in the configuration 3 parameter lock-outs section can be accessed.

"ProP" - Enter proportional band
"Intt" - Enter integral time
"dErt" - Enter derivative time
"AL-1" - Enter value for alarm #1
"AL-2" - Enter value for alarm #2
"CodE" - Enter access value to unprotected mode

∗ *These parameters may not appear due to option configuration or other programming.*

HIDDEN FUNCTIONS MODE ∗

The hidden mode is accessible from the normal operating mode by holding the PAR button for 3 seconds. The five functions in this mode may be locked-out individually in configuration 3 parameter lock-outs section.

" CP" - Invoke control point x
"Prun" - Control ramp/hold profile state
"trnF" - Transfer between automatic (PID) control and Manual control
"tUNE" - Invoke/Cancel PID auto-tune
"ALrS" - Reset latched alarms

∗ *These parameters may not appear due to option configuration or other programming.*

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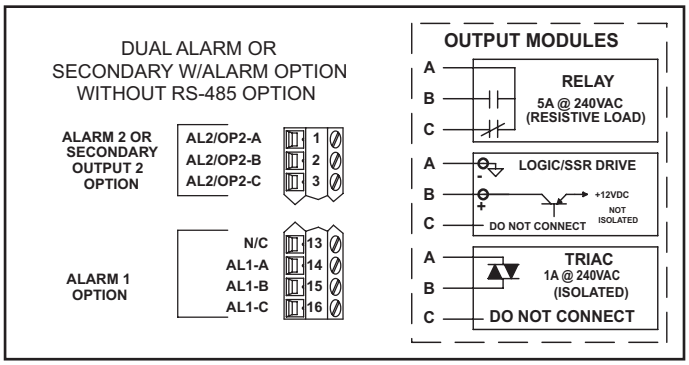
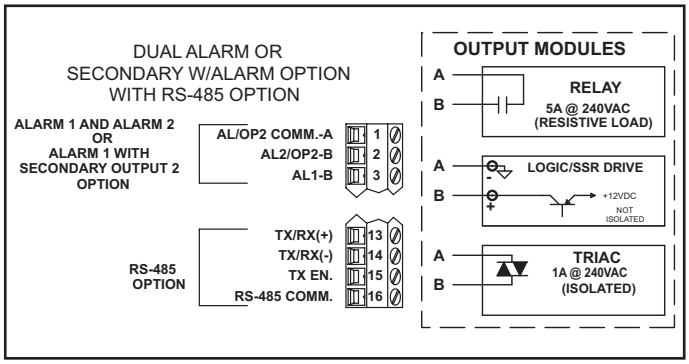
OUTPUT VARIATIONS WITHOUT RS485 OPTION

The Dual Alarm or the Secondary with Alarm output, without the RS485 option, has independent outputs. Therefore, the secondary output and/or alarm output*(s)* can be installed with any combination of output modules.



OUTPUT VARIATIONS WITH RS485 OPTION

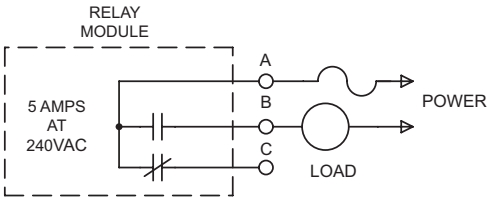
The Dual Alarm or the Secondary with Alarm output, with RS485 option, does not have independent outputs. In this case, the secondary output and/or alarm output*(s)* must have the same type of output modules installed since they share the common terminal.



OUTPUT MODULES

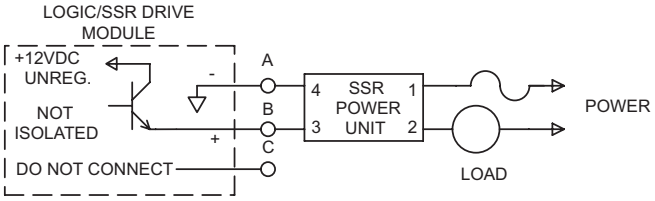
Units equipped with RS485 option must have the Dual Alarm or Secondary w/alarm options fitted with the same type of output modules. The controller's main output (OP1) can be fitted with any output module. Output modules are shipped separately and must be installed by the user.

TYPICAL CONNECTIONS

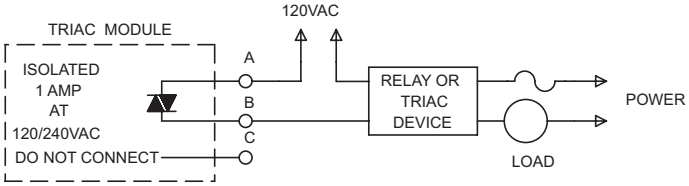


Relay:

Type: Form -C (Form-A with RS485 option only)
Rating: 5 Amps @ 120/240 VAC or 28 VDC (resistive load), 1/8 HP @ 120 VAC (inductive).
Life Expectancy: 100,000 cycles at maximum load rating.
(Decreasing load and/or increasing cycle time, increases life expectancy).



Logic/SSR Drive: can drive multiple SSR Power Units.
Type: Non-isolated switched DC, 12 VDC typical.
Drive: 45 mA max.



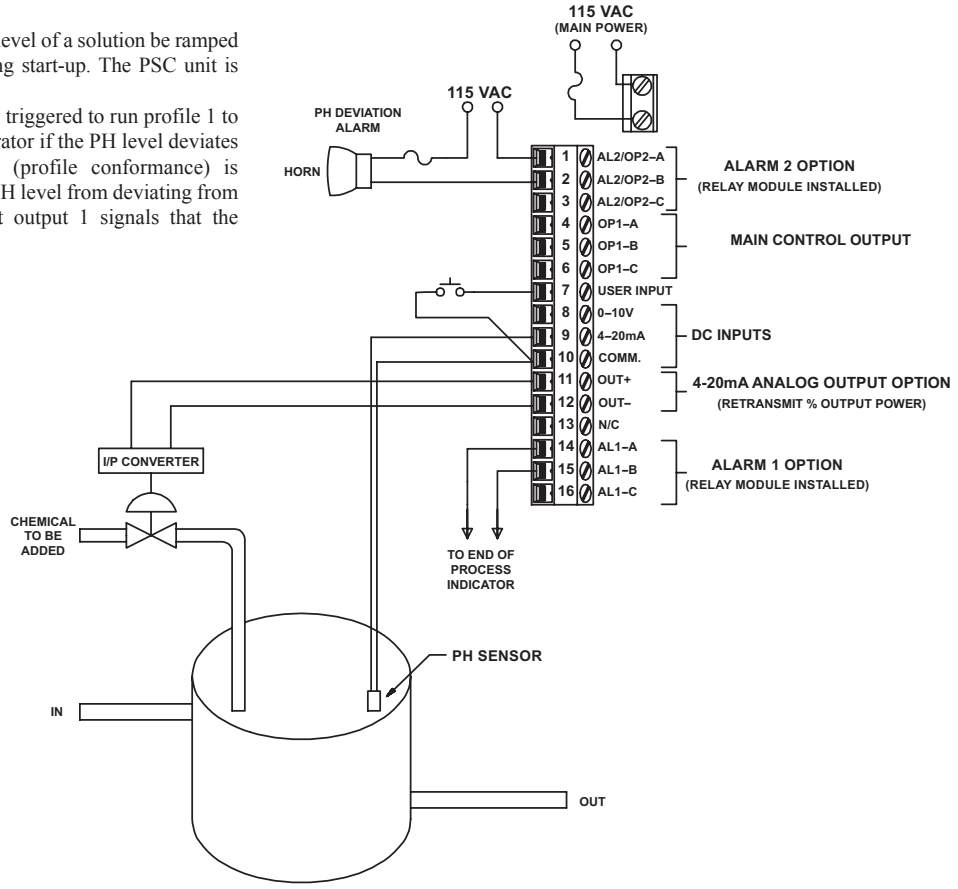
Triac:

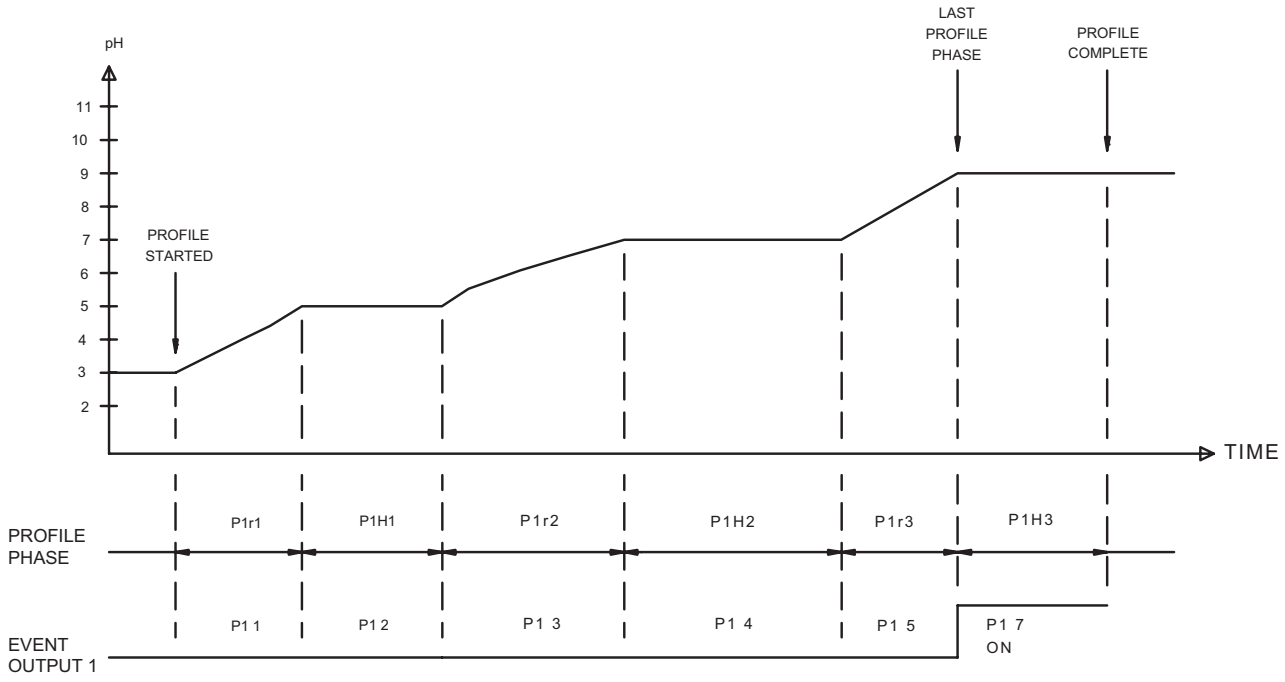
Type: Isolated, Zero Crossing Detection.
Rating:
Voltage: 120/240 VAC.
Max. Load Current: 1 Amp @ 35°C
0.75 Amp @ 50°C
Min. Load Current: 10 mA
Off State Leakage Current: 7 mA max @ 60 Hz.
Operating Frequency: 20 to 500 Hz.
Protection: Internal Transient Snubber, Fused.

APPLICATION

A chemical treatment process requires the PH level of a solution be ramped at staged levels over specific time periods during start-up. The PSC unit is installed to meet this requirement.

After the tank is filled, the PSC's user input is triggered to run profile 1 to start the process. Alarm output 2 signals the operator if the PH level deviates outside the running profile. The error band (profile conformance) is programmed to the desired value to prevent the PH level from deviating from the programmed setpoint profile. Timed event output 1 signals that the profile process is complete.





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ORDERING INFORMATION

MODEL NO	DESCRIPTION	Type 4X/IP65 BEZEL	4 to 20 mA ANALOG OUTPUT	0 to 10 VDC ANALOG OUTPUT	ALARM OUTPUTS	SECONDARY OUTPUT	RS485 COM	PART NUMBER
PSC	Process Setpoint Controller	YES	YES	NO	2	NO	NO	PSC11001
		YES	YES	NO	2	NO	YES	PSC11004
		YES	YES	NO	1	YES	YES	PSC11005
		YES	NO	YES	2	NO	YES	PSC12004
		YES	NO	YES	1	YES	YES	PSC12005
	Relay Module							OMD00000
	Triac Module							OMD00001
	Logic/SSR Drive Module							OMD00003
PMK5	Panel Mount Adapter Kit (1/4 DIN to 1/8 DIN)							PMK50000
RLY	45 A Single Phase Panel Mount SSR							RLY50000
	25 A Single Phase DIN Rail Mount SSR							RLY60000
	40 A Single Phase DIN Rail Mount SSR							RLY6A000
	25 A Three Phase DIN Rail Mount SSR							RLY70000

These models have dual alarm outputs, or single alarm with secondary outputs, with shared common terminals (Form A Type). As a result, these outputs should be fitted with the same type of output module. The main output (OP1) may be fitted with any type of output

Note: Output Modules are NOT supplied with the controller. When specifying the controller, be sure to purchase the appropriate output module for the Main Control Output and if necessary, the alarm output(s) and secondary output. The controller can be fitted with any combination of output modules that do not have the RS485 option.

The Logic/SSR Drive Module is a switched DC source, intended to drive the DC input of an SSR power unit. It should never be connected to a line voltage.

All modules are shipped separately and must be installed by the user.

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MODEL TLA - TEMPERATURE LIMIT ALARM

- *FM APPROVED, UL RECOGNIZED*
- *2-LINE BY 4-DIGIT DISPLAY*
- *EXCEED, OUTPUT, AND ALARM ANNUNCIATORS*
- *FOUR BUTTON SILICONE RUBBER KEYPAD*
- *THERMOCOUPLE OR RTD SENSOR INPUT*
- *REMOTE RESET INPUT*
- *MAIN LIMIT OUTPUT: 5A RELAY. SELECTABLE FOR HIGH OR LOW TRIP ACTIVATION*
- *OPTIONAL ALARMS: 5A RELAY(S)*
- *OPTIONAL NEMA 4X/IP65 SEALED FRONT BEZEL*
- *PARAMETER SECURITY VIA PROGRAMMABLE LOCKOUTS*

FM
APPROVED

UL Recognized Component, File # E156876

GENERAL DESCRIPTION

The TLA is a Factory Mutual approved temperature limit alarm, intended to provide an independent shutdown for thermal processes. The TLA accepts signals from a variety of temperature sensors (thermocouple or RTD elements), and its comprehensive programming allows it to meet a wide variety of application requirements.

Dual 4-digit displays allow viewing of the process temperature and limit setpoint simultaneously. Front panel indicators inform the operator of the process and output status. The main limit output and alarm outputs are field replaceable.

The limit output is selectable for high or low trip activation. If the process temperature goes above the limit setpoint for a high trip, or below the limit setpoint for a low trip, the limit relay will de-energize to initiate a process shutdown. The limit output cannot be reset until the process temperature returns to the proper operating range; manual reset is required (local or remote). Sensor failure will initiate a process shutdown.

Relay alarm(s) can be configured to activate according to a variety of actions (Absolute HI or LO, Deviation HI or LO, and Band IN or OUT) with adjustable hysteresis. A standby feature suppresses the alarm during power-up until the process stabilizes outside the alarm region.

The unit is constructed of a lightweight, high impact plastic case with a tinted front panel. The front panel meets NEMA 4X/IP65 specifications when properly installed. Multiple units can be stacked horizontally or vertically. Modern surface-mount technology, extensive testing, plus high immunity to noise interference makes the TLA extremely reliable in industrial environments.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the manual or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Do not use the TLA to directly command motors, valves, or other actuators not equipped with safeguards. To do so can be potentially harmful to persons or equipment in the event of a fault to the unit.

CAUTION: Risk of Danger.
Read complete instructions prior to installation and operation of the unit.

CAUTION: Risk of electric shock.

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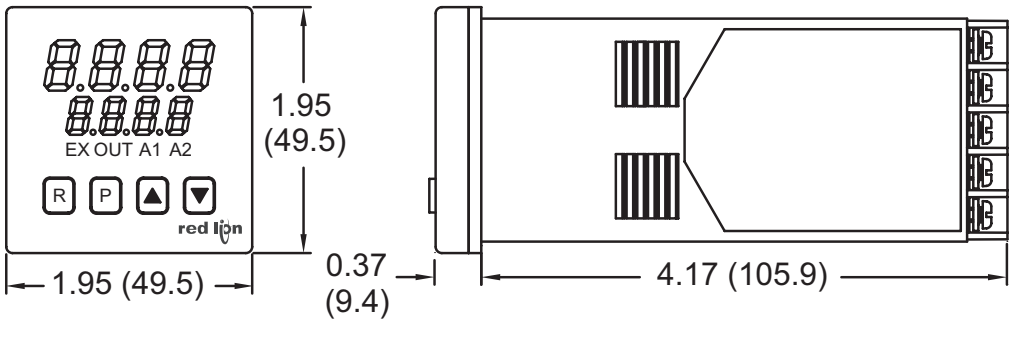
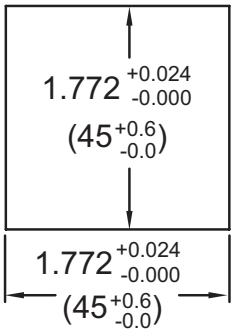
DIMENSIONS In inches (mm)



PANEL CUT-OUT



GENERAL SPECIFICATIONS

1. **DISPLAY**: 2 line by 4-digit LED
   Upper (Main) Display: 0.4" (10.2 mm) high red LED
   Lower (Secondary) Display: 0.3" (7.6 mm) high green LED
   Display Messages:
   "OLOL" - Appears when measurement exceeds + sensor range.
   "ULUL" - Appears when measurement exceeds - sensor range.
   "OPEN" - Appears when open sensor is detected.
   "SHrt" - Appears when shorted sensor is detected (RTD only)
   "..." - Appears when display values exceed + display range.
   "-.." - Appears when display values exceed - display range.

LED Status Annunciators:
EX - Temperature exceeds limit setpoint
OUT - Limit output is de-energized
A1 - Alarm #1 is active
A2 - Alarm #2 is active

2. **POWER:**
   Line Voltage Models: 85 to 250 VAC, 50/60 Hz, 8 VA.
   Low Voltage Models:
   DC Power: 18 to 36 VDC, 7 W.
   AC Power: 24 VAC +/-10%, 50/60 Hz, 9 VA
3. **CONTROLS:** Four rubber push buttons: R, P, Up, Down
4. **MEMORY:** Nonvolatile E^2PROM retains all programmable parameters and values.
5. **ENVIRONMENTAL CONDITIONS:**
   Operating Range: FM rated @ 0 to 65°C, UL rated @ 0 to 55°C
   Storage Range: -40 to 80°C
   Operating and Storage Humidity: 85% max. relative humidity (non-condensing) from 0°C to 65°C.
   Vibration to IEC 68-2-6: Operational 5 to 150 Hz, 2 g.
   Shock to IEC 68-2-27: Operational 20 g (10 g relay).
   Altitude: Up to 2000 meters
6. **ISOLATION BREAKDOWN RATINGS:**
   AC line with respect to all inputs and outputs: 2300 V for 1 minute (250 V working)
   Relay contacts to all other inputs and outputs: 2300 VAC
   DC Power with respect to sensor input: 50 V working (500 V for 1 minute)
7. **CERTIFICATIONS AND COMPLIANCES:**
   CE Approved
   EN 61326-1 Immunity to Industrial Locations
   Emission CISPR 11 Class A
   IEC/EN 61010-1
   RoHS Compliant
   Factory Mutual (FM) Listed: File #3014646
   UL Recognized Component: File #E156876
   Type 4X Enclosure rating (Face only)
   IP65 Enclosure rating (Face only)
   IP20 Enclosure rating (Rear of unit)
   Refer to EMC Installation Guidelines section of the bulletin for additional information.
8. **CONNECTION:** Wire clamping screw terminals
   Wire Gage Capacity: Two 14 AWG (2.55 mm), four 18 AWG (1.02 mm), or four 20 AWG (0.61 mm).
   Terminal Torque: 1.0Nm (8.9 in-lbs.).
   1.4Nm (12.4 in-lbs.) max.
9. **CONSTRUCTION:** Black plastic alloy case and collar style panel latch. Panel latch can be installed for vertical or horizontal instrument stacking. One piece tinted plastic bezel. Bezel assembly with circuit boards can be removed from the case to change the output board without removing the case from the panel or disconnecting wiring. Unit meets NEMA 4X/IP65 requirements for indoor use, when properly installed. Flame resistant. Installation Category II, Pollution Degree 2.
10. **WEIGHT:** 0.38 lbs (0.17 kgs)

INPUT SPECIFICATIONS

1. **SENSOR INPUT:**
   Sample Period: 100 msec
   Step Response Time: Less than 300 msec typ., 400 msec max. (to within 99% of final value)
   Normal Mode Rejection: Greater than 40 dB @ 50/60 Hz
   Common Mode Rejection: Greater than 120 dB, DC to 60 Hz
   Overvoltage Protection: Input overload 120 VAC for 15 seconds max.
2. **Failed Sensor Response:**
   Main Output: Sensor failure will initiate a process shutdown
   Display: "OPEN"
   Alarms: Upscale
3. **INDICATION ACCURACY:** ±(0.3% of Span +1°C) at 23°C ambient after 20 minute warm-up. (Includes NIST conformity, cold junction effect, A/D conversion errors and linearization conformity.
   Span Drift (maximum): 130 PPM/°C
4. **RTD INPUT:** 2 or 3 wire, 100 Ω platinum, alpha = 0.00385 (DIN 43760), alpha = 0.0039162
   Excitation: 150 µA typical
   Resolution: 1 or 0.1 degree
   Lead Resistance: 15 Ω max. per input lead

RTD TYPE	RANGE
385	-200 to +600°C -328 to +1100°F
392	-200 to +600°C -328 to +1100°F
OHMS	2.0 to 320.0

5. **THERMOCOUPLE INPUT:**
   Types: T, E, J, K, R, S, B, N, Linear mV, software selectable
   Input Impedance: 20 MΩ all types
   Lead resistance effect: 0.25 µV/Ω
   Cold junction compensation: Less than ±1°C typ., (±1.5°C max), error over 0 to 65°C max. ambient temperature range. Defeated for Linear mV indication mode.
   Resolution: 1° for all types, or 0.1° for T, E, J, K, and N onlY.

TC TYPE	RANGE	WIRE COLOR	
		ANSI	BS 1843
T	-200 to +400°C -328 to +752°F	blue (+) red (-)	white (+) blue (-)
E	-200 to +750°C -328 to +1382°F	violet (+) red (-)	brown (+) blue (-)
J	-200 to +760°C -328 to 1400°F	white (+) red (-)	yellow (+) blue (-)
K	-200 to +1250°C -328 to +2282°F	yellow (+) red (-)	brown (+) blue (-)
R	0 to 1768°C +32 to +3214°F	black (+) red (-)	white (+) blue (-)
S	0 to 1768°C +32 to 3214°F	black (+) red (-)	white (+) blue (-)
B	+149 to +1820°C +300 to +3308°F	grey (+) red (-)	no standard
N	-200 to +1300°C -328 to +2372°F	orange (+) red (-)	orange (+) blue (-)
mV	-5.00 to +56.00	no standard	no standard

6. **REMOTE RESET INPUT:** Internally pulled up to +5 VDC (1MΩ).
   V_{IL}: 0.85 V max., V_{IH}: 3.65 V min., V_{IN} MAX: 5.25 VDC, I_{OFF}: 1µA max.

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OUTPUT SPECIFICATIONS

1. **LIMIT AND ALARM OUTPUT RELAYS**:
   Contact Rating: 5 A @ 250 VAC or 30 VDC (resistive load).
   Life Expectancy: 100,000 cycles at max. load rating. (Decreasing load increases life expectancy.)
2. **LIMIT OUTPUT**: TLA21000: Form-C relay; TLA11100: Form-A relay. Selectable for high or low trip activation. If the process temperature goes above the limit setpoint for a high trip, or below the limit setpoint for a low trip, the limit relay will de-energize to initiate a process shutdown. The limit output cannot be reset until the process temperature returns to the proper operating range; manual reset is required (local or remote).
   Annunciators:
   "EX" - Lit when the process temperature exceeds the limit setpoint.
   "OUT" - Lit when the limit output is de-energized.
3. **ALARM OUTPUTS (Optional)**: One or two Form-A relays.
   Modes:

Absolute High Acting	Absolute Low Acting
Deviation High Acting	Deviation Low Acting
Inside Band Acting	Outside Band Acting

   Reset Action: Programmable; automatic or latched. Latched alarms can be reset regardless of limit exceed condition.
   Standby Mode: Programmable; enable or disable.
   Hysteresis: Programmable.
   Annunciator: "A1" and "A2" programmable for normal or reverse acting.

ORDERING INFORMATION

85 to 250 VAC

LIMIT OUTPUT	ALARM 1 OUTPUT	ALARM 2 OUTPUT	REPLACEMENT OUTPUT BOARD	PART NUMBERS
Form-C Relay	Form-A Relay		RBDLA210	TLA21000
Form-A Relay	Form-A Relay	Form-A Relay	RBD48111	TLA11100

18 to 36 VDC / 24 VAC

LIMIT OUTPUT	ALARM 1 OUTPUT	ALARM 2 OUTPUT	REPLACEMENT OUTPUT BOARD	PART NUMBERS
Form-C Relay	Form-A Relay		RBDLA210	TLA21010
Form-A Relay	Form-A Relay	Form-A Relay	RBD48111	TLA11110

EMC INSTALLATION GUIDELINES

Although Red Lion Controls Products are designed with a high degree of immunity to Electromagnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, source or coupling method into a unit may be different for various installations. Cable length, routing, and shield termination are very important and can mean the difference between a successful or troublesome installation. Listed are some EMI guidelines for a successful installation in an industrial environment.

1. A unit should be mounted in a metal enclosure, which is properly connected to protective earth.
2. Use shielded cables for all Signal and Control inputs. The shield connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield to earth ground (protective earth) at one end where the unit is mounted.
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is over 1 MHz.
3. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors, feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be run through metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter. Also, Signal or Control cables within an enclosure should be routed as far away as possible from contactors, control relays, transformers, and other noisy components.
4. Long cable runs are more susceptible to EMI pickup than short cable runs.
5. In extremely high EMI environments, the use of external EMI suppression devices such as Ferrite Suppression Cores for signal and control cables is effective. The following EMI suppression devices (or equivalent) are recommended:
   Fair-Rite part number 0443167251 (RLC part number FCOR0000)
   Line Filters for input power cables:
   Schaffner # FN2010-1/07 (Red Lion Controls # LFIL0000)
6. To protect relay contacts that control inductive loads and to minimize radiated and conducted noise (EMI), some type of contact protection network is normally installed across the load, the contacts or both. The most effective location is across the load.
   a. Using a snubber, which is a resistor-capacitor (RC) network or metal oxide varistor (MOV) across an AC inductive load is very effective at reducing EMI and increasing relay contact life.
   b. If a DC inductive load (such as a DC relay coil) is controlled by a transistor switch, care must be taken not to exceed the breakdown voltage of the transistor when the load is switched. One of the most effective ways is to place a diode across the inductive load. Most RLC products with solid state outputs have internal zener diode protection. However external diode protection at the load is always a good design practice to limit EMI. Although the use of a snubber or varistor could be used.
   RLC part numbers: Snubber: SNUB0000
   Varistor: ILS11500 or ILS23000
7. Care should be taken when connecting input and output devices to the instrument. When a separate input and output common is provided, they should not be mixed. Therefore a sensor common should NOT be connected to an output common. This would cause EMI on the sensitive input common, which could affect the instrument's operation.

Visit RLC's web site at http://www.redlion.net/Support/InstallationConsiderations.html for more information on EMI guidelines, Safety and CE issues as they relate to Red Lion Controls products.

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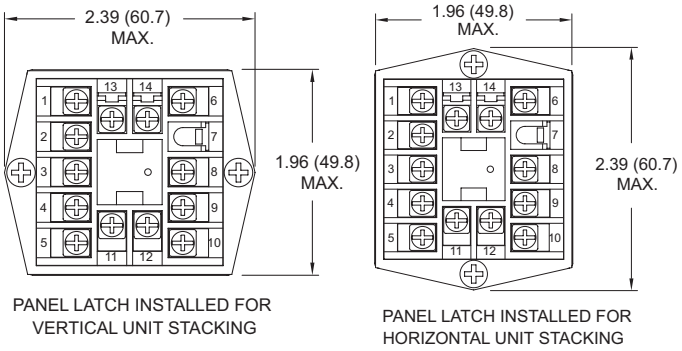
1.0 INSTALLING THE TLA

The TLA meets NEMA 4X/IP65 requirements for indoor use to provide a watertight seal in steel panels with a minimum thickness of 0.09 inch, or aluminum panels with a minimum thickness of 0.12 inch. The units are intended to be mounted into an enclosed panel. It is designed so that the units can be stacked horizontally or vertically. The bezel assembly **MUST** be in place during installation of the unit.



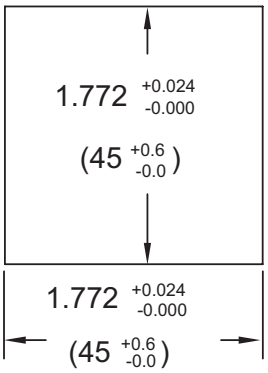
PANEL LATCH INSTALLED FOR VERTICAL UNIT STACKING

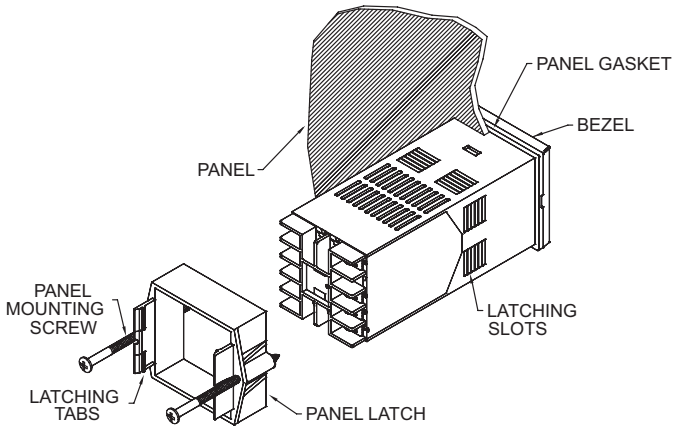
PANEL LATCH INSTALLED FOR HORIZONTAL UNIT STACKING

Instructions:

1. Prepare the panel cutout to the dimensions.
2. Remove the panel latch from the unit. Discard the cardboard sleeve.
3. Carefully remove the center section of the panel gasket and discard. Slide the panel gasket over the unit from the rear, seating it against the lip at the front of the case.
4. Insert the unit into the panel cutout. While holding the unit in place, push the panel latch over the rear of the unit, engaging the tabs of the panel latch in the farthest forward slot possible.
5. To achieve a proper seal, tighten the panel latch screws evenly until the unit is snug in the panel, torquing the screws to approximately 7 in-lbs (79 N-cm). Over tightening can result in distortion of the panel, and reduce the effectiveness of the seal.

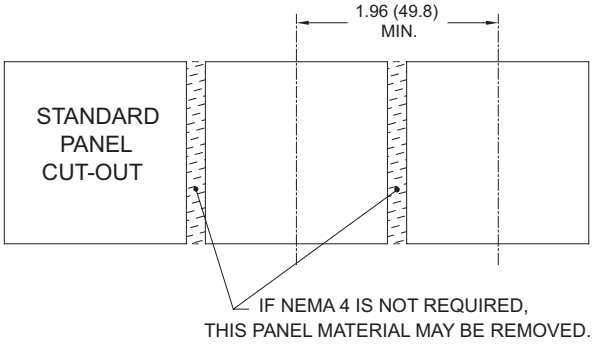
Note: The installation location of the TLA is important. Be sure to keep it away from heat sources (ovens, furnaces, etc.), and away from direct contact with caustic vapors, oils, steam, or any other process byproducts in which exposure may affect proper operation.





Multiple Unit Stacking

The TLA is designed for close spacing of multiple units. Units can be stacked either horizontally or vertically. For vertical stacking, install the panel latch with the screws to the sides of the unit. For horizontal stacking, the panel latch screws should be at the top and bottom of the unit. The minimum spacing from center line to center line of units is 1.96" (49.8 mm). This spacing is the same for vertical or horizontal stacking.



Note: When stacking units, provide adequate panel ventilation to ensure that the maximum operating temperature range is not exceeded.

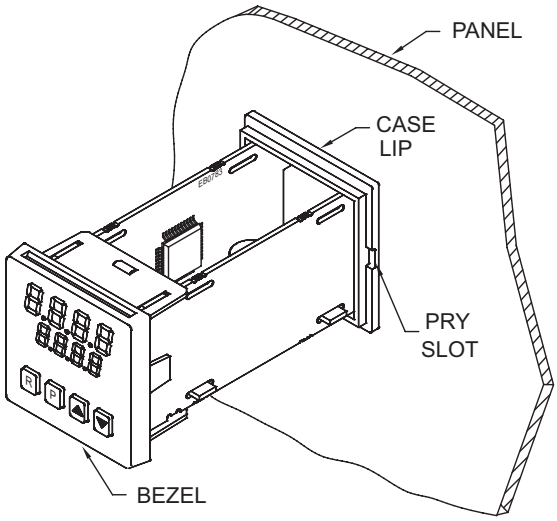
Caution: Disconnect power to the unit and to the output control circuits to eliminate the potential shock hazard when removing the bezel assembly.

Unit Removal Procedure

To remove a unit from the panel, first loosen the panel latch screws. Insert flat blade screwdrivers between the latch and the case on either side of the unit, so that the latches disengage from the grooves in the case. Push the unit through the panel from the rear.

Removing Bezel Assembly

The bezel assembly must be removed from the case to replace the output board. To remove the bezel assembly, insert a flat blade screwdriver into the pry slot on either side of the unit. Twist the screwdriver handle until the unit is ejected enough to allow removal.



Caution: The bezel assembly contains electronic circuits that can be damaged by static electricity. Before removing the assembly, discharge static charge on your body by touching an earth ground point. It is also important that the bezel assembly be handled only by the bezel itself. Additionally, if it is necessary to handle a circuit board, be certain that hands are free from dirt, oil, etc., to avoid circuit contamination that may lead to malfunction. If it becomes necessary to ship the unit for repairs, place the unit in its case before shipping.

Installing Bezel Assembly

To install the bezel assembly, insert the assembly into the case until the bezel is fully seated against the lip of the case. Properly installing the bezel assembly is necessary for watertight sealing.

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2.0 WIRING THE TLA

After the unit has been mechanically mounted, it is ready to be wired. All wiring connections are made to the rear screw terminals. When wiring the unit, use the numbers on the label and those embossed on the back of the case, to identify the position number with the proper function.

All conductors should meet voltage and current ratings for each terminal. Also cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that power supplied to the unit (AC or DC) be protected by a fuse or circuit breaker. Strip the wire, leaving approximately 1/4" (6 mm) bare wire exposed (stranded wires should be tinned with solder). Insert the wire under the clamping washer and tighten the screw until the wire is clamped tightly.

Caution: Unused terminals are NOT to be used as tie points. Damage to the TLA may result if these terminals are used.

POWER WIRING

AC Power

Primary AC power is connected to terminals #11 and #12, labeled AC. To reduce the chance of noise spikes entering the AC line and affecting the TLA, an AC feed separate from that of the load should be used to power the TLA. Be certain that the AC power to the TLA is relatively "clean" and within the variation limit. Connecting power from heavily loaded circuits or circuits that also power loads that cycle on and off (contacts, relays, motors, etc.), should be avoided.

DC Power

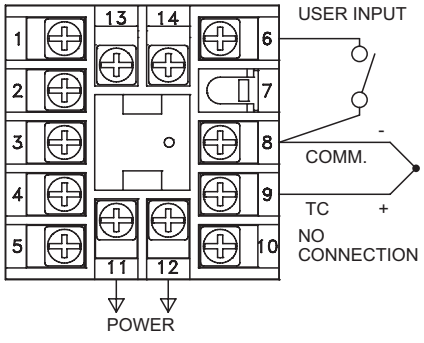
DC Power (18 to 36 VDC) is connected to terminals #11 and #12 labeled DC+ and DC- respectively.

CAUTION: Observe proper polarity when connecting DC voltages. Damage to the unit may occur if polarity is reversed.

SIGNAL WIRING

Thermocouple

When connecting the thermocouple, be certain that the connections are clean and tight. If the thermocouple probe cannot be connected directly to the TLA, thermocouple wire or thermocouple extension-grade wire must be used to extend the connection points (copper wire does not work). Always refer to the thermocouple manufacturer's recommendations for mounting, temperature range, shielding, etc. For multi-probe temperature averaging applications, two or more thermocouple probes may be connected to the TLA (always use the same type). Paralleling a single thermocouple to more than one TLA is not recommended. Generally, the red wire from the thermocouple is negative and connected to the TLA's common.



Thermocouple Connection

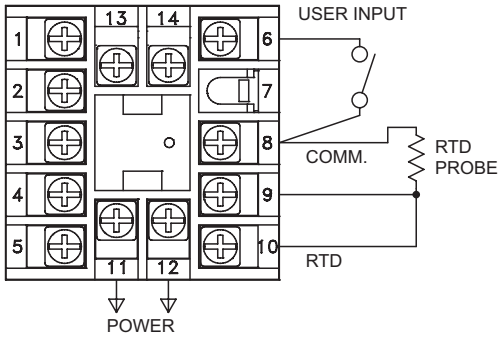
RTD

When connecting the RTD, be certain that the connections are clean and tight. RTD sensors have a higher degree of accuracy and stability than thermocouple sensors. Most RTD sensors available are the three wire type. The third wire is a sense lead for canceling the effects of lead resistance of the probe. Four wire RTD elements may be used by leaving one of the sense leads disconnected. Two wire RTD sensors may be used in either of two ways:

A) Attach the RTD to terminals #8 and #10. Install a copper sense wire of the same wire gauge as the RTD leads. Attach one end of the wire at the probe and the other end to terminal #9. Complete lead wire compensation is obtained. This is the preferred method.

B) Attach the RTD to terminals #8 and #10. Install a shorting wire between terminals #9 and #10. A temperature offset error of 2.5°C/ohm of lead resistance exists. The error may be compensated by programming a temperature offset.

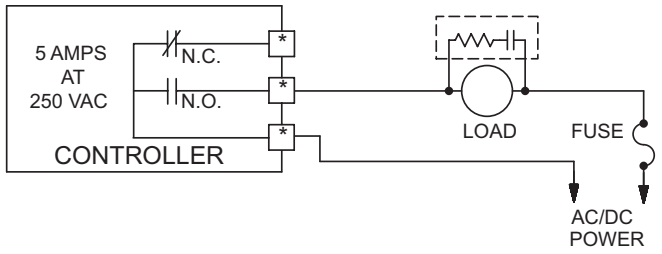
Note: With extended cable runs, be sure the lead resistance is less than 15 ohms/ lead.



RTD Connection

RELAY CONNECTIONS

To prolong contact life and suppress electrical noise interference due to the switching of inductive loads, it is good installation practice to install a snubber across the contactor. Follow the manufacturer's instructions for installation.



Note: Snubber leakage current can cause some electromechanical devices to be held ON.

*Terminal numbers are model dependent. See Terminal Configurations for description.

REMOTE RESET WIRING

The use of shielded cable is recommended. Follow the EMC installation guidelines for shield connection.

Terminal #6 is the Remote Reset. Any form of mechanical switch may be connected to terminal #6 (REMOTE RESET) and terminal #8 (COMM.). Sinking open collector logic with less than 0.7 V saturation and off-state leakage current of less than 1 µA may also be used.

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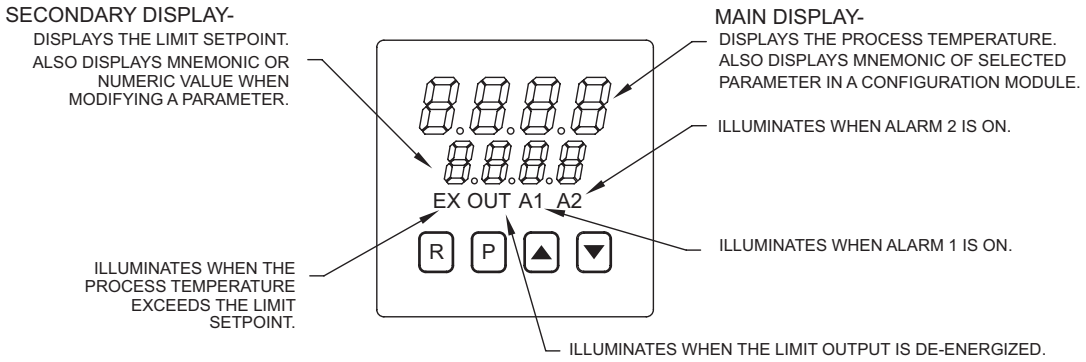
3.0 FRONT PANEL DESCRIPTION



The front panel bezel material is flame and scratch resistant, tinted plastic that meets NEMA 4X/IP65 requirements, when properly installed. Continuous exposure to direct sunlight may accelerate the aging process of the bezel. The bezel should be cleaned only with a soft cloth and neutral soap product. Do NOT use solvents. There are two 4-digit LED displays, a red upper Main Display and a lower green Secondary Display.

There are up to four panel annunciators, with red backlighting, that illuminate to inform the operator of the TLA and output status. See the front panel diagram for a description of the annunciators. Four front panel buttons are used to access different modes and parameters. The following is a description of each button.

Do NOT use tools of any kind (screwdrivers, pens, pencils, etc) to operate the keypad of this unit.

Button Functions

R - The Reset (R) button is used to reset the limit and alarm relays. The limit output cannot be reset until the process temperature returns to the proper operating range. Latched alarms can be reset regardless of limit exceed condition.

P - The Parameter (P) button is used to access programming, enter the change, and scroll through the available parameters in any mode.

UP, DN - The Up/Down buttons are used to modify parameters.

TLA POWER-UP

Upon applying power, the TLA delays input indication and control action for five seconds to perform several self-diagnostic tests and to display basic TLA information. Initially, the TLA illuminates both displays and all annunciators to verify that all display elements are functioning. The TLA then displays the programmed input sensor type in the main (top) display and the revision number of the TLA's operating system in the secondary (bottom) display. The TLA checks for correct internal operation and displays an error message (E-xx) if an internal fault is detected. (See the Troubleshooting section for further information.)

Upon completion of this sequence, the TLA begins displaying the input value and setpoint, and updates the outputs based upon this condition.

TLA CONFIGURATION OVERVIEW

The TLA is programmed with certain parameter settings from the factory. Factory settings are listed in parentheses in the various Configuration of Parameters tables. In many cases, these settings must be changed to the particulars of the application before proper operation can be started.

The TLA is typically in the Normal Display Mode. In this mode, the process temperature is displayed in the main (top) display, and the limit setpoint is displayed in the secondary (bottom) display. When changes to the parameter configurations are needed, the P button is pressed, and the TLA will enter into the Parameter Mode.

PARAMETER CONFIGURATION BASIC STARTUP

For basic start-up, it is important to verify or change Input Parameter Module (1-IN) parameters tYPE and SCAL, and Output Parameter Module (2-OP) parameter LiAC (Limit Trip Action). For alarm set-up, it is important to verify or change Alarms Parameter Module (4-AL) parameters ACt1, AL-1, ACt2, and AL-2.

If the above Input parameters or the input wiring connections are not correct, then the main (top) display may display an error message or incorrect value. Verify the input programming and wiring. (If incorrect display continues, refer to the Troubleshooting section.) All other parameter configurations are important but will not prevent the TLA from showing a correct display.

4.0 PARAMETER MODE

The Parameter Mode is accessed by pressing the P Button from the Normal Display Mode. While in the Parameter Mode, the temperature is displayed in the main (top) display, and the parameter is displayed in the secondary (bottom) display. The correct password must be entered before any parameters can be accessed. To modify values, use the UP or DOWN button while the parameter is displayed. Use the P button to accept the new value, and to scroll through the parameters. The TLA will automatically return to the normal display mode if no action is taken. The TLA responds to the new values immediately, but the change is not committed to non-volatile memory until the TLA is returned to the Normal Display Mode. If power loss occurs before returning to the normal display mode, the new values must be re-entered.

To gain access to the Configuration Parameter Modules continue to CNFP and press the UP button. These modules allow access to the fundamental set-up parameters of the TLA. If the setpoint or alarm values are modified, the CNFP step will be skipped.

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Parameter Mode Reference Table

Display	Parameter	Range	Description
PASS	Password to access parameters	0 to 250	If an incorrect value is entered, the TLA will display "End" momentarily, and then return to the normal display mode. The default password is 10. The wildcard password is 222 (in case the password is forgotten).
SP	Limit setpoint	-999 to 9999	Range limited by SPLO & SPHI.
AL-1 *	Alarm #1	-999 to 9999	The Alarm parameters can be independently locked out from appearing. See Configuration Module 3, Parameter Lock-outs.
AL-2 *	Alarm #2	-999 to 9999	
CNFP	Configuration parameter modules	"Up" button: enter configuration modules.	These modules allow access to the fundamental set-up parameters of the TLA. The modules are grouped into related programming steps, such as inputs, outputs, alarms, etc. Upon completion of each module, the program returns to "CNFP".
End	End of Parameter Mode		When the parameter list has been scrolled through, the TLA will display "End" momentarily, and then return to the normal display mode.

* Model Number Dependent.

CONFIGURATION PARAMETER MODULES

The Configuration Parameter modules are accessed by pressing the UP button from CNFP in the Parameter Mode. The UP or DOWN buttons can be pressed to move to the desired Parameter Module. The P button is then pressed to enter into that module. The main (top) display will be the parameter, and the secondary (bottom) display will be the parameter value. The UP or DOWN buttons are used to modify the desired parameter value, and the P button enters the new value, and moves to the next parameter. The TLA responds to the new values after the P button is pressed, however, the change is not committed to permanent memory until the TLA is returned to the Normal Display Mode. If power loss occurs before returning to the Normal Display Mode, the new values must be entered again. At the end of each module, the TLA will go back to CNFP. Other Parameter Modules can be accessed by pressing the UP or DOWN buttons, or pressing P will return to the Normal Display Mode.

Parameters that are model number, or program dependent will only be displayed when the appropriate options are installed or programmed.

CONFIGURE MODULE 1 - INPUT PARAMETERS (1-IN)

Display	Parameter	Range (Factory Setting)	Description/ Comments
TYPE	Input Type	tc-t - Type T TC tc-E - Type E TC tc-J - Type J TC tc-K - Type K TC tc-r - Type R TC tc-S - Type S TC tc-b - Type B TC tc-n - Type N TC L in - Linear mV r385 - 385 curve RTD r392 - 392 curve RTD rL in - Linear ohms (tc-J)	Select from the list of various thermocouple and RTD sensors.
SCAL	Temperature Scale	°F or °C (°F)	Select either degrees Fahrenheit (F) or degrees Celsius (C). **If changed, be sure to check all parameters.**
dCPt	Temperature Resolution	0 or 0.0 (0)	Select either 1 or 0.1 degree resolution. **If changed, be sure to check all parameters.**
FLtr	Digital Input Filtering and Display Update	0 to 4 0 - least input filtering 3 - most input filtering 4 - most input filtering and slower 500 msec display update rate (outputs still update at 100 msec rate) (1)	Select the relative degree of input signal filtering and display update rate. The filter is an adaptive digital filter that discriminates between measurement noise and actual process changes. Therefore, the influence on step response time is minimal. If the signal is varying too greatly due to measurement noise, increase the filter value. Conversely, if the fastest TLA response is desired, decrease the filter value.
SHFt	Input Signal Shift (correction offset)	-999 to 9999 1 or 0.1 degree (0)	If the TLA temperature disagrees with a reference temperature instrument or if the temperature sensor has a known calibration, the TLA temperature can be compensated by a correction offset. The following equation expresses the relationship: Desired Display Temp = (TLA Temp) + SHFt. Normally set to 0.
SPLO	Limit Setpoint Lower Limit	-999 to 9999 1 or 0.1 degree (0)	The TLA has programmable high and low setpoint limit values to restrict the setting range of the limit setpoint. Set the limit values so that the temperature setpoint value cannot be set outside the safe operating area of the process. SPHI must be above SPLO.
SPHI	Limit Setpoint Upper Limit	-999 to 9999 1 or 0.1 degree (9999)	

CONFIGURE MODULE 2 - OUTPUT PARAMETERS (2-OP)

Display	Parameter	Range (Factory Setting)	Description/ Comments
L iAc	Limit Output Trip Action	LO - Low Acting HI - High Acting (HI)	The limit output is selectable for high or low trip activation. If the process temperature goes above the limit setpoint for a high trip, or below the limit setpoint for a low trip, the limit relay will de-energize to initiate a process shutdown. See the Limit Output Action section for details.

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Configure Module 3 - Lockout Parameters (3-LC)

Display	Parameter	Range (Factory Setting)	Description/ Comments
PASS	Password	0 to 250 (10)	The password is required to access all parameters. The password can be set to any value between 0 and 250. A wildcard password, 222, can be used as an alternative to the programmed password.
AL *	Alarms #1 and #2 access level	LOC - lockout, prevents the alarms from appearing rEd - read only, alarms appear, but cannot be modified Ent - enter, alarms appear, and can be modified (Ent)	The alarm(s) parameter in the Parameter Mode can be configured to be completely locked out, read only, or fully accessible.
FPrS	Front panel reset	NO - disabled YES - active (YES)	The front panel R button can be enabled or disabled. The Remote Reset input is not affected by this setting.

* Model Number Dependent.

Configure Module 4 - Alarms Parameters (4-AL)

Display	Parameter	Range (Factory Setting)	Description/ Comments
Act 1	Alarm 1 action mode	A-HI - absolute high A-LO - absolute low d-HI - deviation high d-LO - deviation low b-IN - band inside b-Ot - band outside (A-HI)	When deviation low-acting with positive alarm value (d-LO), deviation high-acting with negative value (d-HI), or band inside-acting (b-IN) is selected for the alarm action, the indicator is OFF when the alarm output is ON. See the Alarms section for complete details of each action. **If changed, check alarm values.**
rSt 1	Alarm 1 reset mode	Auto - automatic LATC - manual reset (Auto)	Automatic reset alarms are reset by the TLA when the alarm condition clears. Latched alarms require operator action to reset the alarm condition. The front panel R button, if enabled, can be used to reset a latched alarm (see FPrS in Configure Module 3). A latched alarm condition may also be reset via the Remote Reset input. See the Reset Action diagram in the Alarms section.
Stb 1	Alarm 1 standby function (delay)	NO or YES (NO)	The alarm(s) may be independently configured to exhibit a power-on, standby delay which suppresses the alarm output from turning ON until the temperature first stabilizes outside the alarm region. After this condition is satisfied, the alarm standby delay is canceled and the alarm triggers normally, until the next TLA power-on. This feature also works for deviation and band alarms when the setpoint is changed via keypad. This action suppresses “nuisance” alarms. See the Alarm Standby diagram in the Alarms section.
AL - 1	Alarm 1 value	-999 to 9999 (0)	The alarm values are either absolute values, or relative to the limit setpoint value (deviation and band alarms). An absolute alarm value is the value that is entered for the alarm. A relative alarm value is the mathematical sum of the temperature limit setpoint value and the alarm value (positive or negative), thus a relative alarm tracks the limit setpoint value as it is changed. If the alarm action is set as a Band Alarm, then only a positive alarm value can be entered.
Act2 *	Alarm 2 action mode	A-HI - absolute high A-LO - absolute low d-HI - deviation high d-LO - deviation low b-IN - band inside b-Ot - band outside (A-HI)	The Alarm 2 parameters are programmed independently of alarm 1. See the corresponding Alarm 1 parameter for description.
rSt2 *	Alarm 2 reset mode	Auto - automatic LATC - manual reset (Auto)	
Stb2 *	Alarm 2 standby function (delay)	NO or YES (NO)	
AL -2 *	Alarm 2 value	-999 to 9999 (0)	
AHYS	Alarm hysteresis value	1 to 250 (1)	The alarm value(s) have a programmable hysteresis band to prevent alarm output chatter near the alarm trigger point. The hysteresis value should be set to eliminate this effect. A value of 2 to 5 is usually sufficient for most applications. A single alarm hysteresis value applies to both alarms. See the Alarm Action Figures, in the Alarms section, for the effect of hysteresis on the various alarm types.

* Model Number Dependent.

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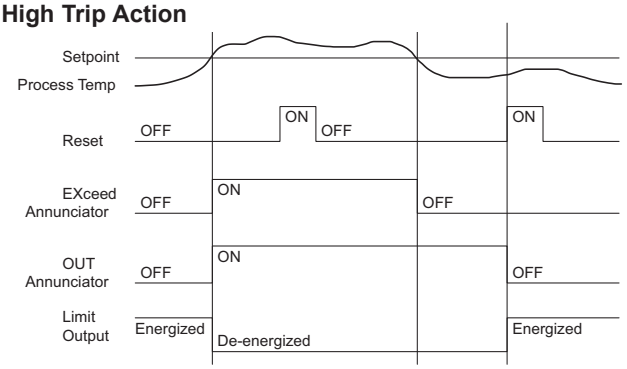
CONFIGURE MODULE 9 - FACTORY SERVICE OPERATIONS (9-FS)

Display	Parameter	Range	Description/ Comments
CodE	Factory service function code	48 - Calibrate instrument	TLA calibration. Refer to the Calibration section for details.
		66 - Reset parameters to factory settings	Entering code 66 restores all parameters to factory settings. The unit indicates the operation after the P button is pressed, by displaying “rSEt” in the lower display momentarily.
		77 (twice in succession) - Reset TLA calibration to nominal values	Caution: this operation erases the TLA calibration values and defaults the values to nominal settings. Reading errors of ±10% may result. Do not perform this operation unless the TLA has lost calibration. Loss of calibration is signaled by an “E-CL” error flag at power-up. To clear this flag, perform calibration procedure as noted in the Calibration section. Alternatively, “stepping” through one of the calibration procedures clears the error flag, but does NOT validate the calibration accuracy in any manner.

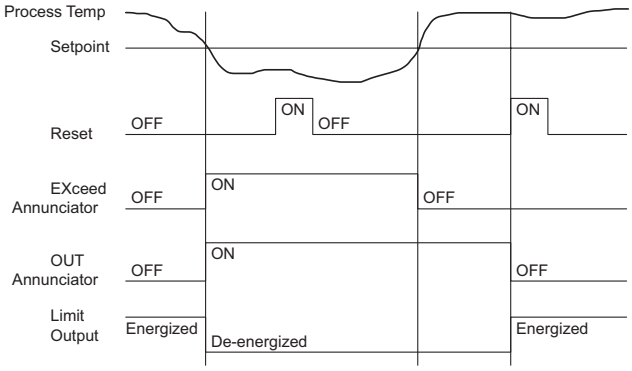
LIMIT OUTPUT ACTION

The limit output is selectable for high or low trip activation. If the process temperature goes above the limit setpoint for a high trip, or below the limit setpoint for a low trip, the limit relay will de-energize to initiate a process shutdown. The limit output cannot be reset until the process temperature returns to the proper operating range; manual reset is required. The following action figures describe the status of the limit output and the front panel indicators for various over/under setpoint, and reset conditions. Reset is either by the front panel R button, if enabled, or by the Remote Reset input, terminal #6. Refer to Configure Module 2 - Output Parameters for details of configuring the limit output. Refer to Configure Module 3 - Lockout Parameters for details of configuring the front panel Reset button.

High Trip Action

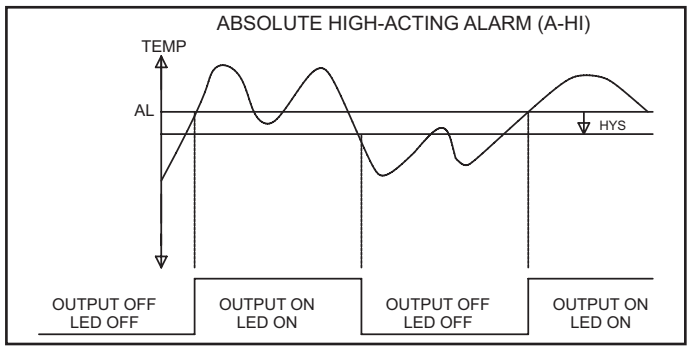


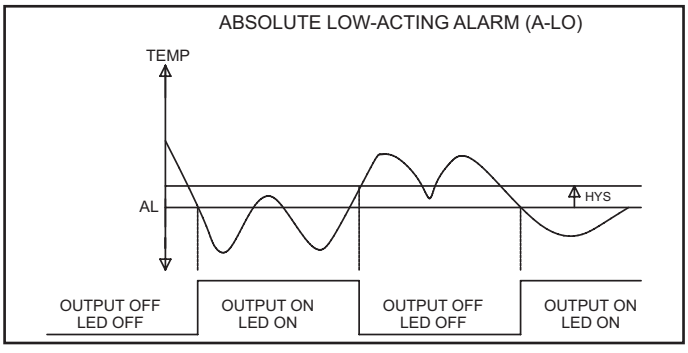
Low Trip Action

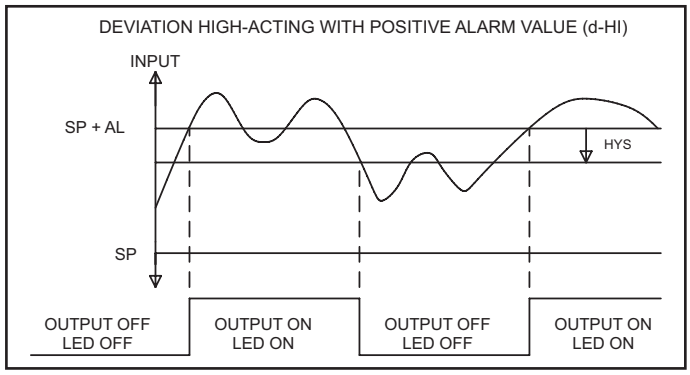


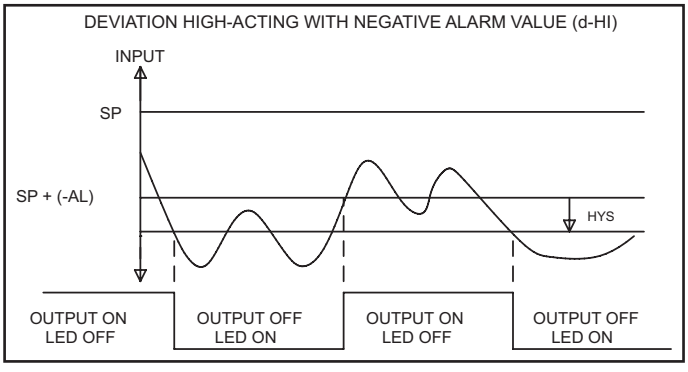
5.0 Alarms (Optional)

The alarm action figures describe the status of the alarm output and the front panel indicator for various over/under temperature conditions. The alarm output wave form is shown with the output in the automatic reset mode. Select the alarm action with care -- in some configurations, the front panel indicator (LED) might be OFF while the output is ON. Refer to Configure Module 4 - Alarm Parameters for details of configuring the alarms.









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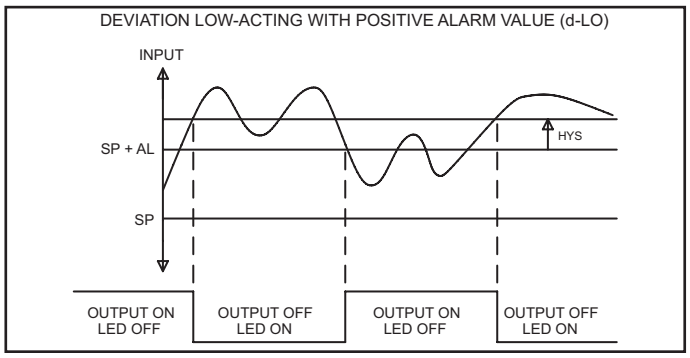
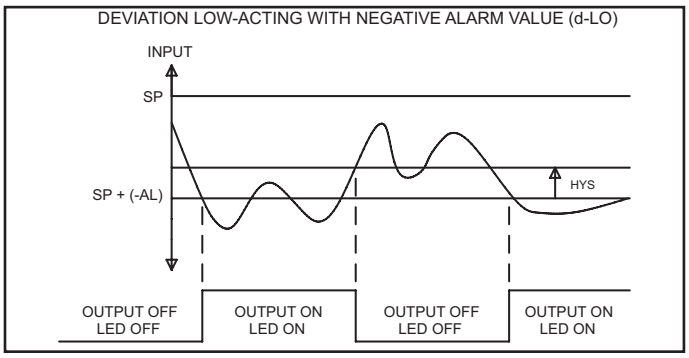
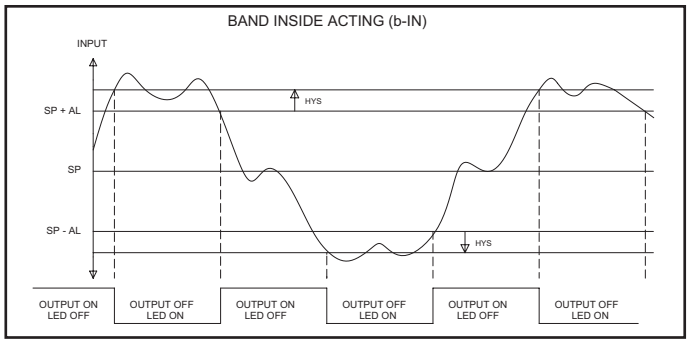
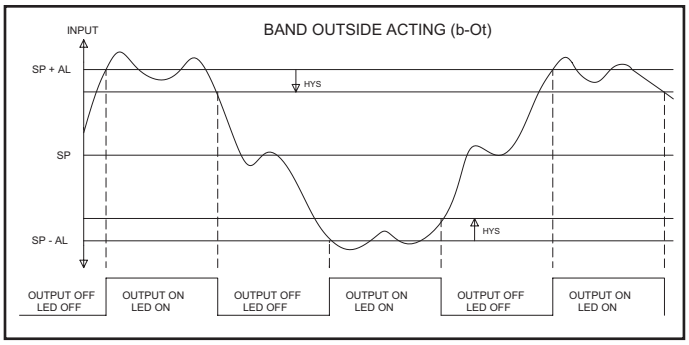
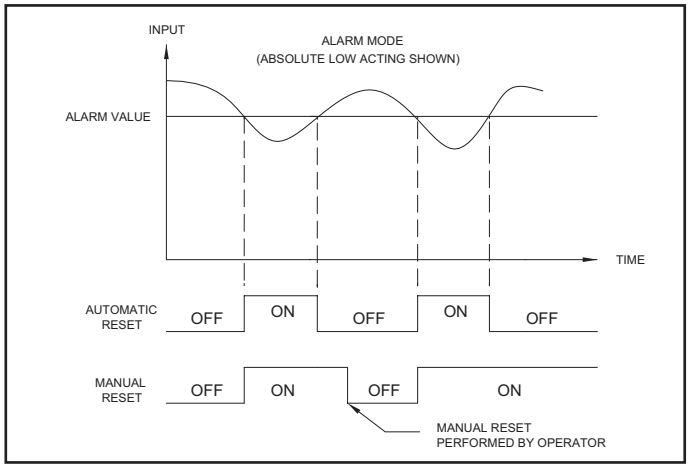




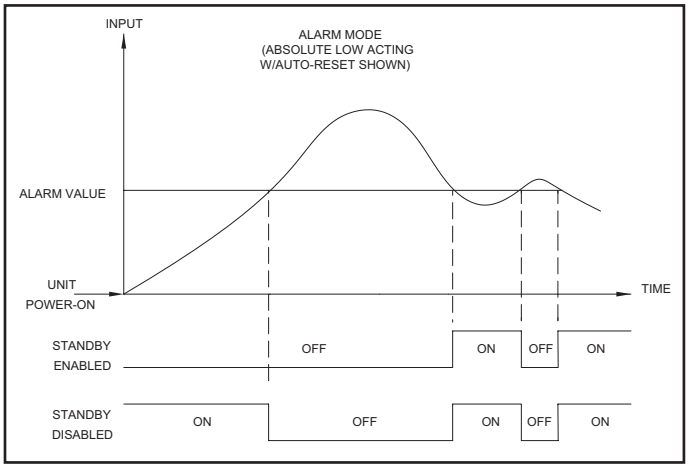




Alarm Reset Sequence



Alarm Standby Delay Sequence



CALIBRATION CHECKS

The instrument has been fully calibrated at the factory for all input types. If the unit appears to be indicating or controlling incorrectly, see the Troubleshooting section before attempting this procedure.

If the TLA is suspected of reading incorrectly, the instrument may be checked for indication accuracy without disturbing the factory calibration. The following procedures may be used for this purpose.

Note: Allow ½ hour warm-up before checking these parameters.

mV Reading Check

1. Connect a DC mV source with an accuracy of 0.03% or better to terminal #8 (-) & #9 (+).
2. Configure Input Parameters Module 1 for linear mV (Lin) input, under tYPE.
3. Compare the TLA read-out to the standard at various points over the range (-5.00 mV to 56.00 mV). The tolerance is ±(0.15% of reading + 1 LSD).
4. Calibrate the TLA if the readings are out of tolerance.

Thermocouple Cold Junction Temperature Check

1. Connect a thermocouple probe of known accuracy (Types T, E, J, K, N only) to TLA. Select the probe used in Configure Module 1.
2. Connect a reference temperature probe to measuring end of thermocouple to monitor temperature. Allow sufficient time for temperatures to equalize.
3. Compare TLA display with reference temperature probe. The TLA display should equal the calibrated probe temperature. (Tolerance is ±1ºC.)
4. Calibrate the cold junction temperature if out of tolerance.

RTD Ohms Reading Check

1. Connect RTD simulator (with an accuracy of 0.1 ohm or better) capable of operating with less than 150 µA to terminals #8, #9, & #10.
2. Configure Input Parameters Module 1 for linear ohms (rLin) input, under tYPE.
3. Compare the TLA read-out with the RTD simulator at various points over the range 2.0 to 300.0 ohms. The tolerance is ±(0.3% of span + 1 LSD).
4. Calibrate the TLA RTD ohms if out of tolerance.

Error Flag E-CL

If error flag "E-CL" appears at power-up, a loss of calibration parameters due to noise spikes has occurred. Entering code 77 twice in Factory Service Operations Module (9-FS) erases the TLA calibration values and defaults the values to nominal settings. Reading errors of ±10% may result. It is recommended that the TLA be fully recalibrated. If using thermocouple only, the RTD calibration need not be performed.

Note: the "E-CL" flag may be cleared by "stepping" through cold junction calibration procedure without the need to change any calibration values. A ±10% reading error will still exist.

6.0 CALIBRATION

When re-calibration is required (generally every two years), this procedure should be performed by qualified technicians using appropriate equipment. Equipment source accuracy of 0.03% or better is required.

The procedure consists of: applying accurate mV signals, setting the thermocouple cold junction temperature, and applying precision resistance, among others. Allow a 30 minute warm-up period before starting this procedure. Do not use thermocouple wire for the millivolt or RTD ohms calibration.

This procedure may be aborted by disconnecting power to the TLA before exiting the configuration mode. The existing calibration settings remain in affect.

Note: After completing any of the calibration sequences, the TLA defaults the input sensor type to thermocouple type "J" (tc-J). Be sure to set input sensor for proper type.

Note: The TLA must be restored to normal display mode before any data is stored.

Factory Service Operations - Calibration (9-FS)

Display	Parameter	Range	Description/ CoMMENTS
CodE	Enter function code	48	Calibrate instrument.
CAL	Millivolt calibration	yes/no	Calibration required for both RTD and TC input. If this procedure is performed, the cold junction temp or RTD ohms calibration procedures in turn must be completed.
CJC	Thermocouple cold junction temperature calibration	yes/no	Not required if only using RTD input. This procedure can only be performed AFTER an accurate mV calibration.
rtd	RTD resistance calibration	yes/no	Not required if only using TC input. This procedure can only be performed AFTER an accurate mV calibration.

Millivolt Calibration (CAL)

Connect precision millivolt source with an accuracy of 0.03% to terminals #8 (-) & #9 (+). Cold Junction or RTD ohms calibration MUST be performed after millivolt calibration.

Display	action	Description/ CoMMENTS
StP1	Apply 0.0 mV	Wait 10 seconds, press P.
StP2	Apply 14.0 mV	Wait 10 seconds, press P.
StP3	Apply 28.0 mV	Wait 10 seconds, press P.
StP4	Apply 42.0 mV	Wait 10 seconds, press P.
StP5	Apply 56.0 mV	Wait 10 seconds, press P.

Thermocouple Cold Junction Calibration (CJC)

This procedure must be performed AFTER an accurate mV calibration.

1. Exit Factory Service Operations (continually press P until "End"), and return to Normal Display Mode.
2. Connect a thermocouple probe of known accuracy to the TLA (Types T, E, J, K, and N only). Select the probe type used in Configure Module 1.
3. Connect a reference temperature probe to the measuring end of the TLA thermocouple probe. The two probes should be shielded from air movement and allowed sufficient time to equalize in temperature. (As an alternative, the TLA thermocouple probe may be placed in a calibration bath of known temperature.)
4. Compare TLA display with reference temperature probe (or calibration bath). If the displayed TLA temperature does not equal the reference probe temperature, calculate the CJ error as follows:
   CJ Error = reference probe temperature - displayed TLA temperature
5. Enter Factory Service Operations Module (9-FS).

Display	Parameter	Description/ CoMMENTS
CJC	Cold Junction Temperature	Observe the indicated cold junction temperature. Add the calculated CJ Error to the displayed value. Enter the sum as the new value for CJC. Exit 9-FS and repeat step 4.
		Note: If the initial value for CJC is not within the range of 15°C to 40°C, enter 25.0° for CJC and repeat the Cold Junction Calibration procedure.

RTD Ohms Calibration (RTD)

This procedure must be performed AFTER an accurate mV calibration. Connect one leg of precision resistance (accuracy of 0.1 ohm) to terminals #9 and #10 together, and the other leg to #8.

Display	action	Description/ CoMMENTS
rtd1	Connect 0.0 ohm (jumper wire)	Wait 10 seconds, press P.
rtd2	Connect 277.0 ohm	Wait 10 seconds, press P.

F

7.0 TROUBLESHOOTING

The majority of problems can be traced to improper connections or incorrect set-up parameters. Be sure all connections are clean and tight, that the correct output board is fitted, and that the set-up parameters are correct.

For further technical assistance, contact technical support at the appropriate company numbers listed.

Problems	Possible Cause	Remedies
NO DISPLAY	1. Power off. 2. Brown-out condition. 3. Loose connection or improperly wired. 4. Bezel assembly not fully seated into rear of TLA.	1. Check power. 2. Verify power reading. 3. Check connections. 4. Check installation.
TLA NOT WORKING	1. Incorrect parameter set-up.	1. Check set-up parameters.
"E-FP" IN DISPLAY	1. Defective front panel button.	1. Press R to escape, then check all buttons for proper operation. 2. Replace unit.
"E-UP" IN DISPLAY	1. Internal problem with TLA.	1. Replace unit.
"E-E2" IN DISPLAY	1. Loss of setup parameters due to noise spike or other EMI event.	1. Press R to escape, then check all set-up parameters. a. Check sensor input and AC line for excessive noise. b. If fault persists, replace TLA.
"E-CL" IN DISPLAY	1. Loss of calibration parameters due to noise spike or other EMI event.	1. Press R to escape, then check TLA accuracy. a. Recalibrate TLA. (See Factory Service Module code 77.) b. Reset parameters to factory default settings.
"..." or "-.." IN DISPLAY	1. Display value exceeds display range. 2. Defective or mis-calibrated cold junction circuit. 3. Loss of set-up parameters. 4. Internal malfunction.	1. Change resolution to display whole number and verify reading. 2. Perform cold junction calibration. 3. Check set-up parameters. 4. Perform Input calibration.
"OPEN" IN DISPLAY	1. Probe disconnected. 2. Broken or burned-out probe. 3. Corroded or broken terminations. 4. Excessive process temperature.	1. Connect probe. 2. Replace probe. 3. Check connections. 4. Check process parameters.
"OLOL" IN UPPER DISPLAY	1. Check input parameters. 2. Change to input sensor with a higher temperature range. 3. Replace transmitter or probe. 4. Reduce temperature. 5. Perform input calibration.	1. Input exceeds range of TLA. 2. Temperature exceeds range of input probe. 3. Defective or incorrect transmitter or probe. 4. Excessive high temperature for probe. 5. Loss of setup parameters.
"ULUL" IN UPPER DISPLAY	1. Input is below range of TLA. 2. Temperature below range of input probe. 3. Defective or incorrect transmitter or probe. 4. Excessive low temperature for probe. 5. Loss of setup parameters.	1. Check input parameters. 2. Change to input sensor with a lower temperature range. 3. Replace transmitter or probe. 4. Raise temperature. 5. Perform input calibration.
"OLOL" OR "ULUL" IN LOWER DISPLAY	1. Signal input exceeds allowable range by 5%.	1. Check remote signal source.

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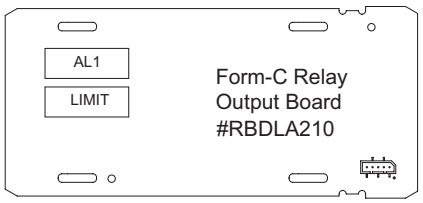
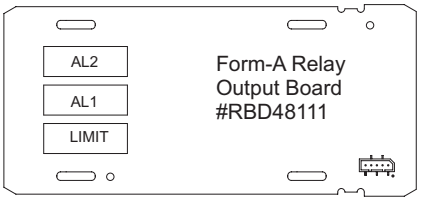
8.0 Installing an Output Board

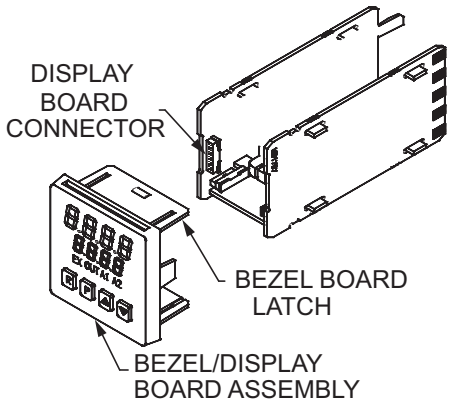
The TLA is supplied with an output board installed.

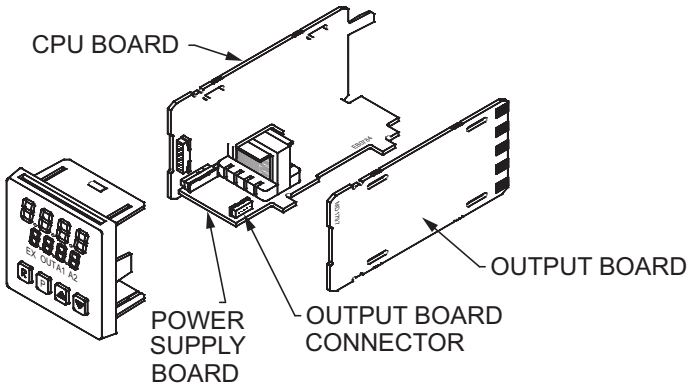
Replacing Output Board

1. Remove the bezel assembly.
2. Lift up on the top bezel board latch while gently pulling out on the bezel/ display board assembly. Do NOT remove the display board from the bezel.
3. Remove the output board by pulling it away from the other boards. Replace the output board by aligning the board to board connector. Be certain the connector is fully mated.
4. Connect the bezel/ display board assembly by guiding the board ends into the bezel latches. Slide the assembly on evenly until the display board connector is completely engaged and bezel latches are fully seated onto the boards.





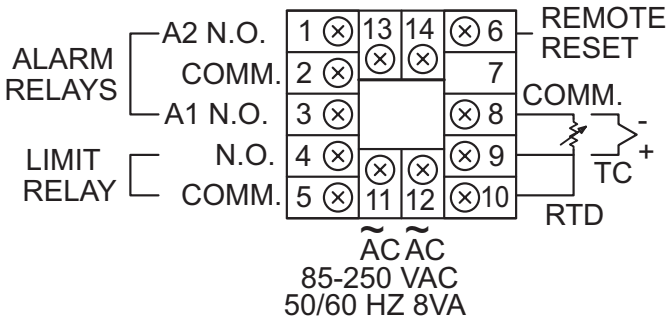




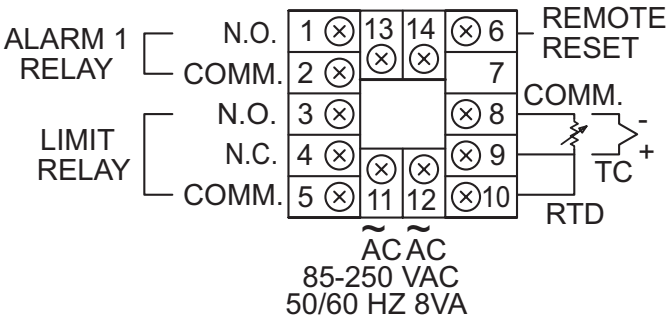
9.0 Terminal Configurations

AC Models

Form-A Limit Relay with 2 Alarms

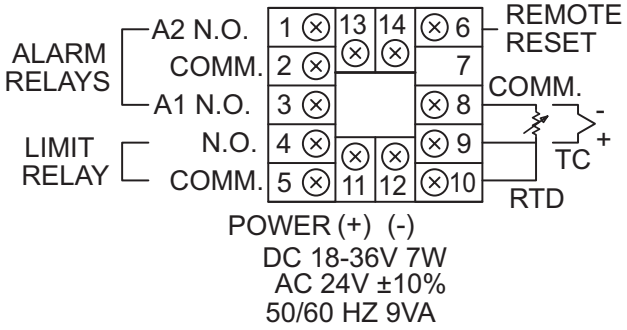


Form-C Limit Relay with 1 Alarm

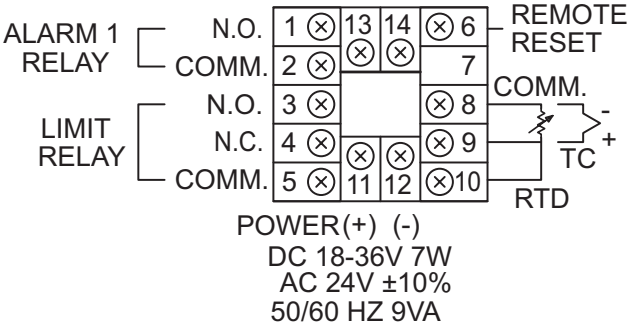


DC Models

Form-A Limit Relay with 2 Alarms



Form-C Limit Relay with 1 Alarm



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