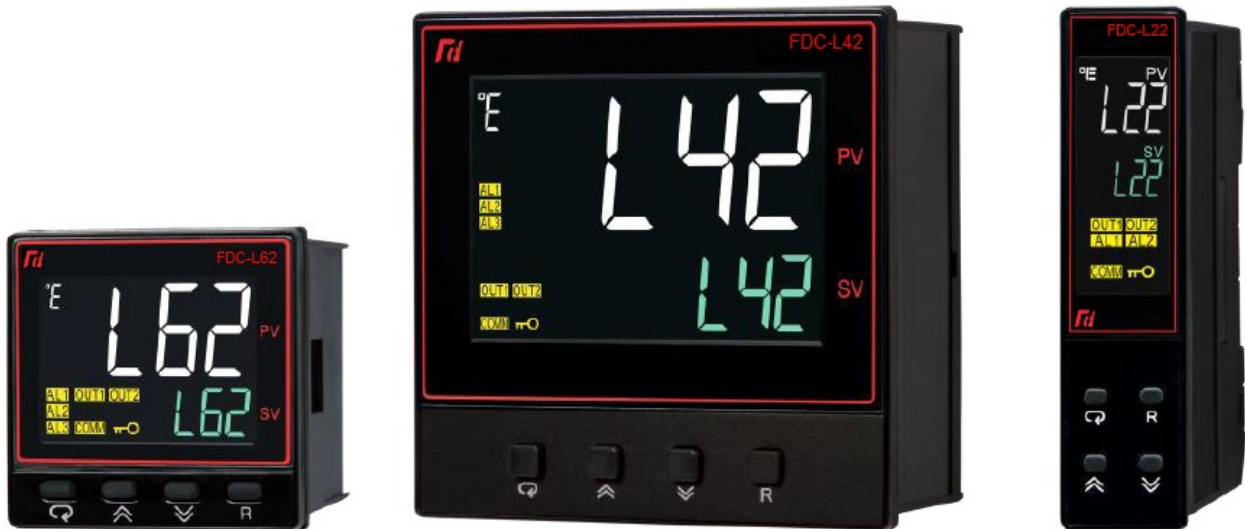


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# PROCESS LIMIT CONTROLLER L22/L62/L42 USER MANUAL

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## Preface

Future Design Controls Inc. (herein referred to as FDC) reserves the right to change information available in this document without notice. FDC is not liable for any damages incurred to equipment and/or personnel during installation or use of the L22, L62 or L42 process limit control as explained in this document. The end user must acquire sufficient knowledge and skill set prior to using the process limit control in the application and follow all the local standards and regulations to meet all applicable safety requirements.

## Revision History

Version	Description	Date
UM0L621A	Initial Release	February, 2022
UM0L621B	Power-Up Mode Addition	April, 2023

## Safety Information in this Manual

Notes, cautions and warnings appear throughout this book to draw your attention to important operational and safety information.

A “**NOTE**” marks a short message to alert you to an important detail.

A “**CAUTION**” appears with information that is important for protecting your equipment and ensuring performance.

A “**WARNING**” appears with information that is important for protecting you, others and equipment from damage. Pay very close attention to all warnings that apply to your application.



This symbol (an exclamation point in a triangle) precedes a general CAUTION or WARNING statement.



This symbol (a lightning bolt in a lightning bolt in a triangle) precedes an electric shock hazard CAUTION or WARNING safety statement.

## Copyright

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# 1 Introduction

The L22, L62 and L42 are FM Approved process limit controls that can be configured either as a high limit, a low limit or both a high and low limit control.

The limit controls can be powered by either an 11-26 or 90-250 VDC / VAC supply, incorporating a 2 ampere (resistive) relay output as standard. An optional second output can be used as an annunciator output or as a separate process alarm. Additional options (depending upon limit control model) include two event inputs, up to 3 alarm outputs, RS485 communications and retransmit output. Each limit control model features a universal programmable input with an 18-bit high resolution A to D converter. A fast-sampling rate allows the process limit controls to respond and protect fast moving processes.

Model No.	Mounting Type	DIN Size	Dimensions L x W x D (mm)	Depth behind Panel (mm)
L22	DIN Rail	-	22.5 x 96 x 80	-
L62	Panel Mount	1/16 DIN	48 x 48 x 59	50
L42	Panel Mount	1/4 DIN	96 x 96 x 59	50

## 1.1 Why Use a Limit Control?

When a temperature control is maintaining the temperature of a furnace or other heating device for example, a malfunction in the temperature control may result in a rise in furnace temperature resulting in damage to the heated product or the furnace itself. When a separate process limit control is incorporated into the control system design, if the temperature rises above the pre-set limit temperature, the limit output will open, and the heater system circuit can be shut down to disable the heat source. In addition, the limit output will remain open even when the temperature returns to the normal range requiring the unit to be manually reset.

A manual reset is required for safety limits. This prevents the system from repeatedly restarting without user intervention as subsequent temperature excursions (in the example above) could result in product or system damage. The process limit controls also offer low limit operation so that the limit function operates when the temperature falls below the limit setting value (cooling application).

When an input error occurs, the limit output will open regardless of low or high limit operation to disable the system and will remain in this condition until the sensor error is corrected and a manual reset is provided.

## 1.2 Features

The new generation of process limit controls offer a set of unique features including:

- High brightness LCD display
- Universal Input (linear voltage/current, thermocouple and RTD)
- High accuracy 18-Bit A to D input conversion (true 0.1°F resolution for T/C and RTD sensors)
- Fast input sampling rate of 200 msec
- Advanced power-up modes (normal, reset, normal-latch)
- Bidirectional menu navigation
- Direct DIN rail mounting (L22 model only)
- Micro USB programming port (for firmware upgrades and configuration capabilities)
- Up to two event inputs (remote reset/lock, switch limit set points and more)
- Up to three additional process alarm outputs (in addition to primary limit output)
- Optional RS-485 serial communications
- Optional analog retransmit with 15-bit D to A convert for accurate linear current or voltage output

### 1.3 Specifications

Specification	L22	L62	L42	
Power Supply	90 to 250VAC, 47 to 63Hz, 20 to 28 VAC,47-63Hz / 11 to 40 VDC			
Power Consumption	8VA, 4W Maximum	10VA, 5W Maximum.,	12VA, 6W Maximum	
Over Voltage Category	II			
<b>Signal Input</b>				
Type	Thermocouple (J, K, T, E, B, R, S, N, L, U, P, C, D), RTD (PT100(DIN), PT100(JIS)) Current(mA), Voltage (V, mV)			
Resolution	18 Bits			
Sampling Rate	5 Times / Second (200msec)			
Maximum Rating	-2VDC minimum, 12VDC maximum			
Input Characteristics	<b>Type</b>	<b>Range</b>	<b>Accuracy @ 25°C</b>	<b>Input Impedance</b>
	J	-120°C to 1000°C (-184°F to 1832°F)	±2°C	2.2 MΩ
	K	-200°C to 1370°C (-328°F to 2498°F)	±2°C	2.2 MΩ
	T	-250°C to 400°C (-418°F to 752°F)	±2°C	2.2 MΩ
	E	-100°C to 900°C (-148°F to 1652°F)	±2°C	2.2 MΩ
	B	0°C to 1820°C (32°F to 3308°F)	±2°C (200°C to 1800°C)	2.2 MΩ
	R	0°C to 1767.8°C (32°F to 3214°F)	±2°C	2.2 MΩ
	S	0°C to 1767.8°C (32°F to 3214°F)	±2°C	2.2 MΩ
	N	-250°C to 1300°C (-418°F to 2372°F)	±2°C	2.2 MΩ
	L	-200°C to 900°C (-328°F to 1652°F)	±2°C	2.2 MΩ
	U	-200°C to 600°C (-328°F to 1112°F)	±2°C	2.2 MΩ
	P	0°C to 1395°C (32°F to 2543°F)	±2°C	2.2 MΩ
	C	0°C to 2300°C (32°F to 4172°F)	±2°C	2.2 MΩ
	D	0°C to 2300°C (32°F to 4172°F)	±2°C	2.2 MΩ
	PT100(DIN)	-210°C to 700°C (-346°F to 1292°F)	±0.4°C	1.3KΩ
	PT100(JIS)	-200°C to 600°C (-328°F to 1112°F)	±0.4°C	1.3KΩ
	mA	-3mA to 27mA	±0.05%	2.5Ω
VDC	-1.3VDC to 11.5VDC	±0.05%	1.5MΩ	
mV	0 to 50mV	±0.05%	2.2 MΩ	
Temperature Effect	1.5μV /°C for all inputs except mA input, 3.0μV /°C for mA			
Sensor Lead Resistance Effect	<b>Thermocouple:</b> 0.2 μV /°Ω; <b>3-wire RTD:</b> 2.6°C /Ω of Difference of Resistance of two leads <b>2-wire RTD:</b> 2.6°C /Ω of Sum of Resistance of two leads			
Burn-out Current	200nA			
CMRR	120 dB			
NMRR	55 dB			
Sensor Break Detection	Sensor open for Thermocouple, RTD and mV inputs, Sensor short for RTD input, Below 1mA for 4-20mA input, Below 0.25VDC for 1 - 5VDC input, Not available for other inputs.			
Sensor Break Response Time	Within 4 seconds for Thermocouple, RTD and mV inputs, 0.1 second for 4-20mA and 1 - 5VDC inputs.			
<b>Digital Filter</b>				
Function	First Order			
Time Constant	0, 0.2, 0.5, 1, 2, 5, 10, 20, 30, 60 seconds (programmable)			
<b>Event Input</b>				
Number of Event Inputs	1	2	2	
Logic Low	-10VDC minimum, 0.8VDC maximum.			
Logic High	2VDC minimum, 10VDC maximum			
Functions	Remote Lock, Remote Reset Output1, HSP2, LSP2, HLS2, HSP3, LSP3, HLS3, Reset Alarm1, Reset Alarm2, Reset Alarm 3, Reset All Alarms, Cancel Latch, Reset Reference data			
<b>Output 1</b>				
Limit Control Function	High Limit, Low Limit and High / Low Limit			
Type	Relay, Source Voltage			

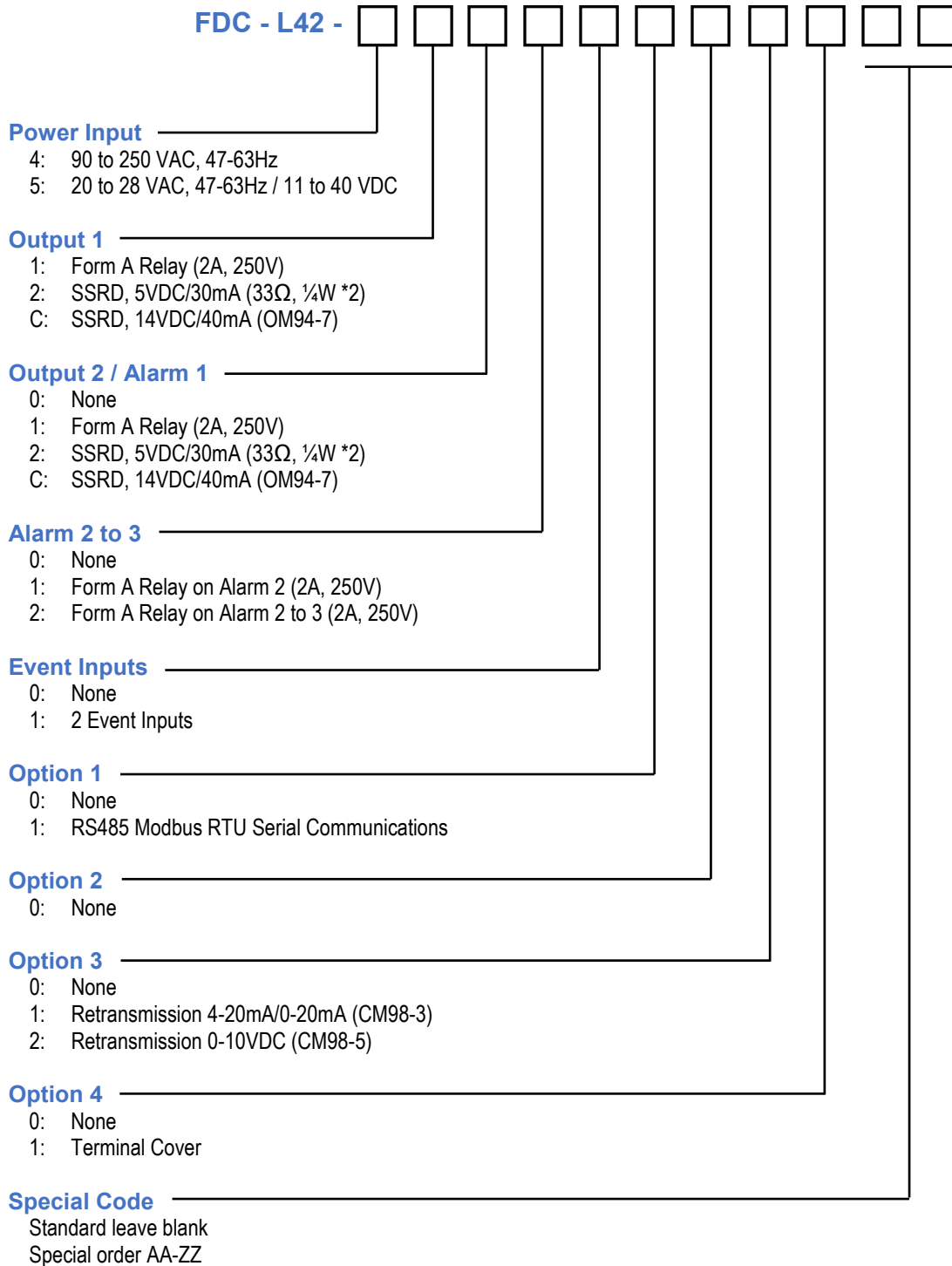
Specification	L22	L62	L42
Relay Type	Form A		
Relay Rating	2A, 240VAC, 200000 Life Cycles for Resistive Load		
Sourced Voltage	5VDC/30mA, Current Limiting Resistance 66Ω, 14VDC/40mA		
<b>Output 2 / Alarm 1</b>			
Limit Control Function	Annunciator		
Type	Relay, Source Voltage		
Relay Type	Form A		
Relay Rating	2A,240V AC,200000 Life Cycles for Resistive Load		
Sourced Voltage	5VDC/30mA, Current Limiting Resistance 66Ω, 14VDC/40mA		
<b>Alarm 2 and Alarm 3</b>			
Relay Type	Form A		
Maximum Rating	2A, 240VAC, 200000 Life Cycles for Resistive Load		
Alarm Functions	Process High, Process Low		
Alarm Mode	Normal, Latching, Normal Reverse, Latching Reverse		
<b>Data Communication</b>			
Interface	RS485 (serial)		
Protocol	Modbus RTU (slave)		
Address	1 to 247		
Baud Rate	2400, 4800, 9600, 14.4K, 19.2K, 28.8K, 38.4K, 57.6K, 115K (programmable)		
Parity Bit	None, Even or Odd		
Stop Bit	1		
Data Length	8		
Communication Buffer	160 Bytes		
<b>Analog Retransmission</b>			
Output Signal	4-20mA, 0-20 mA, 0 - 10VDC		
Resolution	15 Bits		
Accuracy	±0.05% of Span ± 0.0025% / °C		
Load Resistance	0 to 500Ω for current output, 10KΩ minimum for Voltage Output		
Output Regulation	0.01% for full load change		
Output Setting Time	0.1Second (stable to 99.9%)		
Isolation Breakdown	1000VAC min		
Integral Linearity Error	±0.005% of span		
Temperature Effect	±0.0025% of span /°C		
Saturation Low	0mA or 0VDC		
Saturation High	22.2mA or 5.55V, 11.1V min		
Linear Output Ranges	0 - 22.2mA (0 - 20mA/4 - 20mA), 0 - 5.55VDC (0 - 5VDC, 1 - 5VDC), 0 - 11.1VDC (0 - 10VDC)		
<b>User Interface</b>			
Keypad	4 Keys		
Display Type	4 Digit LCD Display		
No of Display	2		
Upper Display Size	0.31" (8mm)	0.58" (15mm)	0.98" (25mm)
Lower Display Size	0.25" (6.5mm)	0.3" (7.8mm)	0.55" (14mm)
<b>Programming Port</b>			
Interface	Micro USB		
PC Communication Function	Firmware upgrade		
<b>Environmental and Physical Specifications</b>			
Operating Temperature	-10°C to 50°C		
Storage Temperature	-40°C to 60°C		
Humidity	0 to 90 % RH (Non-Condensing)		

Specification	L22	L62	L42
Altitude	2000 Meters Maximum		
Pollution	Degree II		
Insulation Resistance	20MΩ Minimum (@500V DC)		
Dielectric Strength	2000VAC,50/60 Hz for 1 Minute		
Vibration Resistance	10 to 55 Hz, 10m/s <sup>2</sup> for 2 Hours		
Shock Resistance	200 m/s <sup>2</sup> (20g)		
Housing	Flame Retardant Polycarbonate		
Mounting	DIN-Rail	Panel	Panel
DIN Size	-	1/16	1/4
Dimensions (W*H*D) (mm)	22.5*96*83	48*48*59	96*96*59
Depth Behind Panel (mm)	-	50	50
Cut Out Dimensions (mm)	-	45*45	92*92
Weight (grams)	160	160	290
<b>Approval Standards</b>			
Safety	FM Class 3545, UL61010-1, CSA 22.2 No.61010-1-12, EN61010-1 (IEC1010-1), ROHS, REACH		
Protective Class	IP50 for the front panel, IP20 for rear terminals and housing. All indoor use.		
EMC	EN61326		

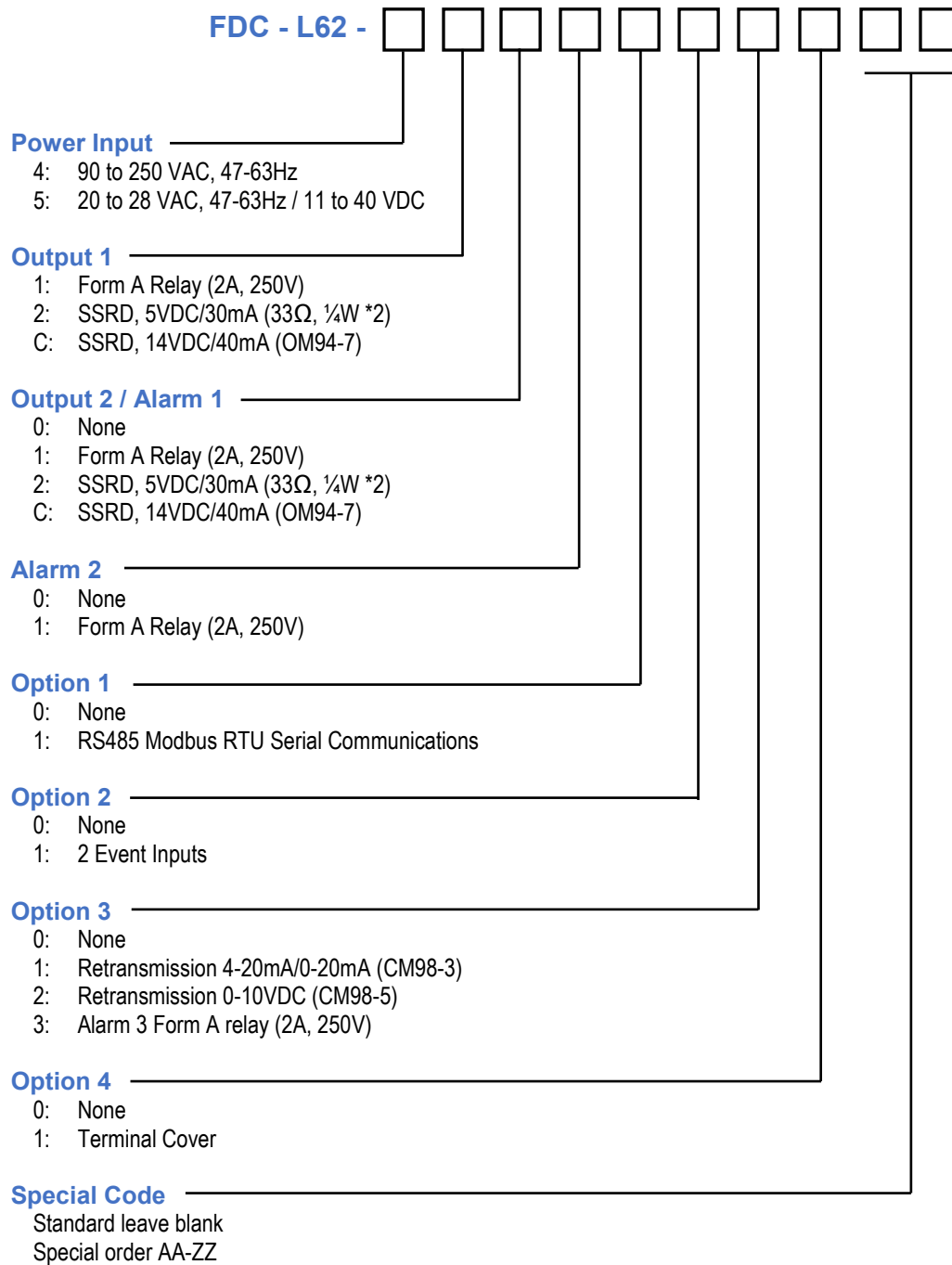


## 1.4 Ordering Code

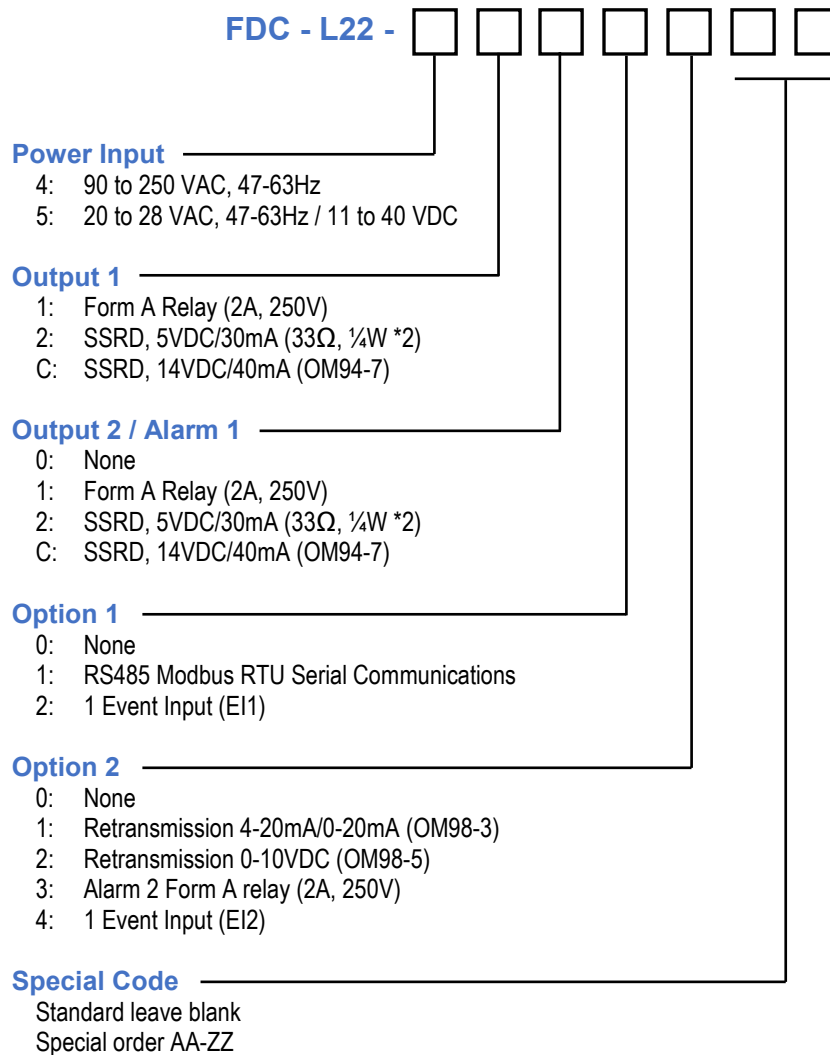
### 1.4.1 L42 Ordering Code



**1.4.2 L62 Ordering Code**



**1.4.3 L22 Ordering Code**



**1.4.4 Accessories**

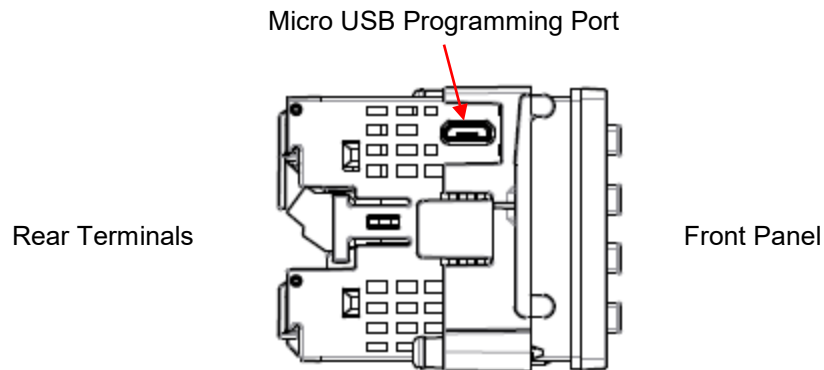
- OM94-7 14VDC/40mA SSR Drive Module
- OM98-3 Isolated 4-20mA/0-20mA Retransmission Module for L22
- OM98-5 Isolated 0-10VDC Retransmission Module for L22
- CM98-3 Isolated 4-20mA/0-20mA Retransmission Module for L62 and L42
- CM98-5 Isolated 0-10VDC Retransmission Module for L62 and L42
- PA98-1 USB Programming Adaptor
- CC98-1 Programming Port Cable (1.5m)

**1.4.5 Related Products**

- SNA10A Smart Network Adaptor for third party software (converts RS232 to RS422/485)
- FDC-Set Configuration Software

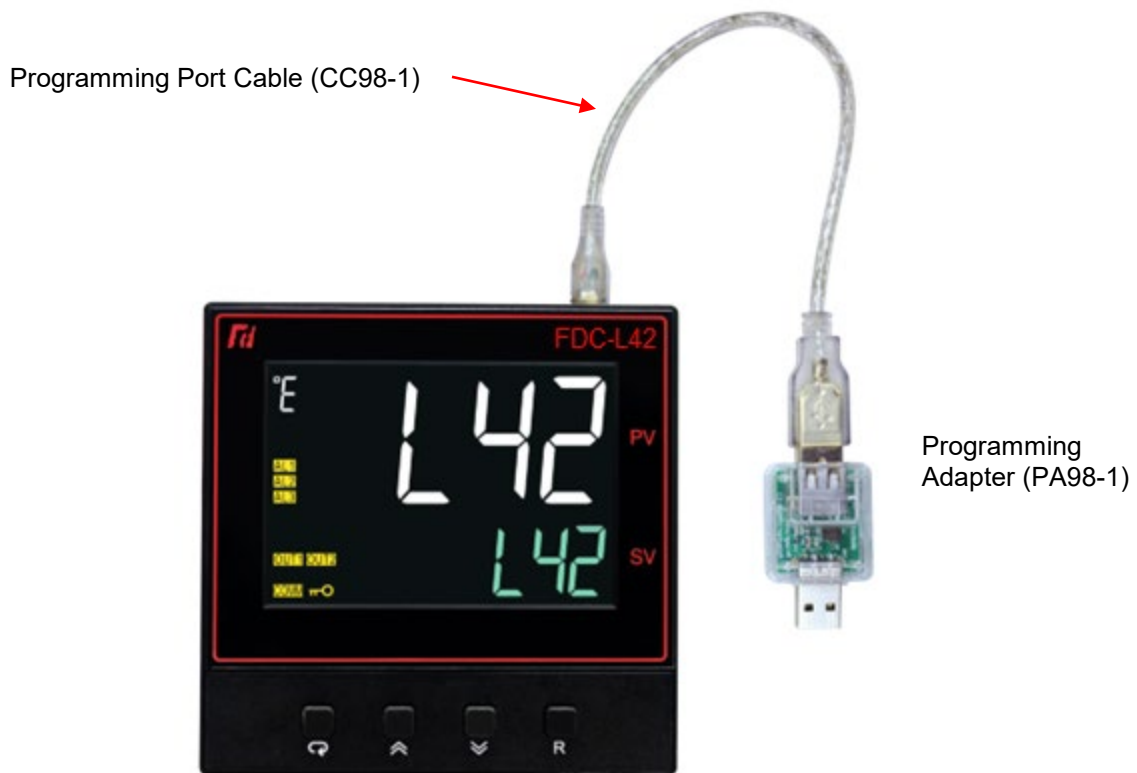
### 1.5 Programming Port

A Micro USB Port provided on the limit control can be used to connect it to a PC by using a programming port cable (CC98-1) and adapter (PA98-1) for firmware updates.



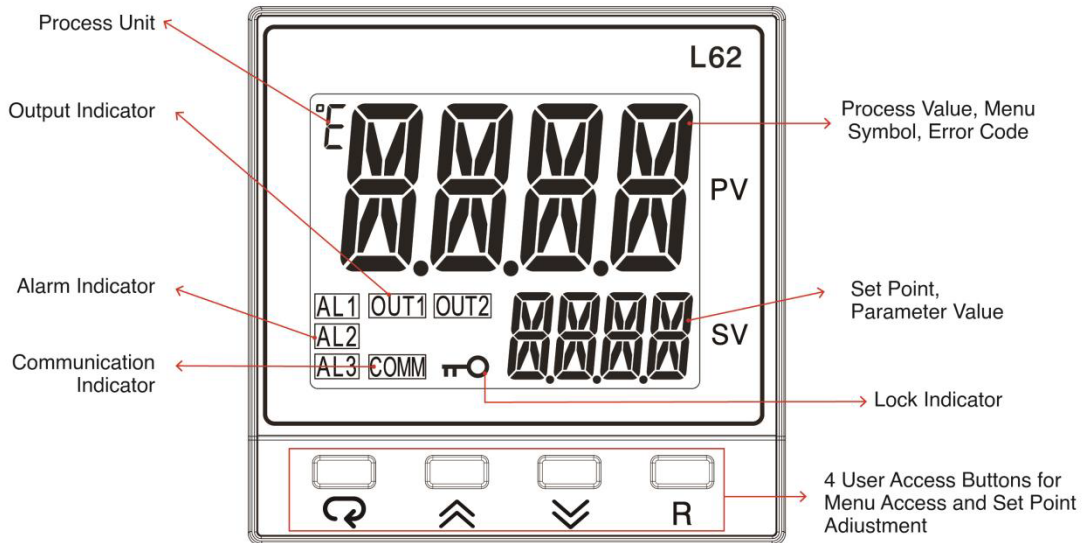
The limit control will be powered via the USB port adapter when connected to a PC so separate power is not required. The programming port is used for off-line automatic setup and testing procedures only. By using PC programming software such as FDC-Set, you can save limit configurations to a file and then download them to the limit control eliminating the need to manually enter settings on every unit.

**Note:** Do not attempt to make any connections to this port while the limit control is under normal operation.

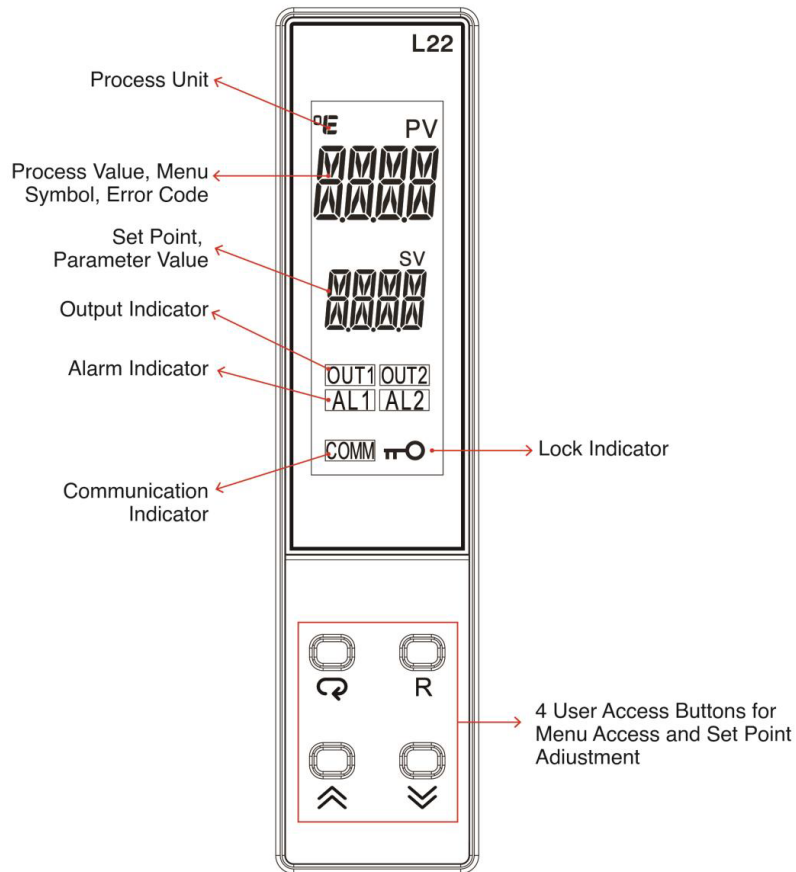


## 1.6 Keys and Displays

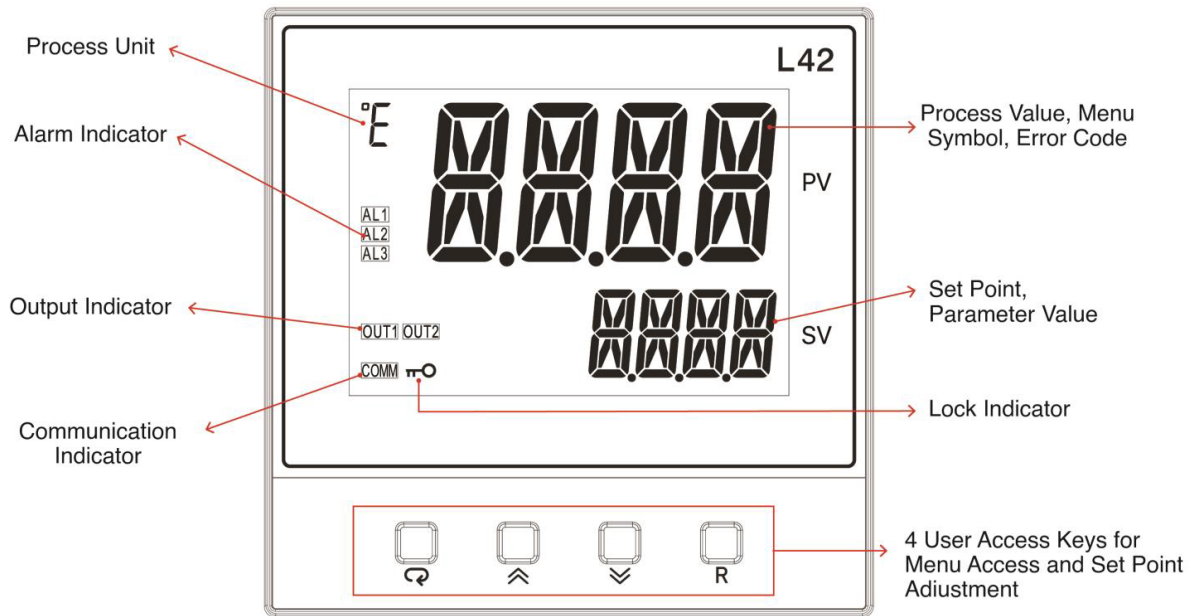
The following figures depict the interface arrangement for each of the process limit control models.



**L62 Front Panel Keys and Display**



**L22 Front Panel Keys and Display**



**L42 Front Panel Keys and Display**

**1.6.1 Keypad Operation**

**SCROLL KEY:**

This scroll key is used to select a parameter to be viewed and/or adjusted as well as navigate to the next parameter. Repeatedly pressing and releasing the key advances through each available parameter under the current menu. Once the last parameter under the menu is reached, it will loop back to the first value. Pressing and releasing the scroll key at the same time as the up key will advance to the previous parameter. This provides the ability to scroll back to the previous parameter without having to advance all the way through the menu and back to the beginning,

The scroll key also acts as an **ENTER** key. This is done by pressing and holding the key for a specific amount of time. It provides access to the various menus including setup and calibration. See section [1.7 Menu Navigation](#).

**UP KEY:**

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

**DOWN KEY:**

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

**RESET KEY:**

This key is used to:

1. Revert the display to the home screen.
2. Reset a latching alarm once the alarm condition is removed.
3. Reset the limit condition after the process is within the limit set point.
4. Reset the limit annunciator.

**Note:** *If the reset key is left pressed, only one reset operation will occur. If the unit subsequently goes into a state where reset is required again, the reset key (or remote reset contacts) must be released (opened) and pressed (closed) again.*

**1.6.2 Display Operation**

**POWER UP SEQUENCE:**

During power up the following sequence will be followed.

1. All segments of the display and indicators will be off for ~4 seconds.
2. The upper display will show PRoG, and the lower display will show the model number and firmware version for ~1.5 seconds.
3. The upper display will show bULd and the lower display will show the build number for ~1 second.

**NORMAL DISPLAY:**

During normal operation (non-limit condition), the unit will display the process value, and the word SAFE. The OUT1 indicator will be off, and the output 1 contacts will be closed.

**ABNORMAL DISPLAY:**

Whenever the process is outside the normal range, the lower display will display the limit set point value that has been exceeded instead of displaying the word SAFE. The OUT1 indicator will be on, and the output 1 contacts will be open.

**SENSOR BREAK DISPLAY:**

If a sensor break is detected in the sensor circuit, the upper display will flash SbER. The OUT1 indicator will also be on, and the output 1 contacts will be open.

**A-D FAILURE DISPLAY:**

If failure is detected in the A-D input circuit, the upper display will flash AdER. The OUT1 indicator will also be on, and the output 1 contacts will be open.

A	B	C	D	E	F	G
H	I	J	K	L	M	N
O	P	Q	R	S	T	U
V	W	X	Y	Z		

*How Characters are Displayed on the LCD Screen*

## 1.7 Menu Navigation

The process limit control provides three menu groups:

**User Menu:** Provides access to the low/high limit set point values, viewing of minimum and maximum process values, time in limit condition and select parameter values as defined in setup.

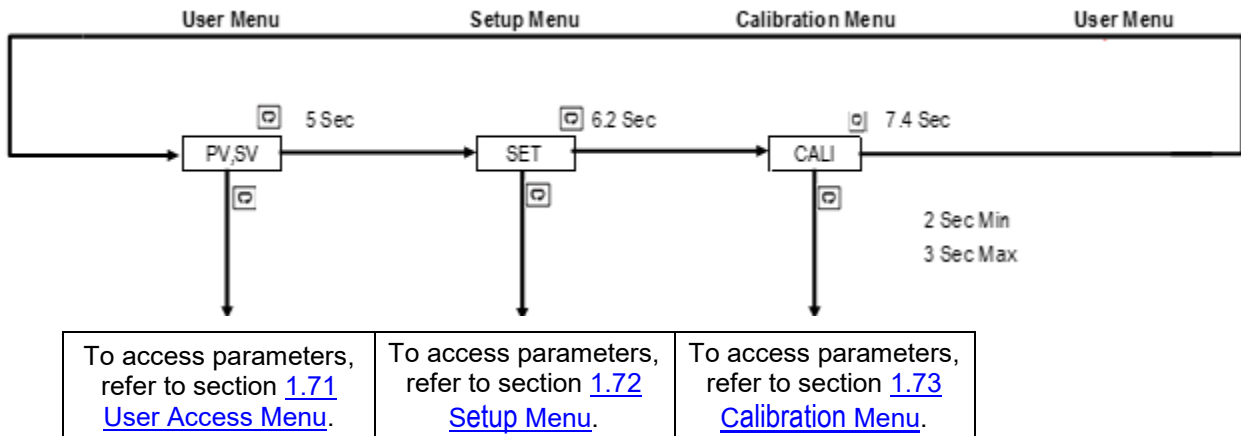
The User menu is the default (home) menu. It can be accessed when in the Setup or Calibration menus by simply pressing the reset key.

**Setup Menu:** Provides access to all setup menus for configuring the limit mode of operation, outputs, alarms and communications settings if applicable.

To access the Setup menu from the User menu, press and hold the scroll key. After ~5 seconds, the upper display will show SET and then immediately release the scroll key.

**Calibration Mode Menu:** Provides access to the input calibration parameters and functions.

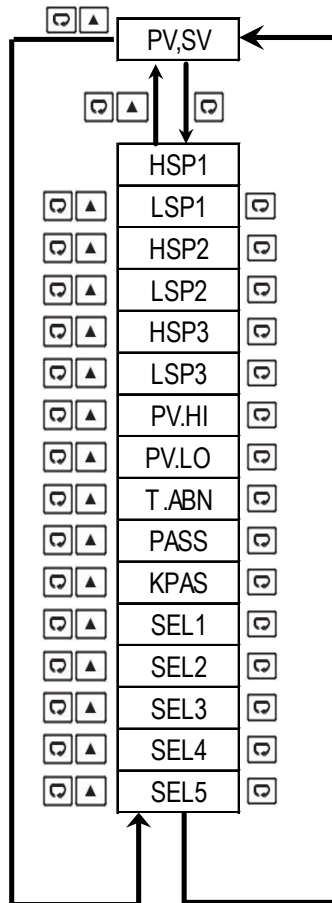
To access the Calibration menu from the User or Setup menu, press and hold the scroll key. After ~6 seconds, the upper display will show CALI and then immediately release the scroll key.





### 1.7.1 User Access Menu

The user menu is the default (home) menu of the limit control. Repeatedly pressing the scroll key cycles through the list of parameters as shown below. When scrolling through the available parameters, the upper display will provide the parameter description, i.e., HSP1 for high limit set point 1 for example, while the lower display will indicate the current value.



Pressing the up or down key when on an adjustable parameter such as the high limit set point, increases or decreases the current value. Note that not all of the parameters listed may be available. The availability of the different high and low set points and selectable parameters (SEL1 to SEL5) are dependent upon the configuration of the limit. Therefore, the parameters are only available when the option is enabled under the Setup menu.

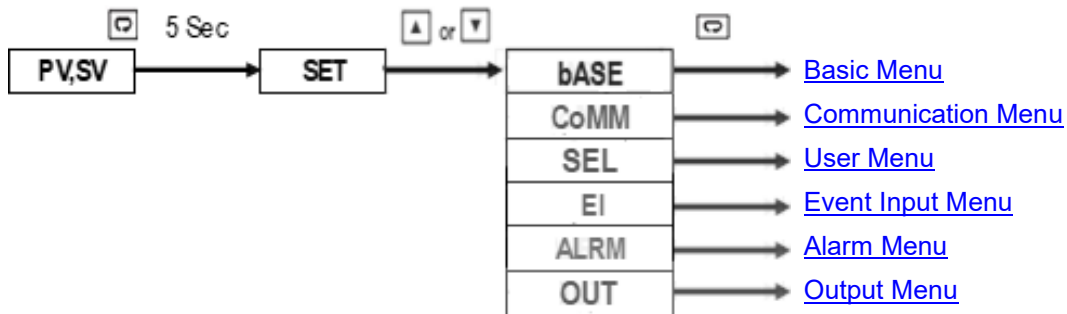
#### 1.7.1.1 Reference Data

There are three reference data parameters displayed in the user access menu. The reference data parameters are read only. The maximum historical process value (**PV.HI**), indicates the maximum process value since the last UNLOCK operation. The minimum historical process value (**PV.Lo**), indicates the minimum process value since the last UNLOCK operation. The abnormal time (**t.AbN**), indicates the total accumulated time (in minutes) during which the process value has exceeded the high or low limit set point the last UNLOCK operation.

The values of the reference parameters will be cleared by pressing and holding the reset key for 4 seconds (UNLOCK operation). After the UNLOCK operation is performed, the PV.HI and PV.Lo values will be initialized to the current process value and t.AbN will be set to zero.

### 1.7.2 Setup Menu

The setup menu is divided into six categories to make the configuration process easier. To access the setup menu from the user menu, press and hold the scroll key for ~5 seconds. One the upper display shows SEt (for setup menu), immediately release the scroll key. The lower display will then indicate one of the six categories of the setup menu as shown below:






Once in the setup menu, pressing the up or down key will scroll between the six categories. To cycle through the parameters under the chosen category, repeatedly press the scroll key.

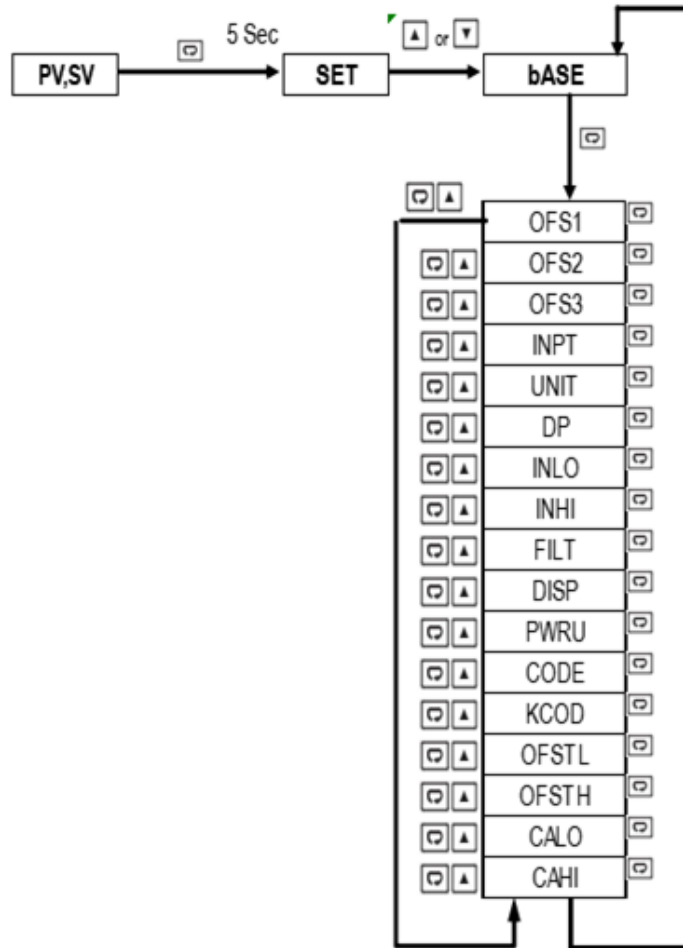
**Note:** *The availability of certain parameters under the setup menus is dependent upon available hardware and configuration settings. See section [1.8 Parameter Availability](#) for a list of all the parameters and their conditions of availability.*

*For a description of each of the available parameters along with their range of entry, see section [1.9 Parameter Description](#).*




**1.7.2.1 Basic Menu (bASE)**

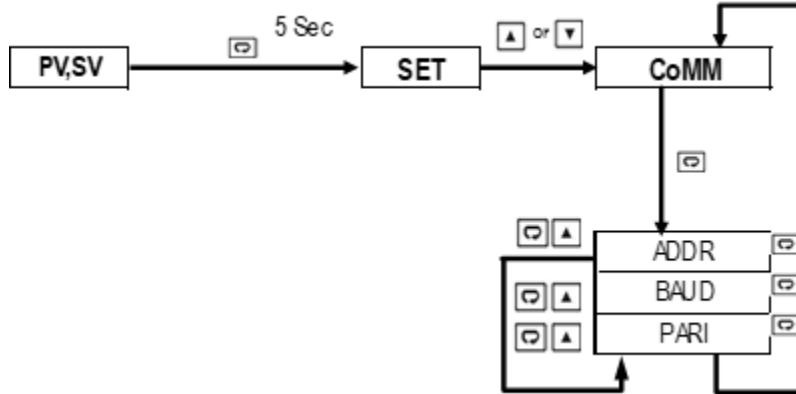
Upon entering the setup menu, the upper display will show Set. To access the base menu, use the  or  key to get bASE in the lower display. Then press the  key to access the basic menu parameters. The upper display will show the parameter description and the lower display will indicate the parameter value.

**Note:** *The availability of certain parameters under the setup menus is dependent upon available hardware and configuration settings. See section [1.8 Parameter Availability](#) for a list of all the parameters.*






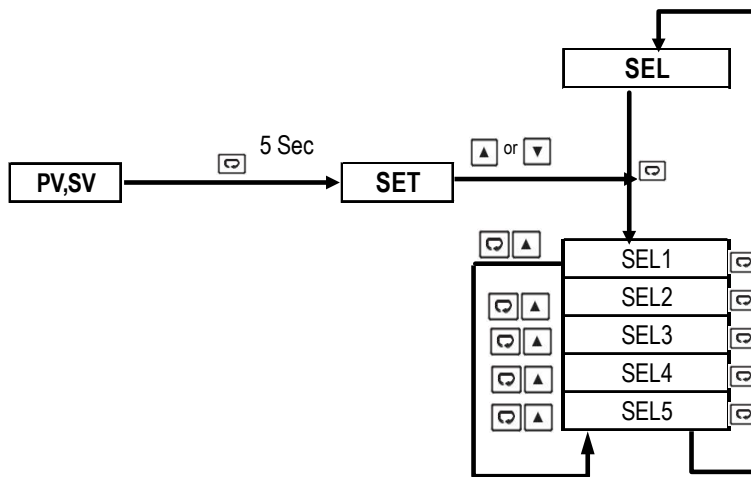
**1.7.2.2 Communication Menu (CoMM)**

Upon entering the setup menu, the upper display will show Set. To access the communications menu, use the  or  key to get CoMM in the lower display. Then press the  key to access the communication menu parameters. The upper display will show the parameter description and the lower display will indicate the parameter value.






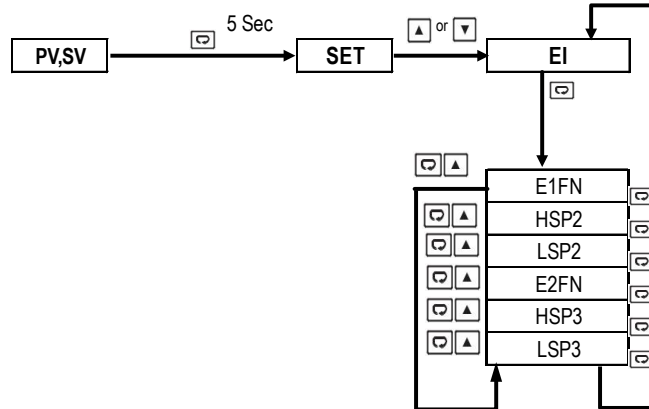
**1.7.2.3 User Select Menu (SEL)**

Upon entering the setup menu, the upper display will show Set. To access the user select menu, use the  or  key to get SEL in the lower display. Then press the  key to access the user select menu parameters. The upper display will show the parameter description and the lower display will indicate the parameter value.






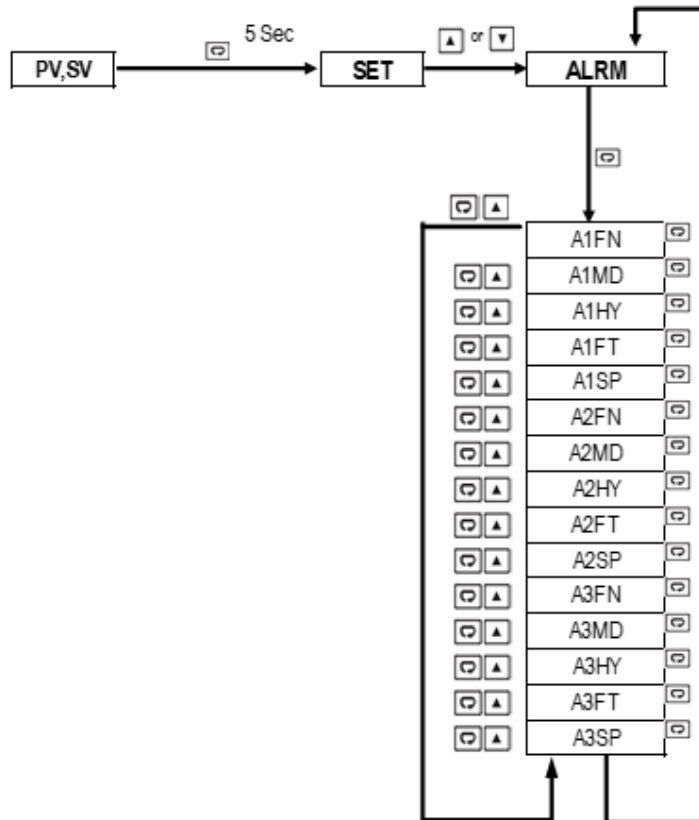
**1.7.2.4 Event Input Menu (EI)**

Upon entering the setup menu, the upper display will show Set. To access the event input menu, use the  or  key to get EI in the lower display. Then press the  key to access the event input menu parameters. The upper display will show the parameter description and the lower display will indicate the parameter value.






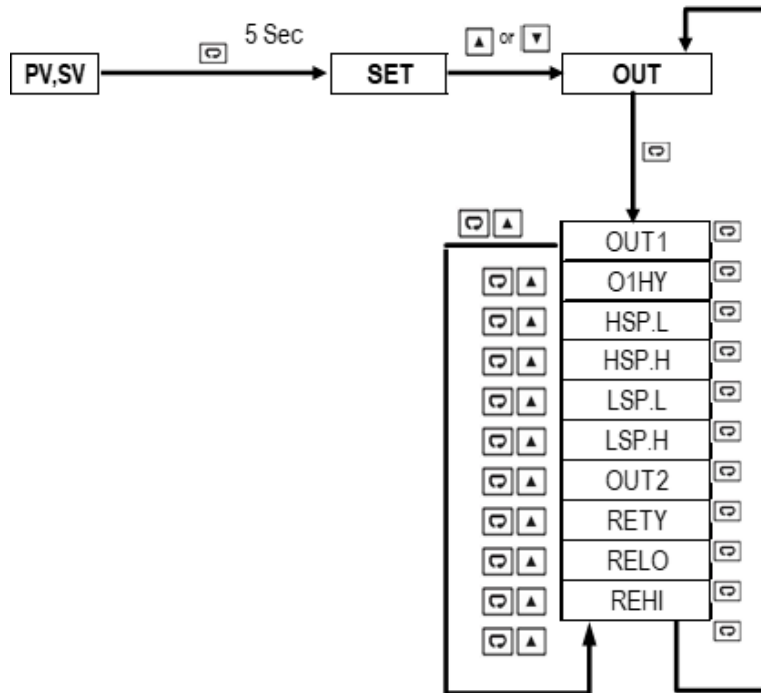
**1.7.2.5 Alarm Menu (ALRM)**

Upon entering the setup menu, the upper display will show Set. To access the alarm menu, use the  or  key to get ALRM in the lower display. Then press the  key to access the alarm menu parameters. The upper display will show the parameter description and the lower display will indicate the parameter value.



**1.7.2.6 Output Menu (OUT)**

Upon entering the setup menu, the upper display will show Set. To access the output menu, use the  or  key to get OUT in the lower display. Then press the  key to access the output menu parameters. The upper display will show the parameter description and the lower display will indicate the parameter value.

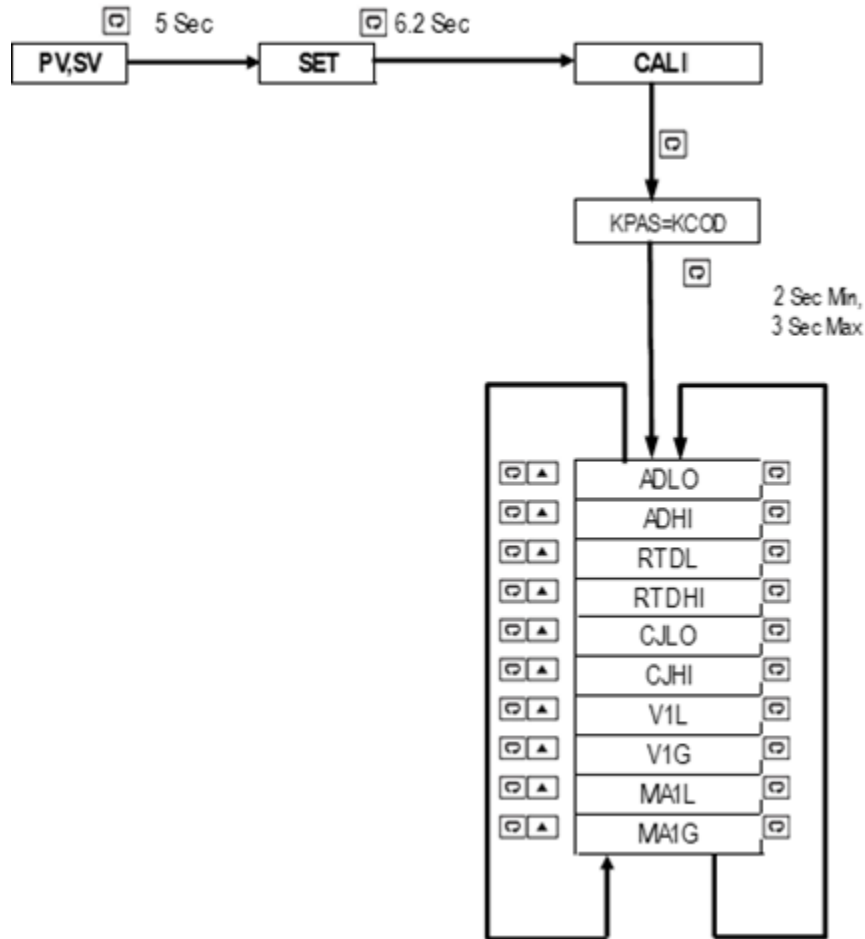


**1.7.3 Calibration Menu**

Accessing the calibration mode menu is a two-step process. The first step is accessing the top-level calibration menu. This is done by pressing and holding the scroll key for just over 6 seconds. Once the upper display shows CALI and the lower display shows "----", release the scroll key. To enter the calibration mode menu, press and hold the scroll key for a minimum of 2 seconds but not greater than 3 seconds. Upon releasing the scroll key, If the time duration is correct, the upper display will show the first calibration parameter AdLo and the lower display will indicate the current value.

**Note:** *In order to access the calibration mode menu, the KPAS parameter must be set to match the KCOD value. This must be set from the user menu prior to attempting to enter the calibration mode menu. If they do not match, pressing and holding the scroll key for the 2 to 3 second time period at the top-level calibration menu will not provide access to the calibration parameters. See section [3.1.1 Calibration Security](#).*

Once in the calibration mode menu, repeatedly pressing and releasing the scroll key will cycle through the calibration parameters as shown below. For information on setting security levels of the process limit control, see section [3.1 Security](#). For information on proper the steps necessary to perform input calibration, see section [4 Calibration](#).



**1.8 Parameter Availability**

Register Address	Modbus Address	Parameter Notation	L22	L62	L42	Existence Conditions
0	400001	HSP1	✓	✓	✓	Exists if OUT1 selects HI or HL
1	400002	LSP1	✓	✓	✓	Exists if OUT1 selects Lo or HL
2	400003	HSP2	✓	✓	✓	Exists if E1FN exists and E1FN selects HSP2 or HLS2 or if E2FN exists and E2FN selects HSP2 or HLS2
3	400004	LSP2	✓	✓	✓	Exists if E1FN exists and E1FN selects LSP2 or HLS2 or if E2FN exists and E2FN selects LSP2 or HLS2
4	400005	HSP3	✓	✓	✓	Exists if E1FN exists and E1FN selects HSP3 or HLS3 or if E2FN exists and E2FN selects HSP3 or HLS3
5	400006	LSP3	✓	✓	✓	Exists if E1FN exists and E1FN selects LSP3 or HLS3 or if E2FN exists and E2FN selects LSP3 or HLS3
6	400007	INPT	✓	✓	✓	Exists unconditionally
7	400008	UNIT	✓	✓	✓	Exists unconditionally
8	400009	DP	✓	✓	✓	Exists unconditionally
9	400010	INLO	✓	✓	✓	Exists if INPT selects 4-20mA or 0-20mA or 0-5V or 1-5V or 0-10V or 0-50mV
10	400011	INH1	✓	✓	✓	
11	400012	HSPL	✓	✓	✓	Exists if OUT1 selects HI or HL
12	400013	HSPH	✓	✓	✓	Exists if OUT1 selects HI or HL
13	400014	LSPL	✓	✓	✓	Exists if OUT1 selects Lo or HL
14	400015	LSPH	✓	✓	✓	Exists if OUT1 selects Lo or HL
15	400016	FILT	✓	✓	✓	Exists unconditionally
16	400017	DISP	✓	✓	✓	Exists unconditionally
17	400018	OUT1	✓	✓	✓	Exists unconditionally
18	400019	O1HY	✓	✓	✓	Exists unconditionally
19	400020	OUT2	✓	✓	✓	Exists unconditionally
20	400021	A1FN	✓	✓	✓	Exists if OUT2 selects AL1
21	400022	A1MD	✓	✓	✓	Exists if OUT2 selects AL1 and A1FN selects PVHI or PVLO
22	400023	A1HY	✓	✓	✓	Exists if OUT2 selects AL1 and A1FN selects PVHI or PVLO
23	400024	A1FT	✓	✓	✓	Exists if OUT2 selects AL1 and A1FN selects PVHI or PVLO
24	400025	A1SP	✓	✓	✓	Exists if OUT2 selects AL1 and A1FN selects PVHI or PVLO
25	400026	A2FN	✓	✓	✓	<b>L62/L42:</b> Exists unconditionally <b>L22:</b> Exists if OFS2 selects AL2
26	400027	A2MD	✓	✓	✓	<b>L62/L42:</b> Exists if A2FN selects PVHI or PVLO, <b>L22:</b> Exists if OFS2 selects AL2 and A2FN selects PVHI or PVLO
27	400028	A2HY	✓	✓	✓	
28	400029	A2FT	✓	✓	✓	
29	400030	A2SP	✓	✓	✓	
30	400031	A3FN		✓	✓	<b>L42:</b> Exists unconditionally <b>L62:</b> Exists if OFS3 is set to ALM3 <b>L22:</b> Not available
31	400032	A3MD		✓	✓	<b>L42:</b> Exists if A3FN selects PVHI or PVLO, <b>L62:</b> Exists if OFS3 is set to ALM3 and A3FN is set to PVHI or PVLO <b>L22:</b> Not available
32	400033	A3HY		✓	✓	
33	400034	A3FT		✓	✓	
34	400035	A3SP		✓	✓	
35	400036	OFS1	✓	✓	✓	Exists unconditionally
36	400037	OFS2	✓	✓	✓	Exists unconditionally
37	400038	OFS3		✓	✓	<b>L62/L42:</b> Exists unconditionally <b>L22:</b> Not available
38	400039	E1FN	✓	✓	✓	<b>L42:</b> Exists unconditionally <b>L62:</b> Exists if OFS2 selects E12 <b>L22:</b> Exists if OFS1 selects E11
39	400040	E2FN	✓	✓	✓	<b>L42:</b> Exists unconditionally <b>L62:</b> Exists if OFS2 selects E12 <b>L22:</b> Exists if OFS2 selects E12
40	400041	RETY	✓	✓	✓	<b>L62/L42:</b> Exists if OFS3 selects 4-20 or 0-20 or 0-5V or 1-5V or 0-10
41	400042	RELO	✓	✓	✓	



Register Address	Modbus Address	Parameter Notation	L22	L62	L42	Existence Conditions
42	400043	REHI	✓	✓	✓	<b>L22:</b> Exists if OFS2 selects 4-20 or 0-20 or 0-5V or 1-5V or 0-10
43	400044	ADDR	✓	✓	✓	Exists if OFS1 selects RS-485
44	400045	BAUD	✓	✓	✓	Exists if OFS1 selects RS-485
45	400046	PARI	✓	✓	✓	Exists if OFS1 selects RS-485
46	400047	OFTL	✓	✓	✓	Exists unconditionally
47	400048	OFTH	✓	✓	✓	Exists unconditionally
48	400049	CALO	✓	✓	✓	Exists unconditionally
49	400050	CAHI	✓	✓	✓	Exists unconditionally
50	400051					
51	400052	ADLO	✓	✓	✓	Exists unconditionally
52	400053	ADHI	✓	✓	✓	Exists unconditionally
53	400054	RTDL	✓	✓	✓	Exists unconditionally
54	400055	RTDH	✓	✓	✓	Exists unconditionally
55	400056	CJLO	✓	✓	✓	Exists unconditionally
56	400057	CJHI	✓	✓	✓	Exists unconditionally
57	400058	V1L	✓	✓	✓	Exists unconditionally
58	400059	V1G	✓	✓	✓	Exists unconditionally
59	400060	MA1L	✓	✓	✓	Exists unconditionally
60	400061	MA1G	✓	✓	✓	Exists unconditionally
61	400062	CJCL	✓	✓	✓	Exists unconditionally
62	400063	CJCT	✓	✓	✓	Exists unconditionally
63	400064	T.ABN	✓	✓	✓	Exists unconditionally
64	400065	PV	✓	✓	✓	Exists unconditionally
65	400066	HSV1	✓	✓	✓	Exists unconditionally
66	400067	LSV1	✓	✓	✓	Exists unconditionally
67	400068	PV.HI	✓	✓	✓	Exists unconditionally
68	400069	PV.LO	✓	✓	✓	Exists unconditionally
69	400070	EROR	✓	✓	✓	Exists unconditionally
70	400071	MODE	✓	✓	✓	Exists unconditionally
71	400072	PROG	✓	✓	✓	Exists unconditionally
72	400073	CMND	✓	✓	✓	Exists unconditionally
73	400074	JOB1	✓	✓	✓	Exists unconditionally
74	400075	JOB2	✓	✓	✓	Exists unconditionally
75	400076	JOB3	✓	✓	✓	Exists unconditionally
76	400077	SEL1	✓	✓	✓	Exists unconditionally
77	400078	SEL2	✓	✓	✓	Exists unconditionally
78	400079	SEL3	✓	✓	✓	Exists unconditionally
79	400080	SEL4	✓	✓	✓	Exists unconditionally
80	400081	SEL5	✓	✓	✓	Exists unconditionally
81	400082					
82	400083					
83	400084					
84	400085					
85	400086	PASS	✓	✓	✓	Exists unconditionally
86	400087	KPAS	✓	✓	✓	Exists unconditionally
87	400088	CODE	✓	✓	✓	Exists if CODE is 0 or 500, or CODE equal to PASS
88	400089	KCOD	✓	✓	✓	Exists if CODE is 0 or 500, or CODE equal to PASS
128	400129	PV	✓	✓	✓	Exists unconditionally
129	400130	HSV1	✓	✓	✓	Exists unconditionally
130	400131	LSV1	✓	✓	✓	Exists unconditionally
131	400132	T.ABN	✓	✓	✓	Exists unconditionally

Register Address	Modbus Address	Parameter Notation	L22	L62	L42	Existence Conditions
132	400133	MODE	✓	✓	✓	Exists unconditionally
133	400134	PWRU	✓	✓	✓	Exists unconditionally
134	400135					
135	400136					
136	400137					
137	400138					
138	400139					
139	400140	EROR	✓	✓	✓	Exists unconditionally
140	400141	PROG	✓	✓	✓	Exists unconditionally
141	400142					
142	400143	CMND	✓	✓	✓	Exists unconditionally
143	400144	JOB1	✓	✓	✓	Exists unconditionally

## 1.9 Parameter Description

Register Address	Modbus Address	Parameter Notation	Parameter Description	Range	Default Value	Data Access Type	Scale	
							Low	High
0	400001	HSP1	High Limit Set Point1	Low: HSP.L High: HSP.H	100.0°C (212.0°F)	R/W	-19999	45536
1	400002	LSP1	Low Limit Set Point1	Low: LSP.L High: LSP.H	0.0°C (32.0°F)	R/W	-19999	45536
2	400003	HSP2	High Limit Set Point2	Low: -19999 High: 45536	110.0°C (230.0°F)	R/W	-19999	45536
3	400004	LSP2	Low Limit Set Point2	Low: -19999 High: 45536	-10.0°C (14.0°F)	R/W	-19999	45536
4	400005	HSP3	High Limit Set Point3	Low: -19999 High: 45536	90.0°C (194.0°F)	R/W	-19999	45536
5	400006	LSP3	Low Limit Set Point3	Low: -19999 High: 45536	-50.0°C (-58.0°F)	R/W	-19999	45536
6	400007	INPT	Input sensor selection	<b>0 J_tC:</b> J type Thermocouple <b>1 K_tC:</b> K type Thermocouple <b>2 t_tC:</b> T type Thermocouple <b>3 E_tC:</b> E type Thermocouple <b>4 b_tC:</b> B type Thermocouple <b>5 R_tC:</b> R type Thermocouple <b>6 S_tC:</b> S type Thermocouple <b>7 N_tC:</b> N type Thermocouple <b>8 L_tC:</b> L type Thermocouple <b>9 U_tC:</b> U type Thermocouple <b>10 P_tC:</b> P type Thermocouple <b>11 C_tC:</b> C type Thermocouple <b>12 d_tC:</b> D type Thermocouple <b>13 Pt.dN:</b> PT100 Ω DIN curve <b>14 Pt.JS:</b> PT100 Ω JIS curve <b>15 4-20:</b> 4-20mA linear current <b>16 0-20:</b> 0-20mA linear current <b>17 0-5V:</b> 0-5VDC linear voltage <b>18 1-5V:</b> 1-5VDC linear voltage <b>19 0-10:</b> 0-10VDC linear voltage <b>20 0-50:</b> 0-50mVDC linear voltage	1	R/W	0	65535
7	400008	UNIT	Input unit selection	<b>0 oC:</b> °C unit <b>1 oF:</b> °F unit <b>2 Pu:</b> Process unit	0	R/W	0	65535
8	400009	DP	Decimal point selection	<b>0 No.dP:</b> No decimal point <b>1 1-dP:</b> 1 decimal digit <b>2 2-dP:</b> 2 decimal digits <b>3 3-dP:</b> 3 decimal digits	1	R/W	0	65535
9	400010	INLO	Input low scale value	Low: -19999 High: 45536	-17.8°C (0.0°F)	R/W	-19999	45536

Register Address	Modbus Address	Parameter Notation	Parameter Description	Range	Default Value	Data Access Type	Scale	
							Low	High
10	400011	INHI	Input high scale value	Low: -19999 High: 45536	93.3°C (200.0°F)	R/W	-19999	45536
11	400012	HSPL	Low limit of high limit set point value	Low: -19999 High: HSPH	0.0°C (32.0° F)	R/W	-19999	45536
12	400013	HSPH	High limit of high limit set point value	Low: HSPL High: 45536	500.0°C (932.0°F)	R/W	-19999	45536
13	400014	LSPL	Low limit of low limit set point value	Low: -19999 High: LSPH	-100.0°C (-148.0° F)	R/W	-19999	45536
14	400015	LSPH	High limit of low limit set point value	Low: LSPL High: 45536	0.0°C (32.0°F)	R/W	-19999	45536
15	400016	FILT	Filter damping time constant of PV	<b>0 0:</b> 0 second time constant <b>1 0.2:</b> 0.2 second time constant <b>2 0.5:</b> 0.5 second time constant <b>3 1:</b> 1 second time constant <b>4 2:</b> 2 second time constant <b>5 5:</b> 5 second time constant <b>6 10:</b> 10 second time constant <b>7 20:</b> 20 second time constant <b>8 30:</b> 30 second time constant <b>9 60:</b> 60 second time constant	2	R/W	0	65535
16	400017	DISP	Normal display format	<b>0 SAFE:</b> Display SAFE <b>1 HSP1:</b> Display HSP1 value <b>2 LSP1:</b> Display LSP1 value	1	R/W	0	65535
17	400018	OUT1	Output 1 function	<b>0 HI:</b> High Limit Control <b>1 LO:</b> Low Limit Control <b>2 HL:</b> High / Low Limit Control	0	R/W	0	65535
18	400019	O1HY	Output Hysteresis	Low: 0.1°C (0.2°F) High: 50.0°C (90.0°F)	0.1° C (0.2 °F)	R/W	0	65535
19	400020	OUT2	Output 2 function	<b>0 NoNE:</b> Output2 turned off <b>1 DCPS:</b> DC Power Supply <b>2 AL1:</b> Alarm 1 Function <b>3 L_An:</b> Limit Annunciator	2	R/W	0	65535
20	400021	A1FN	Alarm 1 function for alarm 1 output	<b>0 NoNE:</b> No alarm function <b>1 PV.HI:</b> Process value high alarm <b>2 PV.Lo:</b> Process value low alarm	2	R/W	0	65535
21	400022	A1MD	Alarm 1 operation mode	<b>0 NoRM:</b> Normal alarm action <b>1 LtCH:</b> Latching alarm action <b>2 NoR.R:</b> Normal alarm reverse action <b>3 LtC.R:</b> Latching alarm reverse action	0	R/W	0	65535
22	400023	A1HY	Alarm 1 Hysteresis control	Low: 0.1°C High: 50.0°C(90.0°F)	0.1° C (0.2 °F)	R/W	0	65535
23	400024	A1FT	Alarm 1 failure transfer mode	<b>0 oFF:</b> Alarm output OFF if sensor fails <b>1 oN:</b> Alarm output ON if sensor fails	1	R/W	0	65535
24	400025	A1SP	Alarm 1 set point	Low: -19999 High: 45536	100.0 °C (212.0°F)	R/W	-19999	45536
25	400026	A2FN	Alarm 2 functions for alarm 2 output	Same as A1FN	2	R/W	0	65535
26	400027	A2MD	Alarm 2 operation mode	Same as A1MD	0	R/W	0	65535
27	400028	A2HY	Alarm 2 Hysteresis control	Low: 0.1°C High: 50.0°C(90.0°F)	0.1° C (0.2° F)	R/W	0	65535
28	400029	A2FT	Alarm 2 failure transfer mode	<b>0 oFF:</b> Alarm output OFF if sensor fails <b>1 oN:</b> Alarm output ON if sensor fails	1	R/W	0	65535
29	400030	A2SP	Alarm 2 set point	Low: -19999 High: 45536	100.0 °C (212.0°F)	R/W	-19999	45536
30	400031	A3FN	Alarm 3 functions for alarm 3 output	Same as A1FN	2	R/W	0	65535
31	400032	A3MD	Alarm 3 operation mode	Same as A1MD	0	R/W	0	65535

Register Address	Modbus Address	Parameter Notation	Parameter Description	Range	Default Value	Data Access Type	Scale	
							Low	High
32	400033	A3HY	Alarm 3 Hysteresis control	Low: 0.1°C High: 50.0°C(90.0°F)	0.1°C (0.2°F)	R/W	0	65535
33	400034	A3FT	Alarm 3 failure transfer mode	0 <b>oFF</b> : Alarm output OFF if sensor fails 1 <b>oN</b> : Alarm output ON if sensor fails	1	R/W	0	65535
34	400035	A3SP	Alarm 3 set point	Low: -19999 High: 45536	100.0°C (212.0°F)	R/W	-19999	45536
35	400036	OFS1	Option1	<b>L62/ L42:</b> 0 <b>NoNE</b> : Not selected 1 <b>R485</b> : RS-485 <b>L22:</b> 0 <b>NoNE</b> : Not selected 1 <b>R485</b> : RS-485 2 <b>EI1</b> : Event 1 input	0	R/W	0	65535
36	400037	OFS2	Option 2	<b>L42:</b> 0 <b>NoNE</b> : Not selected <b>L62:</b> 1 <b>NoNE</b> : Not selected 2 <b>EI1.2</b> : Event input 1 and Event input 2 <b>L22:</b> 0. <b>NoNE</b> : No selected 1. <b>4-20</b> : 4-20mA retransmission output 2. <b>0-20</b> : 0-20mA retransmission output 3. <b>0-5V</b> : 0-5V retransmission output 4. <b>1-5V</b> : 1-5V retransmission output 5. <b>0-10</b> : 0-10 retransmission output 6. <b>AL2</b> : Alarm 2 output 7. <b>EI2</b> : Event2 Input	0	R/W	0	65535
37	400038	OFS3	Option 3	<b>L42:</b> 0 <b>NoNE</b> : Not selected 1 <b>4-20</b> : 4-20mA retransmission output 2 <b>0-20</b> : 0-20mA retransmission output 3 <b>0-5V</b> : 0-5VDC retransmission output 4 <b>1-5V</b> : 1-5VDC retransmission output 5 <b>0-10</b> : 0-10VDC retransmission output <b>L62:</b> 6 <b>NoNE</b> : Not selected 7 <b>4-20</b> : 4-20mA retransmission output 8 <b>0-20</b> : 0-20mA retransmission output 9 <b>0-5V</b> : 0-5VDC retransmission output 10 <b>1-5V</b> : 1-5VDC retransmission output 11 <b>0-10</b> : 0-10VDC retransmission output 12 <b>AL3</b> : Alarm 3 output	0	R/W	0	65535
38	400039	E1FN	Event input 1 function	0 <b>NoNE</b> : none 1 <b>LOCK</b> : Remote Lock 2 <b>RRST</b> : Remote Reset 3 <b>HSP2</b> : HSP2 activated to replace HSP1 4 <b>LSP2</b> : LSP2 activated to replace LSP1 5 <b>HLS2</b> : HSP2 & LSP2 activated to replace HSP1 & LSP1 6 <b>HSP3</b> : HSP3 activated to replace HSP1 7 <b>LSP3</b> : LSP3 activated to replace LSP1 8 <b>HLS3</b> : HSP3 & LSP3 activated to replace HSP1 & LSP1 9 <b>rS.A1</b> : Reset alarm 1 output 10 <b>rS.A2</b> : Reset alarm 2 output 11 <b>rS.A3</b> : Reset alarm 3 output 12 <b>rS.Ao</b> : Reset all alarm outputs 13 <b>CA.LH</b> : Cancel alarm latch 14 <b>R.REF</b> : Reset Reference Data  <i>E1FN ≠ E2FN, except selects NONE</i>	0	R/W	0	65535
39	400040	E2FN	Event input 2 function	Same as E1FN  <i>E1FN ≠ E2FN, except selects NONE</i>	0	R/W	0	65535

Register Address	Modbus Address	Parameter Notation	Parameter Description	Range	Default Value	Data Access Type	Scale	
							Low	High
40	400041	RETY	Retransmission type	0 <b>PV</b> : Retransmit Process Value 1 <b>HSP</b> : Retransmit HSP1 2 <b>LSP</b> : Retransmit LSP1	0	R/W	0	65535
41	400042	RELO	Retransmission low scale value	Low: -19999 High: 45536	0.0°C (32.0°F)	R/W	-19999	45536
42	400043	REHI	Retransmission high scale value	Low: -19999 High: 45536	100.0 °C (212.0 °F)	R/W	-19999	45536
43	400044	ADDR	Address assignment of digital communication	Low: 1 High: 255	-----	R/W	0	65535
44	400045	BAUD	Baud rate of digital communication	0 <b>2K4</b> : 2.4 Kbits/s baud rate 1 <b>4K8</b> : 4.8 Kbits/s baud rate 2 <b>9K6</b> : 9.6 Kbits/s baud rate 3 <b>14K4</b> : 14.4 Kbits/s baud rate 4 <b>19K2</b> : 19.2 Kbits/s baud rate 5 <b>28K8</b> : 28.8 Kbits/s baud rate 6 <b>38K4</b> : 38.4 Kbits/s baud rate 7 <b>57K6</b> : 57.6 Kbits/s baud rate 8 <b>115K</b> : 115.2 Kbits/s baud rate	2	R/W	0	65535
45	400046	PARI	The parity bit of digital communication	0 <b>EVEN</b> : Even Parity 1 <b>Odd</b> : Odd parity 2 <b>NoNE</b> : No parity bit	0	R/W	0	65535
46	400047	OFTL	Offset value for low point calibration	Low: -1999 High: 1999	0	R/W	-19999	45536
47	400048	OFTH	Offset value for high point calibration	Low: -1999 High: 1999	0	R/W	-19999	45536
48	400049	CALO	Input signal value during low point calibration	Low: -19999 High: CAHI-1  CALO≠CAHI	0	R/W	-19999	45536
49	400050	CAHI	Input signal value during high point calibration	Low: CALO+1 High: 45536  CALO≠CAHI	1000	R/W	-19999	45536
50	400051							
51	400052	ADLO	mV calibration low coefficient	Low: -1999 High: 1999	-----	R/W	-19999	45536
52	400053	ADHI	mV calibration high coefficient	Low: -1999 High: 1999	-----	R/W	-19999	45536
53	400054	RTDL	RTD calibration low coefficient	Low: -1999 High: 1999	-----	R/W	-19999	45536
54	400055	RTDH	RTD calibration high coefficient	Low: -1999 High: 1999	-----	R/W	-19999	45536
55	400056	CJLO	Cold junction calibration low coefficient	Low: -5.00 High: 40.00	-----	R/W	-19999	45536
56	400057	CJHI	Cold junction calibration high coefficient	Low: -1999 High: 1999	-----	R/W	-19999	45536
57	400058	V1L	V1 calibration low coefficient	Low: -1999 High: 1999	-----	R/W	-19999	45536
58	400059	V1G	V1 calibration high coefficient	Low: -1999 High: 1999	-----	R/W	-19999	45536
59	400060	MA1L	MA1 calibration low coefficient	Low: -1999 High: 1999	-----	R/W	-19999	45536
60	400061	MA1G	MA1 calibration high coefficient	Low: -1999 High: 1999	-----	R/W	-19999	45536
61	400062	CJCL	Sensor voltage during cold junction calibration low	Low: 0 High: 7552	-----	R	0	65535

Register Address	Modbus Address	Parameter Notation	Parameter Description	Range	Default Value	Data Access Type	Scale	
							Low	High
62	400063	CJCT	Cold Junction Temperature	Low: -4000 High: 9000	-----	R	-19999	45536
63	400064	T.ABN	Accumulated time during abnormal condition	Low: 0.0 High: 6553.5 Minutes	-----	R	0	65535
64	400065	PV	Current Process value	Low: -19999 High: 45536	-----	R	-19999	45536
65	400066	HSV1	Current High Limit Set point value	Low: SP1L High: SP1H	-----	R	-19999	45536
66	400067	LSV1	Current Low Limit Set point value	Low: SP1L High: SP1H	-----	R	-19999	45536
67	400068	PV.HI	Historical Maximum. Value of PV	Low: -19999 High: 45536	-----	R	-19999	45536
68	400069	PV.LO	Historical Minimum. Value of PV	Low: -19999 High: 45536	-----	R	-19999	45536
69	400070	EROR	Error code	Low: 0 High: 65535	-----	R	0	65535
70	400071	MODE	Operation mode & alarm status	See section: <a href="#">5.4 Operational Mode and Alarm Status</a>	-----	R	0	65535
71	400072	PROG	Program code	L42:45. XX L62:64. XX L22:26. XX	-----	R	0	65535
72	400073	CMND	Command code	Low: 0 High: 65535	-----	R/W	0	65535
73	400074	JOB1	Job code	Low: 0 High: 65535	-----	R/W	0	65535
74	400075	JOB2	Job code	Low: 0 High: 65535	-----	R/W	0	65535
75	400076	JOB3	Job code	Low: 0 High: 65535	-----	R/W	0	65535
76	400077	SEL1	1'st parameter for the user menu	<b>0 NoNE:</b> No Parameter <b>1 dISP:</b> DISP <b>2 o1HY:</b> O1HY <b>3 A1HY:</b> A1HY <b>4 A1SP:</b> A1SP <b>5 A2HY:</b> A2HY <b>6 A2SP:</b> A2SP <b>7 OFTL:</b> OFTL <b>8 OFTH:</b> OFTH <b>9 CALO:</b> CALO <b>10 CAHI:</b> CAHI <b>11 A3HY:</b> A3HY (Not Exists in L22) <b>12 A3SP:</b> A3SP (Not Exists in L22)	0	R/W	0	65535
77	400078	SEL2	2'nd parameter for the user menu	Same as SEL1	0	R/W	0	65535
78	400079	SEL3	3'rd parameter for the user menu	Same as SEL1	0	R/W	0	65535
79	400080	SEL4	4'th parameter for the user menu	Same as SEL1	0	R/W	0	65535
80	400081	SEL5	5'th parameter for the user menu	Same as SEL1	0	R/W	0	65535
81	400082							
82	400083							
83	400084							
84	400085							
85	400086	PASS	Password entry	Low: 0 High: 9999	0	R/W	-32768	32767
86	400087	KPAS	Calibration Password entry	Low: 0 High: 9999	0	R/W	-32768	32767

Register Address	Modbus Address	Parameter Notation	Parameter Description	Range	Default Value	Data Access Type	Scale	
							Low	High
87	400088	CODE	Security code for parameter protection	Low: 0 High: 9999  See section <a href="#">3.1 Security</a> for more details	0	R/W	-32768	32767
88	400089	KCOD	Security code for calibration protection	Low: 0 High: 9999  See section <a href="#">3.1 Security</a> for more details	0	R/W	-32768	32767
128	400129	PV	Current Process value	Low: -19999 High: 45536	-----	R	-19999	45536
129	400130	HSV1	Current High Limit Set point value	Low: SP1L High: SP1H	-----	R	-19999	45536
130	400131	LSV1	Current Low Limit Set point value	Low: SP1L High: SP1H	-----	R	-19999	45536
131	400132	T.ABN	Accumulated time during abnormal condition	Low: 0.0 High: 6553.5 Minutes	-----	R	0	65535
132	400133	MODE	Operation mode & alarm status	See section: <a href="#">5.4 Operational Mode and Alarm Status</a>	-----	R	0	65535
133	400134	PWRU	Power-Up Logic	<b>0 NoRM</b> :Normal <b>1 RST</b> : Reset <b>2 NoRL</b> : Normal Latch	0	R/W	0	65535
134	400135							
135	400136							
136	400137							
137	400138							
138	400139							
139	400140	EROR	Error code	Low: 0 High: 65535	-----	R	0	65535
140	400141	PROG	Program code	<b>L42:45</b> . XX <b>L62:64</b> . XX <b>L22:26</b> . XX	-----	R	0	65535
141	400142							
142	400143	CMND	Command code	Low: 0 High: 65535	-----	R/W	0	65535
143	400144	JOB1	Job code	Low: 0 High: 65535	-----	R/W	0	65535

## 2 Installation and Wiring

Before beginning installation, it is recommended to completely read through this section to gain an understanding of the entire installation process. Consider the installation carefully. Plan for proper routing of the power, signal and control wiring before installing the process limit control. Also consider the cabinet space, hardware dimensions, environmental conditions and utilize good wiring practices to minimize problems that may occur due to electrical interference.



Dangerous voltages with the potential to cause serious injury and/or death may be present within the instrument. Before performing any installation or troubleshooting procedures, the power to the equipment must be switched off and isolated.



Prevent metal fragments and pieces of wire from dropping inside the housing of the instrument. If necessary, place a cover over the unit during installation and wiring. Ingress of such fragments and chips may result in a fire hazard, cause damage to or result in malfunction of the instrument.

### 2.1 Enclosure Guidelines

The process limit control is designed for installation within a suitable enclosure. Care must be taken when locating components to ensure that AC power wiring, contactors, starters, relays and other sources of electrical interference are properly located to minimize their impact on the instrument. Particular note should be taken to the position of variable speed drives and switching power supplies. Their input and load cables should be screened and properly grounded to a central equipment grounding point to prevent radiated emissions from affecting instrument operation.

The limit controller is designed for indoor use only and should not be installed where fast temperature variations may occur as this can cause condensation of water vapor on the instrument. DO NOT install the instrument in hazardous locations in which it will be exposed to excessive shock, vibration, dirt, moisture, corrosive gases, oils or solvents.

Environmental Parameter	Specification
Operating Temperature	-10°C to 50 °C
Humidity	0% to 90% RH (non-condensing)
Altitude	2000 M Maximum

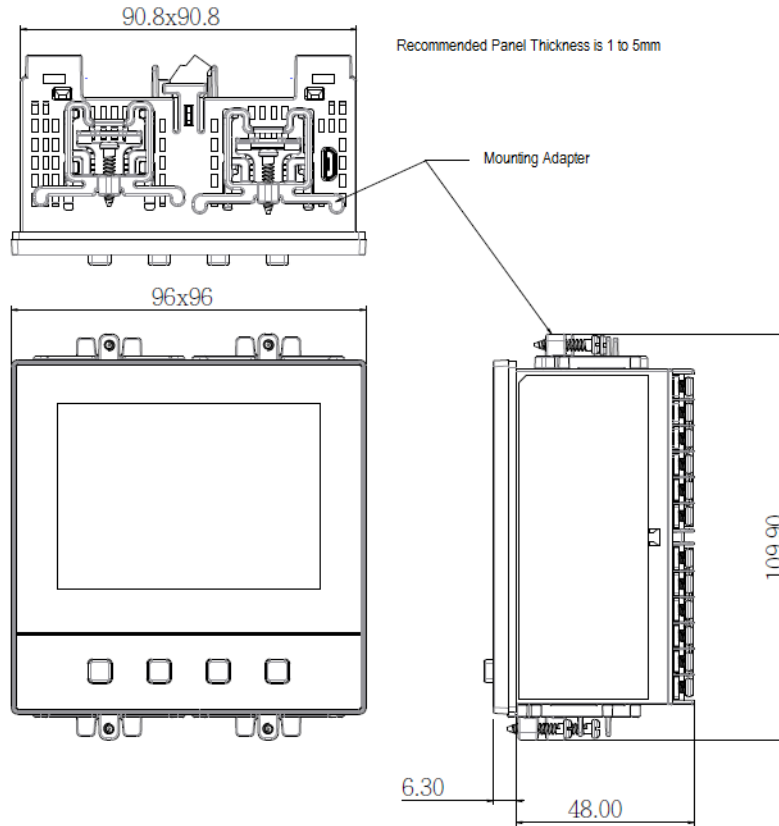
### 2.2 Mounting

Make the panel cut out as per the dimensions required by the specific model of process limit control (L42 or L62). Proper enclosure depth is required to ensure that there is adequate spacing between the rear of the unit and the front of any high voltage devices mounted in the enclosure when the enclosure door is closed. It is required that a minimum separation of 2" be maintained for proper wiring clearance, so plan a depth to accommodate at least 4" (102mm) behind the front of the panel.

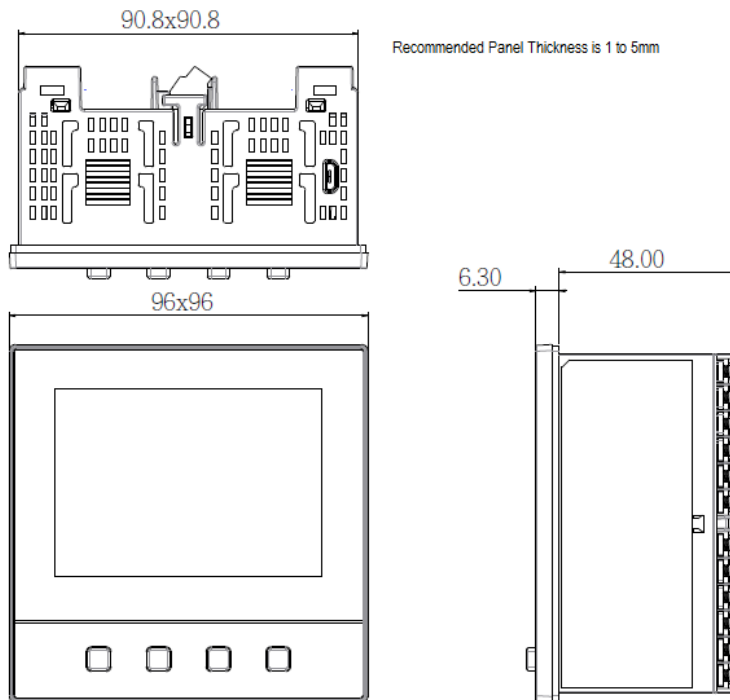
The L62 is supplied with four mounting clips. The L42 is equipped with a single mounting bracket. To install the limit control, first remove the mounting bracket and then insert it into the panel cutout. After inserting the limit control into the panel cut out, re-install the mounting bracket. Gently tighten the clamp screws until the limit control is properly secured into the cutout.



**2.2.1 L42 Dimensions**

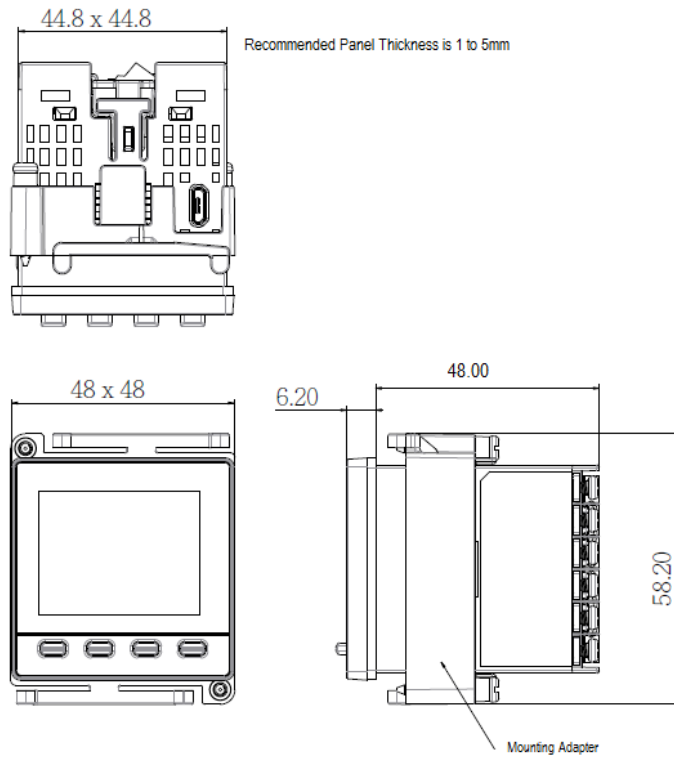


***Dimension with Clamps***

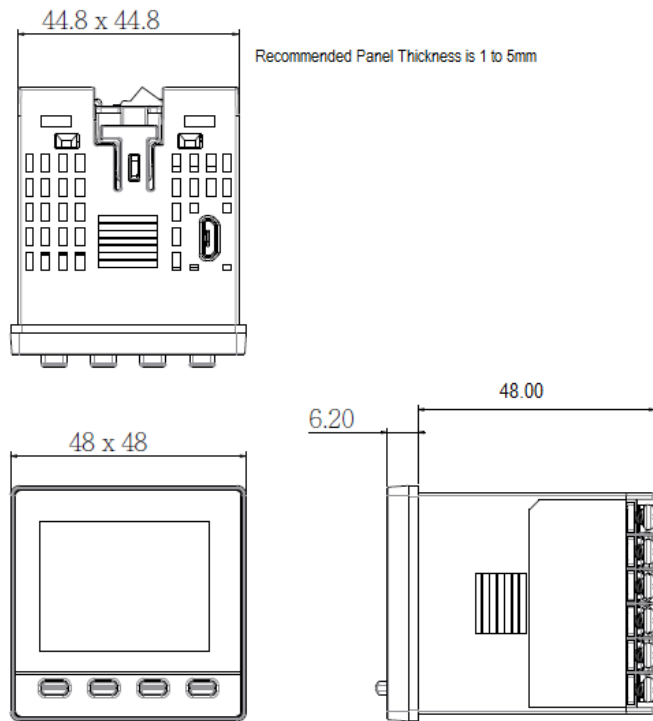


***Dimension without Clamps***

**2.2.2 L62 Dimensions**

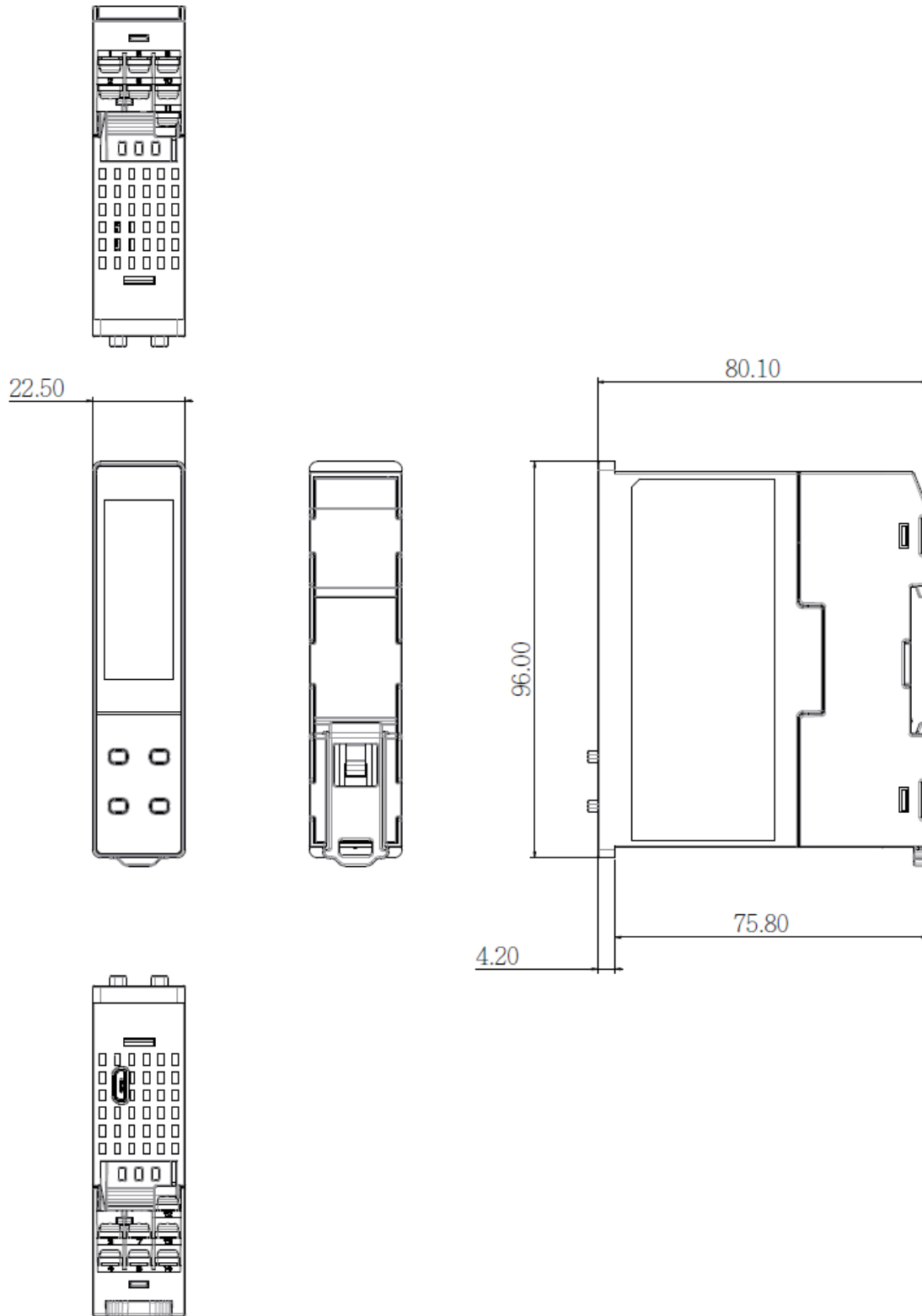


***Dimension with clamp***



***Dimension without Clamp***

### 2.2.3 L22 Dimensions

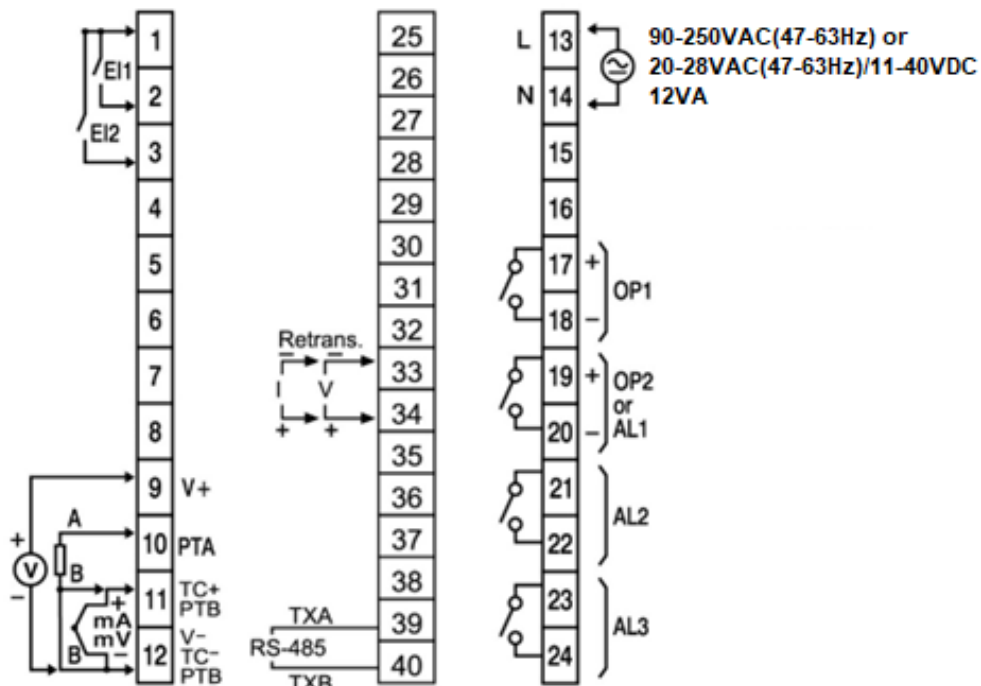


### 2.3 Wiring Precautions

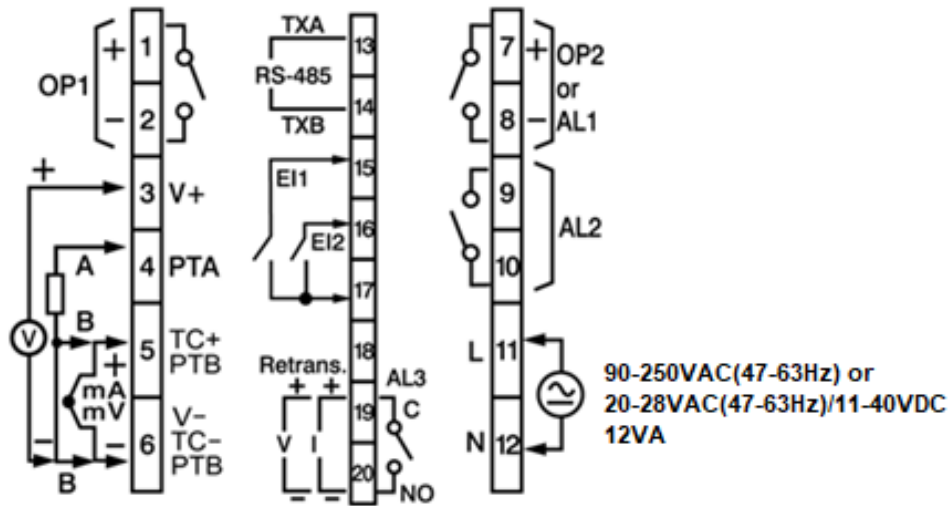
- Prior to wiring, check the product label for the correct model number and options.
- To avoid potential electric shock and other hazards, all mounting and wiring must conform to the National Electric Code (NEC) and/or all other locally applicable codes.
- Power supply wiring must be protected by fuse or circuit breakers rated at the lowest value possible.
- Unused control terminals should not be used as jumper points as they may be internally connected, causing damage to the unit.
- DO NOT exceed the maximum voltage rating specified on the label.
- DO NOT over-tighten terminals. Maximum torque not to exceed 1N-m (8.9 Lb-in or 10.2 Kg F-cm).
- All wiring, except thermocouple input, should use copper conductors with a maximum of 18 AWG.



#### 2.3.1 L42 Terminal Connections

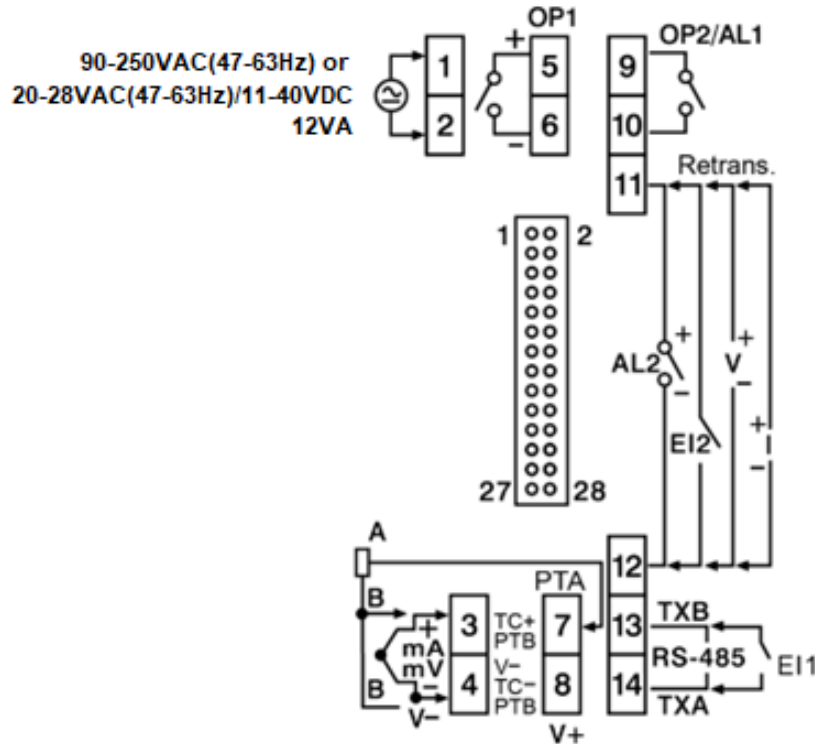


### 2.3.2 L62 Terminal Connections



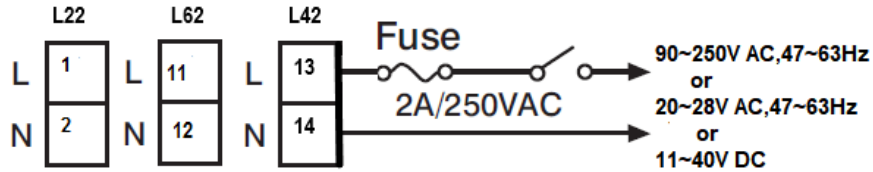
**Note:** Terminals 13 to 20 except a single solid or stranded conductor (with ferrule) only. They do not accept fork terminals.

### 2.3.3 L22 Terminal Connections



## 2.4 Power Wiring

The process limit control is designed to operate at either 11-40VDC/20-28VAC or 90-250VAC depending on the power input option ordered. Check that the installation voltage corresponds with the power rating indicated on the product label before connecting power to the limit control. A fuse rated at a maximum of 2A/250VAC should be equipped as shown in the following diagram.



## 2.5 Sensor Installation

Proper sensor installation can eliminate many problems in a control system. The probe should be placed so that it can detect any process change with minimal lag. In a process that requires fairly constant heat output for example, the probe should be placed close to the heating element. In a process where the heat demand is variable, the probe should be placed closer to the work area. Some experimentation with probe location may be required in order to find the optimum position.

In a liquid process, the addition of a mixer or agitator can help to eliminate lag. Since a thermocouple is a point measuring device, placing more than one thermocouple in parallel can provide an average temperature measurement over a large area. This can produce better results in most air heated processes.

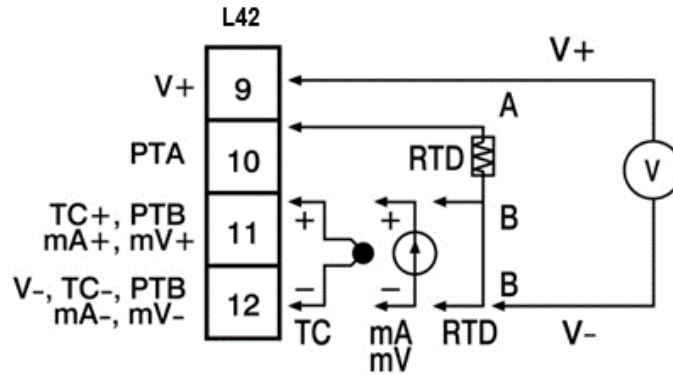
The proper sensor type is also a very important factor in obtaining precise measurements. The sensor must have the correct temperature range to meet the process requirements. Depending upon the application, the sensor may have different requirements such as being leak-proof, vibration resistant, antiseptic, etc.

Standard sensor limits of error for thermocouples are  $\pm 4^{\circ}\text{F}$  ( $\pm 2^{\circ}\text{C}$ ) or 0.75% of sensed temperature (half that for special limits of error), plus drift caused by improper protection or an over-temperature occurrence. This error is far greater than limit control error and cannot be corrected on the sensor except by proper selection and replacement.

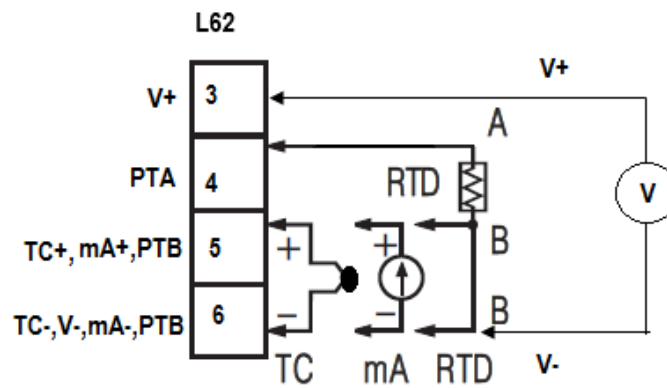
**Note:** *In order for the process limit control to perform its intended function, i.e., protect the process from a low and/or high limit excursion, sensor selection and placement is crucial. The limit control cannot properly protect the system if it is not installed correctly.*

### 2.5.1 Sensor Input Wiring

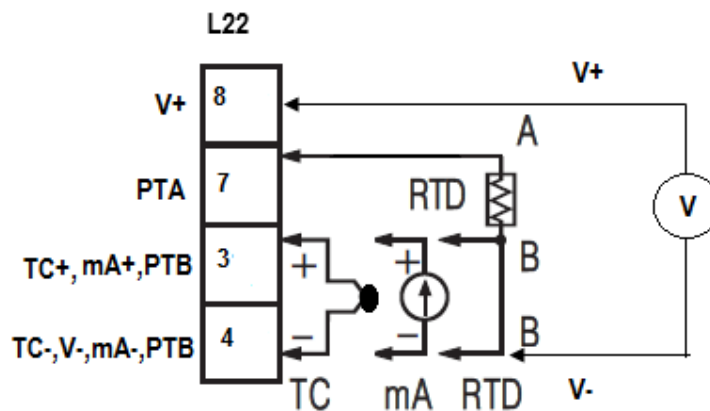
The process limit control features a universal input. When connecting the sensor, be sure to wire to the appropriate terminals according to the sensor type used. Once the sensor is connected, the limit control must then be programmed to utilize the connected sensor type. See section [3.2 Input Settings](#).



*L42 Sensor Input Wiring*



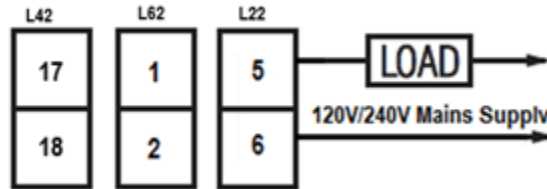
*L62 Sensor Input Wiring*



*L22 Sensor Input Wiring*

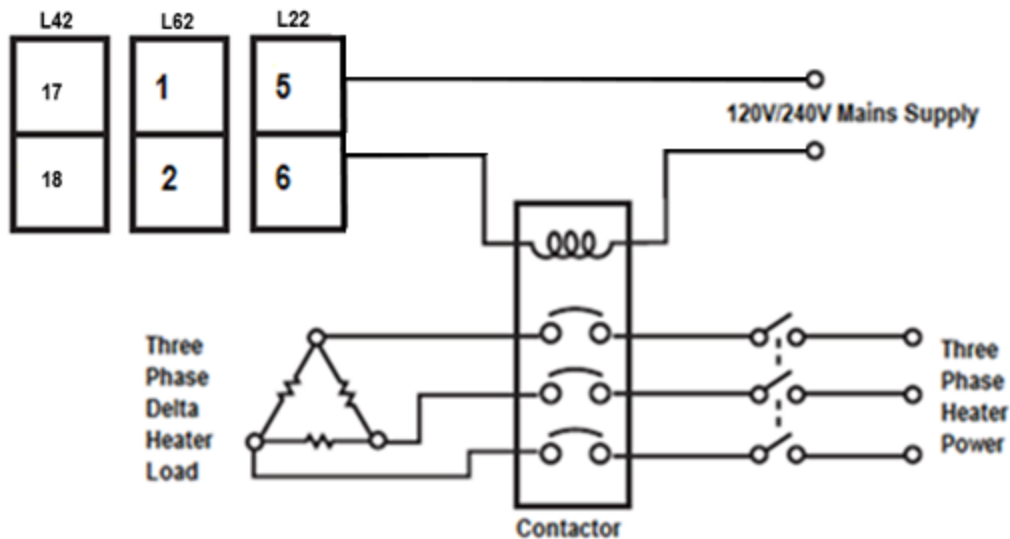
## 2.6 Limit Control Output Wiring

The limit control output is provided by output 1. During normal operation, the output will be energized. When in a low or high limit condition, the output will be de-energized. The output can be either a relay contact rated at 240VAC and 2A max resistive, or a sourced voltage output that can be used to directly drive the input of an SSR (solid-state relay).



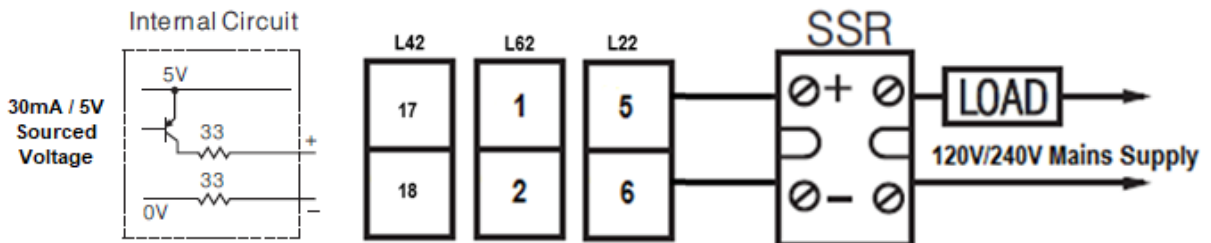
*Output 1 Relay to Drive Load*

Typically, the standard relay output of the limit control is utilized to provide power to the coil of a contactor or other high-power device that is used to interrupt power (to a heater for example) disabling the system in a low or high limit condition.



*Output 1 Relay to Drive Contactor*

The sourced voltage output option can be used for TTL level circuits or to power low voltage relays or SSR's. Note that solid state relays cannot typically be used in a safety circuit as these devices tend to fail closed. Thus, if they fail, they cannot interrupt power to the load to turn it off in a limit condition.



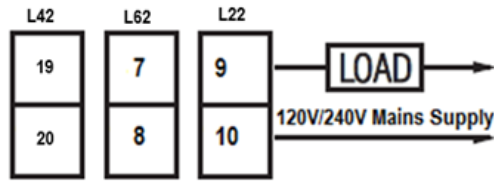


## 2.7 Alarm Wiring

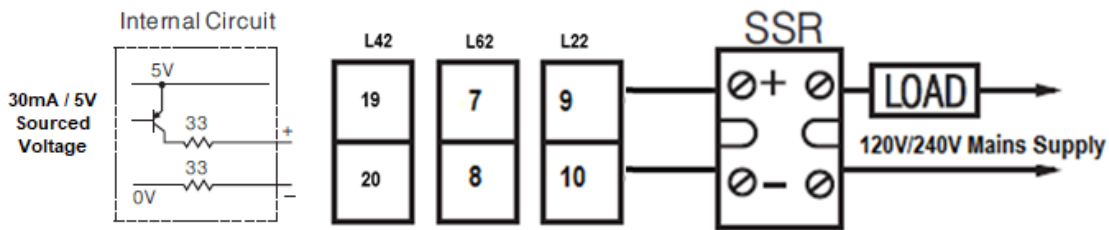
Depending upon the limit control model, it has the option for up to three additional alarm outputs. These outputs act as either process low or process high alarms with set points independent of the main limit low/high set points. See section [3.5 Alarm Settings](#) for information on configuring the alarms outputs for operation.

### 2.7.1 Alarm 1 (Output 2)

Output 2 can function either as a limit alarm annunciator or as an alarm output. See section [3.4 Alarm Settings](#) on how to configure output 2 for operation.

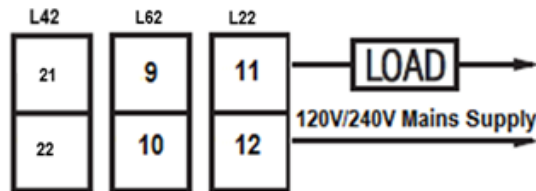


*Alarm 1 Relay Output to Drive Load*



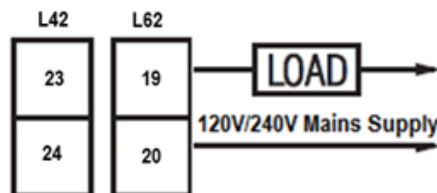
*Alarm 1 Sourced Voltage Output to Drive Load*

### 2.7.2 Alarm 2



*Alarm 2 Output to Drive Load*

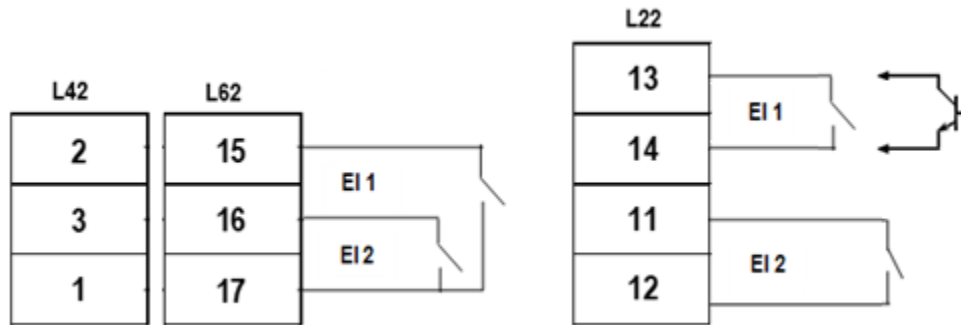
### 2.7.3 Alarm 3



*Alarm 3 Output to Drive Load*

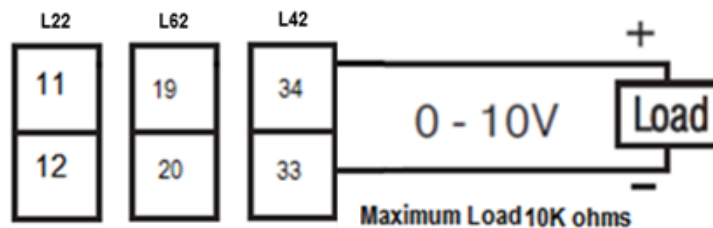
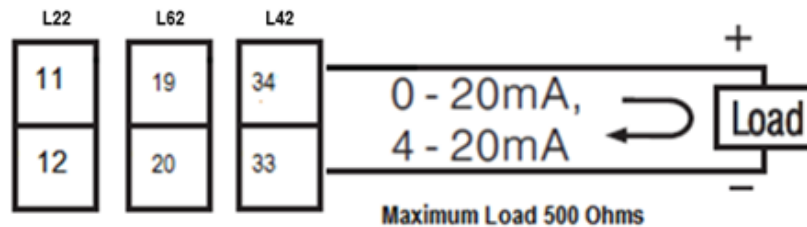
## 2.8 Event Input Wiring

The event input can accept a relay or switch (dry contact) or a TTL level or open collector (pull down) signal. The event input function (EIFN) is activated as the switch is closed or an open collector (or a logic signal) is pulled down. See section [3.11 Event Input Settings](#) for information on how to configure the event input(s) for use.



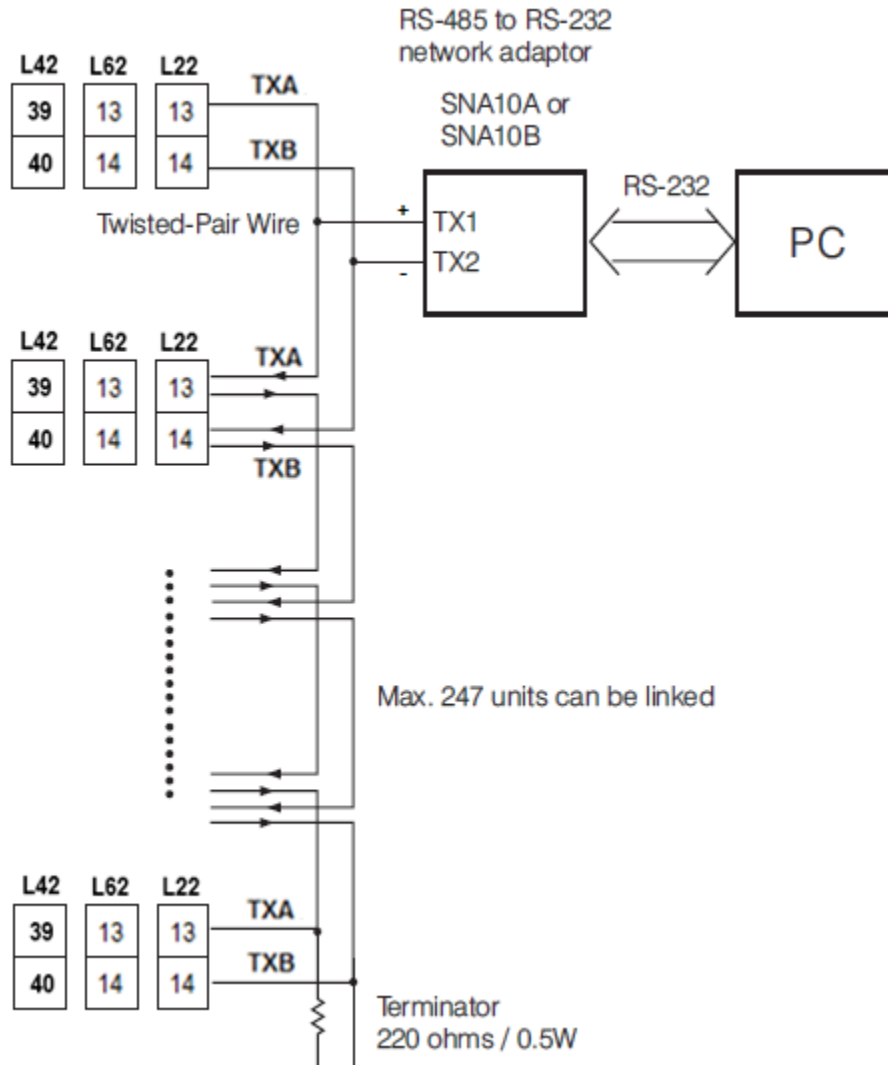
## 2.9 Retransmission Wiring

The retransmit output option allows the process limit control to provide a linear voltage or current output to transmit the current process value, low limit set point value or high limit set point value. See section [3.10 Retransmit Settings](#) for information on how to configure the serial communication interface for use.



## 2.10 RS-485 Serial Communication Wiring

The process limit control offers an RS485 serial communication option. This provides a means for remote monitoring/control from a PC running third-party software or other device capable of RS485 serial communications utilizing Modbus RTU protocol. See section [3.9 Communication Settings](#) for information on how to configure the serial communication interface for use.



### 3 Configuration

To configure the process limit control, you must enter the setup menu. To do so, press and hold the scroll key for ~5 seconds until the upper display shows “SET” and then immediately release the key. Use the up or down key to select the desired setup menu group (shown in the lower display). When the desired setup menu group is shown, repeatedly press and release the scroll key to cycle through all of the available parameters. The upper display will show the parameter notation, and the lower display will indicate the value of the selected parameter. Pressing the up or down key on the chosen parameter will adjust its value.

#### 3.1 Security

There are two parameters PASS (password) and CODE (security code) which control access to the limit configuration parameters. The default CODE value is 0, which disables security. This allows all parameters to be changed regardless of the password (PASS) value. There are three pre-defined security code values (500, 1000 and 9999) which limit access to specific parameters.

CODE Value	PASS Value	Access Rights
0	Any Value	All parameters are changeable
500	=500	All parameters are changeable
	≠500	All parameters are changeable except calibration parameters
1000	=1000	All parameters are changeable
	≠1000	User menu parameters only changeable
9999	=9999	All parameters are changeable
	≠9999	HSP1 to HSP3 & LSP1 to LSP3 only changeable
Others	=CODE	All parameters are changeable
	≠CODE	No parameters can be changed

The user can also set their own security code value which is listed as “Others” in the table above. Any user defined security code will lock out all parameters. In order to modify any of the configuration parameters, the password (PASS) value must be set to match the user defined security code.

The CODE parameter is located under the [Basic Menu](#) while the PASS value is entered under the [User Access Menu](#). When a parameter is locked, the LOCK indicator will be displayed on the front panel. In the case of a CODE value of 500 for example, only the calibration values are protected. Thus, when viewing non-calibration values, the LOCK indicator will not be shown. However, when the calibration parameters are viewed under the calibration menu, if the password (PASS) is not set to 500, the LOCK indicator will be displayed indicating that the calibration values are password protected and cannot be changed.

**Notes:** For CODE parameter values other than 0 and 500, the CODE parameter will not be accessible under the basic menu unless the password value (PASS) is set to the CODE value.

*When security is enabled (CODE value other than 0), the limit control will be automatically locked (logout) after an idle period of one minute or when power is removed. In order to modify any of the limit parameters, the user will have to set PASS=CODE to login again.*

*If the Remote Lock function is activated by an event input, the remote lock must be released in order to access the limit control parameters. If the LOCK indicator on the front panel of the limit control remains illuminated after the PASS value is set to match the CODE value, deactivate the remote lock event input.*

*In order to use the remote lock function of an event input, the password value must be set to a value other than 0. The remote lock function will not work when security is disabled (PASS = 0). See section [3.11 Event Input Settings](#).*

### 3.1.1 Calibration Security

The calibration of the limit control is protected with separate security access. There are two parameters, KPAS (calibration password) and KCOD (calibration security code) which control access to the calibration parameters. In order to enter the calibration menu, the calibration password must be set to match the calibration code. The default KCOD value is 0; however, unlike the security code, a KCOD value of 0 does not disable calibration security.

KCOD Value	KPAS Value	Access Rights
KCOD	=KCOD	Calibration parameters are accessible
	≠KCOD	Calibration parameters cannot be accessed

All KCOD values are active, so in order to access the calibration parameters, KPAS must always be set to match KCOD. If the values do not match, pressing the scroll key for 2 to 3 seconds and releasing will not allow entry into the [Calibration Menu](#) to access the calibration parameters. The upper display will continue to show CALL and not display the calibration parameters.

**Note:** Calibration security operates in conjunction with security. If security is enabled (CODE ≠ 0) and the security code value protects the calibration parameters, both the security password (PASS) and calibration password (KPAS) must be set to the respective CODE and KCOD values in order to adjust calibration parameters. If either password is not correct, the calibration parameters will be locked or unable to be accessed.

### 3.2 Input Settings

The input parameters are located under the [Basic Menu](#). They are used to define the input type, measurement units, decimal resolution and input range for the connected sensor type.

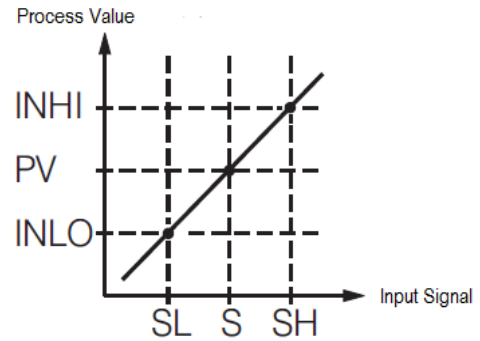
- INPt** Defines the sensor type or signal type for the signal input. Selections include:  
 Thermocouple: J\_tC, K\_tC, T\_tC, E\_tC, B\_tC, R\_tC, S\_tC, N\_tC, L\_tC, U\_tC, P\_tC, C\_tC, d\_tC  
 RTD: PT.DN, PT.JS  
 Linear: 4-20mA, 0-20mA, 0-5V, 1-5V, 0-10V, 0-50mV
- UNIt** Defines the engineering units for the input. Selections include °C or °F for temperature input types, (thermocouple and RTD) and PU (process unit) for non-temperature input types (linear voltage and current).
- dP** Defines the resolution of the process value. For temperature input types (thermocouple and RTD) the decimal resolution can be set for 0 (No.dP) or 1 (1-dP). For linear voltage and current inputs, the decimal resolution can be set for 0 (No.dP), 1 (1-dP), 2 (2-dP) or 3 (3-dP).
- FILt** Defines the time constant for the input filter. See section [3.2.1 Digital Filter](#).

The following parameters are also provided to allow the user to apply an offset to the measured process value in order to correct for error introduced by lead length or sensor drift. See section [3.2.2 User Calibration \(PV Offset\)](#) for more information.

- oFtL** User calibration constant for process value offset low.
- oFtH** User calibration constant for process value offset high.
- CALo** User calibration constant for sensor input offset low.
- CAHI** User calibration constant for sensor input offset high.

When a linear input type is specified, two additional parameters will be shown in the Basic Menu. These are **INLo** and **INHI** which are used to define the low and high scale values for the input signal.

For example, if 4-20mA is selected for the input type, let *SL* represent the low scale of the input signal (i.e. 4 mA) and let *SH* represent the high scale of the input signal (i.e. 20 mA). If *S* represents the current input signal value, the conversion curve of the process value is as follows:



Formula:  $PV = INLo + (INHI - INLo) \left( \frac{S - SL}{SH - SL} \right)$

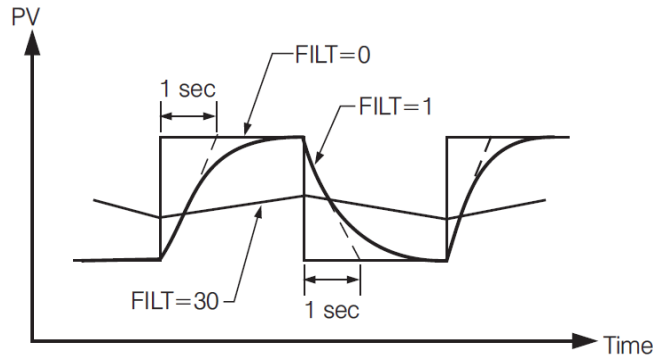
Example: 4-20mA pressure transducer with a range of 0-15 psia is connected to the input. Input settings are INPt = 4-20, UNIt = PU, INLo = 0.00, INHI = 15.00 and dP = 2-dP.

If the input signal is 7.3 mA, according to the formula the process value will be:

$$PV = 0.00 + (15.00 - 0.00) \left( \frac{7.3 - 4.0}{20.0 - 4.0} \right) = 3.09 \text{ psia}$$

### 3.2.1 Digital Filter

In certain applications, the process value may be too unstable to be easily read. To improve this, a programmable low pass filter is incorporated in the limit control. This is a first-order filter with a time constant specified by the input filter parameter (**FILT**). A value of 0.5 seconds is the default setting. The time constant provides selections ranging from 0 to 60 seconds. When the filter parameter is set for 0, no filter is applied to the input signal. The filter is characterized by the following diagram.



**Note:** The filter is applied to the process value (PV) and is for the displayed value only. For all limit and alarm functions, the unfiltered value is used. If the filtered value were used, it could lag far behind the actual process (for time constants of 30 or 60 seconds for example) resulting in a long delay for the limit or alarm function to occur resulting in damage to product and/or equipment.

If the limit or an alarm is activating and it appears that the process value (PV) has not reached the limit/alarm set point, check the filter parameter as the displayed value may be lagging behind due to a longer time constant being used to filter the value. It is recommended to use the shortest time constant possible to minimize the chance that the user may inadvertently think something is not functioning correctly or a set point is incorrect when it is just the lag in the displayed value due to the input filter.

### 3.2.2 User Calibration (PV Offset)

Each unit is calibrated at the factory before shipment. This calibration is highly stable and does not require frequent adjustment. To perform an actual input calibration, special equipment and procedures are required in order to maintain proper input accuracy (see section [4 Calibration](#)). However, the user calibration allows the user to offset the factory calibration without altering the factory calibration constants to:

- Calibrate the limit controller to meet a user reference standard.
- Match the calibration of the limit control to that of a particular transducer or sensor.
- Calibrate the limit control to suit the characteristics of a particular installation.
- Remove long term drift in the factory set calibration.

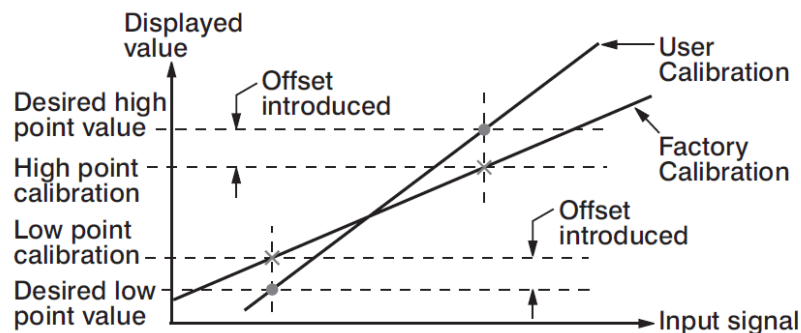
There are two parameters called offset low (**oFtL**) and offset high (**oFtH**) for applying an offset to correct for an error in the process value. There are also two parameters for the sensor input range. These two signal values are **CALo** and **CAHi**. They are used to specify the operating range for which the offset values are applicable to.

For example: the limit control is programmed with a T-type thermocouple input for measuring temperature between the range of -250°C and 400°C. However, the process will only be operating between the range of -50°C and 250°C. The temperature between -50 and 250 has a non-linear error and the desire is to make it as accurate as possible. To do this, the user calibration offset can be applied.

To begin, set the CALo parameter to -50 and the CALH parameter to 250. Next, connect an input signal with the low scale operating temperature (-50°C). Monitor the process value and compare it to the desired value of -50. If the PV is not equal to CALo, adjust the oFtL parameter so that PV is equal to CALo.

Next, apply an input signal with high scale operating temperature (250°C). Monitor the process value and compare it to the desired value of 250. If the PV is not equal to CAHi, adjust the oFtH parameter so that PV is equal to CALH.

As shown in the diagram below, the two points oFtL and oFtH construct a straight line. For accuracy, it is best to calibrate with the two points as far apart as possible.



**Note:** After a user calibration offset is applied (either oFtL or oFtH or both not equal to 0), the selected input type will be stored in memory. If the input type is changed, a calibration error will occur and an error code CAEr will be displayed. To clear the error, both oFtL and oFtH must be set to 0.

### 3.3 Limit (Output 1) Settings

The limit output parameters are located under the [Output Menu](#). They are used to set the mode of operation for the output as well as define the limit set point range and dead band of when the output can be reset.

**oUt1** Defines the mode of operation for the limit control output. Selections include high limit control (**HI**), low limit control (**Lo**) and high/low limit control (**HI.Lo**).

**HI** When selected, the unit will perform high limit control. When power is first applied the output 1 relay is de-energized. After the power-on test completes (~6.5 seconds), if the process value is below the high limit set point (HSP1), the output relay will be energized and the OUT1 indicator will be off. If the process goes above the high limit set point, the relay will be de-energized and the OUT1 indicator will turn on.

**Lo** When selected, the unit will perform low limit control. When power is first applied the output 1 relay is de-energized. After the power-on test completes (~6.5 seconds), if the process value is above the low limit set point (LSP1), the output relay will be energized and the OUT1 indicator will be off. If the process goes below the low limit set point, the relay will be de-energized and the OUT1 indicator will turn on.

**HI.Lo** When selected, the unit will perform high/low limit control. When power is first applied the output 1 relay is de-energized. After the power-on test completes (~6.5 seconds), if the process value is below the high limit set point (HSP1) and above the low limit set point (LSP1), the output relay will be energized and the OUT1 indicator will be off. If the process goes above the high limit set point or below the low limit set point, the relay will be de-energized and the OUT1 indicator will turn on.

Once a limit set point has been exceeded, in order for the output to be re-energized, the process value must fall below the high limit set point and/or rise above the low limit set point and the reset button must be manually pressed or remote reset input activated. The output relay will then energize and OUT1 indicator will turn off.

**o1HY** Defines the output 1 hysteresis value. The hysteresis is safe-sided, i.e., the process value must fall below the high limit set point or rise above the low limit set point by the hysteresis value in order for the limit output to be reset.

**HSP.L** Defines the lower limit of the high limit set point HSP1. This is the lowest value that the user can adjust the high limit set point to. The parameter is hidden if Lo is selected for oUT1.

**HSP.H** Defines the upper limit of the high limit set point HSP1. This is the highest value that the user can adjust the high limit set point to. The parameter is hidden if Lo is selected for oUT1.

**LSP.L** Defines the lower limit of the low limit set point LSP1. This is the lowest value that the user can adjust the low limit set point to. The parameter is hidden if HI is selected for oUT1.

**LSP.H** Defines the upper limit of the low limit set point LSP1. This is the highest value that the user can adjust the low limit set point to. The parameter is hidden if HI is selected for oUT1.



### 3.4 Output 2 (Limit Annunciator/Alarm)

The output 2 function parameter (**oUt2**) is located under the [Output Menu](#). This is used to set the mode of operation for the output.

**NoNE** The output does not perform any function and remains off.

**dCPS** This mode of operation is selected when output 2 is equipped with the DC power supply option only. If the limit control is not equipped with the DC power supply option in output 2 and this mode is selected, the output will not perform any function and will remain off.

**AL1** When selected, the output will perform the alarm 1 function as defined under the alarm settings menu. See section [3.5 Alarm Settings](#).

**L\_AN** When selected, the output will perform the limit annunciator function. This will energize output 2 and turn on the OUT2 indicator on the front panel when a high or low limit condition has been reached. The output will remain energized and the OUT2 indicator illuminated until the reset key is pressed or remote reset input is activated.

### 3.5 Alarm Settings

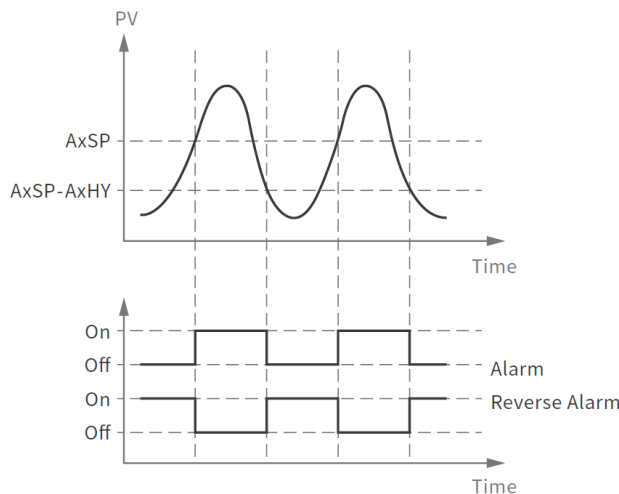
The limit control can provide up to three alarm outputs (in addition to the primary limit output) depending on the limit control model. All alarm parameters are located under the [Alarm Menu](#). They are used to set the type of alarm, modes of operation and respective set points.

**Note:** For the following parameters, **X** represents 1, 2 or 3 referring to the parameter for alarm 1, alarm 2 or alarm 3. The availability of the parameters under the alarm menu for each alarm is dependent upon the model, installed options and configuration of the limit control.

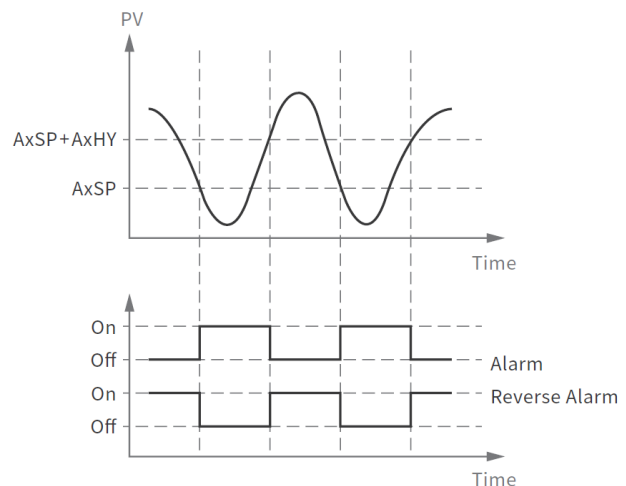
**AX.FN** Defines the type of alarm. Selections include process value high alarm (PV.HI) and process value low alarm (PV.Lo).

**PV.HI** When selected, the alarm will trigger when the process value is higher than  $Ax.SP$ . The alarm is off when the process value is lower than  $Ax.SP - Ax.HY$ .

**PV.Lo** When selected, the alarm will trigger when the process value is less than  $Ax.SP$ . The alarm is off when the process value is greater than  $Ax.SP + Ax.HY$ .



**Process Value High (PV.HI)**



**Process Value Low (PV.Lo)**

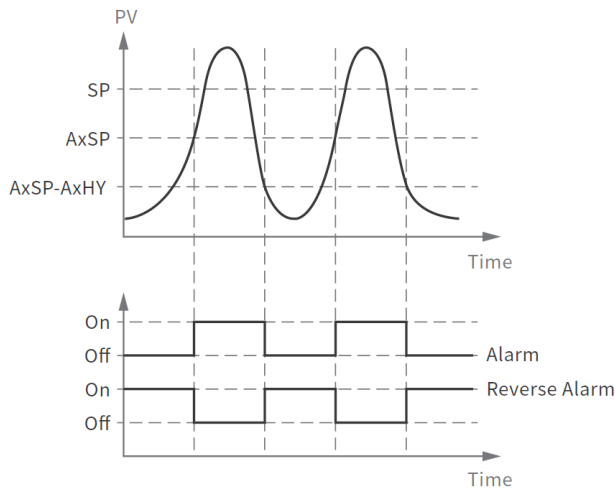
**AX.Md** Defines the mode of operation of the alarm. Selections include normal (NoRM), latching (LtCH), normal reverse (NoRR) and latching reverse (LtCR).

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

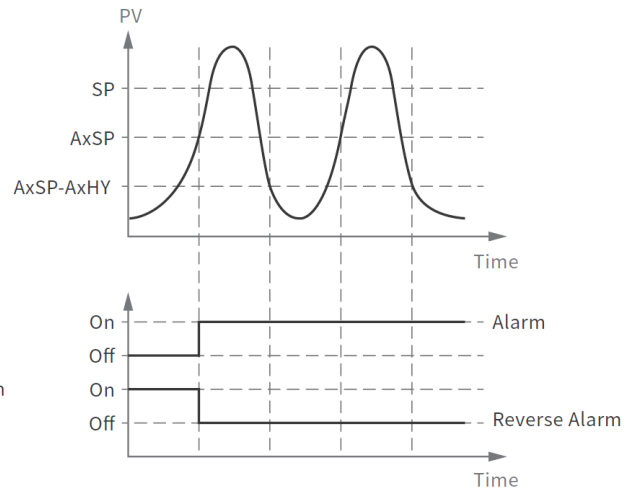
**LtCH** When latching is selected, once the alarm output is energized, it will remain energized even if the alarm condition is cleared. The alarm output can be de-energized by pressing the reset key or activating the remote reset input once the alarm condition is removed.

**NoRR** When normal alarm reverse output is selected, once the alarm output is energized in the non-alarm condition and de-energized in an alarm condition.

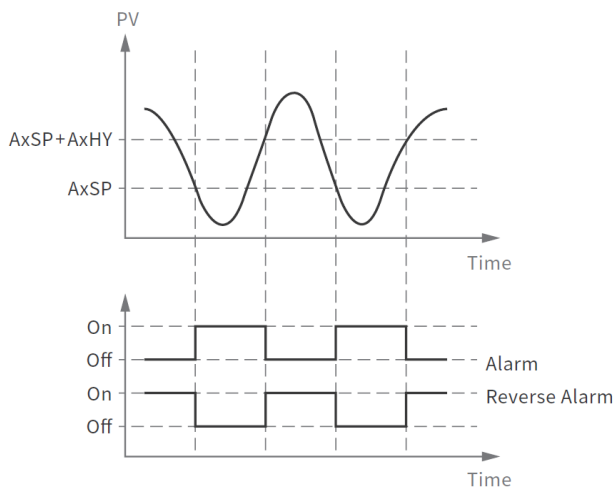
**LtCR** When latching alarm reverse output is selected, once the alarm output is de-energized (in an alarm condition) it will remain de-energized even if the alarm condition is cleared. The alarm output can be energized by pressing the reset key or activating the remote reset input once the alarm condition is removed.



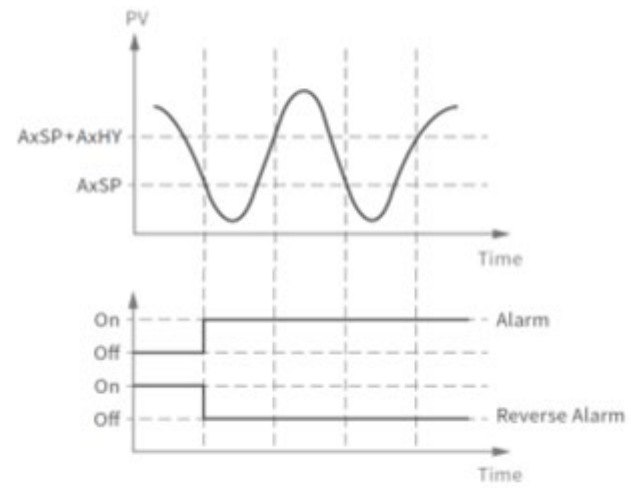
**Process Value High-Normal Alarm**



**Process Value High-Latching Alarm**



**Process Value Low-Normal Alarm**



**Process Value Low-Latching Alarm**

**AX.HY** Defines the alarm hysteresis value. The hysteresis is safe-sided, i.e., the process value must fall below the alarm set point when acting as a high alarm or rise above the alarm set point when acting as a low alarm.

**AX.Ft** Defines the output state of the alarm when failure transfer is activated. The selections are **oN** or **oFF**. The unit will enter failure mode if a sensor break occurs or if the A-D converter fails.

**AX.SP** Defines the alarm set point value. When the set point is exceeded, the alarm will activate.

### 3.6 User Select Menu Settings

Conventional limit controls are designed with parameters in a fixed order. If the user desires more convenient menu operation to suit their application, most conventional limit controls do not offer a solution. The new L-Series of limit controls have the flexibility to allow the user to select specific parameters that the user accesses most and put these parameters into the readily accessed user menu.

The user menu select parameters are accessed under the [User Select Menu](#). There are five user configurable menu selections (**SEL1 – SEL5**). Each of these parameters allows the user to select one of up to eight of the following parameters to be placed into the user menu.

- **NoNE** When selected, no additional parameter will be added to the user menu.
- **dISP** Adds the display mode parameter (see section [3.7 Display Mode](#)).
- **o1HY** Adds the limit output 1 hysteresis parameter (see section [3.5 Alarm Settings](#)).
- **A1.HY** Adds the alarm 1 hysteresis parameter (see section [3.5 Alarm Settings](#)).
- **A1.SP** Adds the alarm 1 set point parameter (see section [3.5 Alarm Settings](#)).
- **A2.HY** Adds the alarm 2 hysteresis parameter (see section [3.5 Alarm Settings](#)).
- **A2.SP** Adds the alarm 2 set point parameter (see section [3.5 Alarm Settings](#)).
- **oFtL** Adds the input offset low parameter (see section [3.2 Input Settings](#)).
- **oFtH** Adds the input offset high parameter (see section [3.2 Input Settings](#)).
- **CALo** Adds the input calibration low parameter (see section [3.2 Input Settings](#)).
- **CAHI** Adds the input calibration high parameter (see section [3.2 Input Settings](#)).
- **A3.HY** Adds the alarm 3 hysteresis parameter (see section [3.5 Alarm Settings](#)).
- **A3.SP** Adds the alarm 3 set point parameter (see section [3.5 Alarm Settings](#)).

**Note:** *Not all of the parameters listed above may be available depending upon the model and other configuration settings of the limit control. Parameters for alarm 3 for example, are only available on the L42 and L62 if the alarm 3 option is installed.*

### 3.7 Display Mode

The display mode parameter (**dISP**) is located under the [Basic Menu](#). It is used to configure what value is to be shown in the lower display of the limit control during normal operation. Selections include safe (SAFE), high limit set point 1 (HSP1) and low limit set point 1 (LSP1).

**SAFE** When selected, the lower display of the limit control will display the word SAFE when a limit condition is not present. When the process value exceeds the high or low limit set point, lower display will show the value of the limit set point that has been exceeded.

**HSP1** When selected, regardless of the limit condition, the lower display will show the current high limit set point value.

**LSP1** When selected, regardless of the limit condition, the lower display will show the current low limit set point value.

### 3.8 Power Up Mode

The power up mode parameter (**PWRU**) is located under the [Basic Menu](#). It allows the user to define what actions the limit control output 1 and annunciator output 2 should take when power is first applied. Selections include normal (NoRM), reset (RSt) and normal latch (NoR.L). The following table describes the operation of each mode and provides example cases detailing output operation of each mode.

Limit Configuration for Example Cases			
INPt	K_tC	E1.FN	R.RSt (remote reset)
oUt1	HI.Lo (high and low limit)	o1HY	1
HSP1	250	LSP1	-50
oUt2	L_AN (limit annunciator)		

PWRU	Example Case	Relay		LED Indicator	
		OUT1	OUT2	OUT1	OUT2
<b>NoRM</b>	Normal is the default setting. When selected, after power down, the limit control will return to normal operation when power is reapplied in the same state as before power was removed unless a limit is exceeded.				
Normal	PV < 250 and PV > -50	ON	OFF	OFF	OFF
	PV > 250 or PV < -50	OFF	ON	ON	ON
	PV > 250 or PV < -50 Reset Applied	OFF	OFF	ON	OFF
	PV < 249 and PV > -49 Reset Applied	ON	OFF	OFF	OFF
	Before Power Off PV > 250 or PV < -50	OFF	ON	ON	ON
	After Power On PV > 250 or PV < -50	OFF	ON	ON	ON
	PV > 250 or PV < -50 Reset Applied	OFF	OFF	ON	OFF
	After Power On PV < 249 and PV > -49	ON	OFF	OFF	OFF
	PV < 249 and PV > -49 Reset Applied	ON	OFF	OFF	OFF
	Before Power Off PV < 250 and PV > -50	ON	OFF	OFF	OFF
	After Power On PV > 250 or PV < -50	OFF	ON	ON	ON
	PV > 250 or PV < -50 Reset Applied	OFF	OFF	ON	OFF
	After Power On PV < 249 and PV > -49	ON	OFF	OFF	OFF
	PV < 249 and PV > -49 Reset Applied	ON	OFF	OFF	OFF

<b>RSt</b>	When selected, after power down, the limit control output 1 will have to be manually reset by pressing the reset key on the front panel of the unit or by activation an event input configured for remote reset. The unit will require manual reset even if the process is not in a limit condition.  <b>Note:</b> The limit annunciator output does not activate on power up in reset mode even if a limit condition is present since the unit always requires manual reset.				
Reset	PV < 250 and PV > -50	ON	OFF	OFF	OFF
	PV > 250 or PV < -50	OFF	ON	ON	ON
	PV > 250 or PV < -50 Reset Applied	OFF	OFF	ON	OFF
	PV < 249 and PV > -49 Reset Applied	ON	OFF	OFF	OFF
	Before Power Off PV > 250 or PV < -50	OFF	ON	ON	ON
	After Power On PV > 250 or PV < -50	OFF	OFF	ON	OFF
	PV > 250 or PV < -50 Reset Applied	OFF	OFF	ON	OFF
	After Power On PV < 249 and PV > -49	OFF	OFF	ON	OFF
	PV < 249 and PV > -49 Reset Applied	ON	OFF	OFF	OFF
	Before Power Off PV < 250 and PV > -50	ON	OFF	OFF	OFF
	After Power On PV > 250 or PV < -50	OFF	OFF	ON	OFF
	PV > 250 or PV < -50 Reset Applied	OFF	OFF	ON	OFF
	After Power On PV < 249 and PV > -49	OFF	OFF	ON	OFF
	PV < 249 and PV > -49 Reset Applied	ON	OFF	OFF	OFF

PWRU	Example Case	Relay		LED Indicator		
		OUT1	OUT2	OUT1	OUT2	
NoR.L	When selected, after power down, the limit control will return to normal operation when power is reapplied in the same state as before power was removed unless a limit is exceeded. If the limit was latched at power down, the unit will be in "Limit" at power up and have to be manually reset.					
Normal Latch	PV < 250 and PV > -50	ON	OFF	OFF	OFF	
	PV > 250 or PV < -50	OFF	ON	ON	ON	
	PV > 250 or PV < -50 Reset Applied	OFF	OFF	ON	OFF	
	PV < 249 and PV > -49 Reset Applied	ON	OFF	OFF	OFF	
	Before Power Off PV > 250 or PV < -50 No Reset Applied	OFF	ON	ON	ON	
	After Power On PV > 250 or PV < -50	OFF	ON	ON	ON	
	PV > 250 or PV < -50 Reset Applied	OFF	OFF	ON	OFF	
	After Power On PV < 249 and PV > -49	OFF	ON	ON	ON	
	PV < 249 and PV > -49 Reset Applied	ON	OFF	OFF	OFF	
	Before Power Off PV > 250 or PV < -50 Reset Applied	OFF	OFF	ON	OFF	
	After Power On PV > 250 or PV < -50	OFF	OFF	ON	OFF	
	PV > 250 or PV < -50 Reset Applied	OFF	OFF	ON	OFF	
	After Power On PV < 249 and PV > -49	OFF	OFF	ON	OFF	
	PV < 249 and PV > -49 Reset Applied	ON	OFF	OFF	OFF	
	Before Power Off PV < 249 and PV > -49	ON	OFF	OFF	OFF	
	After Power On PV > 250 or PV < -50	OFF	ON	ON	ON	
	PV > 250 or PV < -50 Reset Applied	OFF	OFF	ON	OFF	
After Power On PV < 249 and PV > -49	ON	OFF	OFF	OFF		
PV < 249 and PV > -49 Reset Applied	ON	OFF	OFF	OFF		

### 3.9 Communication Settings

When the limit control is equipped with the serial communication option (see section [3.12 Limit Control Option Settings](#)), the communication parameters will be available under the [Communication Menu](#).

**Addr** Sets the communication address for the limit control. Each device on the RS485 communication link must have its own unique address. The address can be set from 1 to 247.

**bAUd** Sets the baud rate. Available selections are 2400 (2K4), 4800 (4K8), 9600 (9K6), 14,400 (14K4), 19,200 (19K2) 28,800 (28K8), 38,400 (38K4), 57,600 (57K6) and 115,000 (115K).

**PARI** Sets the parity of the communication interface. Selections are no parity (NoNE), even parity (EVEN) and odd parity (odd).

Serial communication interfaces also have a stop bit setting. The limit control used the default value of 1 stop bit. This setting cannot be changed.

### 3.10 Retransmit Settings

When the limit control is equipped with the retransmit option, the retransmission parameters will be available under the [Output Menu](#).

- REtY** Selects the parameter to be retransmitted. Selections include the process value (PV), the high limit set point value (H.SP) and the low limit set point value (L.SP).
- RELo** Defines the low scale of the selected retransmission parameter. When the selected parameter value is at or below this value, the retransmit signal will be at its lowest value. For example, with a 4-20mA output, the output signal will be 4mA.
- REHI** Defines the high scale of the selected retransmission parameter. When the selected parameter value is at or above this value, the retransmit signal will be at its highest value. For example, with a 4-20mA output, the output signal will be 20mA.

**Note:** *The retransmit output signal range is set under the oFS2 parameter for the L22 and the oFS3 parameter for the L42 and L62. See section [3.12 Limit Control Option Settings](#)*

### 3.11 Event Input Settings

When the limit control is equipped with the event input option (see section [3.12 Limit Control Option Settings](#)), the event input parameters will be available under the [Event Input Menu](#). The following functions are available for each event input and are set under the respective parameter for each input, i.e., **E1.FN** and **E2.FN** for event input 1 function and event input 2 function respectively.

**Note:** *The same function cannot be selected for more than one event input at a time. Therefore, if setting an event input function and the other event is already set to the same function, the other event must be altered to another function first in order to make that function available.*

- NoNE** The event input will not perform any function when activated.
- LoCK** Selects the remote lock function. When the event input is activated, it will lock out all parameters and prevent the user from changing them. When the remote lock is activated, the key indicator on the front panel will turn on. When the remote lock is deactivated, the key indicator will turn off.  
  
**Note:** *In order for the remote lock function to operate, security must be enabled, i.e., the password parameter (CODE) must be set to a value other than "0". If the code is equal to "0", the remote LOCK function will not work. See section [3.1 Security](#).*
- R.RSt** Selects the remote reset function. When the event input is activated, it will perform the same action as pressing the reset key on the front panel of the limit control.
- H.SP2** When selected, activates high limit set point 2. The parameter HSP2 will then become available under the event input menu. This provides a second high limit set point for limit output operation. When the event input is activated, the value set under the HSP2 parameter will then be used in place of the HSP1 parameter. When the event input is deactivated, HSP1 will again be used for high limit operation.
- L.SP2** When selected, activates low limit set point 2. The parameter LSP2 will then become available under the event input menu. This provides a second low limit set point for limit output operation. When the event input is activated, the value set under the LSP2 parameter will then be used in place of the LSP1 parameter. When the event input is deactivated, LSP1 will again be used for high limit operation.

- H.L.S2** When selected, activates high and low limit set point 2. The parameters HSP2 and LSP2 will then become available under the event input menu. This provides a second set of high and low limit set points for limit output operation. When the event input is activated, the values set under the HSP2 and LSP2 parameters will then be used in place of the HSP1 and LSP1 parameters. When the event input is deactivated, HSP1 and LSP1 will again be used for high and low limit operation.
  
- H.SP3** When selected, activates high limit set point 3. The parameter HSP3 will then become available under the event input menu. This provides an additional high limit set point for limit output operation. When the event input is activated, the value set under the HSP3 parameter will then be used in place of the HSP1 parameter. When the event input is deactivated, HSP3 will again be used for high limit operation.
  
- L.SP3** When selected, activates low limit set point 3. The parameter LSP3 will then become available under the event input menu. This provides an additional low limit set point for limit output operation. When the event input is activated, the value set under the LSP3 parameter will then be used in place of the LSP1 parameter. When the event input is deactivated, LSP3 will again be used for high limit operation.
  
- H.L.S3** When selected, activates high and low limit set point 3. The parameters HSP3 and LSP3 will then become available under the event input menu. This provides an additional set of high and low limit set points for limit output operation. When the event input is activated, the values set under the HSP3 and LSP3 parameters will then be used in place of the HSP1 and LSP1 parameters. When the event input is deactivated, HSP3 and LSP3 will again be used for high and low limit operation.
  
- RS.A1** Selects the reset alarm 1 function. When the event input is activated, it will reset the latched alarm condition on alarm 1 as long as the alarm condition no longer exists. This does not reset the limit output.
  
- RS.A2** Selects the reset alarm 2 function. When the event input is activated, it will reset the latched alarm condition on alarm 2 as long as the alarm condition no longer exists. This does not reset the limit output.
  
- RS.A3** Selects the reset alarm 3 function. When the event input is activated, it will reset the latched alarm condition on alarm 3 as long as the alarm condition no longer exists. This does not reset the limit output.
  
- RS.Ao** Selects the reset all alarms function. When the event input is activated, it will reset the latched alarm condition on all alarms as long as the alarm condition no longer exists. This does not reset the limit output.
  
- CA.LH** Selects the cancel alarm latch function. When the event input is activated, it will cancel the alarm latch for all alarms as long as the alarm set point is not exceeded. This does not affect the limit output.
  
- R.REF** Selects the reset reference data function. See section [1.7.1.1 Reference Data](#) regarding reference data.

### 3.12 Limit Control Option Settings

There are three parameters available under the [Basic Menu](#) that are utilized to configure the limit control for the installed hardware options. These parameters are **oFS1**, **oFS2** and **oFS3**. These are set by the factory according to the options ordered on the limit control. However, if an option is ordered and installed at a later time (or existing options changed), these parameters must be set to match. If they are not set properly, the limit control may not function correctly, and settings associated with the installed options may not be available.

**oFS1** For the L62 and L42 models of limit control, this parameter is used for the RS485 serial communication option. The available selections are **NoNE** when the RS485 option is not installed and **R485** when the serial communication option is installed.

For the L22 model of limit control, this parameter is used for the RS485 and event input 1 options. There are three available selections. **NoNE** is used when neither the serial communication option nor event input 1 option are installed. **R485** is used when the serial communication option is installed. When the event input 1 option is installed, use the **EI1** selection.

**oFS2** For the L42 model limit control, this parameter is not used. The only valid selection is **NoNE**.

For L62 model of limit control, this parameter is used for event input option. The available selections are **NoNE** when the event input option is not installed and **EI1.2** when the event input option is installed.

For the L22 model of limit control, this parameter is used for the retransmit, alarm 2 and event input 2 options. Selections include:

- NoNE** Retransmit, alarm 2 and or input 2 options not installed.
- 4-20** Selects 4-20mA output when the retransmit option for 4-20/0-20mA is installed.
- 0-20** Selects 0-20mA output when the retransmit option for 4-20/0-20mA is installed.
- 0-5V** Selects 0-5V output when the retransmit option for 0-5/1-5/0-10V is installed.
- 1-5V** Selects 1-5V output when the retransmit option for 0-5/1-5/0-10V is installed.
- 0-10** Selects 0-10V output when the retransmit option for 0-5/1-5/0-10V is installed.
- AL2** Selects alarm 2 when the alarm 2 relay output option is installed.
- EI2** Selects event input 2 when the event input 2 option is installed.

**oFS3** This parameter is available for the L42 and L62 model limit controls only. It is used for the retransmit and alarm 3 (L62 only) options. Selections include:

- NoNE** Retransmit or alarm 3 options not installed.
- 4-20** Selects 4-20mA output when the retransmit option for 4-20/0-20mA is installed.
- 0-20** Selects 0-20mA output when the retransmit option for 4-20/0-20mA is installed.
- 0-5V** Selects 0-5V output when the retransmit option for 0-5/1-5/0-10V is installed.
- 1-5V** Selects 1-5V output when the retransmit option for 0-5/1-5/0-10V is installed.
- 0-10** Selects 0-10V output when the retransmit option for 0-5/1-5/0-10V is installed.
- AL3** Selects alarm 3 when the alarm 3 relay output option is installed (L62 only).



## 4 Calibration

Special equipment is needed to perform manual calibration.

1. A high accuracy calibrator (Fluke 5520A Calibrator recommended) with the following functions:
  - 0 - 60 mV millivolt source with 0.005 % accuracy
  - 0 - 10 V voltage source with 0.005 % accuracy
  - 0 - 20 mA current source with 0.005 % accuracy
  - 0 - 300Ω resistant source with 0.005 % accuracy
2. Test chamber providing 25°C to 50°C temperature range with  $\pm 3^\circ\text{C}$  stability.



*Performing calibration will replace the factory calibration coefficients with new values. If calibration is performed incorrectly, it could introduce a large input error resulting in dangerous operating conditions if not detected or render the device inoperable requiring that it be sent back to the factory for repair. Prior to calibrating each coefficient, it is recommended that the current value be recorded.*

*The calibration coefficients can be manually entered so if the calibration process fails, the previous values can be re-entered returning the unit to its previous operational state.*

### 4.1 Manual Calibration Procedure

The calibration procedures described in the following section are step by step manual procedures. The limit control requires a 30-minute warm up period at a temperature of  $25^\circ\text{C} \pm 3^\circ\text{C}$  prior to performing any of the calibration procedures. To begin any of the following input calibration procedures, you must access the calibration mode menu. To access the calibration mode menu:

1. Make sure any event input configured for remote lock is deactivated.
2. Set the security password parameter (PASS) and the calibration password parameter (KPAS) to the security code (CODE) and calibration code (KCOD) parameter values.
3. Press and hold the scroll key until CALI appears on the upper display, then immediately release the scroll key.
4. Press the scroll key for 2-3 seconds then release. The upper display will show AdLo, and the lower display will indicate the parameter value.
5. The unit is now in calibration mode. Proceed to the following sections to perform the calibration procedure for the specific input type.
6. Once the procedure is complete, press the reset key to exit the calibration mode menu.

#### 4.1.1 Calibrate Thermocouple Input

The following steps (1-7) are for calibrating the zero and span of the A to D converter. Steps 8 through 12 are for performing the cold junction calibration. In many instances, a simple cold junction offset calibration can bring a unit within the  $\pm 2^\circ\text{C}$  specification.

**IMPORTANT:** *If calibration of the cold junction compensation is to be performed, you must first set the input type of the limit control to a K thermocouple (INPt = K\_tC) under the [Basic Menu](#) prior to entering the calibration mode menu. This step of the procedure must be performed with a K-type thermocouple.*

1. Using copper conductors, connect a millivolt source to the thermocouple input terminals of the limit control.
2. Apply a 0mV signal.
3. Press and release the scroll key to cycle through the parameters until **AdLo** is in the upper display.
4. With the **AdLo** parameter displayed, press and hold the scroll key until the display blinks and a new value is obtained. If the display does not blink within ~5 seconds or the obtained value is equal to -199.9 or 199.9, then the calibration failed. Check the input connection and signal source and try again.
5. Adjust the millivolt source to 60mV.
6. Press and release the scroll key to cycle through the parameters until **AdHI** is in the upper display.
7. With the **AdHI** parameter displayed, press and hold the scroll key until the display blinks and a new value is obtained. If the display does not blink within ~5 seconds or the obtained value is equal to -199.9 or 199.9, then the calibration failed. Check the input connection and signal source and try again.
8. Connect a K-type thermocouple source using K-Type thermocouple wire to the thermocouple input terminals of the limit control.
9. Apply a 0°C signal.
10. Press and release the scroll key to cycle through the parameters until **CJLo** is in the upper display.
11. Using the up/down keys, manually set the value to 40.00.
12. Press and hold the scroll key until the display blinks and a new value is obtained. If the display does not blink within ~5 seconds or the obtained value is equal to 5.00 or 40.00, then the calibration failed. Check the input connection and signal source and try again.

#### 4.1.1.1 Calibrate Gain of Cold Junction Compensation

An additional calibration mode parameter is provided for cold junction calibration of a thermocouple input. This parameter is for special use only and does not require adjustment. It is used in applications where it is known that the limit control will be operating in a high temperature environment, i.e., the 50°C temperature limit of the unit specifications.

In order to perform the calibration of the cold junction gain parameter, the limit control must be placed in a room with a temperature of  $50 \pm 3^{\circ}\text{C}$  for at least 20 minutes. Due to this high temperature, it is recommended to use a computer to perform the procedure. Thus, it is not something performed in the field.

1. Connect a K-type thermocouple source using K-Type thermocouple wire to the thermocouple input terminals of the limit control.
2. Apply a 0°C signal.
3. Press and release the scroll key to cycle through the parameters until **CJHI** is in the upper display.
4. Press and hold the scroll key until the display blinks and a new value is obtained. If the display does not blink within ~5 seconds or the obtained value is equal to -199.9 or 199.9, then the calibration failed. Check the input connection and signal source and try again.

### 4.1.2 Calibrate RTD Input

1. Using copper conductors, connect a resistance source to the RTD input terminals of the limit control. The “B” terminals of the RTD input must be shorted together.
2. Apply a 100  $\Omega$  input signal.
3. Press and release the scroll key to cycle through the parameters until **RtdL** is in the upper display.
4. With the **RtdL** parameter displayed, press and hold the scroll key until the display blinks and a new value is obtained. If the display does not blink within ~5 seconds or the obtained value is equal to -199.9 or 199.9, then the calibration failed. Check the input connection and signal source and try again.
5. Adjust the resistance source to 300  $\Omega$ .
6. Press and release the scroll key to cycle through the parameters until **RtdH** is in the upper display.
7. With the **RtdH** parameter displayed, press and hold the scroll key until the display blinks and a new value is obtained. If the display does not blink within ~5 seconds or the obtained value is equal to -199.9 or 199.9, then the calibration failed. Check the input connection and signal source and try again.

### 4.1.3 Calibrate Linear Voltage Input

1. Using copper conductors, connect a voltage source to the voltage input terminals of the limit control.
2. Apply a 0V input signal.
3. Press and release the scroll key to cycle through the parameters until **V1L** is in the upper display.
4. With the **V1L** parameter displayed, press and hold the scroll key until the display blinks and a new value is obtained. If the display does not blink within ~5 seconds or the obtained value is equal to -199.9 or 199.9, then the calibration failed. Check the input connection and signal source and try again.
5. Adjust the voltage source to 10V.
6. Press and release the scroll key to cycle through the parameters until **V1G** is in the upper display.
7. With the **V1G** parameter displayed, press and hold the scroll key until the display blinks and a new value is obtained. If the display does not blink within ~5 seconds or the obtained value is equal to -199.9 or 199.9, then the calibration failed. Check the input connection and signal source and try again.

### 4.1.4 Calibrate Linear Current Input

1. Using copper conductors, connect a current source to the current input terminals of the limit control.
2. Apply a 0mA input signal.
3. Press and release the scroll key to cycle through the parameters until **MA1L** is in the upper display.
4. With the **MA1L** parameter displayed, press and hold the scroll key until the display blinks and a new value is obtained. If the display does not blink within ~5 seconds or the obtained value is equal to -199.9 or 199.9, then the calibration failed. Check the input connection and signal source and try again.
5. Adjust the current source to 20mA.
6. Press and release the scroll key to cycle through the parameters until **MA1G** is in the upper display.
7. With the **MA1G** parameter displayed, press and hold the scroll key until the display blinks and a new value is obtained. If the display does not blink within ~5 seconds or the obtained value is equal to -199.9 or 199.9, then the calibration failed. Check the input connection and signal source and try again.

## 5 Communication

The limit control communicates over its optional RS485 serial interface using Modbus RTU protocol. This section provides information on the supported functions and data available over the Modbus interface. It is assumed that the user is already familiar with Modbus protocol and has a basic understanding of its implementation and use. For additional information and support, modbus.org (<http://modbus.org/tech.php>) provides an abundance of technical documents, standards and support applications.

Listed below are a few of the more common software packages that claim to support Modbus protocol. This list is provided as informational only. Contact the software manufacturer for more information on applying their software.

LabView by National Instruments  
 11500 N Mopac Expwy  
 Austin, TX 78759-3504  
 Phone 800-683-8411  
<http://www.natinst.com>

Wonderware by Wonderware  
 26561 Rancho Pkwy. South  
 Lake Forest, CA 92630  
 Phone 949-727-3200  
<http://www.wonderware.com>

SpecView by SpecView Corp.  
 13409 53<sup>rd</sup> Ave NW  
 Gig Harbor, WA 98332  
 Phone 253-853-3199  
<http://www.specview.com>

### 5.1 Functions Supported

The limit control only responds to function codes 03, 06 and 16. The message formats for each function code are described in the following sections.

#### 5.1.1 Function Code 03: Read Holding Registers

Query (From Master)	Slave Address (1~247)	Response (From Slave)	Slave Address (1~247)
	Function Code (03)		Function Code (03)
	Starting Address of Register Hi (00)		Byte Count
	Starting Address of Register Lo (00~49, 51~88, 128~132, 139, 140, 142, 143)		Data1 Hi
	No of Words Hi (00)		Data1 Lo
	No of Words Lo (1~81)		Data2 Hi
	CRC16 Hi		Data2 Lo
	CRC16 Lo		...
			...
			Data 'n' Hi
	Data 'n' Lo		
	CRC16 Hi		
	CRC16 Lo		

### 5.1.2 Function Code 06: Preset Single Register

Query (From Master)	Slave Address (1~247)	Response (From Slave)	Slave Address (1~247)
	Function Code (06)		Function Code (06)
	Starting Address of Register Hi (00)		Starting Address of Register Hi (00)
	Starting Address of Register Lo (00~49, 51~88, 128~132, 139, 140, 142, 143)		Starting Address of Register Lo (00~49, 51~88, 128~132, 139, 140, 142, 143)
	Data Hi		Data Hi
	Data Lo		Data Lo
	CRC16 Hi		CRC16 Hi
	CRC16 Lo		CRC16 Lo

### 5.1.3 Function Code 16: Preset Multiple Registers

Query (From Master)	Slave Address (1~247)		Response (From Slave)	Slave Address (1~247)	
	Function Code (16)			Function Code (16)	
	Starting Address of Register Hi (00)			Starting Address of Register Hi (00)	
	Starting Address of Register Lo (00~49, 51~88, 128~132, 139, 140, 142, 143)			Starting Address of Register Lo (00~49, 51~88, 128~132, 139, 140, 142, 143)	
	No of Words Hi (00)			No of Words Hi (00)	
	No of words Lo (1~81)			No of words Lo (1~81)	
	Bytes Count (2~162)			Bytes Count (2~162)	
	Data1	Hi		Data1	Hi
	Data1	Lo		Data1	Lo
	Data2	Hi		Data2	Hi
	Data2	Lo		Data2	Lo
	...			...	
	...			...	
	Data	'n' Hi		Data	'n' Hi
	Data	'n' Lo		Data	'n' Lo
	CRC16	Hi		CRC16	Hi
CRC16	Lo	CRC16	Lo		

## 5.2 Exception Responses

If the limit controller receives a message which contains a corrupted character (parity check error, framing error etc.), or if the CRC16 check fails, the limit control ignores the message. However, if the limit control receives a syntactically correct message which contains an illegal value, it will send an exception response consisting of five bytes as follows:

**Slave address + offset function code + exception code + CRC16 Hi + CRC16 Lo**

Where the offset function code is obtained by adding the function code to 128 (i.e., function code 3 becomes H'83) and the exception code is equal to the value contained in the following table.

Exception Code	Description	Reason
1	Bad Function Code	The function code is not supported by the limit control
2	Illegal Data Addresses	Register address is out of range
3	Illegal Data Value	Data value out of range or attempt to write a read-only or protected data field

## 5.3 Parameter Mapping

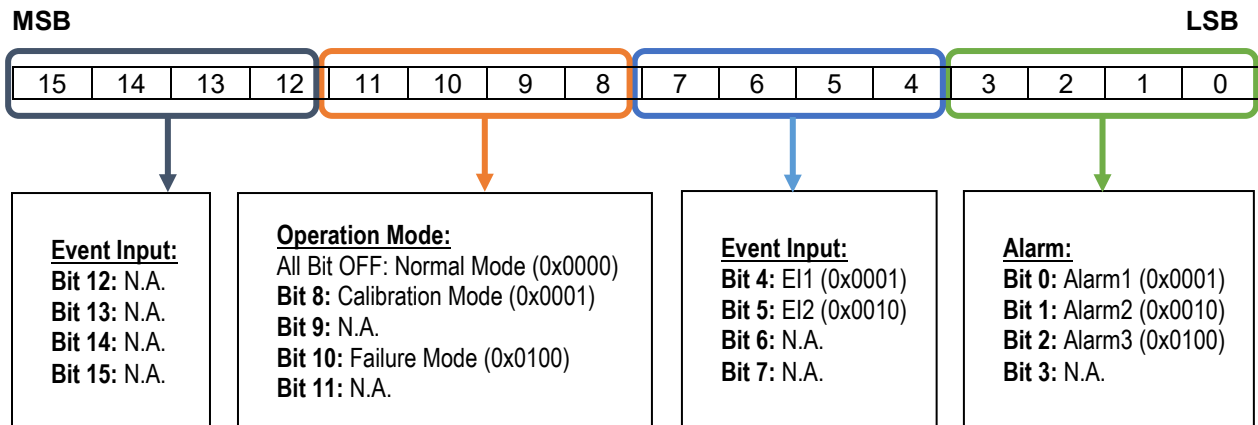
The parameter mapping of Modbus addresses is available in section [1.9 Parameter Description](#).

## 5.4 Operational Mode and Alarm Status

The value of the Mode register is as follows (where “H” designates value in hex format):

Value	H'000X	H'010X	H'040X	H'0X00	H'0x01
Mode	Normal mode	Calibration mode	Failure mode	Alarm status is off	Alarm status is on

Bit wise description of Mode register value as below:



## 5.5 Process Value Scaling

All of the registers and their related values in the limit control are represented as 16-bit unsigned integers. This means that the value of the register can be from 0 (all bits are 0) to 65535 (all bits are 1). This is standard binary counting where each bit represents an increasing power of 2, with the rightmost bit representing  $2^0$ , the next representing  $2^1$ , then  $2^2$ , and so on. The value of a binary number is the sum of the powers of 2 represented by each "1" bit.

As can be seen in the table in section [1.9 Parameter Description](#), most of the registers associated with the process values, limits set points, alarm set points, etc., are listed with a scale of -19999 to 45536. These scale values represent the actual value of the parameter from a register value of 0 to a register value of 65535. Put simply, when reading the register, subtract 19999 from its value to get the value of the parameter. When writing a register, add 19999 to the parameter value and then write it to the register.

**Note:** *When reading and writing parameters that include a decimal point, the decimal point is implied. Therefore, the parameter value must be scaled according to the decimal resolution.*

*When reading a register, first apply the scale offset to the register value (-19999) and then divide the resulting value by 10 for one decimal resolution, 100 for two decimal or 1000 for 3 decimal to get the resultant parameter value.*

*When writing a register, first multiply the parameter value by 10 for one decimal resolution, 100 for two decimal or 1000 for 3 decimal. Then add the scale offset (19999) to get the resultant register value to write to the limit control.*

Examples:

Read the process value (register number 64 / Modbus Address 400065)

If the register value read is 17657, first subtract the scale offset.

$$20241 - 19999 = -242$$

Next, scale the result according to the decimal resolution.

If the input is configured for no decimal:	PV = -242
If the input is configured for one decimal:	PV = -242 / 10 = -24.2
If the input is configured for two decimal:	PV = -242 / 100 = -2.42
If the input is configured for three decimal:	PV = -242 / 1000 = -0.242

Write the high limit set point (register number 0 / Modbus Address 400001)

If the desired high limit set point is 500.0 degrees, first scale the value according to the decimal resolution of the input:

$$500.0 \times 10 = 5000$$

Next, apply the scale offset to the result.

$$5000 + 19999 = 24999$$

Write the value 24999 to register number 0 (Modbus address 400001).

## 5.6 Special Command Codes

The command (CMND) and job1 (JOB1) registers utilize specific command values to perform various tasks.

Command Value		Command	Description	Job1 Value			Function Code	
Dec	Hex			Dec	Hex	06	16	
26668	682C	Unlock	Temporarily unlocks the limit control. CMND register will hold the "PASLOCK" value of 26668 (0x682C) until another CMND value is set or 180 seconds.	...	...	...	✓	✓
26665	6829	Calibration Mode	Calibrate ADLO	ADLO	51	0033		✓
			Calibrate ADHI	ADHI	52	0034		✓
			Calibrate RTDL	RTDL	53	0035		✓
			Calibrate RTDH	RTDH	54	0036		✓
			Calibrate CJLO	CJLO	55	0037		✓
			Calibrate CJHI	CJHI	56	0038		✓
			Calibrate V1L	V1L	57	0039		✓
			Calibrate V1G	V1G	58	003A		✓
			Calibrate MA1L	MA1L	59	003B		✓
		Calibrate MA1G	MA1G	60	003C		✓	
26661	6825	Reset	Do same action as Reset Key	...	...	...	✓	✓

### 5.6.1 Reset Command

The reset command performs the same action as pressing the reset key on the front panel of the limit control. The command is executed by writing the value 26661 (H'6825) to the command mode register (CMND). The command mode Modbus address is 400073 (register address 72).

	06	00	H'48	H'68	H'25	HI	LO
Addr	Function Code	Register Address = 72	CMND=26661	CRC16			

### 5.6.2 Unlock Command

The unlock command performs the same action as entering the security password (PASS) or deactivating an event input configured as remote lock. However, the unlock condition is temporary and only lasts for 180 seconds or until another command code is sent. The unlock command is executed by writing the value 26668 (H'682C) to the command mode register (CMND). The command mode Modbus address is 400073 (register address 72).

	06	00	H'48	H'68	H'2C	HI	LO
Addr	Function Code	Register Address = 72	CMND=26668	CRC16			



### 5.6.3 Calibrate Input Command

The calibrate input command performs the same action as pressing and holding the scroll key while on a calibration parameter in the calibration mode menu. This command requires two registers to be written at once, the command code register and the job1 register. The command code executes the calibration while the job1 register defines which parameter is to be calibrated. The table in section [5.6 Special Command Codes](#) provides the list of values associated with each calibration parameter.

Example: Calibrate **AdLo**

	H'10	00	H'48	00	02	04	H'68	H'29	00	H'33	HI	LO
Addr	Function Code	Register Address =72		No of Words		Byte Count	CMND=26665		JOB1=51		CRC16	

## 7 Error Codes and Troubleshooting

The limit control will display an error code in the upper display should a problem arise during operation. If you are unable to correct the problem, contact Future Design Controls for further assistance.

Error Code	Display Symbol	Description & Reason	Corrective Action
10	ER10	<b>Communication error:</b> bad function code	Correct the communication software to meet the protocol requirements.
11	ER11	<b>Communication error:</b> register address out of range	Do not issue an over-range register address in a command.
14	ER14	<b>Communication error:</b> attempt to write a read-only data	Do not write read-only or protected data.
15	ER15	<b>Communication error:</b> writing out of range value	Do not write an over-range data value to the register.
16	EIER	<b>Event Input Error:</b> Both event inputs are set to the same function.	Do not set the same function to both event input function parameters. (E1FN and E2FN)
29	EEPR	EEPROM cannot be written.	Return to factory for repair.
30	CJER	Cold junction compensation failure.	Return to factory for repair.
39	SBER	Input sensor break, or input current below 1 mA if 4-20 mA is used, or input voltage below 0.25V if 1 - 5V is used.	Replace the input sensor.
40	ADER	A to D converter malfunction.	Return to factory for repair.

## 8 State of California Proposition 65 Warning



**Cancer and Reproductive Harm:** *This warning is intended to address certain Prop 65 chemicals that may be found in Future Design Controls products. These products can expose you to chemicals including lead and lead compounds which are known to the State of California to cause cancer, birth defects or other reproductive harm.*

### **What is the state of California Proposition 65?**

Proposition 65 requires businesses to provide warnings to Californians about significant exposures to chemicals that cause cancer, birth defects or other reproductive harm. These chemicals can be in the products that Californians purchase, in their homes or workplaces, or that are released into the environment. By requiring that this information be provided, Proposition 65 enables Californians to make informed decisions about their exposures to these chemicals.

For more information go to: [www.P65Warnings.ca.gov](http://www.P65Warnings.ca.gov)

The most recent list of chemicals known to the State of California can be seen at:  
<https://oehha.ca.gov/media/downloads/proposition-65/p65list102618.pdf>

**Affected Products:** This applies to all existing and future products offered by Future Design Controls.

## 9 Warranty & Limitations

### Warranty

Future Design Controls **L-Series Limit Controls** are warranted to be free from functional defects in materials and workmanship at the time the products leave Future Design Controls facilities and to conform at that time to the specifications set forth in the relevant Future Design Controls manual, sheet or sheets for a period of **three years** after delivery to the first purchaser for use.

There are no expressed or implied Warranties extending beyond the Warranties herein and above set forth.

### Limitations

Future Design Controls provides no warranty or representations of any sort regarding the fitness of use or application of its products by the purchaser. Users are responsible for the selection, suitability of the products for their application and use of Future Design Controls products.

Future Design Controls shall not be liable for any damages or losses, whether direct, indirect, incidental, special, consequential or any other damages, costs or expenses excepting only the cost or expense of repair or replacement of Future Design Control products as described below.

Future Design Controls sole responsibility under the warranty, at Future Design Controls option, is limited to replacement or repair, free of charge, or refund of purchase price within the warranty period specified. This warranty does not apply to damage resulting from transportation, alteration, misuse or abuse.

Future Design Controls reserves the right to make changes without notification to the purchaser in materials or processing that do not affect compliance with any applicable specifications.

### Return Material Authorization

Contact Future Design Controls for a Return Material Authorization Number prior to returning any product to our facility.

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