MIC 1167 / 1807 / 1407

VALVE MOTOR DRIVER (VMD) CONTROLLERS

OPERATORS
MANUAL

FORM 3719
EDITION 1

PRICE $10.00

Partlow Brand

Information in this installation, wiring, and operation manual is subject to change without notice. One manual is provided with each instrument at the time of shipment. Extra copies are available at the price published on the front cover.

This is the First Edition of the MIC 1167/1807/1407 manual. It was written and produced entirely on a desk-top-publishing system. Disk versions are available by written request to the Partlow Publications Department.

We are glad you decided to open this manual. It is written so that you can take full advantage of the features of your new MIC 1167/1807/1407 Valve Motor Drive controller.

NOTE:
It is strongly recommended that Partlow equipped applications incorporate a high or low limit protective device which will shut down the equipment at a preset process condition in order to preclude possible damage to property or products.

THE INTERNATIONAL HAZARD SYMBOL IS INSCRIBED ADJACENT TO THE REAR CONNECTION TERMINALS. IT IS IMPORTANT TO READ THIS MANUAL BEFORE INSTALLING OR COMMISSIONING THE UNIT.

Table of Contents

Figures & Tables

Product Description 1.1

1.1.1 GENERAL

This instrument is a microprocessor based process controller for use in open loop valve motor drive (VMD) applications. Its standard features include:

- Dual four-digit LED display
- Universal sensor input (thermocouple, 3 wire RTD or DC Linear -mA, mV, V)
- Pre-Tune and Auto-Tune
- 90 to 264V AC Power
- Designed to comply with EN50081 Part 2 (Emission) and EN50082 Part 2 (Immunity) EMC specifications
- Auto/Manual control - user selectable
- Setpoint Ramping

Some optional features:

- 24V AC/DC line voltage
- One alarm output or retransmission output
- RS-485 Communications
- 24V DC Transmitter Power Supply
- Dual Setpoint

1.1.2 DISPLAYS

Each instrument is provided with dual displays and status indicators as shown in Figure 1-1. The upper display displays the value of the process variable. The lower display displays the setpoint value. Status indication is as shown, see Figure 1-1, page 6 & 7.

1.1.3 CONTROL

The instrument can be programmed for motor drive control only, with fully programmable PID parameters.

1.1.4 ALARMS

Alarm indication is standard on all instruments. One alarm output is possible. Alarm type may be set as Process Direct or Reverse (high or low), Deviation Direct or Reverse (above or below setpoint), Deviation Band Type (closed or open within band), or Loop Reverse or Direct. Alarm status is indicated by LED.

FIGURE 1-1
Keys and Indicators

1.1.5 PROCESS VARIABLE/SETPOINT VALUE RETRANSMISSION OUTPUT

If the instrument is specified with this option, this output may be scaled over any desired range and retransmitted.

Installation and Wiring 2.1

Electrical code requirements and safety standards should be observed and installation performed by qualified personnel.

The electronic components of the instrument may be removed from the housing during installation. To remove the components, grip the side edges of the front panel and pull the instrument forward. During reinstallation, the vertically mounted circuit boards should be properly aligned in the housing.

Ensure that the instrument is correctly orientated. A stop will operate if an attempt is made to insert the instrument incorrectly.

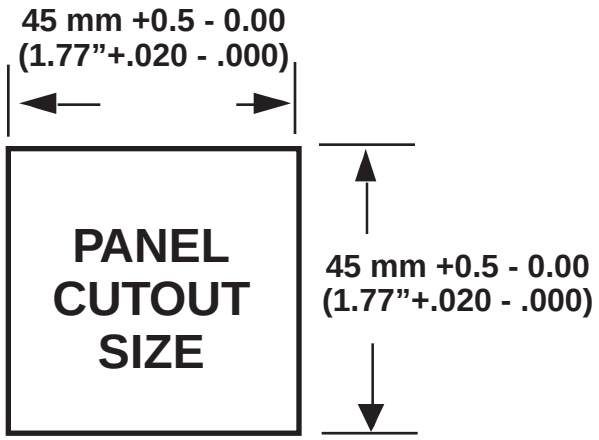
Recommended panel opening sizes are illustrated in Figure 2-1. After the opening is properly cut, insert the instrument into the panel opening. Ensure that the panel gasket is not distorted and that the instrument is positioned squarely against the panel. Slide the mounting clamp into place on the instrument (see Figure 2-3, page 11) and push it forward until it is firmly in contact with the rear face of the mounting panel.

Note: The mounting clamp tongues may engage either on the sides or the top/bottom of the instrument housing. Therefore, when installing several instruments side-by-side in one cut out, use the ratchets on the top/bottom faces.

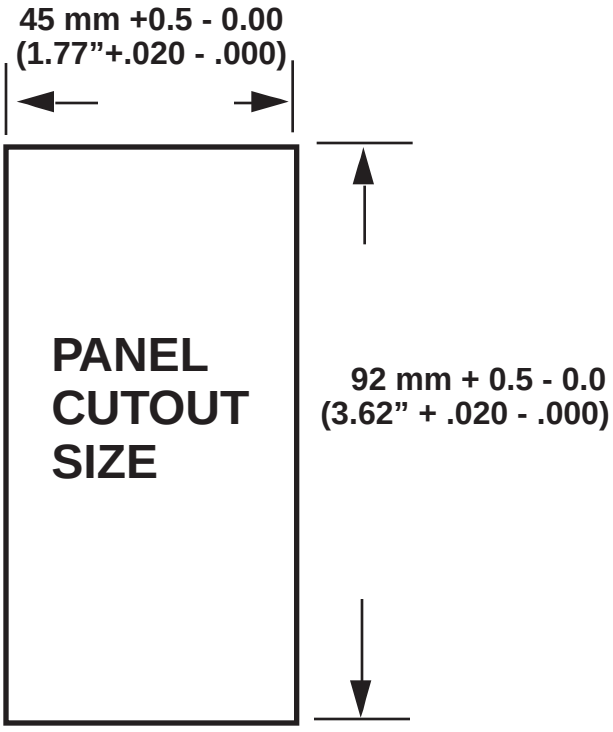
FIGURE 2-1

Panel Cut-Out Dimensions

1/16 DIN



1/8 DIN


45 mm +0.5 - 0.00
(1.77"+.020 - .000)
PANEL
CUTOUT
SIZE
92 mm + 0.5 - 0.0
(3.62" + .020 - .000)

1/4 DIN

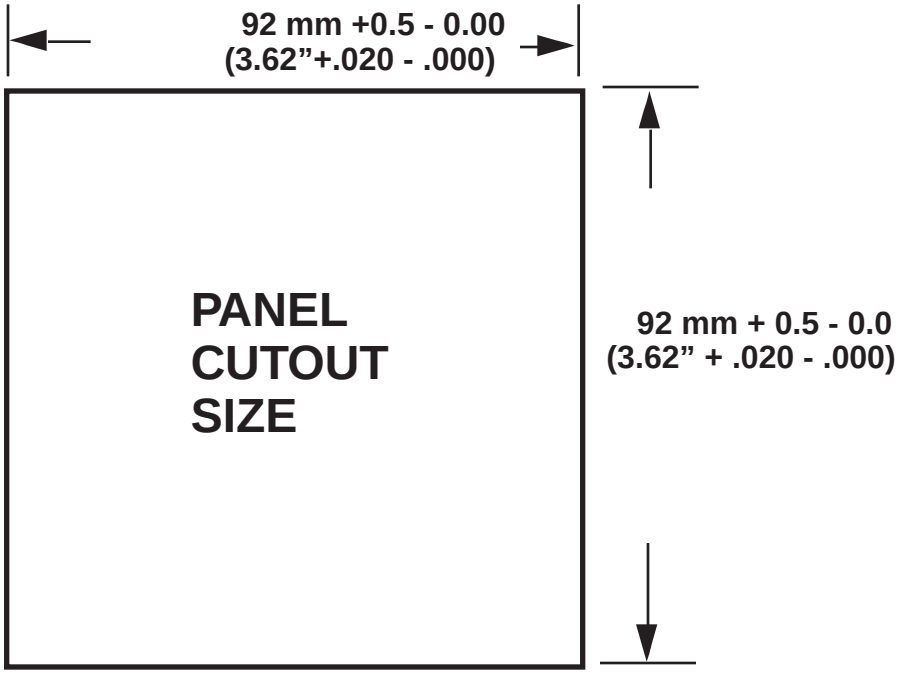
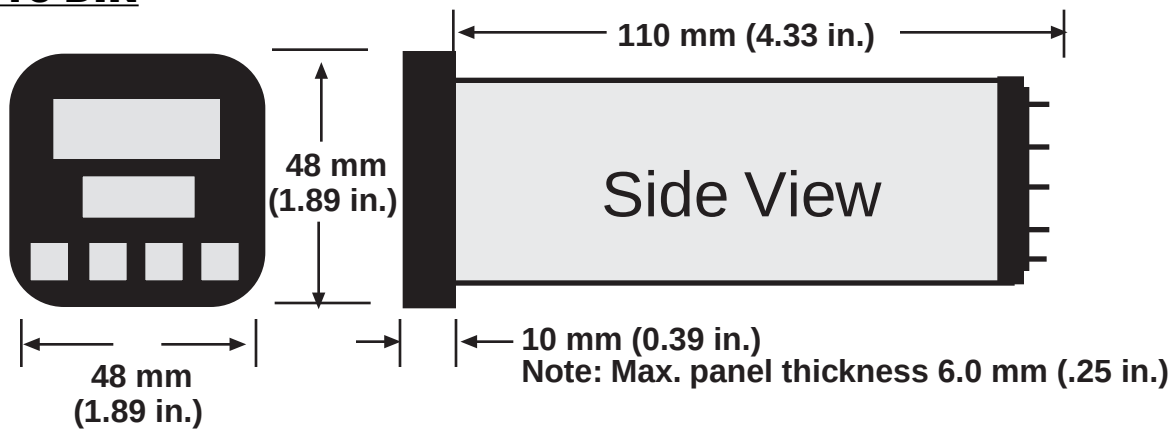
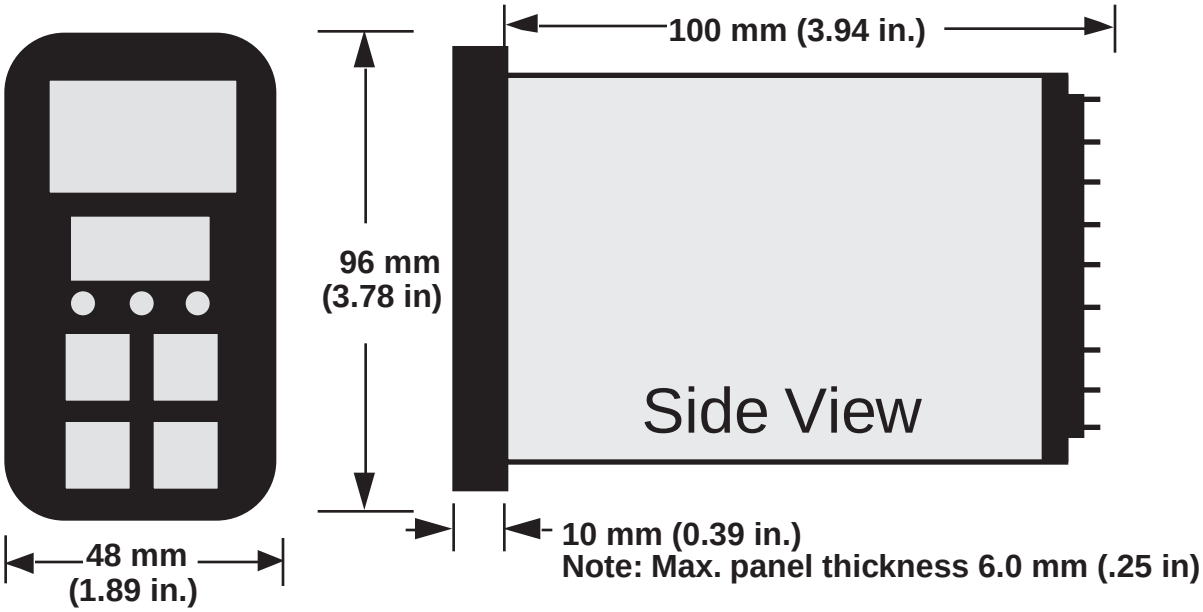

92 mm +0.5 - 0.00
(3.62"+.020 - .000)
PANEL
CUTOUT
SIZE
92 mm + 0.5 - 0.0
(3.62" + .020 - .000)

FIGURE 2-2
Main Dimensions

1/16 DIN



1/8 DIN



1/4 DIN

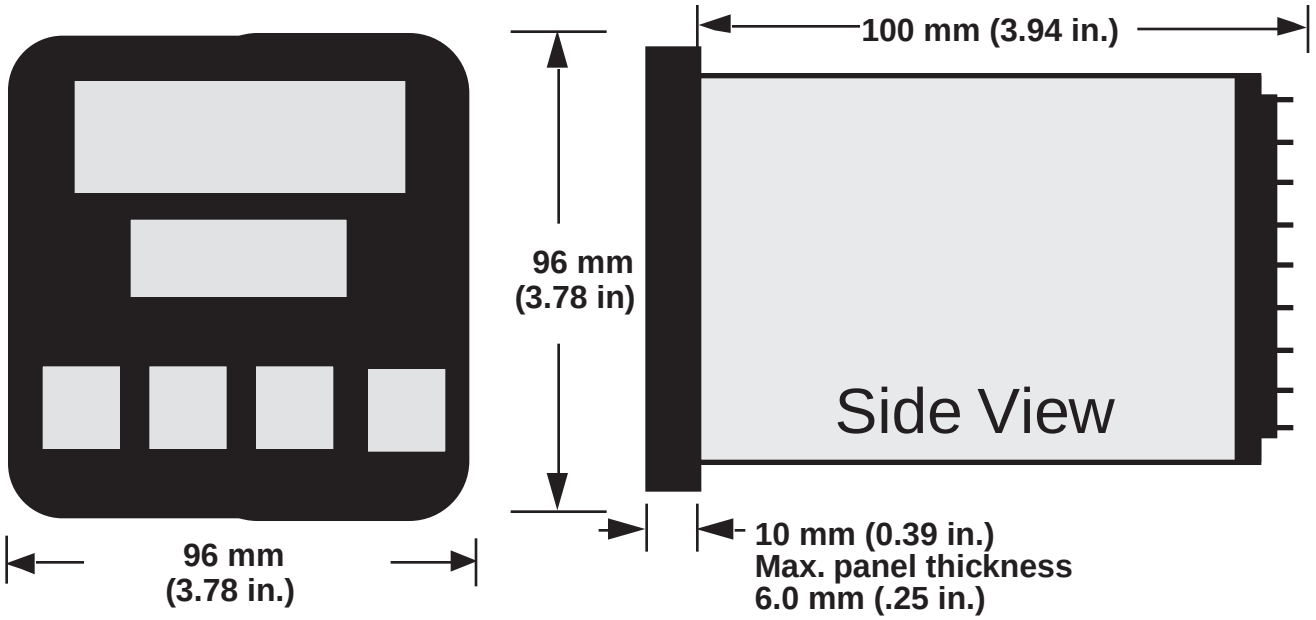
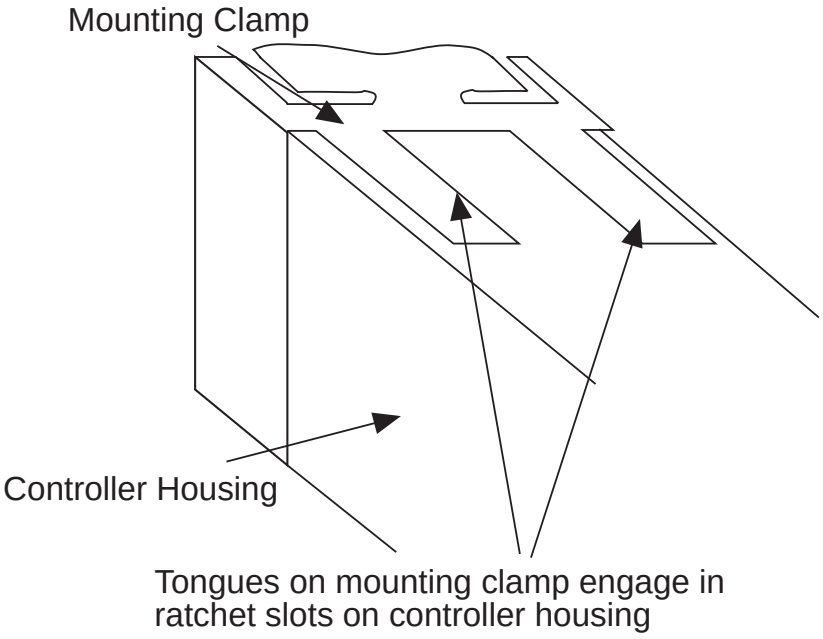


FIGURE 2-3
Panel Mounting the Controller



Preparation for Wiring 2.2

2.2.1 WIRING GUIDELINES

Electrical noise is a phenomenon typical of industrial environments. The following are guidelines that must be followed to minimize the effect of noise upon any instrumentation.

2.2.1.1 INSTALLATION CONSIDERATIONS

Listed below are some of the common sources of electrical noise in the industrial environment:

- Ignition Transformers
- Arc Welders
- Mechanical contact relay(s)
- Solenoids

Before using any instrument near the device listed, the instructions below should be followed:

1. If the instrument is to be mounted in the same panel as any of the listed devices, separate them by the largest distance possible. For maximum electrical noise reduction, the noise generating devices should be mounted in a separate enclosure.

2. If possible, eliminate mechanical contact relay(s) and replace with solid state relays. If a mechanical relay being powered by an instrument output device cannot be replaced, a solid state relay can be used to isolate the instrument.

3. A separate isolation transformer to feed only instrumentation should be considered. The transformer can isolate the instrument from noise found on the AC power input.

4. If the instrument is being installed on existing equipment, the wiring in the area should be checked to insure that good wiring practices have been followed.

2.2.1.2 AC POWER WIRING

Neutral (For 115 VAC)

It is good practice to assure that the AC neutral is at or near ground potential. To verify this, a voltmeter check between neutral and ground should be done. On the AC range, the reading should not be more than 50 millivolts. If it is greater than this amount, the secondary of this AC transformer supplying the instrument should be checked by an electrician. A proper neutral will help ensure maximum performance from the instrument.

2.2.1.3 WIRE ISOLATION

Four voltage levels of input and output wiring may be used with the unit:

- Analog input or output (i.e. thermocouple, RTD, VDC, mVDC, or mADC)
- SPDT Relays
- SSR driver outputs
- AC power

The only wires that should run together are those of the same category. If they need to be run parallel with any of the other lines, maintain a minimum 6 inch space between the wires. If wires must cross each other, do so at 90 degrees. This will minimize the contact with each other and reduces “cross talk”. “Cross Talk” is due to the EMF (Electro Magnetic Flux) emitted by a wire as current passes through it. This EMF can be picked up by other wires running in the same bundle or conduit.

In applications where a High Voltage Transformer is used (i.e. ignition systems) the secondary of the transformer should be isolated from all other cables.

This instrument has been designed to operate in noisy environments, however, in some cases even with proper wiring it may be necessary to suppress the noise at its source.

2.2.1.4 USE OF SHIELDED CABLE

Shielded cable helps eliminate electrical noise being induced on the wires. All analog signals should be run with shielded cable. Connection lead length should be kept as short as possible, keeping the wires protected by the shielding. The shield should be grounded at one end only. The preferred grounding location is the sensor, transmitter or transducer.

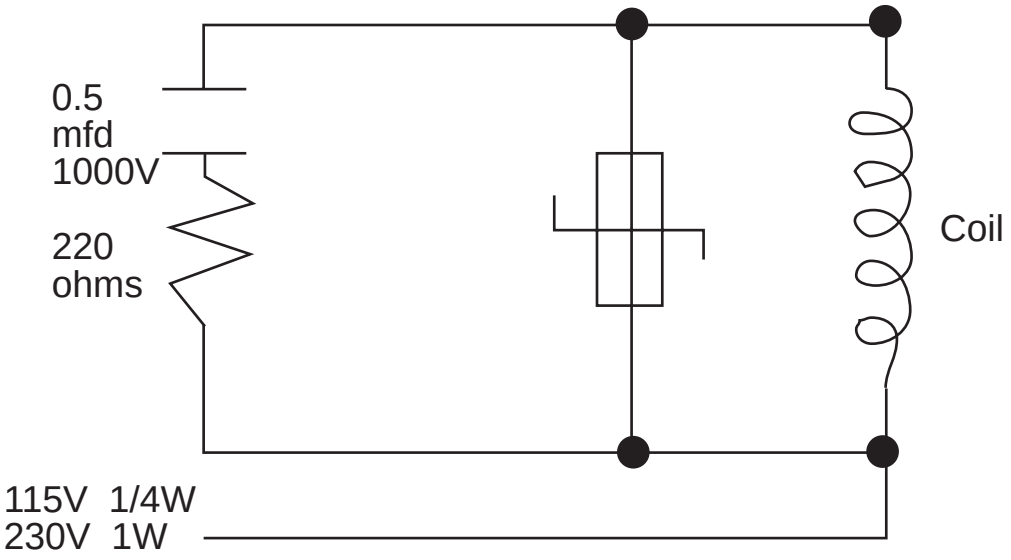
2.2.1.5 NOISE SUPPRESSION AT THE SOURCE

Usually when good wiring practices are followed no further noise protection is necessary. Sometimes in severe electrical environments, the amount of noise is so great that it has to be suppressed at the source. Many manufacturers of relays, contactors, etc. supply “surge suppressors” which mount on the noise source.

For those devices that do not have surge suppressors supplied, RC (resistance-capacitance) networks and/or MOV (metal oxide varistors) may be added.

Inductive Coils - MOV’s are recommended for transient suppression in inductive coils connected in parallel and as close as possible to the coil. See Figure 2-4. Additional protection may be provided by adding an RC network across the MOV.

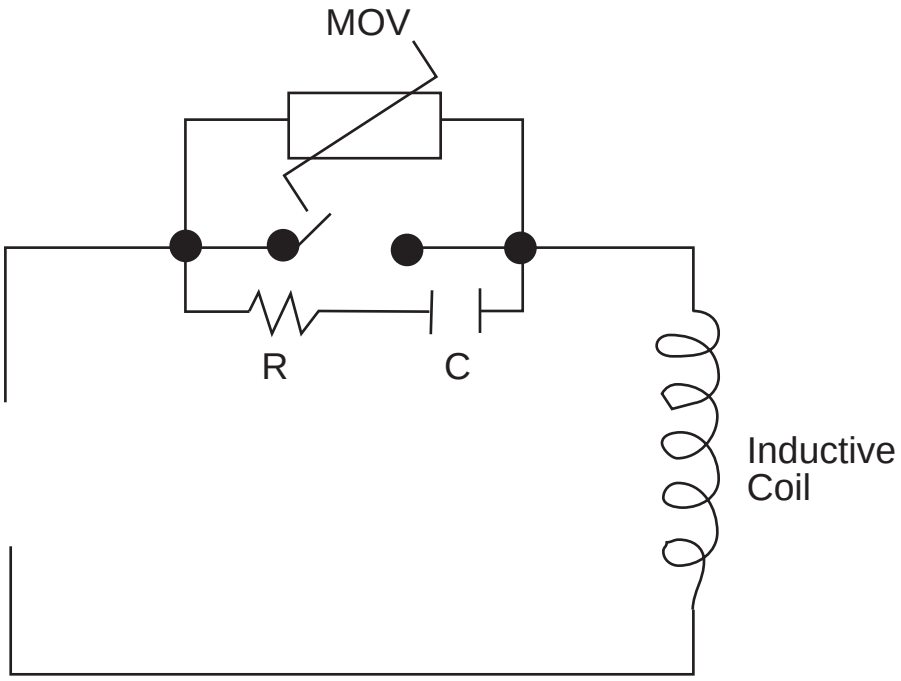
FIGURE 2-4



Contacts - Arcing may occur across contacts when the contact opens and closes. This results in electrical noise as well as damage to the contacts. Connecting a RC network properly sized can eliminate this arc.

For circuits up to 3 amps, a combination of a 47 ohm resistor and 0.1 microfarad capacitor (1000 volts) is recommended. For circuits from 3 to 5 amps, connect 2 of these in parallel. See Figure 2-5, page 12.

FIGURE 2-5



2.2.2 SENSOR PLACEMENT (Thermocouple or RTD)

Two wire RTD's should be used only with lead lengths less than 10 feet.

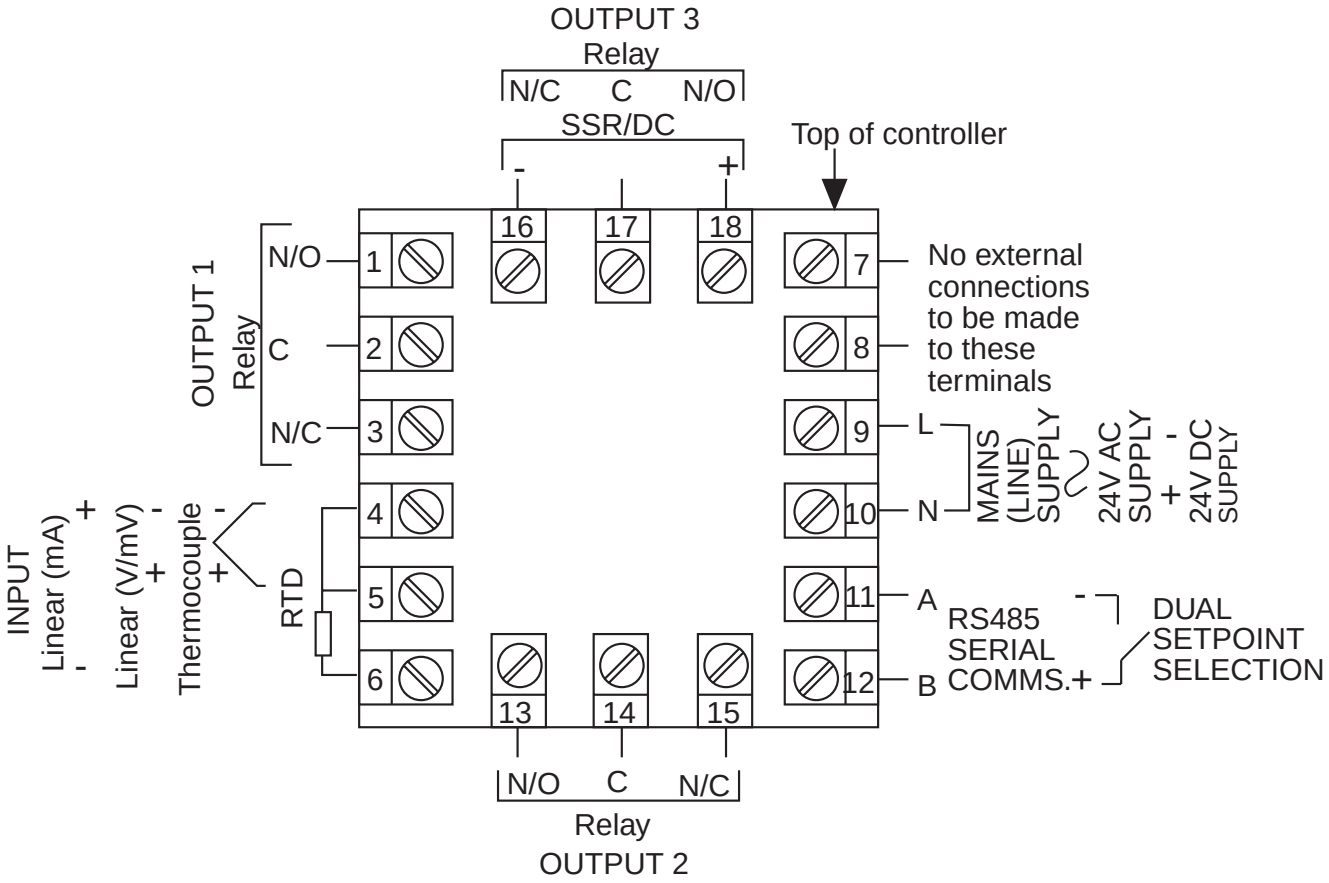
If the temperature probe is to be subjected to corrosive or abrasive conditions, it should be protected by the appropriate thermowell. The probe should be positioned to reflect true process temperature:

In liquid media - the most agitated area
In air - the best circulated area

FIGURE 2-6
Wiring Label

1/16 DIN

Output 3 is used either as
Alarm 1 Output (Relay or SSRD only)
or Retransmission Output (DC only)

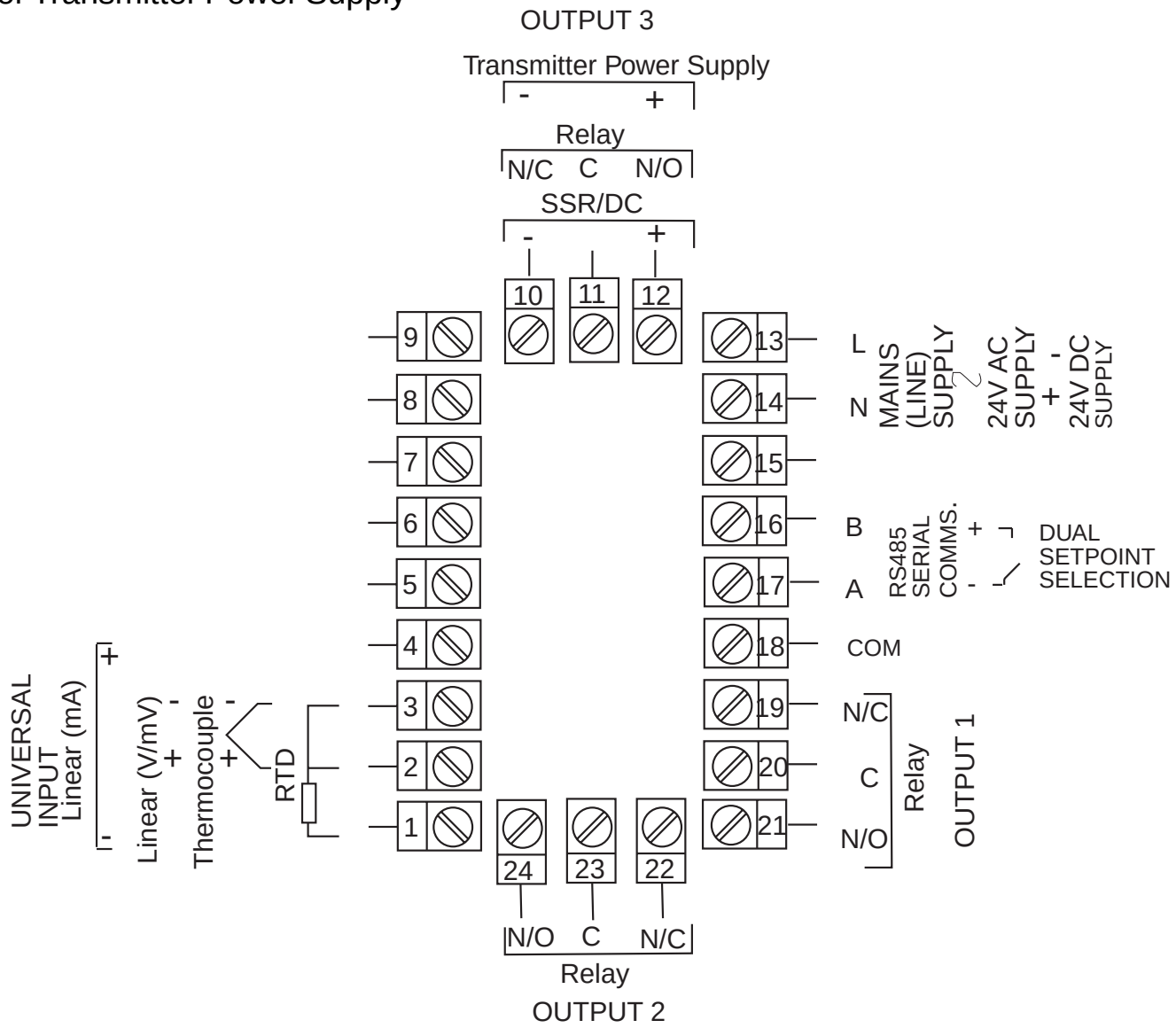


Output 1 is normally used
as the "Open Valve" output.

Output 2 is normally used
as the "Close Valve" output.

1/8 DIN

Output 3 is used either as
Alarm 1 Output (Relay or SSRD only)
or Retransmission Output (DC only),
or Transmitter Power Supply

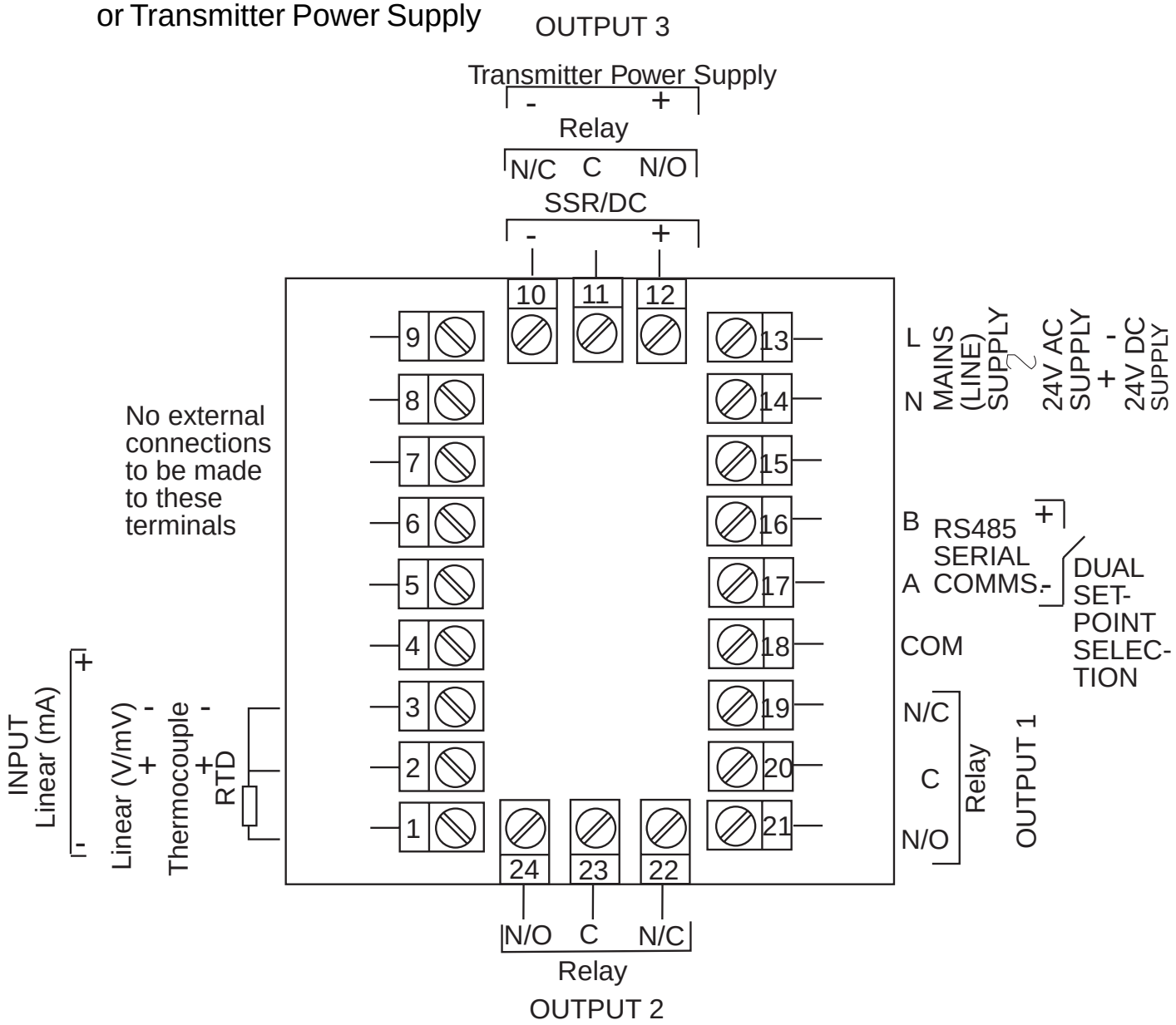


Output 1 is normally used
as the "Open Valve" output.

Output 2 is normally used
as the "Close Valve" output.

1/4 DIN

Output 3 is used either as
Alarm 1 Output (Relay or SSRD only)
or Retransmission Output (DC only),
or Transmitter Power Supply



Output 1 is normally used
as the "Open Valve" output.

Output 2 is normally used
as the "Close Valve" output.

Input Connections 2.3

In general, all wiring connections are made to the instrument after it is installed. Avoid Electrical Shock. AC power wiring must not be connected to the source distribution panel until all wiring connection procedures are completed.

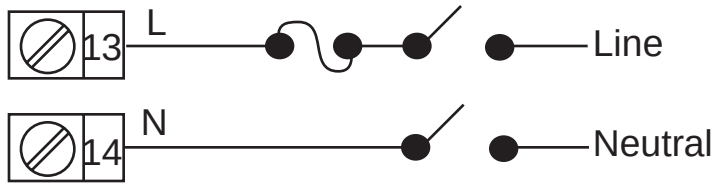
Caution: This equipment is designed for installation in an enclosure which provide adequate protection against electric shock. Local regulations regarding electrical installation should be rigidly observed. Consideration should be given to prevention of access to the power terminations by unauthorized personnel. Power should be connected via a two pole isolating switch (preferably situated near the equipment) and a 1 A fuse, as shown in Figure 2-7, below.

FIGURE 2-7

Main Supply

The instrument will operate on 90-264V AC 50/60 Hz mains (line) supply. The power consumption is approximately 4 VA. If the instrument has relay outputs in which the contacts are to carry mains (line) voltage, it is recommended that the relay contact mains (line) supply should be switched and fused in a similar manner but should be separate from the instrument mains (line) supply.

1/8 & 1/4 DIN



1/16 DIN

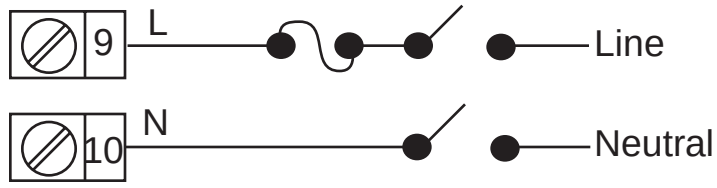


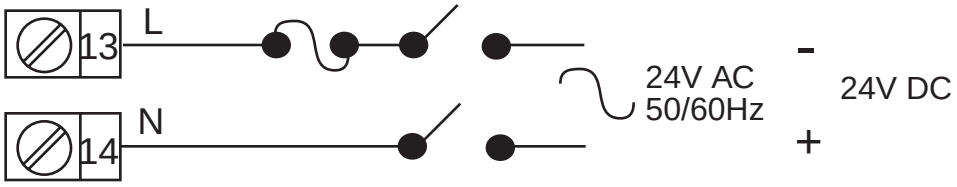
FIGURE 2-7A

24V Nominal AC/DC Supply

The supply connection for the 24V AC/DC option of the instrument are as shown below. Power should be connected via a two pole isolating switch and a 315 mA slow-blow (anti-surge Type T) fuse. With the 24V AC/DC supply option fitted, these terminals will accept the following supply voltage ranges:

24V (nominal) AC 50/60 Hz - 20-50V
24V (nominal) DC - 22-65V

1/8 & 1/4 DIN



1/16 DIN

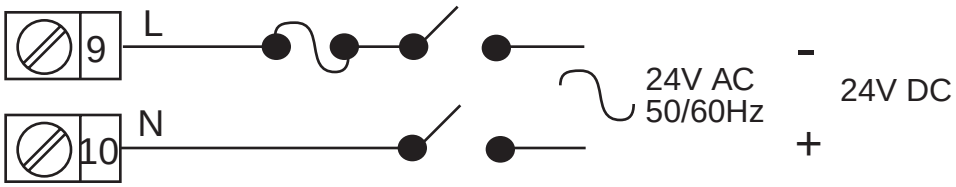
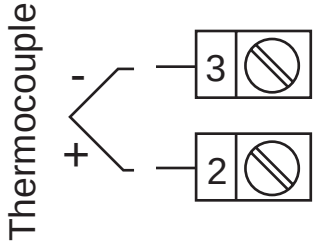


FIGURE 2-8

Thermocouple (T/C) Input

Make thermocouple connections as illustrated below. Connect the positive leg of the thermocouple to terminal 2 (1/8 & 1/4 DIN) or terminal 5 (1/16 DIN) and the negative leg to terminal 3 (1/8 & 1/4 DIN) or terminal 4 (1/16 DIN).

1/8 & 1/4 DIN



1/16 DIN

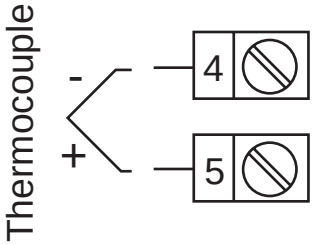
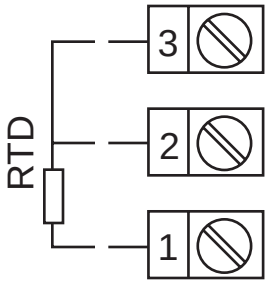


FIGURE 2-9

RTD Input

Make RTD connections as illustrated below. For a three wire RTD, connect the resistive leg of the RTD to terminal 1 (1/8 & 1/4 DIN) or terminal 6 (1/16 DIN) and the common legs to terminals 2 and 3 (1/8 & 1/4 DIN) or terminals 4 and 5 (1/16 DIN). For a two wire RTD, connect one leg to terminal 2 (1/8 & 1/4 DIN) or terminal 5 (1/16 DIN) and the other leg to terminal 1 (1/8 & 1/4 DIN) or terminal 6 (1/16 DIN) as shown below. A jumper wire supplied by the customer must be installed between terminals 2 and 3 (1/8 & 1/4 DIN) or terminals 4 and 5 (1/16 DIN). Input conditioning jumper must be positioned correctly (see Appendix B) and Hardware Definition Code must be correct (see Appendix C).

1/8 & 1/4 DIN



1/16 DIN

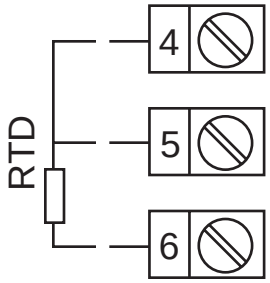


FIGURE 2-10

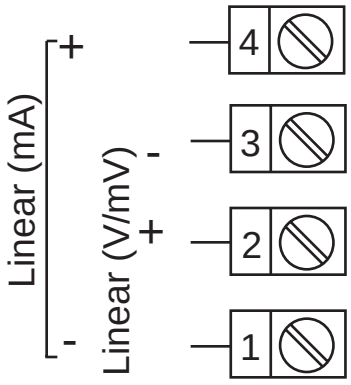
Volt, mV Input

Make volt and millivolt connections as shown below. Input conditioning jumper must be positioned correctly (see Appendix B) and Hardware Definition Code must be correct (see Appendix C).

mADC Input

Make mADC connections as shown below. Input conditioning jumper must be positioned correctly (see Appendix B) and Hardware Definition Code must be correct (see Appendix C).

1/8 & 1/4 DIN



1/16 DIN

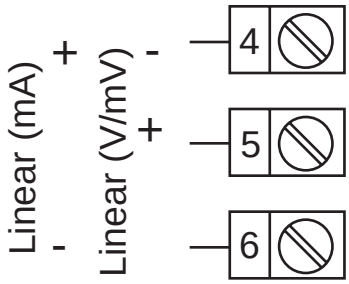
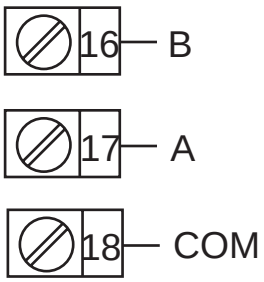


FIGURE 2-11

Remote Digital Communications - RS485

Make digital communication connections as illustrated below.

1/8 & 1/4 DIN



1/16 DIN

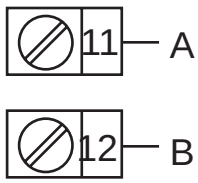
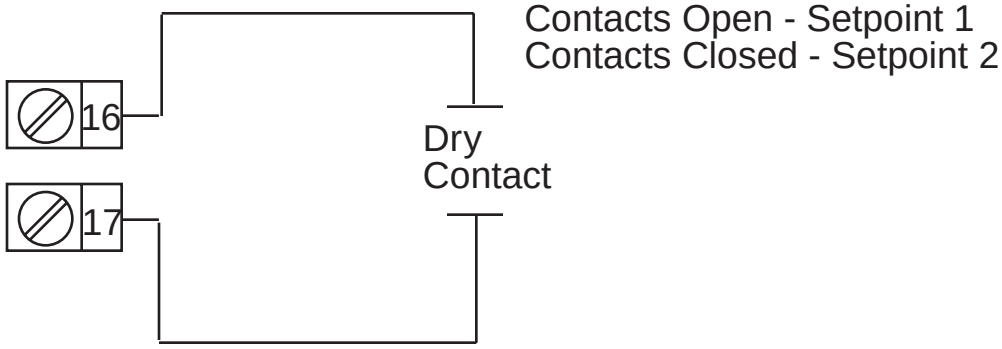


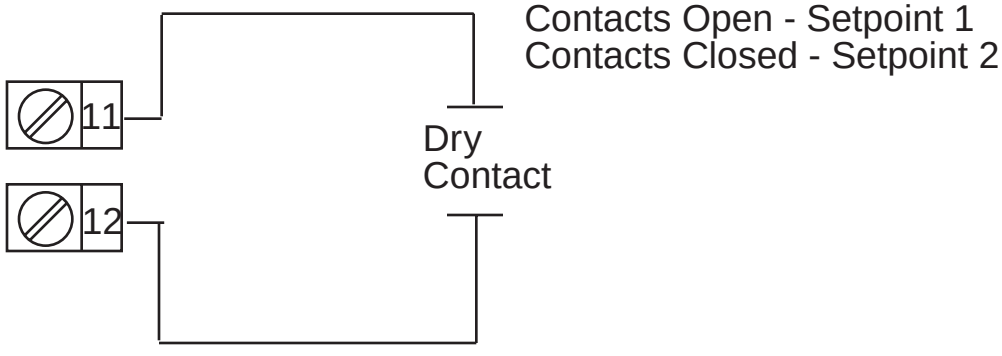
FIGURE 2-12

Dual Setpoint Selection

1/8 & 1/4 DIN



1/16 DIN



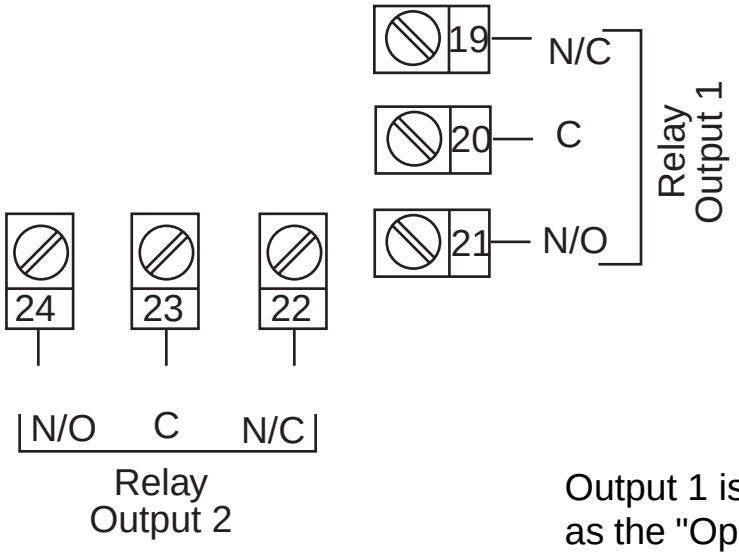
Output Connections 2.4

FIGURE 2-13

Relay Outputs 1 & 2

The contacts are rated at 2A resistive at 120V (motor drive) or 2A at 240V AC (resistive or independent contactor drive). Connections are made as shown below.

1/8 & 1/4 DIN



Output 1 is normally used as the "Open Valve" output.

Output 2 is normally used as the "Close Valve" output.

1/16 DIN

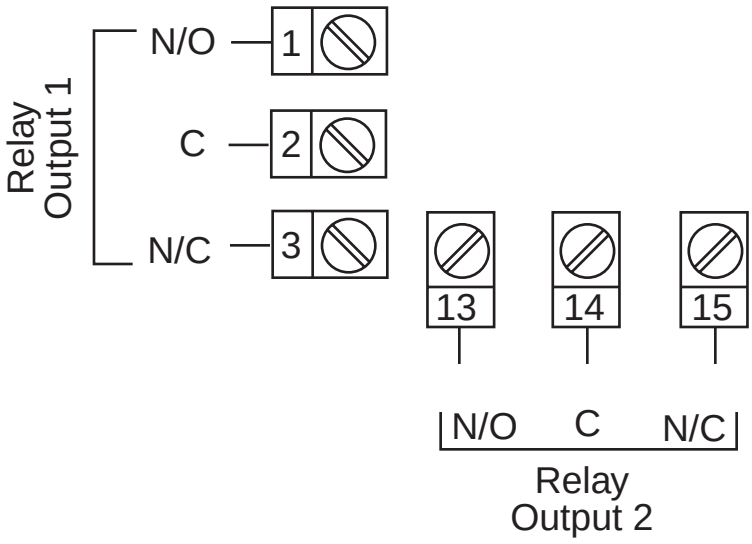
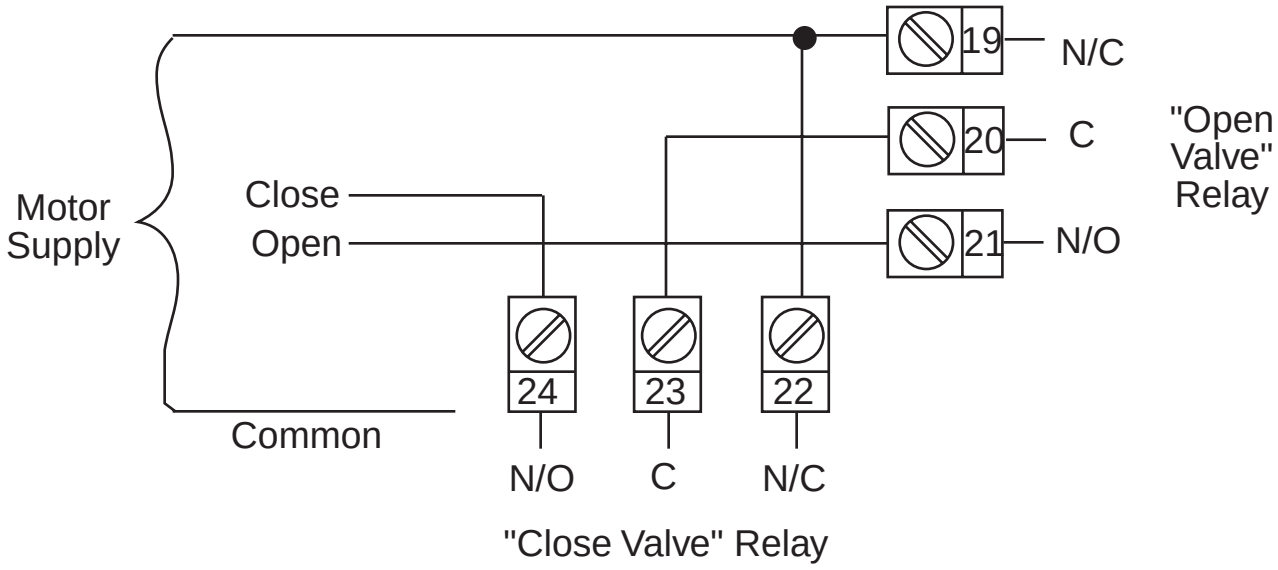


FIGURE 2-14

The controller is designed to switch on either Output 1 or Output 2 (to open or close the valve). However, under fault conditions, both Output 1 and Output 2 relays could be switched ON simultaneously. For safety purposes, an interlock can be included which connects the supply to the motor via the "normally closed" relay contacts on the Output 1 and Output 2 relays (see Figure 2-14)

1/8 & 1/4 DIN



1/16 DIN

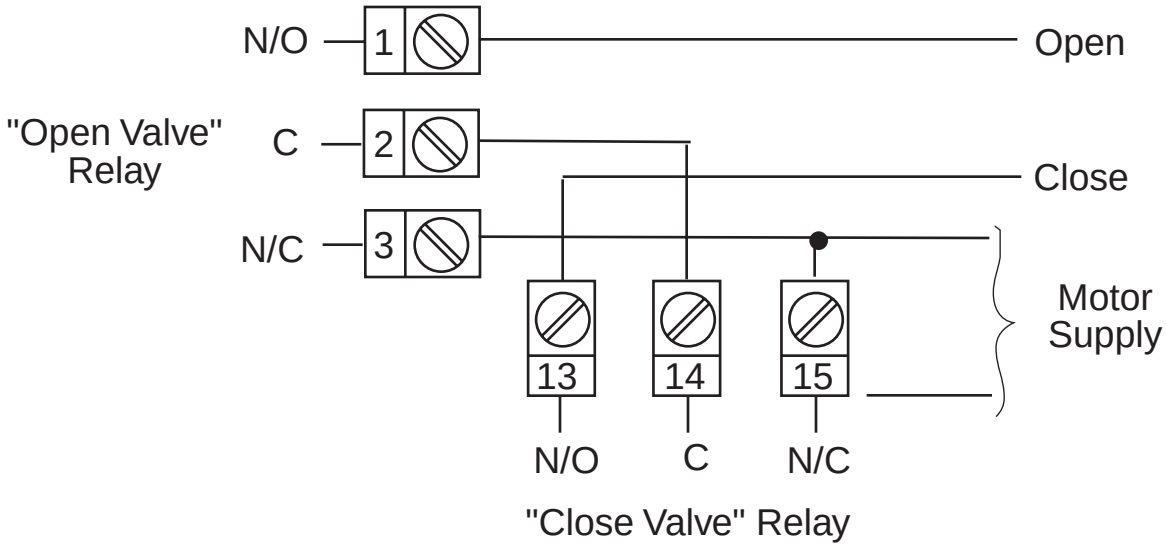
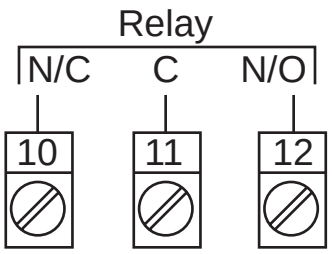


FIGURE 2-15

Relay Output 3

Connections are made to Output 3 relay as illustrated below. The contacts are rated at 2 amp resistive, 120/240 VAC.

1/8 & 1/4 DIN



1/16 DIN

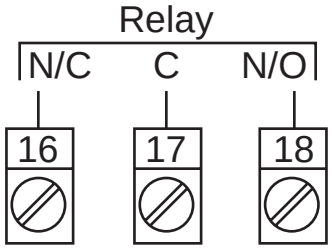
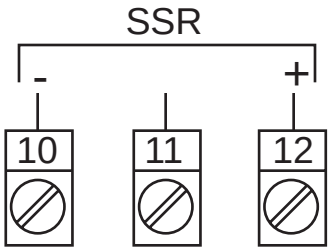


FIGURE 2-16

SSR Driver Output 3

Connections are made to Output 3 SSR Driver as illustrated below. The solid state relay driver is a non-isolated 0-4 VDC nominal signal. Output impedance is 250 ohms.

1/8 & 1/4 DIN



1/16 DIN

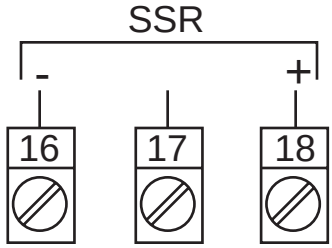
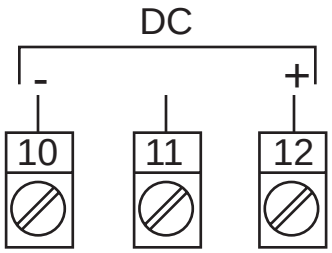


FIGURE 2-17

mADC Output 3 (Recorder Output Only)

Make connections for DC output 3 as illustrated below.

1/8 & 1/4 DIN



1/16 DIN

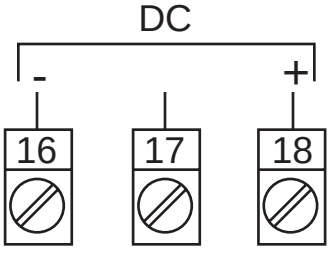
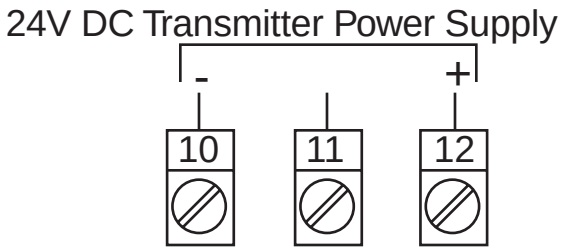


FIGURE 2-18

Transmitter Power Supply

Make connections for 24V DC transmitter power supply as illustrated below.

1/8 & 1/4 DIN (1/16 DIN not available)



Operation 3.1

3.1.1 POWER UP PROCEDURE

Verify all electrical connections have been properly made before applying power to the instrument.

If the instrument is being powered for the first time, it may be desirable to disconnect the controller output connections. The instrument will be into control following the power up sequence and the output(s) may turn ON. During power up, a self-test procedure is initiated during which all LED segments in the two front panel displays appear and all LED indicators are ON. When the self-test procedure is complete, the instrument reverts to normal operation.

Note: A delay of about 3 seconds, when power is first applied, will be seen before the displays light up.

3.1.2 KEYPAD OPERATION

AUTO/MANUAL KEY
This key is used to:

1. Enter the Auto/Manual mode and vice versa.
2. Used to activate the Auto Tune mode.
3. Used to confirm a change in the Program mode.

SCROLL KEY
This key is used to:

1. Select adjustment of the ramping setpoint, if enabled.
2. Select a parameter to be viewed or adjusted.
3. Display enabled modes of operation.
4. Display a mode parameter value.
5. Advance display from a parameter value to the next parameter code.
6. Activate the Pre-tune mode.
7. With the DOWN key to view the current Hardware Definition Code setting.

UP KEY
This key is used to:
1. Increase the displayed parameter value.
2. Increase setpoint.
3. With the DOWN key to enter Pre and Auto Tune mode.

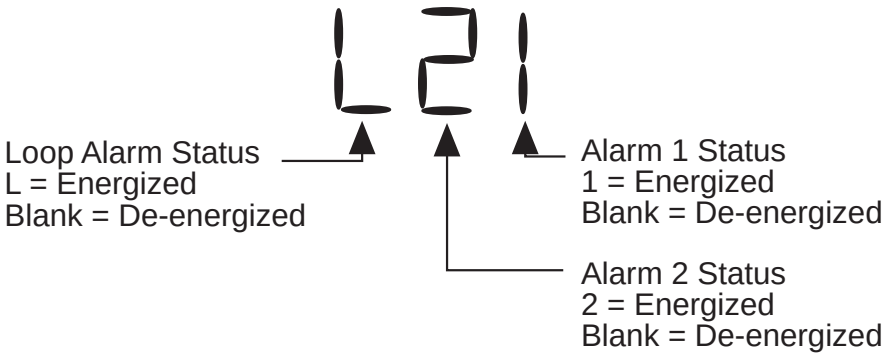
DOWN KEY
This key is used to:
1. Decrease the displayed parameter value.
2. Decrease setpoint.
3. With the UP key to enter the Pre and Auto Tune mode.
4. With the SCROLL key to view the current Hardware Definition Code setting.

3.1.3 DISPLAYS

During configuration the upper display shows the parameter setting. The lower display shows the parameter code for the currently selected parameter. During operation, the upper display shows the value of the process variable. The lower display shows the setpoint value.

*3.1.3.1 ALARM STATUS DISPLAY**

The user may view the status of the instrument's alarm(s) by depressing the SCROLL key until the lower display shows the legend "ALSt" and the upper display shows the alarm status in the following format:



*This display is available only if one or more of the alarms is/are energized.

When "ALSt" is seen in the lower display, to enter the Program or Tune modes, press the UP key with "ALSt" displayed, then the SCROLL key to Program or Tune.

3.1.3.2 OVER-RANGE/UNDER-RANGE DISPLAY

If the process variable attains a value higher than the input scale maximum limit, the upper display will show:

If the process variable attains a value lower than the input scale minimum, the upper display will show:

If a break is detected in the sensor circuit, the upper display will show:

3.1.4 FRONT PANEL INDICATORS

+ Indicates the state of the Output 1 relay. When the indicator is ON the relay is energized.

- Indicates the state of the Output 2 relay. When the indicator is ON the relay is energized.

ALM When flashing, indicates an Alarm condition.

MAN Flashes when the Manual mode has been entered

AT Indicates when the Pre-Tune mode or Auto-Tune mode has been selected; flashing for Pre-Tune and continuously ON for Auto-Tune.

3.1.5 SETPOINT ADJUSTMENT

3.1.5.1 SINGLE SETPOINT

To adjust the instrument setpoint, when single setpoint is specified, proceed as follows:

To adjust the Setpoint, press the UP or DOWN key as applicable. Momentary depression will increment or decrement (as appropriate) the setpoint by one unit in the least significant digit. If the key is held for longer than 1 second, the least significant digit will change at the rate of 25 units per second. If the key is held for longer than 10 seconds, the second least significant digit will change at the rate of 25 units per second. If the key is held for more than 10 seconds, the third least significant digit will change at the rate of 25 units per second.

3.1.5.2 DUAL SETPOINT

To adjust the instrument setpoint when dual setpoint is specified and selected, proceed as follows:

To adjust the ACTIVE Setpoint, press the UP or DOWN key as applicable. Momentary depression will increment or decrement (as appropriate) the setpoint by one unit in the least significant digit. If the key is held for longer than 1 second, the least significant digit will change at the rate of 25 units per seconds. If the key is held for longer than 10 seconds, the second least significant digit will change at the rate of 25 units per second. If the key is held for more than 10 seconds, the third least significant digit will change at the rate of 25 units per second.

If Dual Setpoint has been selected, the "normal" display will be as follows:

Upper Display = Process Variable value
Lower Display = Active Setpoint value (adjustable)

Press the SCROLL key to change the display to:

Upper Display = Blank
Lower Display = the legend SP1

Press the SCROLL key again to change the display to:

Upper Display = Setpoint 1 value (adjustable)
Lower Display = the legend SP1

Press the SCROLL key again to change the display to:

Upper Display = Blank
Lower Display = the legend SP2

Press the SCROLL key again to change the display to:

Upper Display = Setpoint 2 value (adjustable)
Lower Display = the legend SP2

NOTE: The lower display uses the left-most character to distinguish between the ACTIVE and INACTIVE setpoints in the following manner:

_SP2	SP2
ACTIVE SETPOINT	INACTIVE SETPOINT

3.1.5.3 RAMPING SETPOINT

A selectable Ramp Rate function in the range of 1 to 9999 units per hour can be used to limit the rate at which the setpoint used by the control algorithm will change. This feature will also establish a soft start up. Upon power up, the instrument will take the initial process value as the setpoint. A setpoint ramp rate will be calculated to increase the setpoint from the initial process value to the setpoint selected. The setpoint ramp feature disables the Pre-Tune facility. The Auto-Tune facility, if selected, will commence only after the setpoint has completed the ramp.

Sudden changes in the setpoint value entered via the keypad can be inhibited from effecting the control outputs by use of this feature. The internal setpoint used to control the process will ramp to the setpoint value entered at the rate of change selected.

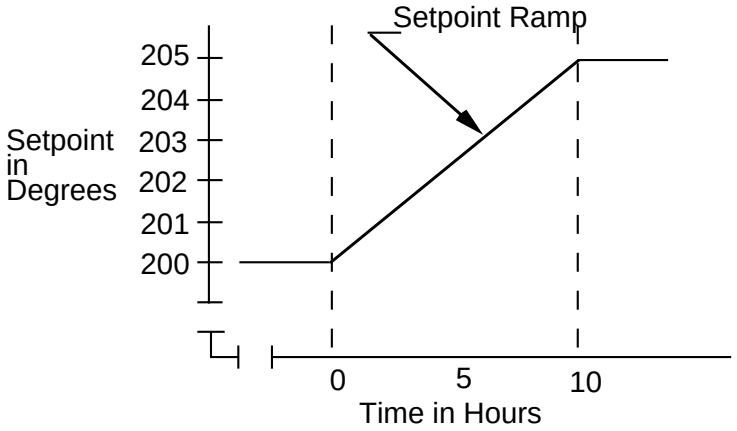
To view the Ramping Setpoint value while in the Control mode and "ESPr" in the Tune mode is disabled, press the SCROLL key until "SPrP" is displayed in the lower display. This is the code for the ramping setpoint value. Press the SCROLL key one more time and the lower display shows "SPrP" and the upper display will show the current ramping setpoint.

SPRr not OFF and ESPr equal to 0

If ESPr is enabled, the display sequence changes to:

*Adjustable

To enter the Program or Tune mode when setpoint ramping is selected, press the SCROLL key until the lower display shows "SPrP" or "SPrr" and the upper display is blank. With "SPrP" or "SPrr" display in the lower display, press the UP key once and "CtrL should be displayed in the lower display. With "CtrL" displayed, press the SCROLL key until "Prog" or "tunE" is displayed in the lower display.



3.1.6 MANUAL CONTROL

Manual Control is not applicable if the Auto/Manual selection in Tune mode is disabled.

To enter the Manual mode, press the AUTO/MANUAL key. The Manual mode status LED will begin to flash indicating that the Manual mode is in use. Shifting from the Control to the Manual mode is bumpless.

The valve position may then be adjusted with the UP/DOWN keys.

To exit from the Manual mode, press the Auto/Manual key. Shifting to the Control mode is bumpless.

Configuration 3.2

All configurable parameters are provided in Tables 3-1 through 3-3 on the following pages. These tables illustrate the display sequence, parameter adjustment and factory setting for each step.

Depression of the SCROLL key will cycle the display if Setpoint Ramp Rate is not enabled (top display is blank, lower display shows the parameter code) through all enabled modes as follows:

CONTROL ----	PROGRAM ----	TUNE
(Ctrl)	(Prog)	(tunE)

If a mode is not enabled it will be skipped over by the routine.

3.2.1 ENABLE MODE

The Enable mode provides a means of enabling or disabling access to the Program and Tune modes. If a mode has been disabled, then that mode will not be displayed or available to the user in the Control mode. See Table 3-1 (page 24-25) for the Enable Mode procedure.

3.2.2 PROGRAM MODE

The Program mode is used to configure or re-configure the instrument. The input and output selections are made in the Program mode. All possible parameters are illustrated in Table 3-2 (page 34). Only those parameters that are applicable to the hardware options chosen will be displayed.

3.2.3 TUNE MODE

The Tune mode is used to adjust the tuning parameters, alarm settings, setpoint limits, and retransmit scaling needed for proper operation of the instrument. See Table 3-3 (page 36) for Tune mode. Only those parameters that are applicable will be displayed.

TABLE 3-1 ENABLE MODE

To enter the Enable mode, press and hold the UP and DOWN keys. After 5 seconds (the AT LED should have flashed once), the display returns to normal. After 5 more seconds, "EnAb" will be displayed. Release the keys, the display should show "EPro". Pressing the DOWN key will display the Enable mode codes in the following sequence:

EPro - - Etun - - ESPC

Pressing the SCROLL key will display the Enable mode codes with the upper display blank. The next depression of the SCROLL key will add the Enable code status (ON or OFF) to the upper display. With the Enable code status displayed, use the UP key to change the status to ON and the DOWN key to change the status to OFF.

To exit the Enable mode, press the UP key with the Enable code displayed in the lower display and the upper display blank.

STEP	DESCRIPTION	DISPLAY CODE	AVAILABLE SETTINGS	FACTORY SETTING
1	Program Mode	EPro	ON/OFF	ON
2	Tune Mode	Etun	ON/OFF	ON
3	Setpoint Changes	ESPC	ON/OFF	ON

TABLE 3-2 PROGRAM MODE

To enter the Program mode, press and release the SCROLL key until "Prog" is displayed. Use the DOWN key to enter the Program mode. Depress and release the SCROLL key to sequence through the parameters and their values, alternately showing the parameter code in the lower display with the upper display blank, then the parameter code with the parameter value displayed. Use the UP and DOWN keys to adjust the parameter values. After adjusting a parameter, the upper display will flash, indicating that the new setting has yet to be confirmed. When the setting is as required, it may be confirmed by pressing the AUTO/MANUAL key and the upper display stops flashing. After confirming a change, press the SCROLL key to proceed to the next parameter. Use the DOWN key to advance to the next parameter when a parameter code is showing in the lower display and the upper display is blank.

To exit the Program mode, press the UP key whenever a parameter code is displayed in the lower display and the upper display is blank.

DEFAULT PARAMETER INDICATION

If a parameter value, such as Input Select, was changed while in the Program mode, when returning to the Control mode, a decimal point after each digit will be lit. This display indicates all Tune mode parameters have been set to their default condition. To clear this condition, enter the Tune mode and make a parameter value change and review each parameter for its proper setting.

STEP	DESCRIPTION	DISPLAY CODE	AVAILABLE SETTINGS	FACTORY SETTING
1	Input Select	inPS	See App. D*	1420
2	Output 1 Action	Out1	Reverse Direct	REV
3	Alarm 1 Type	ALA1	P_hi =Proc High nonE=No Alarm bAnd=Band dE =Deviation P_Lo=Proc Low	P_hi
4	Alarm 2 Type	ALA2	Same selection as ALA1	nonE
5	Alarm Inhibit**		nonE=No alarms inhibited ALA1=Alarm 1 inhibited ALA2=Alarm 2 inhibited both=Both alarms inhibited	
6	Output 3 Usage	USE3	Al_d =Alm Dir rEcP =Rcdr Out P.V. rEcS =Rcdr Out S.P. LP_r =Loop Reverse LP_d=Loop Direct Ad_r =Rev Logic AND Ad_d=Dir Logic AND Or_r =Rev Logic OR Or_d=Dir Logic OR Al_r =Alm Rev	Al_d
7	Com Bit Rate	CbS	1200, 2400, 4800, 9600	4800
8	Com Address	CAd	1 - 32	1
9	CJC Enable	CJC	EnAb diSA	EnAb

* The Hardware Definition Code and input jumper configuration may need to be changed. See Appendix B and C.

** On power-up, an "alarm" condition may occur, based on the alarm value, the process variable value and, if appropriate to the alarm type, the (active) setpoint value. This would normally activate an alarm; however, if the pertinent alarm is inhibited, the alarm indication is suppressed and the alarm will remain inactive. This will prevail until the "alarm" condition returns to the "inactive" state, whereafter the alarm will operate normally.

Also, during dual setpoint operation, whenever there is switching from Setpoint 1 to Setpoint 2 (or vice versa), similar alarm suppression will occur, if the pertinent alarm is inhibited.

TABLE 3-3 TUNE MODE

To enter the Tune mode, press and release the SCROLL key until tunE is displayed. Use the DOWN key to enter the Tune mode. Depress and release the SCROLL key to sequence through the parameters and their values, alternately showing the parameter code in the lower display with the upper display blank, then the parameter code with the parameter value displayed. Use the UP and DOWN keys to adjust the parameter values. After adjusting a parameter, depress the SCROLL key to proceed to the next parameter. Use the DOWN key to advance to the next parameter when a parameter code is showing in the lower display and the upper display is blank.

To exit the Tune mode, press the UP key whenever a parameter code is displayed in the lower display and the upper display is blank.

STEP	DESCRIPTION	DISPLAY CODE	AVAILABLE SETTINGS	FACTORY SETTING
1	Ramping Setpoint Value	SPrP	± Setpoint Limits	Read Only
2	Setpoint Ramp Rate	SPrr	1 to 9999 units/hour and OFF	OFF
3	Input Filter	Filt	0.0 to 100.0 seconds in .5 sec. increments	2.0

STEP	DESCRIPTION	DISPLAY CODE	AVAILABLE SETTINGS	FACTORY SETTING
4	Input Correct	iCor	± Span	0
5	1st Output Prop. Band	Pb1	0.5 to 999.9% of Input Span	5.0
6	Automatic Reset	ArSt	0.01 secs to 99 mins 59 secs	99.59
7	Rate	rAtE	0 sec to 99 mins. 59 secs.	0 secs.
8	Setpoint Upper Limit	SPuL	Span Max.	Span Max.
9	Setpoint Lower Limit	SPLL	Span Min.	Span Min.
10	Process Output Upper	Pou	-1999 to 9999	Span Max.
11	Process Output Lower	PoL	-1999 to 9999	Span. Min.
12	Motor Travel Time	tr	5 secs to 5 minutes	1 min
13	Minimum Motor On Time	tOn	0.0 sec to Motor Travel Time ÷ 10	1 sec
14	Process High Alarm 1	PHA1	± Span	Span Max.
15	Process Low Alarm 1	PLA1	± Span	Span Min.
16	Band Alarm 1	bAL1	0 to Span	5

STEP	DESCRIPTION	DISPLAY CODE	AVAILABLE SETTINGS	FACTORY SETTING
17	Deviation Alarm 1	dAL1	± Span	5
18	Process High Alarm 2	PHA2	± Span	Span Max.
19	Process Low Alarm 2	PLA2	± Span	Span Min.
20	Band Alarm 2	bAL2	0 to Span	5
21	Deviation Alarm 2	dAL2	± Span	5
22	Loop Alarm Enable	LAEn	0=Disable 1=Enable	0
23	Decimal Position	dPoS	0, 1, 2, 3 (Linear Input Only)	1
24	Engineering Units Upper	Euu	-1999 to 9999	1000
25	Engineering Units Lower	EuL	-1999 to 9999	0
26	*Enable Pre Tune	EPtn	0=Disable 1=Enable	0
27	Enable Manual Control	ESby	0=Disable 1=Enable	0
28	**Setpoint Ramp Rate Enable	ESPr	0=Disable 1=Enable	0
29	Comm. Enable	CCon	0=Disable 1=Enable	1

* Activates Pre-Tune on power-up when enabled.
** When enabled, allows user to change ramp rate without having to enter Tune mode.

Pre-Tune Mode 3.3

The Pre-Tune mode may be used to set the instrument's PID parameters to values which are approximately correct, in order to provide a base from which the Auto Tune mode may optimize tuning.

To engage the Pre-Tune mode, with the instrument in Control mode, press and hold the UP and DOWN keys for approximately 5 seconds (the display will flash during this period) until the AT LED flashes once. Release the UP and DOWN keys. Press and hold the SCROLL key for approximately 3 seconds until the AT LED flashes.

To disengage the Pre-Tune mode, press and hold the UP and DOWN keys until the AT LED flashes once. Release the UP and DOWN keys. Press and hold the SCROLL key for approximately 3 seconds until the AT LED is continuously OFF.

Note: Since the Pre-Tune mode is a single-shot operation, it will automatically disengage itself once the operation is complete. If the Enable Pre-Tune parameter in the Tune mode is enabled, then upon a power interruption, the unit will first engage the Pre-Tune mode prior to engaging the Auto-Tune mode when power is restored.

Also note: The Pre-Tune mode will not engage during setpoint ramping. Additionally, if the process variable is within 5% of input span from the setpoint, or if an incorrect key sequence is used, the Pre-Tune mode will not be engaged.

Auto-Tune Mode 3.4

The Auto-Tune mode is used to optimize tuning while the instrument is operating. While Auto-Tune is active, the instrument operates in PI mode.

Manual adjustment of the PID terms provides all the normal benefits of our Open Loop VMD control. Auto-Tune now improves on this in two ways:

a) Auto-Tune selects optimal values for the Proportional Band and Integral Time Constant (Auto Reset).

b) Auto-Tune interacts with the control software to provide even tighter control than is possible under manual tuning conditions, while still keeping valve activity to a minimum.

Notes

1. When Auto-Tune is disengaged, all the benefits of tighter control are retained while the PID terms are left unchanged. Once any manual adjustments are made to Proportional Band, Integral Time Constant (Auto Reset), or Derivative Time Constant (Rate), the instrument reverts to conventional Open Loop VMD control.

2. If Minimum Motor ON time (display code "tON") is set equal to 00 seconds, the valve activity minimization strategy will not operate.

To engage the Auto-Tune mode, with the instrument in Control mode, press and hold the UP and DOWN keys for approximately 5 seconds (the display will flash during this period) until the AT LED flashes once. Release the UP and DOWN keys. Press and hold the AUTO/MAN key for approximately 3 seconds until the AT LED lights continuously.

Note: If the Enable Pre-Tune parameter in the Tune mode is enabled, then on power-up, the unit will automatically engage the Pre-Tune mode prior to engaging the Auto-Tune mode when power is restored.

To disengage the Auto-Tune mode, press and hold the UP and DOWN keys until the AT LED flashes once. Release the UP and DOWN keys. Press and hold the AUTO/MAN key for approximately 3 seconds until the AT LED is continuously OFF.

Manual Tuning Method 3.5

Before starting to tune the instrument to the load, check that the Setpoint Upper and Lower Limits (SPuL and SPLL) are set to safe levels.

The following technique is used to determine values of Proportional Band (Pb) and Integral Time Constant (ArSt). It is recommended that the Derivative Time Constant (rAtE) is always set to 0 seconds, in order to avoid excessive valve activity.

Note: This technique is only suitable for processes which will not be harmed by large fluctuations in the process variable. It provides acceptable values, from which to start fine tuning, for a wide range of processes.

1. Adjust the setpoint to the normal operating value (or to a lower value, if overshoot beyond this point is likely to cause damage).

2. Set the Proportional Band (Pb) to 0.5%.

3. Set the Integral Time Constant (ArSt) to 99mins 59secs.

4. Set the Derivative Time Constant (rAtE) to 0 seconds.

5. Set the Motor Travel Time (tr) to the time required for the valve to travel from "fully closed" to "fully open" (or vice versa).

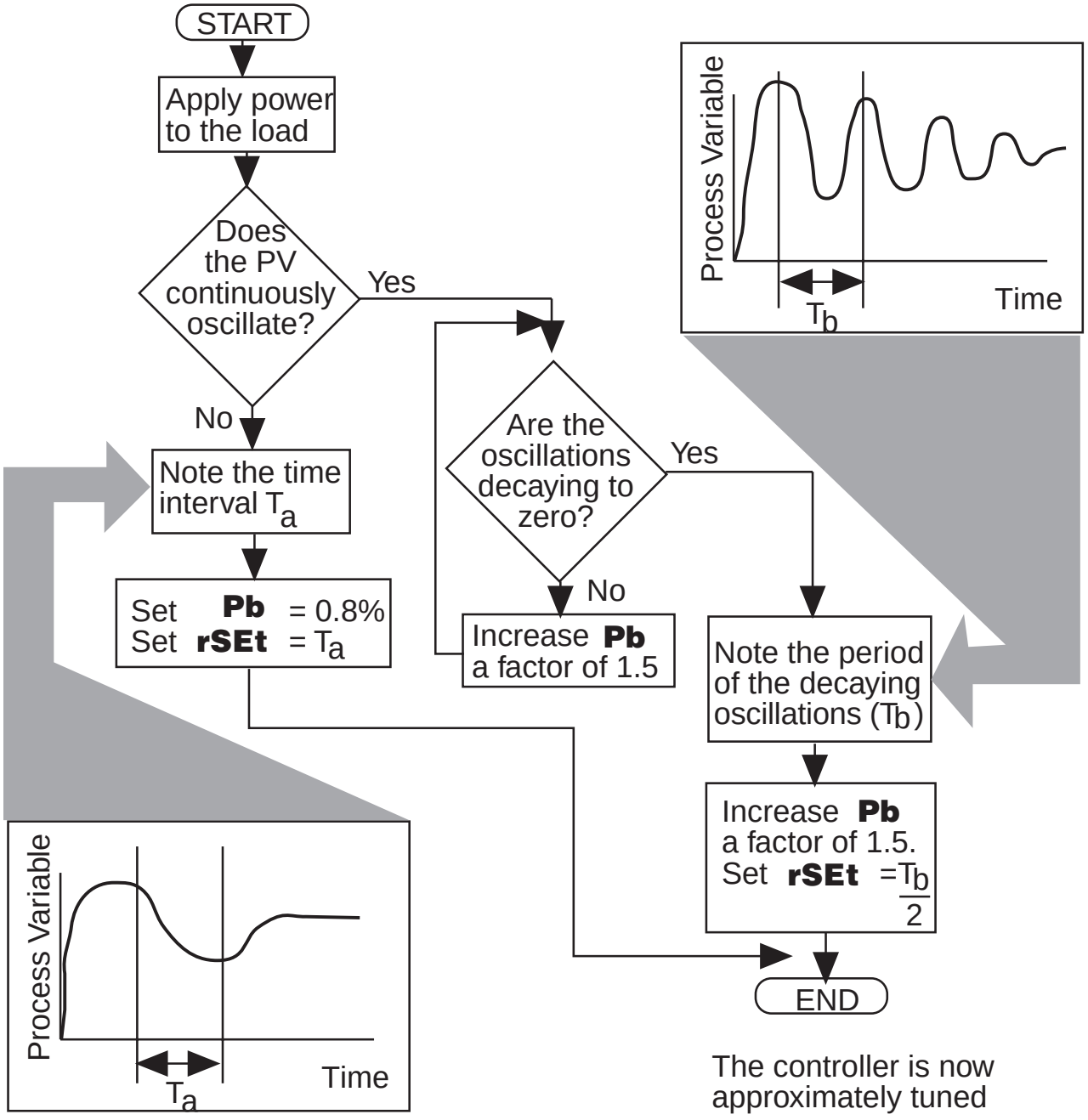
6. Set the Minimum Motor ON Time (tOn) to the minimum motor travel required.

7. Ensure that the valve is positioned away from its end stops; manual control may be used to set the valve position.

8. Follow the instructions in Figure 3-1. At each stage, allow sufficient settling time before moving on the next stage.

Note: After setting up the parameters, set the instrument to Control mode to prevent unauthorized adjustment to the values.

FIGURE 3-1
Manual Tuning Technique



Control Capability 4.1

A variety of user programmable control features and capabilities are available including:

- Auto Tune
- Alarm Functions
- Auto/Manual Switching
- Process Retransmission
- Setpoint Retransmission
- Setpoint Ramp Rate

The capabilities available in a specific unit are dependent upon the hardware options specified when the instrument is ordered. Refer to Appendix F for the decoding of the instrument model number.

Setpoint Adjustment 4.2

To adjust the setpoint with the instrument in the Control mode, press the UP key to raise the setpoint and the DOWN key to lower the setpoint.

Depressing the SCROLL key, if setpoint ramping is enabled and if ramp rate is not OFF will change the displays to:

Upper Display = Ramping Setpoint Value (Read Only)
Lower Display = SPrP

Appendix A
Glossary of Terms

Input Filter Time Constant
This parameter is used to filter out any extraneous impulses on the process variable. This filtered PV is used for all PV-dependent functions (control, alarm, etc). The time constant is adjustable from 0.0 seconds (off) to 100.0 seconds, in 0.5 second increments. Default value is 2.0 seconds. Display code is FiLt.

Input Correction
This parameter is used to modify the actual process variable and is adjustable in the range ± input span. Default value is 0. Display code is iCor.

Proportional Band
This parameter is the portion of the input span over which the valve movement is proportional to changes in the displayed process variable value. It may be adjusted in the range 0.5% to 999.9%. Default value is 5.0%. Display code is Pb1.

Automatic Reset (Integral)
This parameter is used to bias the proportional output to compensate for process load variations. It is adjustable in the range 1 second to 99 minutes 59 seconds per repeat. Decreasing the time increases the Reset. Default value is 99min 59sec. Display code is ArSt.

Rate (Derivative)
This parameter is adjustable in the range 00 seconds to 99 minutes 59 seconds and specifies how the control action responds to the rate of change in the process variable. Default value is 0.0. Display code is rAtE.

Setpoint Upper Limit
This parameter is the maximum limit for setpoint adjustment. It should be set to a value which prevents the setpoint being given a value which will cause damage to the process. The range of adjustment is to Maximum Input Range. Default value is Range Maximum. Display code is SPuL.

Setpoint Lower Limit
This parameter is the minimum limit for setpoint adjustment. It should be set to a value which prevents the setpoint being given a value which will cause damage to the process. The range of adjustment is to Minimum Input Range. Default value is Range Minimum. Display code is SPLL.

Process Output Upper Value
This parameter defines the value of the retransmitted output (process variable or setpoint , whichever is applicable) at its maximum value; for example, for a 0-5V output, this value corresponds to 5V. It may be adjusted within the range -1999 to 9999. The decimal position is always the same as that for the process variable input. Default value is Input Range Maximum. Display code is Pou.

Note: If this parameter is set to a value less than that for the Process Output Lower Value, the relationship between the process variable/setpoint value and the retransmission output is reversed.

Process Output Lower Value
This parameter defines the value of the retransmitted output (process variable or setpoint, whichever is applicable) at its minimum value; for example, for a 0-5V output, this value corresponds to 0 V. It may be adjusted within the range -1999 to 9999. The decimal position is always the same as that for the process variable input. Default value is Input Range Minimum. Display code is PoL.

Note: If this parameter is set to a value greater than that for the Process Output Upper Value, the relationship between the process variable/setpoint value and the retransmission output is reversed.

Motor Travel Time
This parameter is used to select the time taken for the valve to travel from one physical end stop to the other. It is important that this time reflects the physical travel limits of the valve. It may be adjusted within the range of 5 seconds to 5 minutes in 1 second increments. Display code is tr and the default is 1 minute.

Minimum Motor ON Time
This parameter defines the minimum drive effort allowed to initiate valve movement, if the valve was previously stationary. This parameter is used primarily to ensure that valve frictional and inertial effects do not cause controller drive to be ignored by the valve.

If Auto-Tune is OFF, this parameter can be used to influence valve activity. Larger values reduce valve activity but increase the risk of the process variable oscillating about the setpoint. Auto-Tune monitors on-control valve activity and will minimize it automatically. Too large a value of Minimum Motor ON Time can impair the effectiveness of the Auto-Tune facility. If process variable oscillations persist while Auto-Tune is running, it may be for this reason. Default value is 1 second. Adjustment is in the range of 0.0 seconds to Motor Travel Time (in seconds) divided by 10. Example: Motor Travel Time set to 4 minutes; Maximum Minimum Motor ON Time equals 240/10 or 24 seconds. Display code is tOn.

Process High Alarm 1 Value
This parameter, applicable only when Alarm 1 is selected to be a Process High alarm, defines the process variable value at or above which Alarm 1 will be active. Its value may be adjusted between Input Range Maximum and Input Range Minimum. Its default value is Input Range Maximum. Display code is PHA1.

Process Low Alarm 1 Value
This parameter, applicable only when Alarm 1 is selected to be a Process Low alarm, defines the process variable value at or below which Alarm 1 will be active. Its value may be adjusted between Input Range Maximum and Input Range Minimum. Its default value is Input Range Minimum. Display code is PLA1.

Band Alarm 1 Value
This parameter, applicable only if Alarm 1 is selected to be a Band Alarm, defines a band of process variable values, centered on the setpoint value. If the process variable value is outside this band, the alarm will be active. This parameter may be adjusted from 0 to span from the setpoint. The default value is 5. The display code is bAL1.

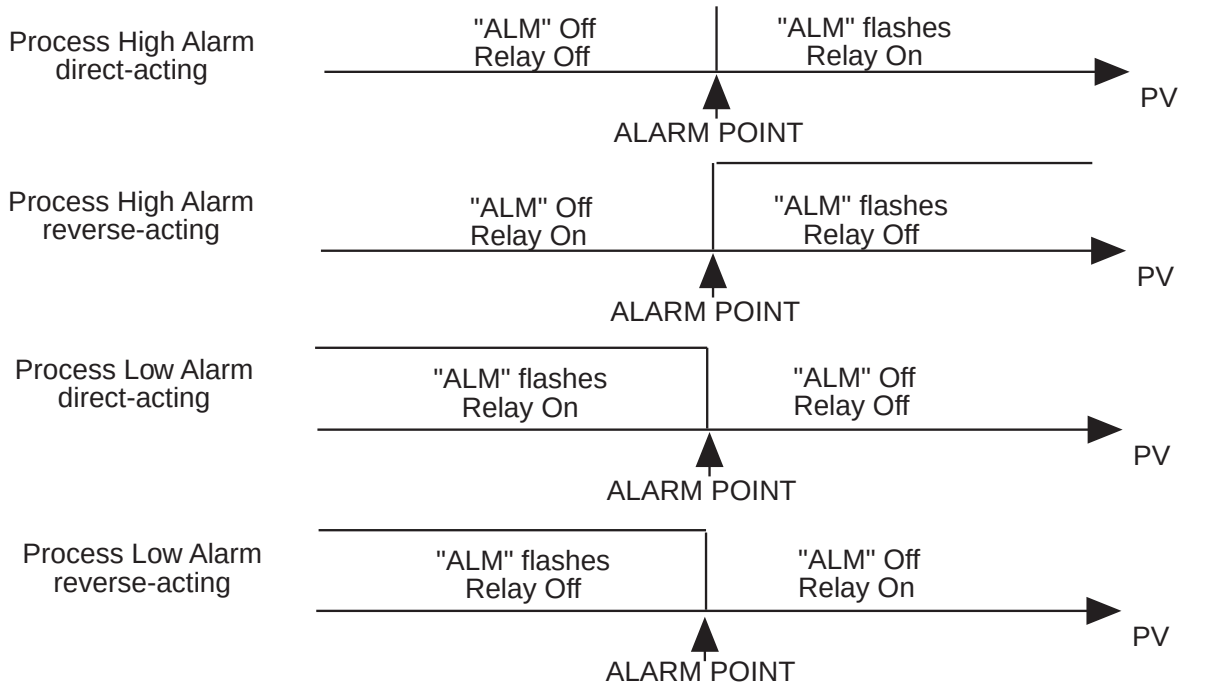
Deviation Alarm 1 Value
This parameter, applicable only if Alarm 1 is selected to be a Deviation High/Low Alarm, defines a value above (positive value - Deviation High Alarm) or below (negative value - Deviation Low Alarm) the setpoint; if the process variable deviates from the setpoint by a margin greater than that defined by this parameter, Alarm 1 goes active. This parameter may be adjusted in the range ± span from setpoint. The default value is 5. Display code is dAL1.

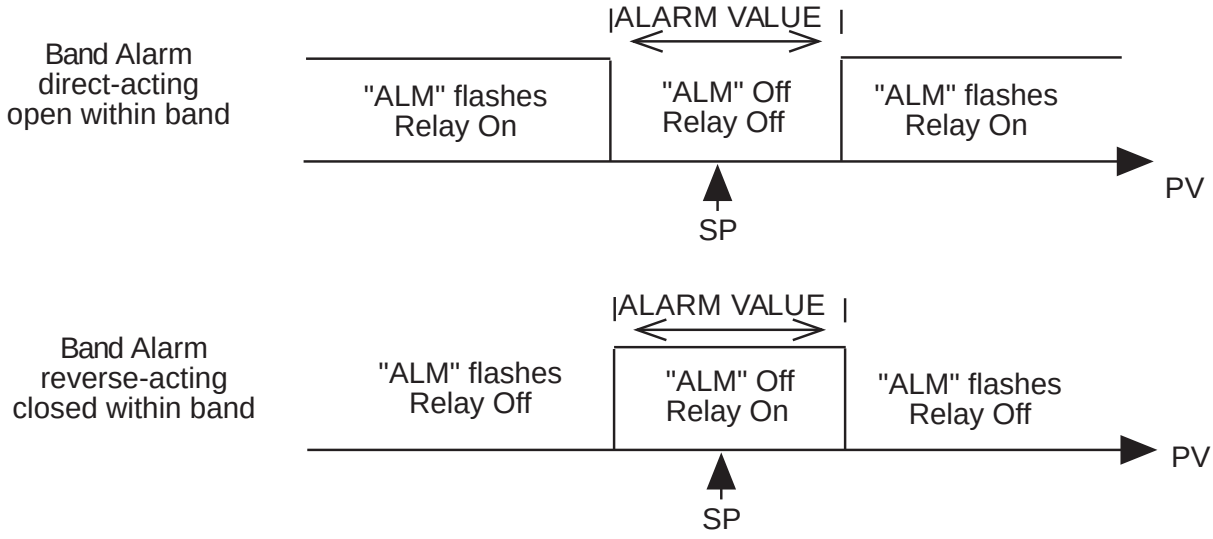
Process High Alarm 2 Value
This parameter, applicable only when Alarm 2 is selected to be a Process High Alarm, defines the process variable value at or above which Alarm 2 will be active. Its value may be adjusted between Input Range Maximum and Input Range Minimum. Its default value is Input Range Maximum. Display code is PHA2.

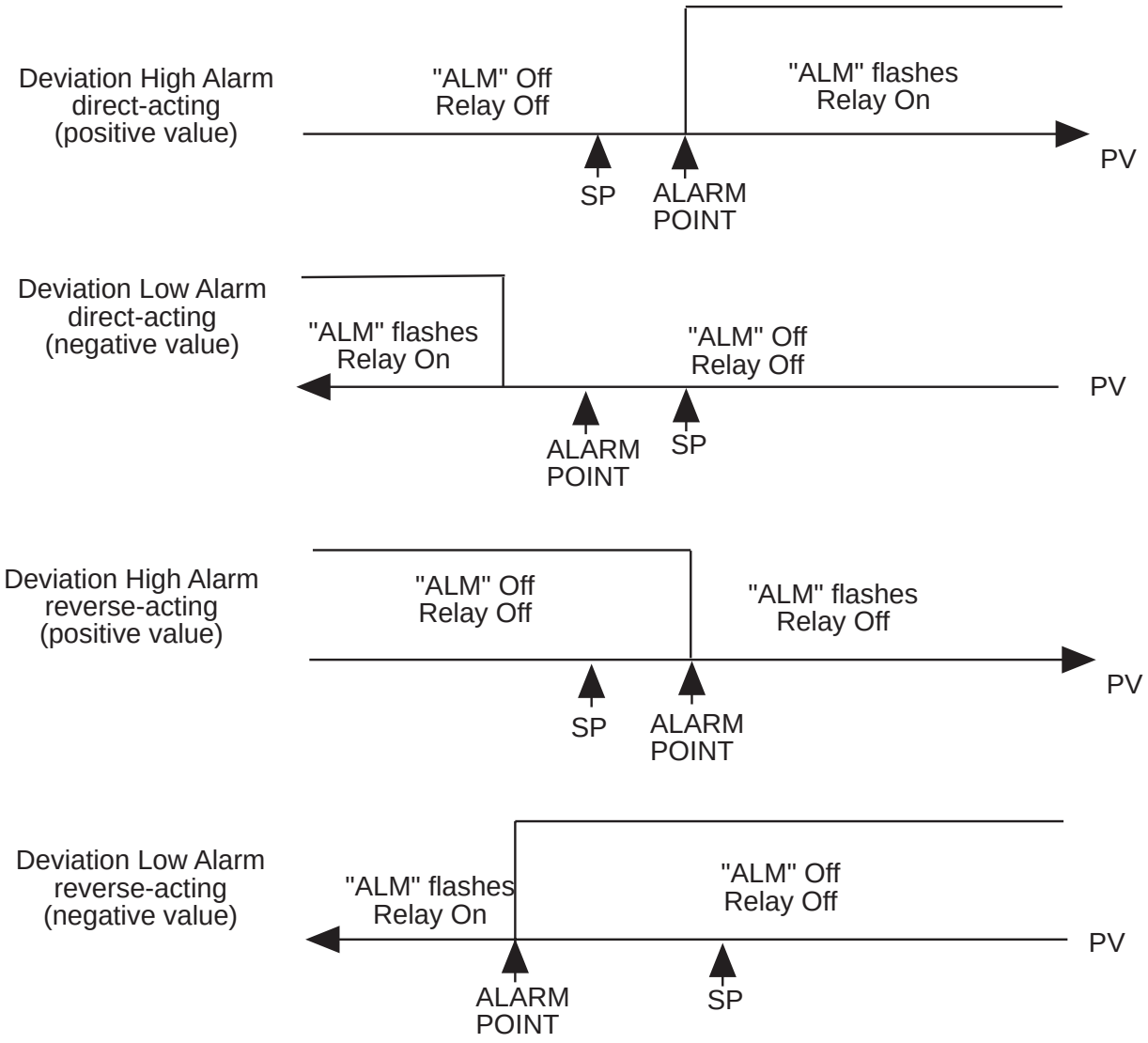
Process Low Alarm 2 Value
This parameter, applicable only when Alarm 2 is selected to be a Process Low Alarm, defines the process variable value at or below which Alarm 2 will be active. Its value may be adjusted between Input Range Maximum and Input Range Minimum. Its default value is Input Range Minimum. Display code is PLA2.

Band Alarm 2 Value
This parameter, applicable only if Alarm 2 is selected to be a Band Alarm, defines a band of process variable values, centered on the setpoint value. If the process variable is outside this band, the alarm will be active. This parameter may be adjusted from 0 to span from the setpoint. The default value is 5. Display code is bAL2.

Deviation Alarm 2 Value
This parameter, applicable only if Alarm 2 is selected to be a Deviation High/Low Alarm, defines a value above (positive value - Deviation High Alarm) or below (negative value - Deviation Low Alarm) the setpoint; if the process variable deviates from the setpoint by a margin greater than that defined by this parameter, Alarm 2 goes active. This parameter may be adjusted in the range ± span from setpoint. The default value is 5. Display code is dAL2.


Process High Alarm
direct-acting
"ALM" Off
Relay Off
"ALM" flashes
Relay On
PV
ALARM POINT
Process High Alarm
reverse-acting
"ALM" Off
Relay On
"ALM" flashes
Relay Off
PV
ALARM POINT
Process Low Alarm
direct-acting
"ALM" flashes
Relay On
"ALM" Off
Relay Off
PV
ALARM POINT
Process Low Alarm
reverse-acting
"ALM" flashes
Relay Off
"ALM" Off
Relay On
PV
ALARM POINT


Band Alarm
direct-acting
open within band
ALARM VALUE
"ALM" flashes
Relay On
"ALM" Off
Relay Off
"ALM" flashes
Relay On
PV
SP
Band Alarm
reverse-acting
closed within band
ALARM VALUE
"ALM" flashes
Relay Off
"ALM" Off
Relay On
"ALM" flashes
Relay Off
PV
SP


Deviation High Alarm
direct-acting
(positive value)
"ALM" Off
Relay Off
"ALM" flashes
Relay On
PV
SP
ALARM
POINT
Deviation Low Alarm
direct-acting
(negative value)
"ALM" flashes
Relay On
"ALM" Off
Relay Off
PV
ALARM
POINT
SP
Deviation High Alarm
reverse-acting
(positive value)
"ALM" Off
Relay Off
"ALM" flashes
Relay Off
PV
SP
ALARM
POINT
Deviation Low Alarm
reverse-acting
(negative value)
"ALM" flashes
Relay On
"ALM" Off
Relay Off
PV
ALARM
POINT
SP

Loop Alarm Enable

This parameter is the means by which the user can enable or disable the Loop Alarm. The Loop Alarm is a special alarm which detects faults in the control feedback loop by continuously monitoring process variable response to the control output(s).

The Loop Alarm, when enabled, repeatedly checks an estimated valve position for saturation (i.e. the valve having been driven in one direction for a time greater than the Motor Travel Time). If the valve is found to be in saturation, the Loop Alarm facility starts a timer; thereafter, if the saturated valve has not caused the process variable to be corrected by a pre-determined amount V after a time T has elapsed, the Loop Alarm goes active. Subsequently, the Loop Alarm facility repeatedly checks the process variable and the valve. When the process varaible starts to change value in the correct sense or when the valve comes out of saturation, the Loop Alarm is de-activated.

The Loop Alarm Time T is always set to twice the value of the Auto Reset parameter.

The value of V is dependent upon the input type:

Deg C:	2°C or 2.0°C
Deg F:	3°F or 3.0°F
Linear Range:	10 least significant display units

Notes:

1. Correct operation of the Loop Alarm depends upon reasonably accurate PID tuning.

2. The Loop Alarm is automatically disabled during Manual Control mode and during execution of the Pre-Tune mode. Upon exit from Manual mode or after completion of the Pre-Tune routine, the Loop Alarm is automatically re-enabled.

Logical Combination of Alarms

Two alarms may be combined logically to create an AND/OR situation. They may be configured for Reverse-acting or Direct-acting. Only Output 3 may be assigned as Logical Output.

Example:

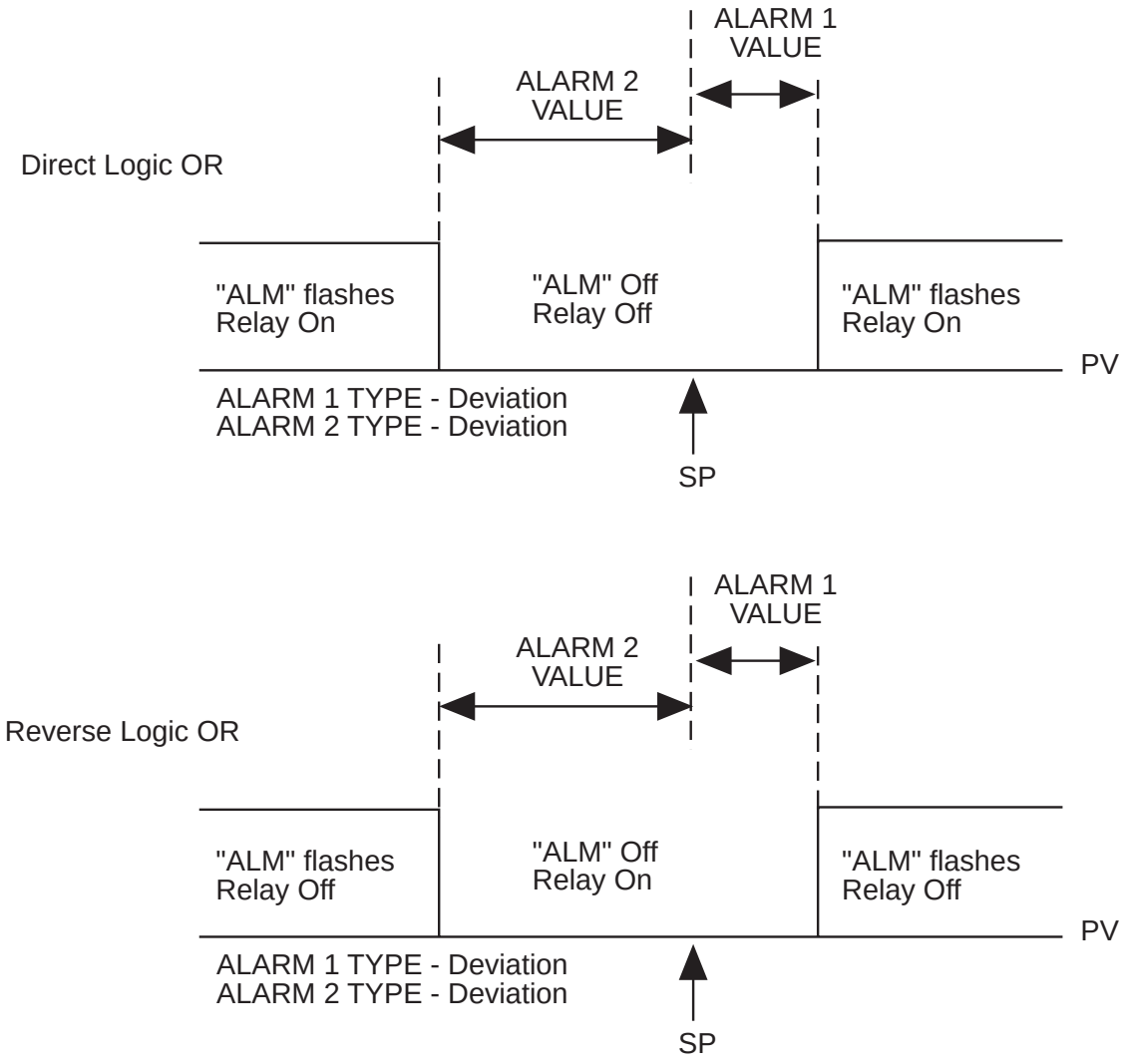
Logical OR of Alarm 1 with Alarm 2

Direct-Acting	Reverse-Acting
AL1 OFF, Al2 OFF: Relay OFF	AL1 OFF, Al2 OFF: Relay ON
AL1 ON, Al2 OFF: Relay ON	AL1 ON, Al2 OFF: Relay OFF
AL1 OFF, Al2 ON: Relay ON	AL1 OFF, Al2 ON: Relay OFF
AL1 ON, Al2 ON: Relay ON	AL1 ON, Al2 ON: Relay OFF

Logical AND of Alarm 1 with Alarm 2

Direct-Acting	Reverse-Acting
AL1 OFF, Al2 OFF: Relay OFF	AL1 OFF, Al2 OFF: Relay ON
AL1 ON, Al2 OFF: Relay OFF	AL1 ON, Al2 OFF: Relay ON
AL1 OFF, Al2 ON: Relay OFF	AL1 OFF, Al2 ON: Relay ON
AL1 ON, Al2 ON: Relay ON	AL1 ON, Al2 ON: Relay OFF

ASYMMETRICAL BAND ALARM



Decimal Point

This parameter, applicable only if a linear input is specified, defines the position of the decimal point in values for the process variable, setpoint, alarm levels and retransmission outputs as follows:

Value	Decimal Point Position
0	XXXX
1	XXX.X
2	XX.XX
3	X.XXX

The default value is 0. Display code is dPoS.

Engineering Units Upper
This parameter, applicable only if a linear input is specified, defines the scaled input value when the process variable input is at its maximum value. It is adjustable between -1999 to 9999. The default value is 1000. This parameter can be set to a value less than (but not equal to) Engineering Units Lower, in which case the sense of the input is reversed. Display code is Euu.

Engineering Units Lower
This parameter, applicable only if a linear input is specified, defines the scaled input value when the process variable input is at its minimum value. It is adjustable between -1999 and 9999. The default value is 0. This parameter can be set to a value greater than (but not equal to) Engineering Units Upper, in which case the sense of the input is reversed. Display code is EuL.

Pre-Tune Enable/Disable
This parameter determines whether or not the instrument Pre-Tune mode is activated on power up or not (0=disabled, 1=enabled). Default is 0. Display code is EPtn.

Manual Mode Enable/Disable
This parameter determines whether operator selection of manual control is enabled or disabled (0=disabled, 1=enabled). The default setting is 0. Display code is ESby.

Setpoint Ramp Enable/Disable
This parameter enables/disables use of the Setpoint Ramp feature (0=disabled, 1=enabled). The default setting is 0. Display code is ESPr.

Communications Enable
This parameter enables/disables the changing of parameter values via the RS485 communications link, if the Communications option is specified. Settings are 0=disabled and 1=enabled. Default setting is 0. Display code is CCon.

Appendix B
Board Layout - Jumper Positioning

FIGURE B-1 PCB POSITIONS - 1/16, 1/8, & 1/4 DIN

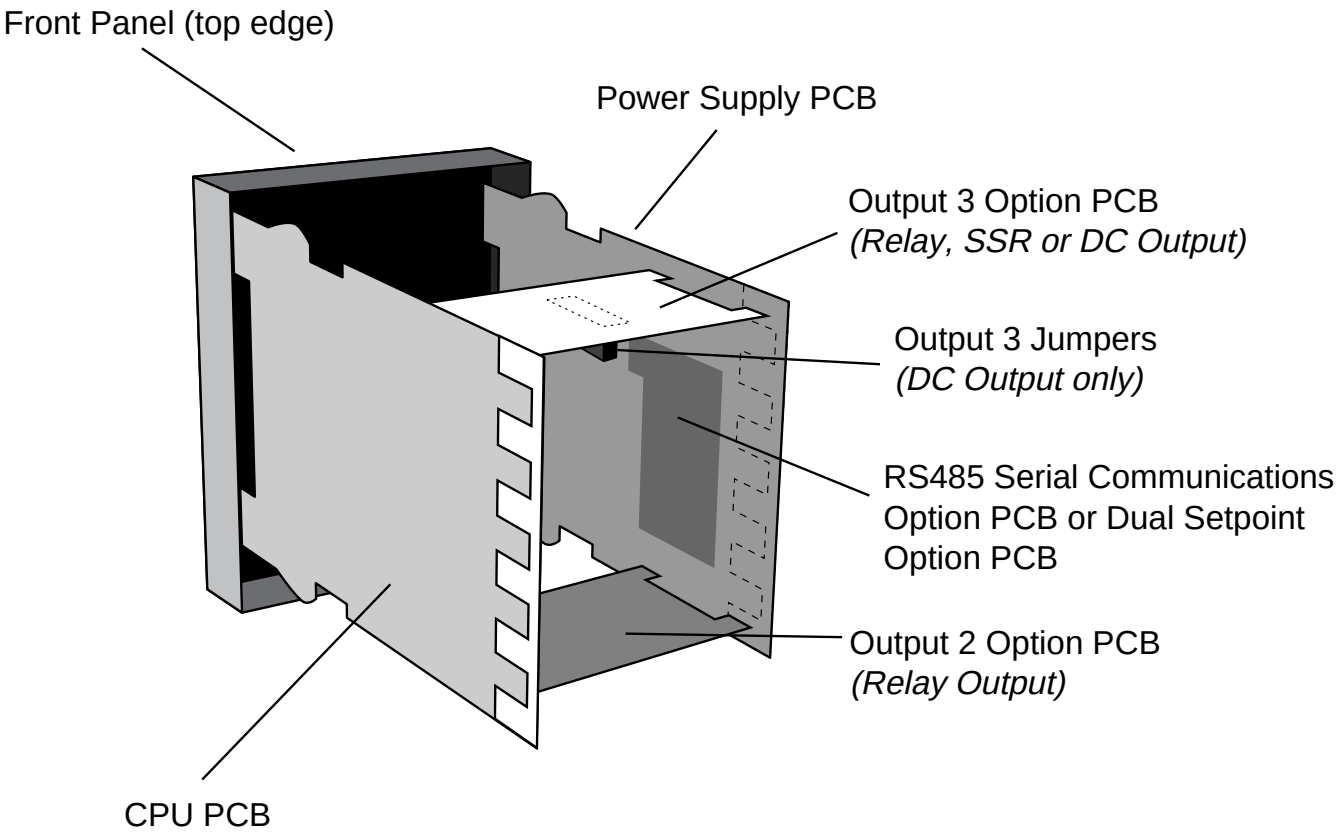
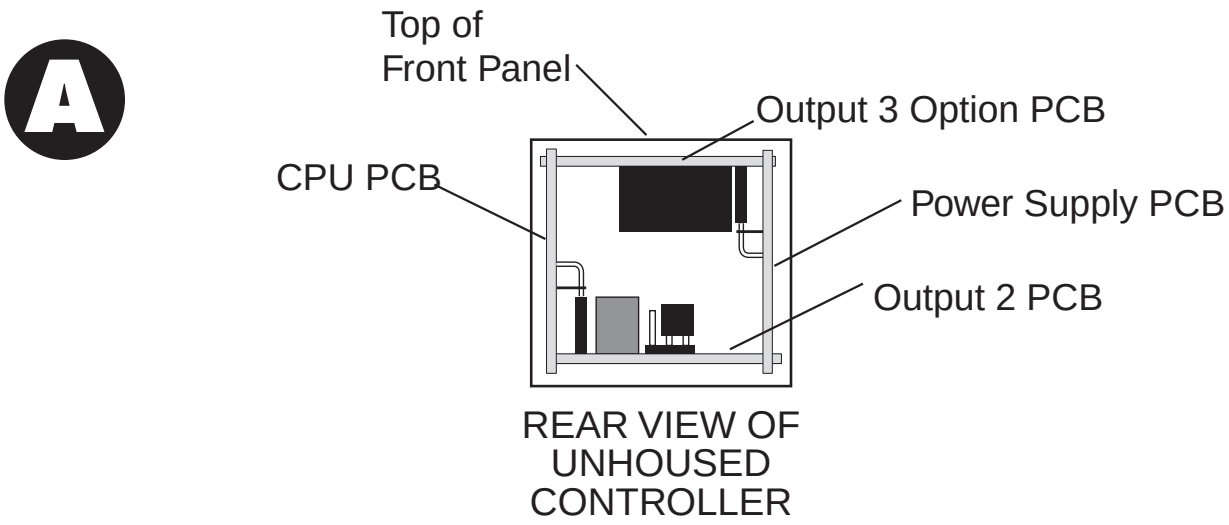
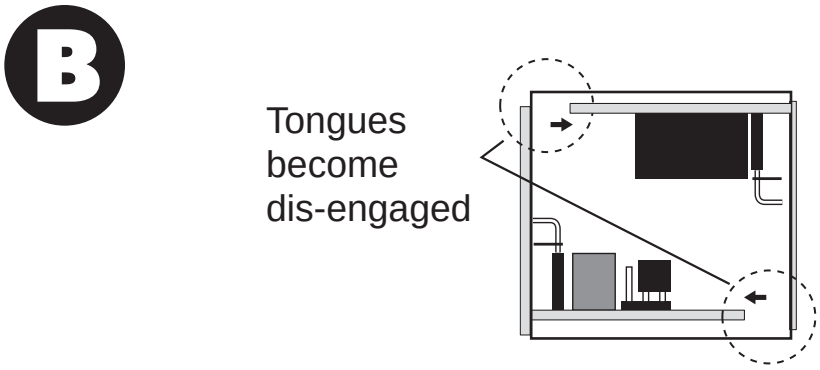


FIGURE B-2 OUTPUT 2, OUTPUT 3 REMOVAL - 1/16 DIN





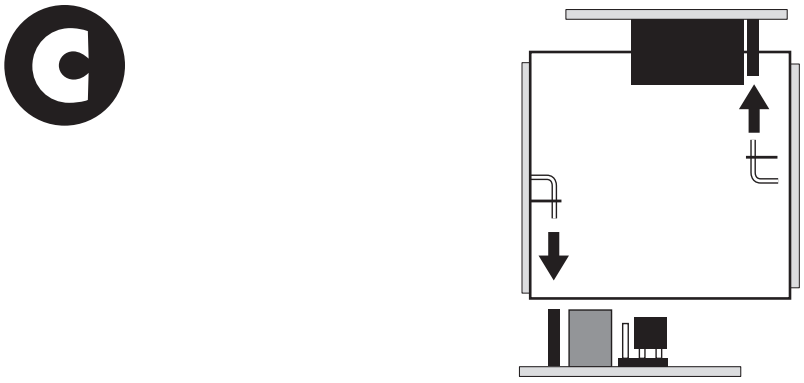


FIGURE B-3 OUTPUT 2, OUTPUT 3 REMOVAL - 1/8 DIN

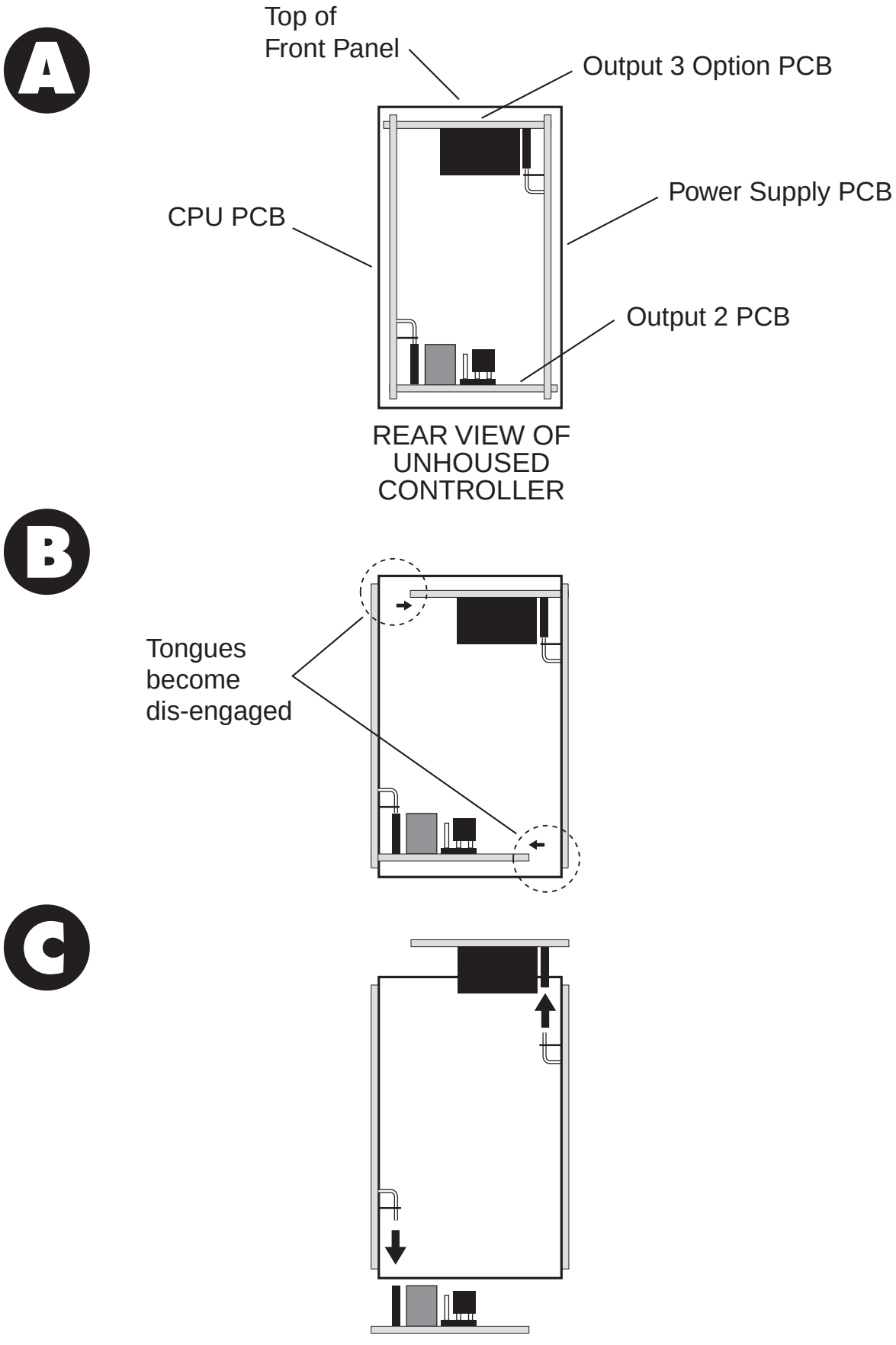


FIGURE B-4 OUTPUT 2, OUTPUT 3 REMOVAL - 1/4 DIN

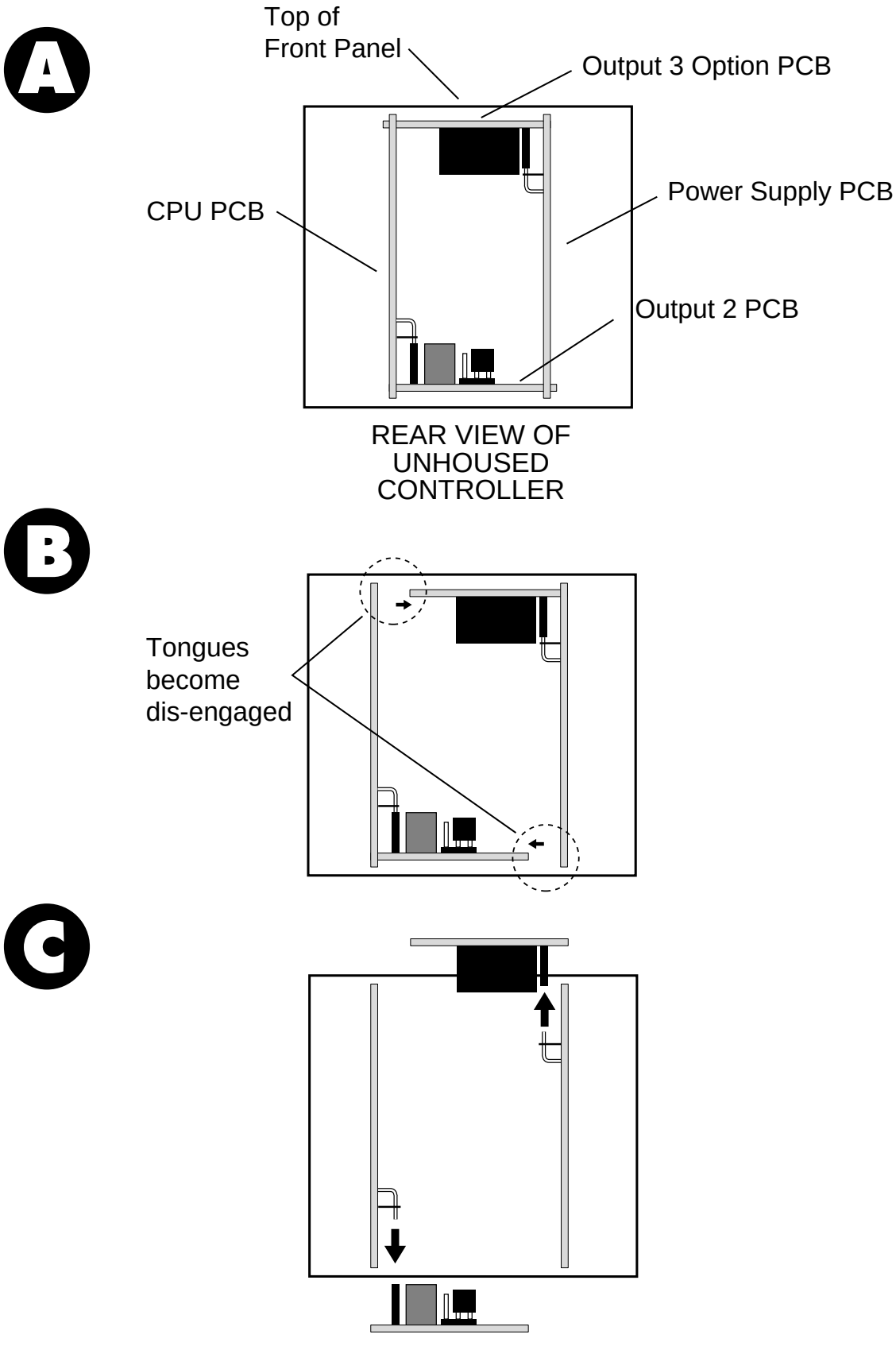


FIGURE B-5 CPU PWA - 1/16, 1/8, & 1/4 DIN

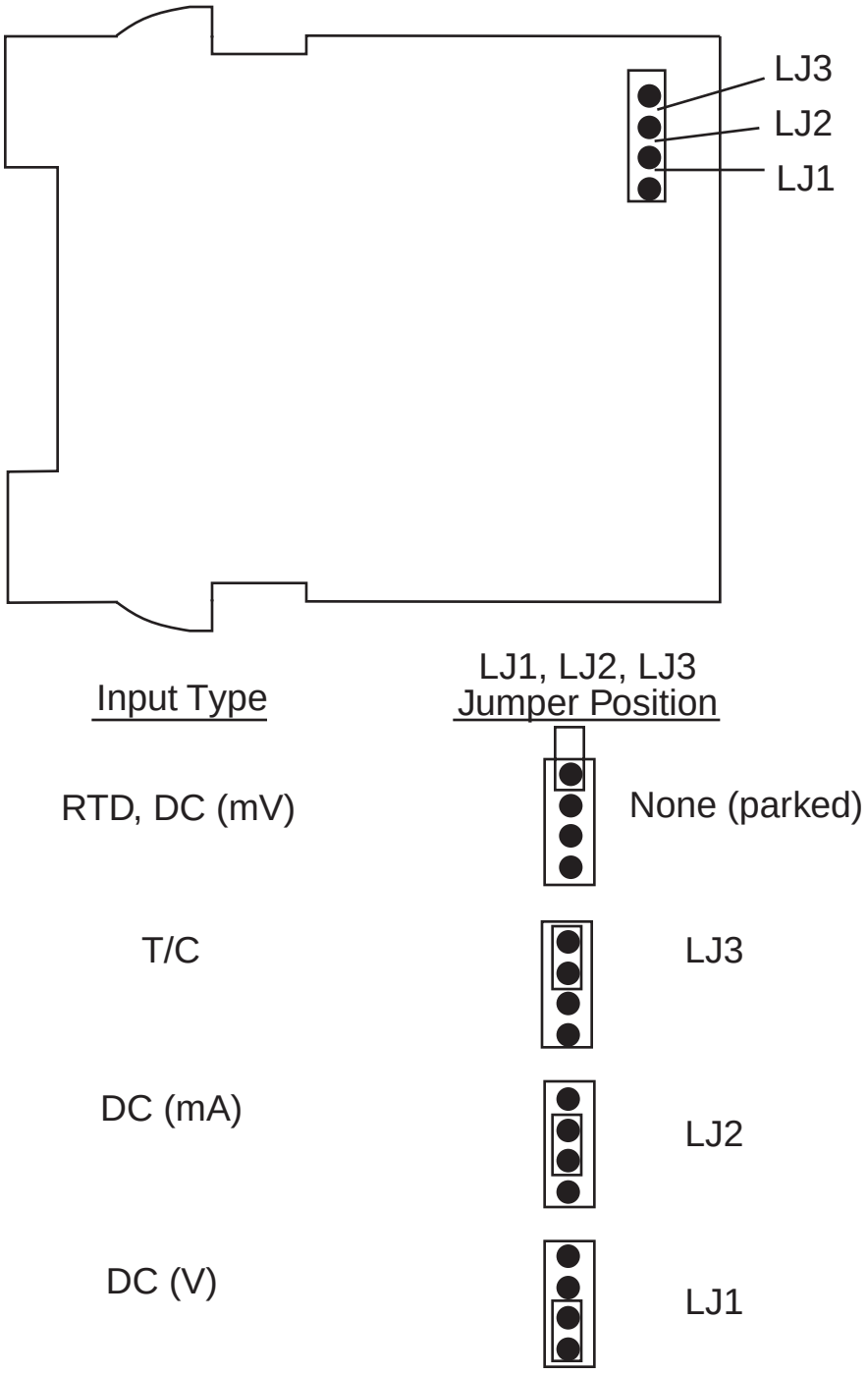
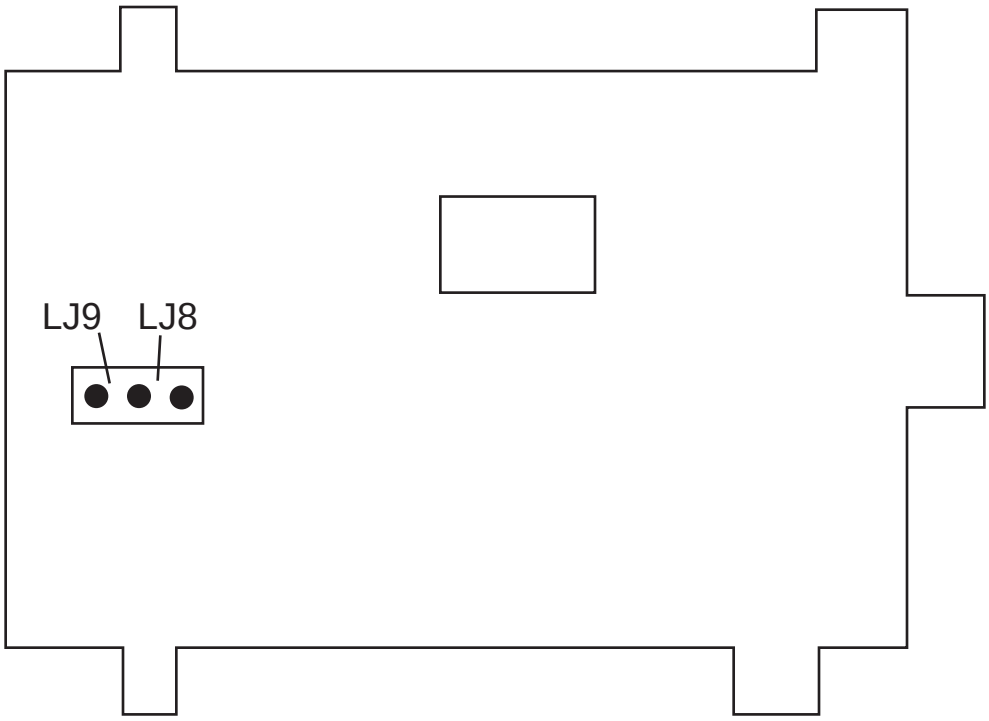


FIGURE B-6 OPTION PWA DC OUTPUT 3 - 1/16, 1/8, & 1/4 DIN



Output Type	LJ8, LJ9 Jumper Position
DC (0-10V)	LJ8
DC (0-20mA)	LJ9
DC (0-5V)	LJ8
DC (4-20mA)	LJ9

Appendix C
Hardware Definition Code

The Hardware Definition Code is used to represent the hardware installed (input type, Output 1 type, Output 2 type and Output 3 type); this must be compatible with the hardware actually installed. It can be accessed, with the instrument in Program mode, by simultaneously depressing the DOWN and SCROLL keys. The displays will show "XXXX" (where X represents any number) in the upper display and "dEFn" in the lower display, where:

the first (left-most) digit is input type:
- 1=RTD/Linear mV
- 2=Thermocouple
- 3=Linear DC mA
- 4=Linear DC V

the second digit is Output 1 type:
- 1=Relay

the third digit is Output 2 type:
- 1=Relay

the fourth digit is Output 3 type:
- 0=Output 3 not installed
- 1=Relay (alarm only)
- 2=SSR (alarm only)
- 3=DC 0-10V (retransmit only)
- 4=DC 0-20mA (retransmit only)
- 5=DC 0-5V (retransmit only)
- 7=DC 4-20mA (retransmit only)

The displayed code may be incremented/decremented using the UP/DOWN keys as required. The maximum setting available is 4117. For example, the code for a thermocouple input and relay Output 3 would be 2111. When the code is first altered, the code display will flash, until the desired value is displayed and confirmed by pressing the Auto/Manual key.

While the Hardware Definition Code is displayed, depressing the SCROLL key will cause the display to change to:

nonE OPtn	or	r485 OPtn	or	duAL OPtn

Where nonE indicates the absence of the communications option, r485 indicates the presence of the communications option, or duAL, indicates the presence of the dual setpoint option.

NOTE: It is essential that this code is changed whenever there is a change to the instrument's hardware configuration (change of input/output type, alarm/retransmit output added/removed etc.). The instrument's software depends upon this code to ensure that the instrument operates correctly.

This code may be viewed as a READ ONLY display in Control mode by simultaneously depressing the DOWN and SCROLL keys.

To exit from the Hardware Definition Code display, depress the DOWN and SCROLL keys simultaneously.

Appendix D
Input Range Codes

The input ranges available (selectable via the front panel) are:

For Thermocouple Inputs

TYPE	INPUT RANGE	DISPLAYED CODE	TYPE	INPUT RANGE	DISPLAYED CODE
R	0 - 1650°C	1127	K	0 - 760°C	1719
R	32 - 3002°F	1128	K	32 - 1400°F	1720
S	0 - 1649°C	1227	K	0 - 1373°C	1723
S	32 - 3000°F	1228	K	32 - 2503°F	1724
J	0.0 - 205.4°C	1415	L	0.0 - 205.7°C	1815
J	32.0 - 401.7°F	1416	L	32.0 - 402.3°F	1816
J	0 - 450°C	1417	L	0 - 450°C	1817
J	32 - 842°F	1418	L	32 - 842°F	1818
J	0 - 761°C	1419	L	0 - 762°C	1819
J	32 - 1402°F	1420	L	32 - 1404°F	1820
T	-200 - 262°C	1525	B	212 - 3315°F	1934
T	-328 - 504°F	1526	B	100 - 1824°C	1938
T	0.0 - 260.6°C	1541			
T	32.0 - 501.1°F	1542			

For RTD Inputs

Note: Input conditioning jumper JU1 needs to be changed, see Appendix B.

INPUT RANGE	DISPLAYED CODE	INPUT RANGE	DISPLAYED CODE
0 - 600°C	2221	0.0 - 100.9°C	2295
32 - 1112°F	2222	32.0 - 213.6°F	2296
32 - 572°F	2229	-200 - 206°C	2297
-101.0 - 100.0°C	2230	-328 - 403°F	2298
-149.8 - 212.0°F	2231	-101.0 - 300.5°C	7201
0 - 300°C	2251	-149.8 - 572.9°F	7202

For DC Inputs

Note: Input conditioning jumper JU1 needs to be changed, see Appendix B. Also, the Hardware Definition Code for the input type must also be changed, see Appendix C.

INPUT RANGE	DISPLAYED CODE	INPUT RANGE	DISPLAYED CODE
0 - 20mA	3413	0 - 5V	4445
4-20mA	3414	1 - 5V	4434
0 - 50mV	4443	0 - 10V	4446
10 - 50mV	4499	2 - 10V	4450

Appendix E
Specifications

INPUT SPECIFICATIONS

General

Input Sample Rate:	Four per second
Input Resolution:	14 bits approximately
Input Impedance:	Greater than 100M ohm resistive (except for DC mA and V inputs)
Isolation:	Universal input isolated from all outputs except SSR at 240 VAC.

Thermocouple

Types:	R, S, J, T, K, L, B and N
Calibration:	Complies with BS4937, NBS125 and IEC584.
Sensor Break Protection:	Break detected within 2 seconds. "Close Valve" output set to ON; alarms operate as if the process variable has gone over-range.

RTD and DC mV

Type and Connection:	Three-wire Pt100
Calibration:	Complies with BS1904 and DIN43760.
Lead Compensation:	Automatic
RTD Current:	150uA (approximately)
Sensor Break Protection:	Break detected within 2 seconds. "Close Valve" output set to ON; alarms operate as if the process variable has gone over-range.

DC mA and DC V

Scale Range Maximum:	-1999 to 9999
Scale Range Minimum:	-1999 to 9999
Minimum Span:	1 display LSD
Sensor Break Protection:	Applicable to 4-20mA, 1-5V, and 2-10V ranges only. Break detected within 2 seconds. "Close Valve" output set to ON; alarms operate as if the process variable has gone under-range.

Dual Setpoint Selection Input

Type:	Voltage-free or TTL compatiable	
Voltage Free Operation:	Connections of contacts of external switch or relay; contacts open equal Setpoint 1 selected (minimum contact resistance=5K ohms), contacts closed equal Setpoint 2 selected (maximum contact resistance=50 ohms)	
TTL Levels:	To select Setpoint 1:	-0.6V to 0.8V
	To select Setpoint 2:	2.0V to 24.0V
Maximum Input Delay: (Off-On)	1 second	
Minimum Input Delay: (On-Off)	1 second	

OUTPUT SPECIFICATIONS

Outputs 1 & 2

General

Types Available:	Relay Only (Output 1 - Open Valve, Output 2 - Close Valve)
Contact Type:	SPDT
Rating:	2A at 120V AC (Motor Drive) 2A at 240V AC (resistive or independent contactor drive)
Lifetime:	>500,000 operations at rated voltage/current
Isolation:	Inherent

Output 3

General

Types Available:	Relay, SSR Driver DC linear (retransmission only) and Transmitter Power Supply

Relay

Contact Type:	SPDT
Rating:	2A resistive at 120/240V AC
Lifetime:	> 500,000 operations at rated voltage/current
Isolation:	Inherent

SSR Drive/TTL

Drive Capability:	SSR>4.2V DC into 1K ohm minimum
Isolation:	Not isolated from input

DC

Resolution:	Eight bits in 250mS (10 bits in 1 second typical, >10 bits in >1 second typical).
Update Rate:	Four times per second
Ranges:	*0-20mA, 4-20mA, 0-10V, and 0-5V
Load Impedance:	0-20mA: 500 ohm maximum
	4-20mA: 500 ohm maximum
	0-10V: 500 ohm minimum
	0-5V: 500 ohm minimum
Isolation:	Isolated from all other inputs and outputs.

* Changes between V and mA ranges also require JU movement.

Transmitter Power Supply

Output:	20-28V DC (24V DC nominal)
Minimum Load Impedance:	910 ohm (22mA @ 20VDC)

CONTROL SPECIFICATIONS

Control Types:	PID
Auto Tune Types:	Pre-Tune and Auto-Tune
Proportional Band:	0.5% to 999.9% of input span @ 0.1% increments
Auto Reset:	1s to 99min 59s/repeat
Rate:	0 (OFF) to 99min 59s
Auto/Manual Control:	User-selectable with "bumpless" transfer into and out of Manual control.
Setpoint Range:	Limited by Setpoint Upper and Setpoint Lower limits
Setpoint Maximum:	Limited by Setpoint and Range Upper Limits
Setpoint Minimum:	Limited by Range and Setpoint Lower Limits
Setpoint Ramp:	Ramp rate selectable 1 to 9999 LSDs per Hour and OFF. Number displayed is decimal point aligned with selected range.

Alarms

Maximum Number:	Two "soft" alarms plus Loop Alarm*
Maximum # Outputs:	One output can be used for alarm purposes
Combination Alarms:	Logical OR or AND of alarms to an individual hardware output is available.
*Loop Alarm:	Detects faults in the control feedback loop by monitoring process variable response to the control output

PERFORMANCE

Reference Conditions

Ambient Temperature:	20°C ± 2°C
Relative Humidity:	60-70%
Supply Voltage:	90-264V AC 50Hz ±1%
Source Resistance:	<10 ohm for T/C input
Lead Resistance:	<0.1 ohm/lead balanced (Pt100)

Performance under Reference Conditions

Common Mode Rejection:	>120dB at 50/60Hz giving negligible effect at up to 264V 50/60Hz
Series Mode Rejection:	>500% of span (at 50/60Hz) causes negligible effect

DC Linear Inputs

Measurement Accuracy:	± 0.25% of span ± -1 LSD

Thermocouple Inputs

Measurement Accuracy:	± 0.25% of span ± -1 LSD Note: Reduced performance with Type B T/C between 100-600 °C (212 - 1112 °F)
Linearization Accuracy:	Better than ± 0.2°C any point, any 0.1°C range (± 0.05°C typical). Better than ± 0.5°C any point, any 1°C range.
Cold Junction Compensation:	Better than ± 0.7°C

RTD Inputs

Measurement Accuracy:	± 0.25% of span ± 1 LSD
Linearization Accuracy:	Better than ± 0.2°C any point, any 0.1°C range (± 0.05°C typical). Better than ± 0.5°C any point, any 1°C range.

DC Output

Output 3 Accuracy:	mA:	0-20mA ± 0.25% of span (20mA) @ 250 ohm
(Recorder Output)		4-20mA ± 0.25% of span (16mA) @ 250 ohm
	V:	0-10V ± 0.25% of span (10V) @ 2K ohm
		0-5V ± 0.25% of span (5V) @ 2K ohm

OPERATING CONDITIONS

Ambient Operating Temperature:	0° to 55°C
Ambient Storage Temperature:	-20° to 80°C
Relative Humidity:	20% - 95% non-condensing
Supply Voltage:	90 - 264VAC 50/60Hz (standard)
	20 - 50 VAC 50/60Hz or 22 to 65VDC (optional)
Source Resistance:	1000Ω maximum (thermocouple)
Lead Resistance:	50Ω per lead maximum balanced (Pt100)

Performance Under Operating Conditions

Temp. Stability:	0.01% of span/°C change in ambient temperature
Cold Junction Comp.: (thermocouple only)	Better than ± 1°C
Supply Voltage Influence:	Negligible
Relative Humidity Influence:	Negligible

Sensor Resistance Influence:	Thermocouple 100 ohm:	<0.1% of span error
	Thermocouple 1000 ohm:	<0.5% of span error
	RTD Pt 100 50 ohm/lead:	<0.5% of span error

ENVIRONMENTAL

EMI Susceptibility:	Designed to meet EN50082 Part 2
EMI Emissions:	Designed to meet EN50081 Part 2
Safety Considerations:	Designed to comply with IEC1010-1 in as far as it is applicable
Supply Voltage:	90-264V AC 50/60 Hz (standard) 20-50V AC 50/60 Hz or 22-65V DC (optional)
Power Consumption:	4 watts (approximately)
Front Panel Sealing:	NEMA4
Agency Approvals:	UL Recognized (pending) cUL Certified for use in Canada (pending)

PHYSICAL

Dimensions:

1/16 DIN:	Front Panel 48mm x 48 mm (1.89" x 1.89") 110mm (4.33") deep
1/8 DIN:	Front Panel 48mm x 96mm (1.89" x 3.78") 100mm (3.94") deep
1/4 DIN:	Front Panel 96mm x 96mm (3.78" x 3.78") 100mm (3.94") deep

Mounting:

Panel Cut Out:

1/16 DIN:	45mm x 45mm (1.77" x 1.77")
1/8 DIN:	45mm x 92mm (1.77" x 3.62")
1/4 DIN:	92mm x 92mm (3.62" x 3.62")

Terminals: Screw type (combination head)

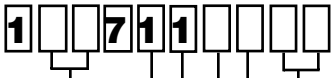
Weight:

1/16 DIN:	8 ounces max.
1/8 DIN:	8 ounces max.
1/4 DIN:	16 ounces max.

Display Character:

1/16 DIN:	Top: .39"; Bottom: .28"
1/8 DIN:	Top: .39"; Bottom: .28"
1/4 DIN:	Top: .53"; Bottom: .39"

Appendix F
Order Matrix



MODEL

16 1/16 DIN
40 1/4 DIN
80 1/8 DIN

OUTPUT 1

1 Relay

OUTPUT 2

1 Relay

OUTPUT 3

0 None
1 Relay
2 SSRD
3 4-20mA*
4 Transmitter Power Supply**

OPTIONS

0 None
1 RS-485
3 Dual Setpoint

SUFFIX

(Blank) None
02 Line Voltage 24V AC/DC

* Retransmission output only
** Not available for 1167

Appendix G
Software Reference Sheet

HDW DEF	
OPTION	

Program Mode	Your Setting
inPS	
Out1	
ALA1	
ALA2	
Inhi	
USE3	
CbS	
CAd	
CJC	

Enable Mode	Your Setting
EPro	
EtuN	
ESPC	

Tune Mode	Your Setting
SPrP	
SPrr	
Filt	
iCor	
Pb1	
ArSt	
rAtE	
SPuL	
SPLL	
Pou	
PoL	
tr	
tOn	
PHA1	
PLA1	
bAL1	
dAL1	
PHA2	
PLA2	
bAL2	
dAL2	

(Continued on next page)

Tune Mode	Your Setting
LAEn	
dPoS	
Euu	
EuL	
EPtn	
ESby	
ESPr	
CCon	

Warranty and Return Statement

These products are sold by The Partlow Corporation (Partlow) under the warranties set forth in the following paragraphs. Such warranties are extended only with respect to a purchase of these products, as new merchandise, directly from Partlow or from a Partlow distributor, representative or reseller, and are extended only to the first buyer thereof who purchases them other than for the purpose of resale.

Warranty

These products are warranted to be free from functional defects in materials and workmanship at the time the products leave the Partlow factory and to conform at that time to the specifications set forth in the relevant Partlow instruction manual or manuals, sheet or sheets, for such products for a period of two years.

THERE ARE NO EXPRESSED OR IMPLIED WARRANTIES WHICH EXTEND BEYOND THE WARRANTIES HEREIN AND ABOVE SET FORTH. PARTLOW MAKES NO WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE PRODUCTS.

Limitations

Partlow shall not be liable for any incidental damages, consequential damages, special damages, or any other damages, costs or expenses excepting only the cost or expense of repair or replacement as described above.

Products must be installed and maintained in accordance with Partlow instructions. Users are responsible for the suitability of the products to their application. There is no warranty against damage resulting from corrosion, misapplication, improper specifications or other operating condition beyond our control. Claims against carriers for damage in transit must be filed by the buyer.

This warranty is void if the purchaser uses non-factory approved replacement parts and supplies or if the purchaser attempts to repair the product themselves or through a third party without Partlow authorization.

Returns

Partlow's sole and exclusive obligation and buyer's sole and exclusive remedy under the above warranty is limited to repairing or replacing (at Partlow's option), free of charge, the products which are reported in writing to Partlow at its main office indicated below.

Partlow is to be advised of return requests during normal business hours and such returns are to include a statement of the observed deficiency. The buyer shall pre-pay shipping charges for products returned and Partlow or its representative shall pay for the return of the products to the buyer.

Approved returns should be sent to:

PARTLOW CORPORATION
2 CAMPION ROAD
NEW HARTFORD, NY 13413 USA

THE PARTLOW-WEST COMPANY
2 CAMPION ROAD • NEW HARTFORD, NY 13413 USA
1-800-866-6659 • 315-797-2222 • FAX 315-797-0403