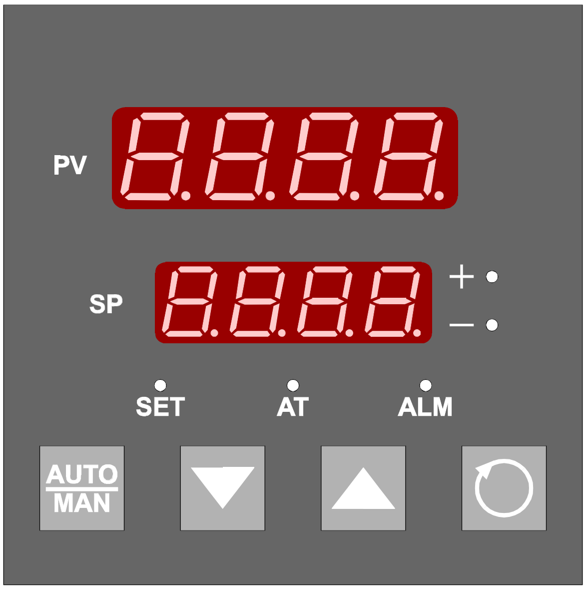
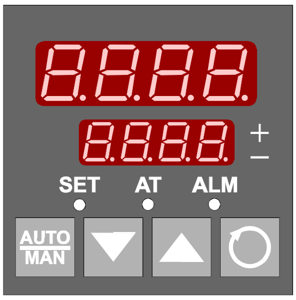




$\frac{1}{4}$-DIN, $\frac{1}{8}$-DIN & $\frac{1}{16}$-DIN OPEN LOOP VALVE MOTOR DRIVE CONTROLLERS

PRODUCT MANUAL

59213

PREFACE

This manual comprises two volumes:

Volume I: This supports normal operation of the $\frac{1}{4}$-DIN, $\frac{1}{8}$-DIN and $\frac{1}{16}$-DIN Open Loop Valve Motor Drive Controllers. In normal operation, all actions taken by the user are to be infront of the panel.

Volume II: This supports the installation, commissioning and configuration of the $\frac{1}{4}$-DIN, $\frac{1}{8}$-DIN and $\frac{1}{16}$-DIN Open Loop Valve Motor Drive Controllers. *It is intended for use only by personnel who are trained, equipped and authorised to carry out these functions.*

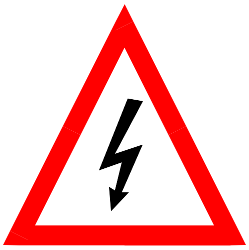
CAUTION: REFER TO MANUAL

The international hazard symbol is inscribed adjacent to the rear connection terminals. It is important to read Volume II of this manual before installing or commissioning this instrument.

$\frac{1}{4}$-DIN, $\frac{1}{8}$-DIN & $\frac{1}{16}$-DIN
OPEN LOOP VALVE MOTOR DRIVE CONTROLLERS

PRODUCT MANUAL

VOLUME I
OPERATING INSTRUCTIONS



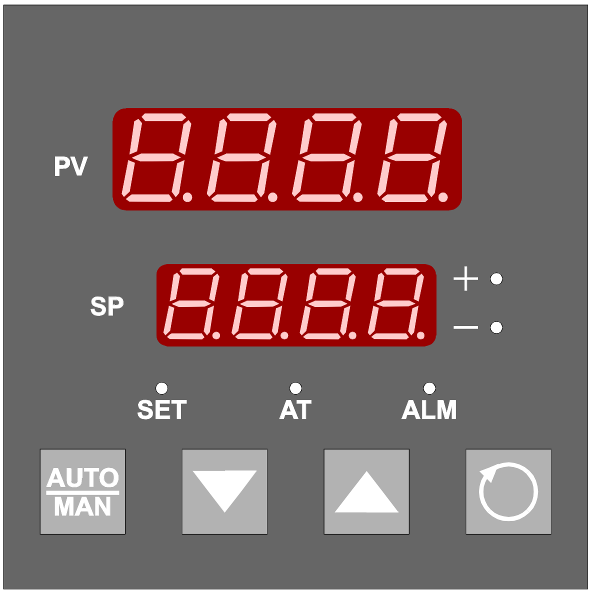
In normal operation, the operator must not remove the controller from its housing or have unrestricted access to the rear terminals, as this would provide potential contact with hazardous live parts.

Installation and configuration must be undertaken by technically-competent servicing personnel. This is covered in Volume II of this manual.

Contents

SECTION 1
INTRODUCTION

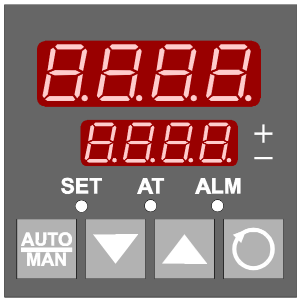
The $\frac{1}{4}$-DIN and $\frac{1}{8}$-DIN Open Loop Valve Motor Drive Controllers are microprocessor-based temperature controllers, incorporating the latest in surface-mount and CMOS technology; they are intended for use in open loop valve motor drive (VMD) applications. Standard features include:



Dual four-digit red LED display.

Universal sensor input - thermocouple, three-wire RTD or DC linear (mA, mV or V)

Relay, SSR, or DC Output 3.



Input range selected from the front panel.

Self-Tune and Pre-Tune

90 - 264V AC power supply.

Designed to comply with EN50081 Part 2 (Emission) and EN50082 Part 2 (Immunity) EMC specifications.

Front panel sealing to IP65 (NEMA 4) standard.

Auto/Manual Control (selectable).

Setpoint ramping.

Programmable digital filter.

Two “soft” alarms (may be linked to a hardware output).

Loop Break alarm (may be linked to a hardware alarm output).

Alarm type selected from front panel.

Sensor Break protection.

Setpoint maximum and minimum limits (user-defined).

and its many optional features include:

Output 3 - Alarm 1 or DC recorder output (setpoint or process variable).

RS485 serial communications

24V AC/DC supply

Dual Setpoint

SECTION 2
OPERATOR MODE

2.1 INTRODUCTION

The Operator Mode is the normal day-to-day mode of the Controller, once it has been set up and configured as required. The Controller front panel indicators and keys are shown in Figure 2-1.

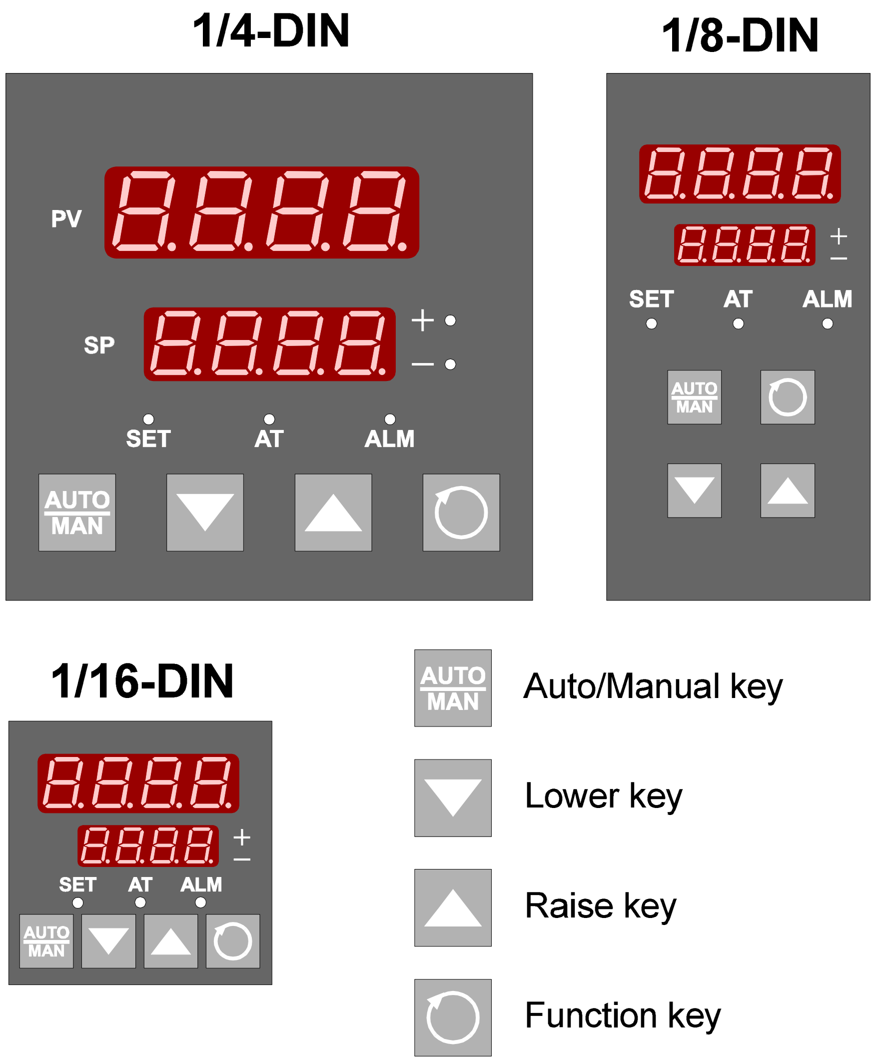
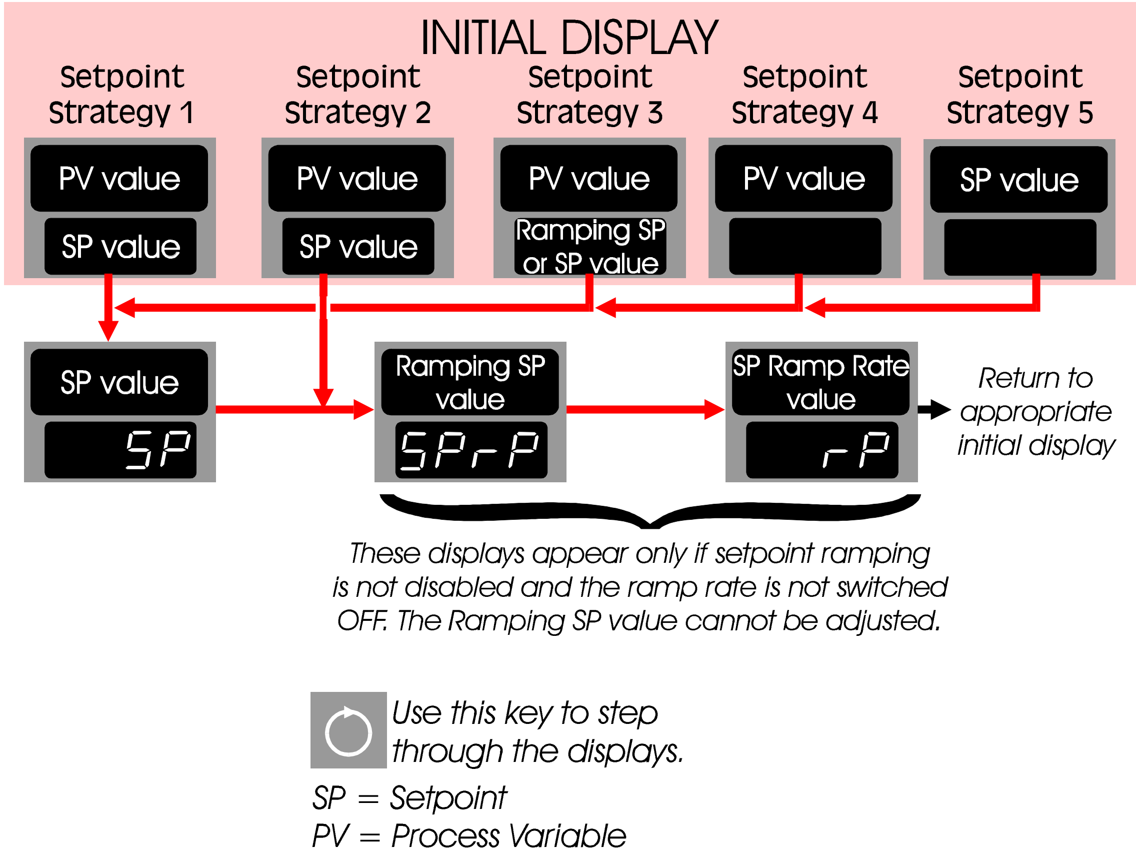


Figure 2-1 Front Panel Keys and Indicators

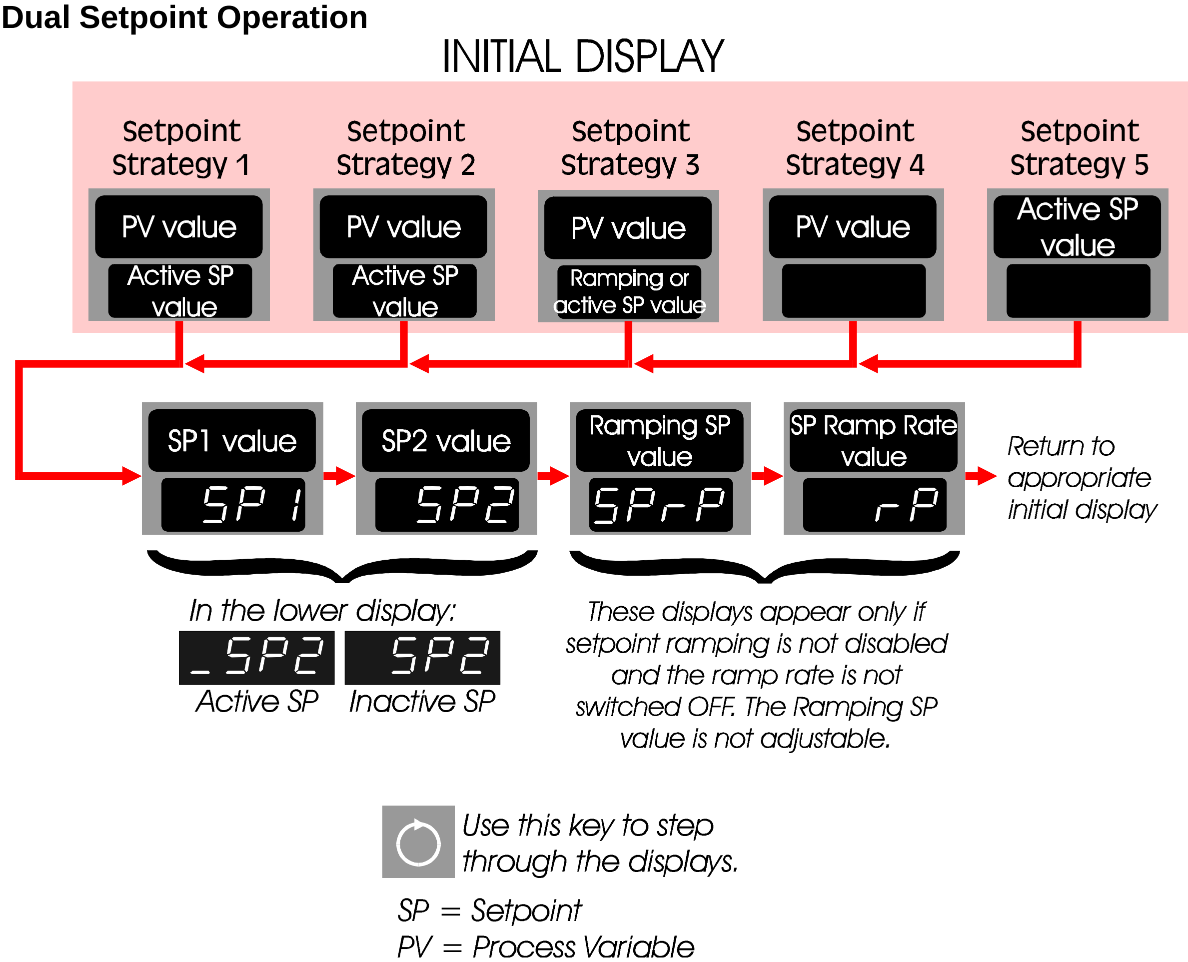
2.2 DISPLAYS AVAILABLE

After the Controller has performed its power-up self-test (during which, if the Function key is held down during power-up, the current Controller firmware revision is displayed), the initial Operator Mode displays appear. These are dependent upon whether the Controller is configured for single setpoint operation or dual setpoint operation.

Single Setpoint Operation



Dual Setpoint Operation



NOTE: In Dual Setpoint operation, the lower display uses the left-most character to distinguish between the active and inactive setpoints in the following manner:

Active Setpoint

Inactive Setpoint

2.3 VIEWING/ADJUSTING THE SETPOINT RAMP RATE

Depressing the Function key repeatedly will step through the displays for the selected setpoint strategy (see above) and will (if setpoint ramping is not disabled - see Subsection 3.2.26) finally cause the displays to show the legend rP (in the lower display) and the current setpoint ramp rate (in the upper display). The ramping rate may be adjusted (using the Raise/Lower keys) within the range 1 to 9999. Any attempt to increase the value beyond 9999 will cause the upper display to go blank and setpoint ramping to be switched OFF. Setpoint ramping can be resumed by decreasing the rate value to 9999 or less.

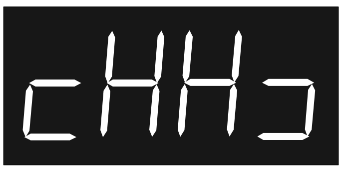
2.4 ALARM STATUS DISPLAY

The operator may view the status of the Controller's alarm(s) by depressing the Function key repeatedly until the lower display shows the legend **ALSt**. The upper display will then be showing the alarm status in the following format:

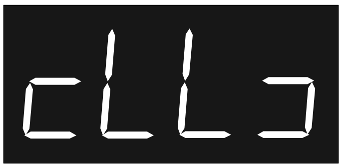
This display is available only if one or more of the alarms is (are) active.

2.5 OVER-RANGE/UNDER-RANGE DISPLAYS

If the process variable attains a value higher than the input scale maximum limit (over-range) or lower than the input scale minimum limit (under-range), the upper display will show:



for the over-range condition and:



for the under-range condition.

2.6 SENSOR BREAK INDICATION

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

The reaction of the outputs and alarms to a detected sensor break is dependent upon the input type.

2.7 MANUAL CONTROL MODE

If selection of Manual Control Mode is enabled (see Subsection 3.2.25) the Manual Control Mode may be entered by depressing the Auto/Manual key. The **SET** indicator will then flash continuously whilst the Controller is in Manual Control Mode. The valve position may then be adjusted with the Raise/Lower keys. A return can be made to Automatic Control Mode by simply depressing the Auto/Manual key again, which causes the usual process variable display to appear.

2.8 PRE-TUNE FACILITY

This facility may be used to set the Controller's PID parameters to values which are approximately correct, in order to provide a base from which the Self-Tune facility may subsequently optimise tuning. Pre-Tune may be activated as follows:

1. With the Controller showing its normal Operator Mode display, depress and hold down simultaneously the Raise and Lower keys (whereupon the numeric displays will start to flash) until the **AT** indicator blinks once (after approximately three seconds - numeric displays will become static).

2. Release the Raise/Lower keys and depress and hold down the Function key for three seconds (approximately). If the process variable is greater than 5% of input span from the setpoint, the **AT** indicator will then flash, indicating that the Pre-Tune facility is engaged and operating. If the process variable is within 5% of input span from the setpoint, or if an erroneous key sequence is used, the Pre-Tune facility will not be engaged.

NOTE: Pre-Tune will not engage if the setpoint is currently ramping. Pre-Tune always sets the Derivative Time Constant (Rate) to 00 seconds (Off)

To dis-engage the Pre-Tune facility:

1. Depress and hold down simultaneously the Raise and Lower keys (whereupon the numeric displays will start to flash) until the **AT** indicator blinks once (after approximately three seconds - numeric displays will become static).

2. Release the Raise/Lower keys and depress and hold down the Function key for three seconds (approximately). The **AT** indicator will then be continuously OFF, indicating that the Pre-Tune facility is dis-engaged.

NOTE Since the Pre-Tune facility is a single-shot operation, it will automatically dis-engage itself once the operation is complete.

2.9 SELF-TUNE FACILITY

This facility is used to optimise tuning whilst the Controller is operating. Self-Tune may be activated as follows:

1. With the Controller showing its normal Operator Mode display, depress and hold down simultaneously the Raise and Lower keys (whereupon the numeric displays will start flashing) until the **AT** indicator blinks once (after approximately three seconds - the numeric displays will stop flashing).

2. Depress and hold down the Auto/Manual key for a further three seconds (approximately). The **AT** indicator will then be ON continuously, indicating that the Self-Tune facility is engaged and operating. If an erroneous key sequence is used, the Self-Tune facility will not be engaged.

To dis-engage the Self-Tune facility:

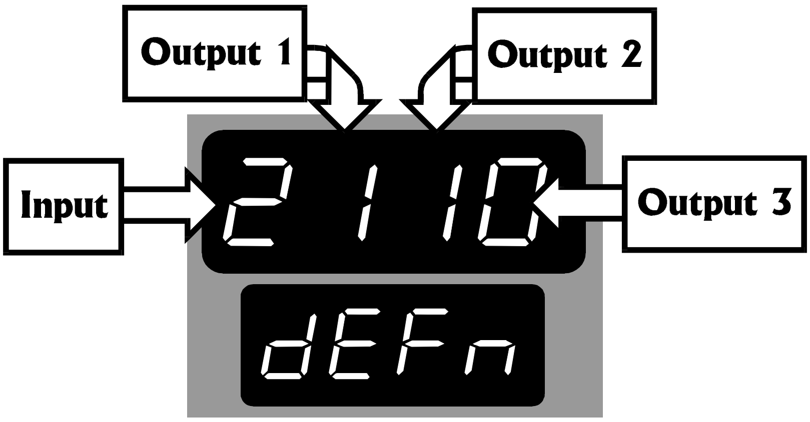
1. Depress and hold down simultaneously the Raise and Lower keys (whereupon the numeric displays will start flashing) until the **AT** indicator blinks once (after approximately three seconds - the numeric displays will stop flashing).

2. Depress and hold down the Auto/Manual key for a further three seconds (approximately). The **AT** indicator will then stay OFF, indicating that the Self-Tune facility is dis-engaged.

2.10 VIEWING THE HARDWARE DEFINITION CODE

The operator may view the current Hardware Definition Code setting by simultaneously depressing the Lower and Function keys (after the Controller has been powered-up for at least 30 seconds). A return may be made to the normal Operator Mode display by simultaneously depressing the Lower and Function keys.

NOTE: An automatic return is made to the normal Operator Mode display after 30 seconds.



The Hardware Definition Code has the following significance:

Value	0	1	2	3	4	5	7
Input		RTD/Linear DC (mV)	T'couple	Linear DC (mA)	Linear DC (V)		
Output 1		Relay					
Output 2		Relay					
Output 3	Not fitted	Relay	SSR Drive	DC (0 - 10mA)	DC (0 - 20mA)	DC (0 - 5V)	DC (4 - 20mA)

SECTION 3
SET UP MODE

3.1 ENTRY INTO SET UP MODE

To enter Set Up Mode, with the Controller initially in Operator Mode with normal display, depress the Raise and Function keys simultaneously. The upper and lower displays will then be as shown in Figure 3-1. Using the Raise and Lower keys, set the upper display to the “Unlock” value; if this matches the “Lock” value (a Set Up Mode parameter), depression of the Function key will achieve entry into Set Up Mode. If the entered upper display value does not equal the “Lock” value when the Function key is depressed, a return is made to the initial display.

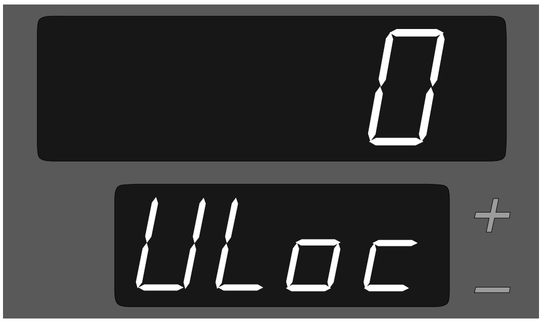


Figure 3-1 Unlock Code Display

NOTE: If the upper display shows:

(i.e. all decimal point positions illuminated), this indicates that one or more of the critical configuration parameters - typically input range or output use/type - have been altered in value/setting and, as a consequence, all Set Up Mode parameters have been automatically set to their default values/settings. To clear this display, simply alter the value/setting of any Set Up Mode parameter (see below). It is recommended that Set Up Mode parameters are not assigned values/settings until *all* configuration parameters have been finalised.

3.2 SET UP MODE PARAMETERS

The parameters available for view/adjustment in Set Up Mode are summarised in Table 3-1. When Set Up Mode is entered, the lower display will show the legend for the first parameter (Filter Time Constant) and the filter time constant value will be shown in the upper display. The user may then step through the Set Up Mode parameters by depressing the Function key. In each case, the legend identifying the parameter will be shown in the lower display and the current value/setting will be shown in the upper display. The value/setting may be altered using the Raise/Lower keys. A detailed description of each of these parameters is given in the following Subsections.

Table 3-1 Set Up Parameters

Parameter	Legend	Adjustment Range	Default
Digital Filter Time Constant	FiLt	OFF, 0.5 to 100.0 secs. in 0.5sec. increments	2.0secs.
Process Variable Offset	OFFS	±input span of Controller	0
Proportional Band	Pb	0.0% to 999.9% of input span	10.0%
Reset (Integral Time Constant)	rSEt	1sec. to 99mins 59secs.	5mins. 00secs.
Rate (Derivative Time Constant)	rAtE	00secs. to 99mins. 59secs.	00secs.
Setpoint High Limit	SPhi	Setpoint to Range Maximum	Range Max.
Setpoint Low Limit	SPLo	Range Minimum to Setpoint	Range Min.
Recorder Output Scale Max.	roPH	–1999 to 9999	Range Max.
Recorder Output Scale Min.	roPL	-1999 to 9999	Range Min.
Motor Travel Time	tr	5secs. to 5mins.	1min.
Minimum Motor ON Time	ton	0.0secs. to (Motor Travel Time + 10)secs.	1.0sec.
Process High Alarm 1 value [1]	h_A1	Range Min. to Range Max.	Range Max.
Process Low Alarm 1 value [1]	L_A1	Range Min. to Range Max.	Range Min.
Band Alarm 1 value [1]	b_A1	0 to span from Setpoint	5 units
Deviation Alarm 1 value [1]	d_A1	±span from Setpoint	5 units
Process High Alarm 2 value [1]	h_A2	Range Min. to Range Max.	Range Max.
Process Low Alarm 2 value [1]	L_A2	Range Min. to Range Max.	Range Min.
Band Alarm 2 value [1]	b_A2	0 to span from Setpoint	5 units
Deviation Alarm 2 value [1]	d_A2	±span from Setpoint	5 units
Loop Alarm Enable	LAEn	0 (Disabled) or 1 (Enabled)	0
Scale Range Decimal Point [2]	rPnt	0, 1, 2 or 3	0
Scale Range Maximum [2]	rhi	-1999 to 9999	1000
Scale Range Minimum [2]	rLo	-1999 to 9999	0000
Auto Pre-Tune Enable/Disable	APt	0 (Disabled) or 1 (Enabled)	0
Manual Control Enable/Disable	PoEn	0 (Disabled) or 1 (Enabled)	0
Setpoint Ramp Enable/Disable	rPEn	0 (Disabled) or 1 (Enabled)	0
Setpoint Strategy	SPSt	0, 1, 2, 3, 4 or 5	1
Communications Enable/Disable [4]	CoEn	0 (Disabled) or 1 (Enabled)	1
Lock Value	Loc	0 to 9999	10
Operator Mode Displays (still available in Set Up Mode)			
Process Variable		-	-
Setpoint [6]	SP	Setpoint lOw Limit to Setpoint High Limit	SP Low Limit
Ramping Setpoint value [3]	SPrP	Read Only	N/A
Setpoint Ramp Rate [5]	rP	1 - 9999 and OFF	OFF (blank)
Alarm Status	ALSt	Read Only (see Subsection 2.4).	

NOTES ON TABLE 3-1

1. These parameters are optional; only one legend will appear for each alarm.
2. Only applicable if a DC Linear input is fitted.
3. Appears only if Ramp Rate is not switched OFF.
4. Applicable only if the RS485 Communications Option PCB is fitted.
5. Does not appear in Operator Mode unless Setpoint Ramp is enabled.
6. In Dual Setpoint operation, the legend displayed will be **SP1** or **SP2**, as appropriate.

3.2.1 Input Filter Time Constant

The Controller input is equipped with a digital filter which is used to filter out any extraneous impulses on the process variable. This filtered PV is used for all PV-dependent functions (control, alarms etc.). The time constant for this filter may be adjusted in the range 0.0 seconds (filter OFF) to 100.0 seconds in 0.5 second increments. The default setting is 2.0 seconds.

CAUTION: If this parameter is set to an excessively high value, the control quality may be significantly impaired. The value chosen should be sufficiently large to attenuate stray noise on the process variable signal but no larger.

3.2.2 Process Variable Offset

This parameter is used to modify the actual process variable value (measured at the Controller's input terminals) in the following manner:

Offset PV value = Actual PV value + Process Variable Offset value.

For Controllers fitted with a linear input, the displayed process variable value is limited by Scale Range Maximum (see Subsection 3.2.22) and Scale Range Minimum (see Subsection 3.2.23). The offset process variable value is used for all PV-dependent functions (control, display, alarm, recorder output etc.).

NOTE: This parameter value should be chosen with care. Any adjustment to this parameter is, in effect, a calibration adjustment. Injudicious application of values to this parameter could lead to the displayed process variable value bearing no meaningful relationship to the actual process variable value. There is no front panel indication when this parameter is in effect (i.e. has been set to a non-zero value).

The default value is 0.

3.2.3 Proportional Band

This parameter is the portion of the input span of the Controller over which valve movement is proportional to changes in the displayed process variable value. It may be adjusted in the range 0.5% to 999.9%. The default value of this parameter is 10.0%.

3.2.4 Reset (Integral Time Constant)

This parameter is adjustable in the range 1 second to 99 minutes 59 seconds.

3.2.5 Rate (Derivative Time Constant)

This parameter is adjustable in the range 00 seconds to 99 minutes 59 seconds.

3.2.6 Setpoint High Limit

This 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 being controlled. The Setpoint High Limit may be adjusted between the current setpoint value and Input Range Maximum. The default value is Input Range Maximum.

3.2.7 Setpoint Low Limit

This 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 being controlled. The Setpoint Low Limit may be adjusted between the Input Range Minimum and the current setpoint value. The default value is Input Range Minimum.

3.2.8 Recorder Output Scale Maximum

This parameter defines the value of process variable or setpoint (whichever is applicable) at which the Recorder Output reaches its maximum value; for example, for a 0 - 5V Recorder Output, this value corresponds to 5V. It may be adjusted within the range –1999 to 9999. The decimal point position for the Recorder Output is always the same as that for the process variable input range. The default value is Input Range Maximum. This parameter is not applicable if the Recorder Output option is not fitted.

> NOTE: If this parameter is set to a value less than that for the Recorder Output Scale Minimum (see Subsection 3.2.9), the relationship between the process variable/setpoint value and the Recorder Output is reversed.

3.2.9 Recorder Output Scale Minimum

This parameter defines the value of the process variable or setpoint (whichever is applicable) at which the Recorder Output reaches its minimum value; for example, for a 0 - 5V Recorder Output, this value corresponds to 0V. It may be adjusted within the range –1999 to 9999. The decimal point position for the Recorder Output is always the same as that for the process variable input range. The default value is Input Range Minimum. This parameter is not applicable if the Recorder Output option is not fitted.

> NOTE: If this parameter is set to a value greater than that for the Recorder Output Scale Maximum (see Subsection 3.2.8), the relationship between the process variable value and the Recorder Output is reversed.

3.2.10 Motor Travel Time

This is 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.

3.2.11 Minimum Motor ON Time

This 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 Self-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. Self-Tune monitors on-control valve activity and will minimise it automatically. Too large a value of Minimum Motor ON Time can impair the effectiveness of the Self-Tune facility; if process variable oscillations persist whilst Self-Tune is running, it may be for this reason.

3.2.12 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. The operation of a process high alarm is illustrated in Figure 3-2.

3.2.13 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. The operation of a process low alarm is illustrated in Figure 3-2.

3.2.14 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, centred on the setpoint value. If the process variable value is outside this band, the alarm will be active. This parameter may be adjusted to be within ((input span) from the setpoint. The default value is five input units. The operation of a band alarm is illustrated in Figure 3-2.

3.2.15 Deviation (High/Low) 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

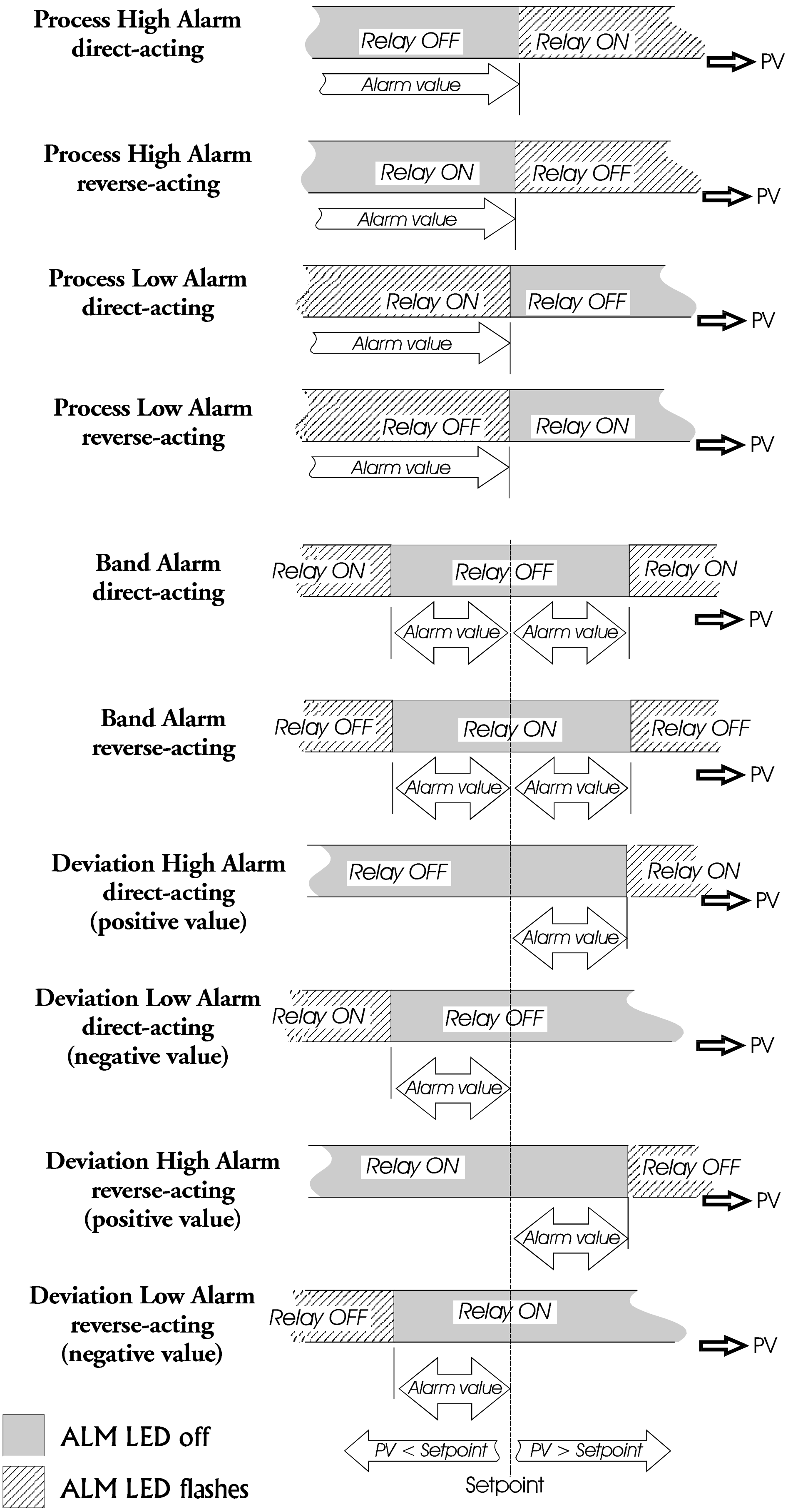


Figure 3-2 Alarm Operation

parameter, Alarm 1 goes active. This parameter value may be adjusted in the range ((input range) from setpoint. The default value is five input range units. The operation of Deviation Alarms is illustrated in Figure 3-2.

3.2.16 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. The operation of a process high alarm is illustrated in Figure 3-2.

3.2.17 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. The operation of a process low alarm is illustrated in Figure 3-2.

3.2.18 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, centred on the setpoint value. If the process variable value is outside this band, the alarm will be active. This parameter may be adjusted to be within ((input span) from the setpoint. The default value is five input units. The operation of a band alarm is illustrated in Figure 3-2.

3.2.19 Deviation (High/Low) 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 value may be adjusted in the range ((input range) from setpoint. The default value is five input range units. The operation of Deviation Alarms is illustrated in Figure 3-2.

3.2.20 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 outputs.

The Loop Alarm facility, 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 variable 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 Reset (Integral Time Constant) parameter. The value of V is dependent upon the input type:

°C ranges:	2°C or 2.0°C
°F ranges:	3°F or 3.0°F
Linear ranges:	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 facility. Upon exit from Manual Control Mode or after completion of the Pre-Tune routine, the Loop Alarm is automatically re-enabled.

3.2.21 Scale Range Decimal Point (linear inputs only)

This parameter defines the position of the decimal point in values of the process variable, setpoint, alarm levels and recorder outputs as follows:

Value	Decimal Point Position
0	xxxx
1	xxx.x
2	xx.xx
3	x.xxx

The default value is 1.

3.2.22 Scale Range Maximum (linear inputs only)

This parameter defines the scaled input value when the process variable input hardware is at its maximum value. It is adjustable between –1999 and 9999 (with decimal point as defined by Scale Range Decimal Point). The default value is 1000. This parameter can be set to a value less than (but not equal to) Scale Range Minimum, in which case the sense of the input is reversed.

3.2.23 Scale Range Minimum (linear inputs only)

This parameter defines the scaled input value when the process variable input hardware is at its minimum value. It is adjustable between –1999 and 9999 (with decimal point as defined by Scale Range Decimal Point). The default value is 0.

This parameter can be set to a value greater than (but not equal to) Scale Range Maximum, in which case the sense of the input is reversed.

3.2.24 Auto Pre-Tune Enable/Disable

This parameter determines whether or not the Controller's Pre-Tune facility is activated automatically on power-up (0 = Disabled, 1 = Enabled). The default setting is 0 (Disabled).

3.2.25 Manual Control Enable/Disable

This parameter determines whether operator selection of manual control is enabled or disabled (0 = Disabled, 1 = Enabled). The default setting is 0 (Disabled).

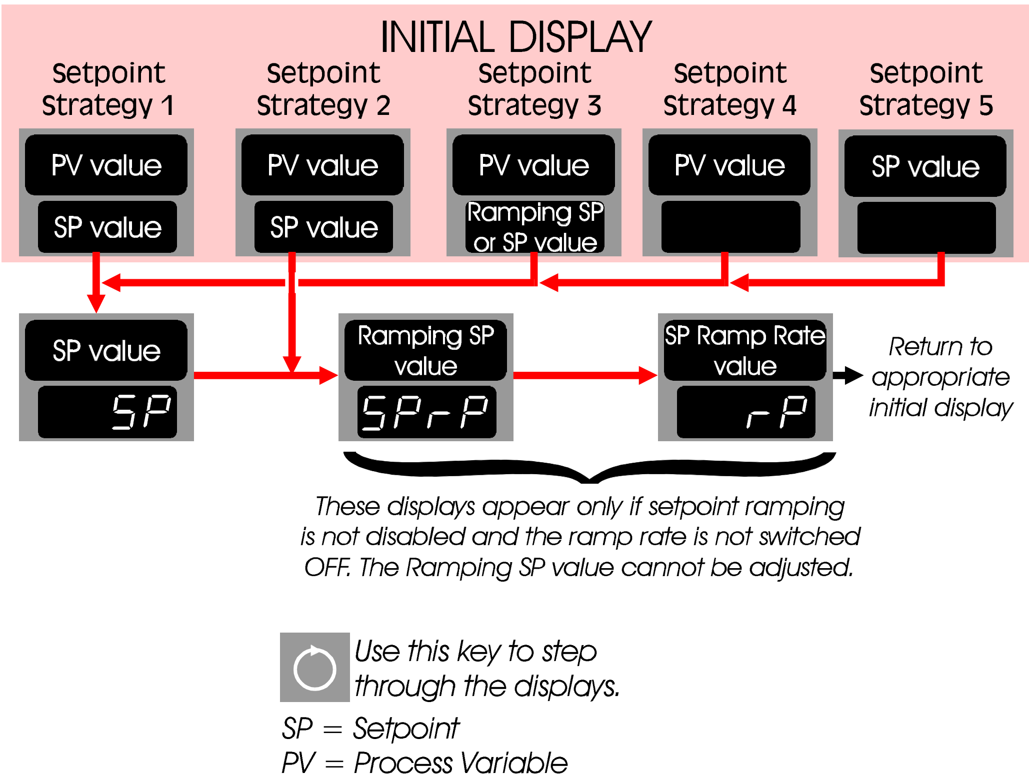
3.2.26 Setpoint Ramp Enable/Disable

This parameter enables/disables use of the setpoint ramping feature at user level (0 = Disabled, 1 = Enabled). The default setting is 0 (Disabled).

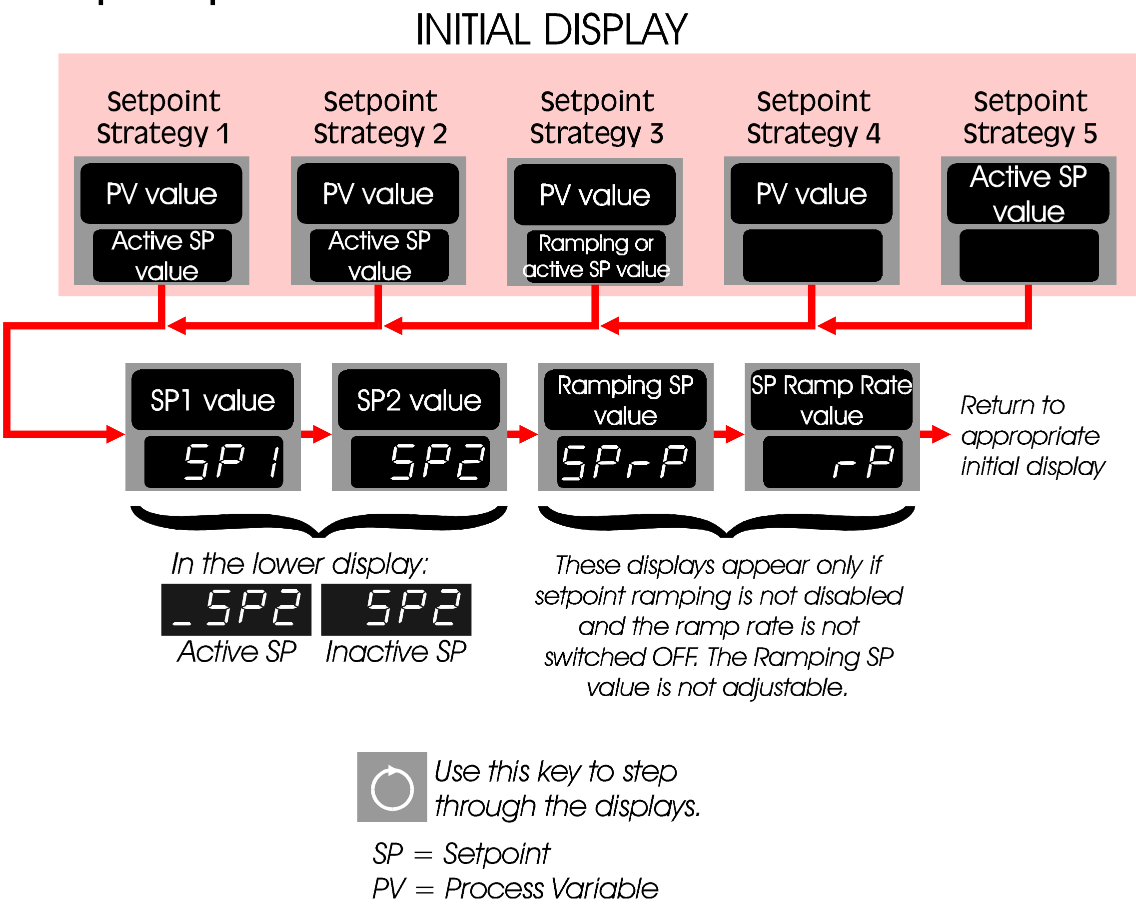
3.2.27 Setpoint Strategy

This parameter defines the Operator Mode setpoint display strategy as follows:

Single Setpoint Operation:



Dual Setpoint Operation:



The default value is 1.

3.2.28 Communications Enable/Disable

This parameter enables/disables Write operations (i.e. the *changing* of parameter values/settings) via the RS485 communications link, if the Communications Option PCB is fitted (0 = Disabled, 1 = Enabled). The default setting is 1 (Enabled). Parameters can be *interrogated* via the link, regardless of the setting of this parameter.

3.2.29 Lock Value

This parameter defines the four-digit code required to enter Set Up Mode. It may be adjusted in the range 0 to 9999. The default setting is 10.

3.3 OPERATOR MODE DISPLAYS

Once the complete cycle of Set Up Mode parameters has been displayed, the user may then step through the Operator Mode displays (see Section 2), making adjustments where required, before re-starting the Set Up Mode parameter cycle, as shown in Table 3-1.

3.4 TUNING THE CONTROLLER MANUALLY

Before starting to tune the Controller to the load, check that the Setpoint High and Low Limits (**SPhi** and **SPLo**) are set to safe levels - see Subsections 3.2.6 and 3.2.7.

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

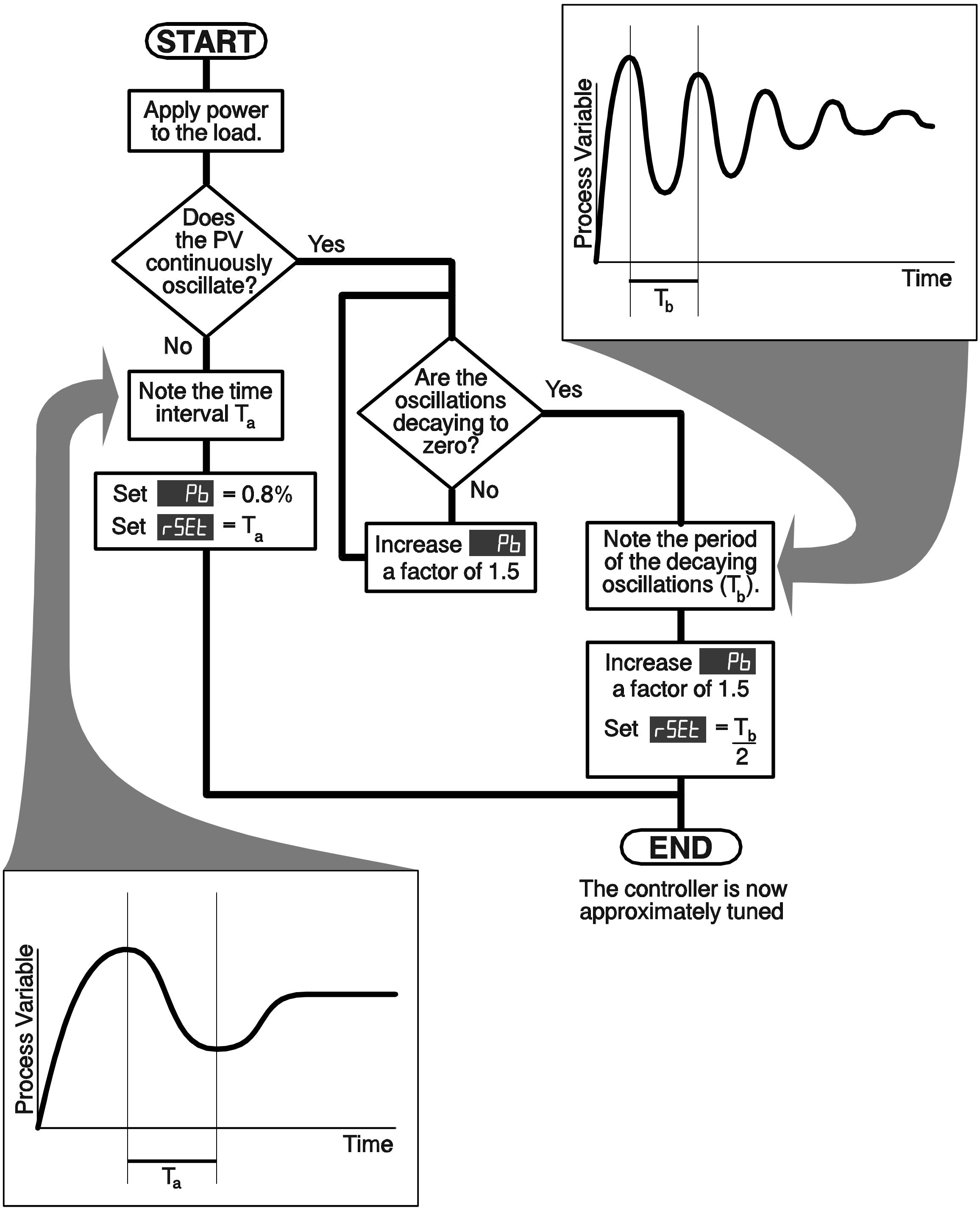


Figure 3-3 Manual Tuning Technique

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. For more information on tuning, including alternative tuning techniques, refer to the booklet Principles of Temperature Control available from West.

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 (**rSEt**) to 99 minutes 59 seconds.

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 3-3. At each stage, allow sufficient settling time before moving on to the next stage.

NOTE: After setting up the parameters, set the Controller to Operator Mode (see Subsection 3.6) to prevent unauthorised adjustment to the values.

3.5 SELF-TUNE AND PRE-TUNE FACILITIES

The Pre-Tune and Self-Tune facilities may be used in Operator Mode to enhance the response of the Controller (see Subsections 2.8 and 2.9).

3.6 EXIT FROM SET UP MODE

To leave Set Up Mode, select the initial Operator Mode display (normally process variable) then depress the Raise and Function keys simultaneously, whereupon the Controller will return to Operator Mode.

NOTE: An automatic return to Operator mode will be executed if there is no key activity in Set Up Mode for two minutes.

SECTION 4
RS485 SERIAL COMMUNICATIONS

The Controller may be equipped with a three-wire RS485-compatible serial communications facility, by which means communication may occur between the Controller and a master device (e.g. a computer or terminal).

4.1 COMMUNICATIONS ENABLE/DISABLE

When Communications are enabled (in Set Up Mode - see Subsection 3.2.28), the Controller parameters may be adjusted by the master device via the serial communications link. If communications are disabled, the Controller will not adjust or change any parameters in response to commands received from the master device and will send a negative acknowledgement in response to such commands. Whether communications are enabled or disabled, the Controller will return the requested information in response to a Type 2 Interrogation message (see Subsection 4.2.5) from the master device.

4.2 PHYSICAL REQUIREMENTS

4.2.1 Character Transmission

Data format is fixed to be even parity, seven data bits and one stop bit. The Baud rate may be selected to be 1200, 2400, 4800 (default) or 9600 Baud.

4.2.2 Line Turn-Round

The communications link is operated as a multi-drop half duplex system. When a device is transmitting, it drives the transmission lines to the appropriate levels; when it is not transmitting, its outputs are set to a high impedance in order that another device can transmit. It is important that a transmitter releases the transmission lines before another device starts transmission. This imposes the following restraints on the master device:

(a) The transmitter must release the transmission lines within 6ms of the end of the last character of a message being transmitted. Note that delays due to buffers such as those used in universal asynchronous receivers/transmitters (UARTs) within the master device must be taken into account.

(b) The transmitter must not start transmission until 6ms has elapsed since the reception of the last character of a message.

All Controllers having an RS485 communications facility adhere to this standard; thus, provided that the master device conforms similarly to the standard, there should be no line contention problems.

4.2.3 Communications Protocol

The protocol assumes half duplex communications. All communication is initiated by the master device. The master sends a command or query to the addressed slave and the slave replies with an acknowledgement of the command or the reply to the query. All messages, in either direction, comprise:

(a) A Start of Message character
(b) One or two address characters (uniquely defining the slave)
(c) A parameter/data character string
(d) An End of Message character

Messages from the master device may be one of four types:

Type 1:	L {N} ? ? *
Type 2:	L {N} {P} {C} *
Type 3:	L {N} {P} # {DATA} *
Type 4:	L {N} {P} I *

where all characters are in ASCII code and:

L	is the Start of Message character (Hex 4C)
{N}	is the slave Controller address (in the range 1 - 32); addresses 1 - 9 may be represented by a single digit (e.g. 7) or in two-digit form, the first digit being zero (e.g. 07).
{P}	is a character which identifies the parameter to be interrogated/modified - see Table 4-2.
{C}	is the command (see below)
#	indicates that {DATA} is to follow (Hex 23)
{DATA}	is a string of numerical data in ASCII code (see Table 4-1)
*	is the End of Message character (Hex 2A)

No space characters are permitted in messages. Any syntax errors in a received message will cause the slave controller to issue no reply and await the Start of Message character.

Table 4-1 {DATA} Element - Sign & Decimal Point Position

{DATA} Content	Sign/Decimal Point Position
abcd0	+abcd
abcd1	+abc.d
abcd2	+ab.cd
abcd3	+a.bcd
abcd5	−abcd
abcd6	−abc.d
abcd7	−ab.cd
abcd8	−a.bcd

Table 4-2 Commands/Parameters and Identifiers

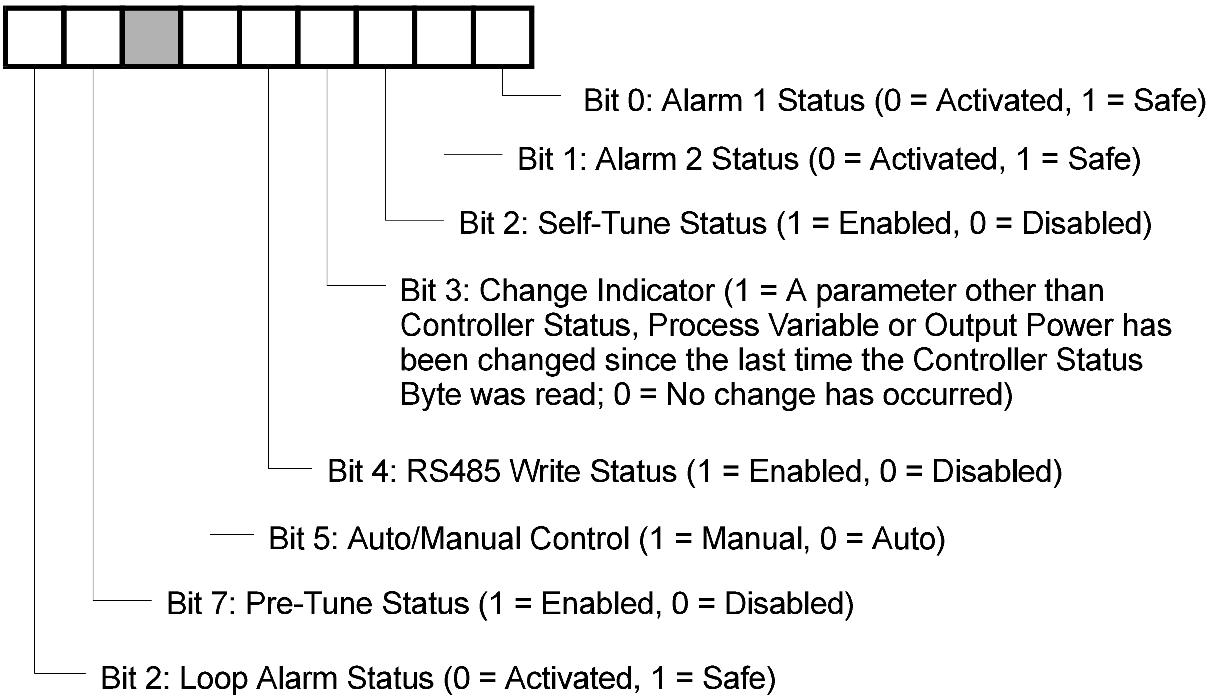
Identifier	Parameter/Command
A	Setpoint High Limit
C	Alarm 1 value
D	Rate (Derivative Time Constant) value [1]
E	Alarm 2 value
G	Scale Range Maximum
H	Scale Range Minimum
I	Reset (Integral Time Constant) value [1]
L	Controller Status [2]
M	Process Variable value
N	Motor Travel Time
O	Minimum Motor ON Time
P	Proportional Band value [1]
Q	Scale Range Decimal Point Position
S	Setpoint value
T	Setpoint Low Limit
V	Deviation value
Z	Controller Commands [3]
[	Recorder Output Scale Maximum
\	Recorder Output Scale Minimum
]	Scan Table
^	Setpoint Ramp Rate
m	Input Filter Time Constant value
v	Process Variable Offset value

The use of identifiers not contained in this table will cause the controller to give a "negative acknowledgement" response.

NOTES ON TABLE 4-2

1. These parameters cannot be modified whilst either the Pre-Tune facility or the Self-Tune facility is activated.

2. The Controller Status byte has the following format:



3. Only Type 3 or Type 4 messages are allowed with this parameter. In the Type 3 message, the {DATA} field must be one of eight five-digit numbers. The reply from the controller also contains the {DATA} field with the same content. When the Master device issues the Type 4 message, the controller responds with the same {DATA} field content. The commands corresponding to the {DATA} field value are:

00030	Activate the Self-Tune facility
00040	De-activate the Self-Tune facility
00050	Request Pre-Tune (see note below)
00060	Abort Pre-Tune
00130	Activate Loop Alarm
00140	De-activate Loop Alarm

NOTE: The controller will go into Pre-Tune mode only if the process variable is at least 5% of input span from the setpoint.

4.2.4 Type 1 Message

L {N} ? ? *

This message is used by the master device to determine whether the addressed slave Controller is active. The reply from the slave Controller, if it is active, is

L {N} ? A *

An inactive Controller will give no reply.

4.2.5 Type 2 Message

L {N} {P} {C} *

This type of message is used by the master device to interrogate or modify a parameter in the addressed Controller. {P} identifies the parameter (as defined in Table 4-2) and {C} represents the command to be executed, which may be one of the following:

+ (Hex 2B) - Increment the value of the parameter defined by {P}
– (Hex 2D) - Decrement the value of the parameter defined by {P}
? (Hex 3F) - Determine the current value of the parameter defined by {P}

The reply from the addressed Controller is of the form:

L {N} {P} {DATA} A *

where {DATA} comprises five ASCII-coded digits whose format is shown in Table 4-1. The data is the value requested in a query message or the new value of the parameter after modification. If the action requested by the message from the master device would result in an invalid value for that parameter (either because the requested new value would be outside the permitted range for that parameter or because the parameter is not modifiable), the Controller replies with a negative acknowledgement:

L {N} {P} {DATA} N *

The {DATA} string in the negative acknowledgement reply will be indeterminate. If the process variable or the deviation is interrogated whilst the process variable is outside the range of the Controller, the reply is:

L {N} {P} < ? ? > 0 A *

if the process variable is over-range, or

L {N} {P} < ? ? > 5 A *

if the process variable is under-range.

Scan Tables

A parameter identifier character "]" in the message from the master device indicates that a "Scan Table" operation is required. This provides a facility for interrogating the values of a group of parameters and status in a single message from the master device. The reply to such a command would be in the form:

L {N}] 20 aaaaa bbbbb ccccc ddddd eeeee A *

where 20 is the number of data digits to follow. The digits are expressed as shown in Table 4-1. For further information, refer to Subsection 4.3.6.3.

4.2.6 Type 3 Message

L {N} {P} # {DATA} *

This message type is used by the master device to set a parameter to the value specified in {DATA}. The command is not implemented immediately by the slave Controller; the slave will receive this command and will then wait for a Type 4 message (see below). Upon receipt of a Type 3 message, if the {DATA} content and the specified parameter are valid, the slave Controller reply is of the form:

L {N} {P} {DATA} I *

(where I = Hex 49) indicating that the Controller is ready to implement the command.. If the parameter specified is invalid or is not modifiable or if the desired value is outside the permitted range for that parameter, the Controller replies with a negative acknowledgement in the form:

L {N} {P} {DATA} N *

4.2.7 Type 4 Message

L {N} {P} I *

This type of message is sent by the master device to the addressed slave Controller following a successful Type 3 message transmission and reply to/from the same slave Controller. Provided that the {DATA} content and the parameter specified in the preceding Type 3 message are still valid, the slave Controller will then set the parameter to the desired value and will reply in the form:

L {N} {P} {DATA} A *

where {DATA} is the new value of the parameter. If the new value or parameter specified is invalid, the slave Controller will reply with a negative acknowledgement in the form:

L {N} {P} {DATA} N *

where {DATA} is indeterminate. If the immediately-preceding message received by the slave Controller was not a Type 3 message, the Type 4 message is ignored.

4.3 INDIVIDUAL PARAMETERS

The individual parameters and how they may be interrogated/modified are described below. Unless otherwise stated, the {DATA} element will follow the standard five-digit format and the decimal point position must be correct for the new value to be accepted and for modification to occur.

> NOTE: The communications identifier character {P} for each parameter is shown to the right of each subsection heading.

4.3.1 Input Parameters

4.3.1.1 PROCESS VARIABLE OR MEASURED VARIABLE {P} = M

This parameter may be interrogated only, using a Type 2 message. If the process variable is out of range, the five-digit {DATA} field in the reply will not contain a number, but will contain <??>0 (over-range) or <??>5 (under-range).

4.3.1.2 PROCESS VARIABLE OFFSET {P} = v

This parameter may be modified/interrogated using a Type 2 message or a Type 3/4 message sequence. It modifies the actual process variable value (as measured at the Controller's input terminals) in the following manner:

> Modified PV value = Actual PV value + process variable offset value

The modified PV value is limited by Range Maximum and Range Minimum and is used for display and alarm purposes and for recorder outputs.

> NOTE: This parameter value should be selected with care. Any adjustment to this parameter is, in effect, an adjustment to the Controller's calibration. Injudicious application of values to this parameter could lead to the displayed PV value having no meaningful relationship to the actual PV value.

4.3.1.3 SCALE RANGE MAXIMUM {P} = G

This parameter (which is adjustable only on DC linear inputs) may be interrogated using a Type 2 message or may be modified using a Type 3/4 message sequence. The decimal point position is as for the input range.

4.3.1.4 SCALE RANGE MINIMUM {P} = H

This parameter (which is adjustable only on DC linear inputs) may be interrogated using a Type 2 message or may be modified using a Type 3/4 message sequence. The decimal point position is as for the input range.

4.3.1.5 SCALE RANGE DECIMAL POINT POSITION {P} = Q

Adjustable on DC linear inputs only, this parameter may be interrogated using a Type 2 message or may be modified using a Type 3/4 message sequence. The value of this parameter defines the decimal point position, as follows:

Value	Decimal Point Position
0	abcd
1	abc.d
2	ab.cd
3	a.bcd

4.3.1.6 INPUT FILTER TIME CONSTANT {P} = m

This parameter may be modified/interrogated using a Type 2 message or a Type 3/4 message sequence.

4.3.2 Output Parameters

4.3.2.1 MOTOR TRAVEL TIME {P} = N

This is 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. This parameter may be modified/interrogated using a Type 2 message or a Type 3/4 message sequence. The {DATA} element is in a format in which the first two digits represent minutes and the second two digits represent seconds. The decimal point position complies with this format and the decimal point is used as a separator between the minutes digits and the seconds digits. The decimal point must be in the correct position for modification to occur.

4.3.2.2 MINIMUM MOTOR ON TIME {P} = O

This 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 Self-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. Self-Tune monitors on-control valve activity and will minimise it automatically. Too large a value of Minimum Motor ON Time can impair the effectiveness of the Self-Tune facility; if process variable oscillations persist whilst Self-Tune is running, it may be for this reason.

This parameter may be modified/interrogated using a Type 2 message or a Type 3/4 message sequence. The {DATA} element is in a format in which the first four digits represent seconds. The decimal point position is set to 1. The decimal point must be in the correct position for modification to occur.

4.3.2.3 RECORDER OUTPUT SCALE MAXIMUM VALUE {P} = [

This parameter may be modified/interrogated using a Type 2 message or a Type 3/4 message sequence. It defines the maximum scale value for the Controller's Recorder Output and may be adjusted within the range –9999 to 9999. This value corresponds to the Input Scale Maximum and the decimal point position will always be the same as that for the input.

NOTE: If this parameter is set to a value less than the Recorder Output Minimum Value, the sense of the Recorder Output is reversed.

4.3.2.4 RECORDER OUTPUT SCALE MINIMUM VALUE {P} = \

This parameter may be modified/interrogated using a Type 2 message or a Type 3/4 message sequence. It defines the minimum scale value for the Controller's Recorder Output and may be adjusted within the range –9999 to 9999. This value corresponds to the Input Scale Minimum and the decimal point position will always be the same as that for the input.

NOTE: If this parameter is set to a value greater than the Recorder Output Maximum Value, the sense of the Recorder Output is reversed.

4.3.3 Setpoint Parameters

4.3.3.1 SETPOINT VALUE {P} = S

This parameter may be modified/interrogated using a Type 2 message or a Type 3/4 message sequence. It can be set to any value between Setpoint High Limit (see Subsection 4.3.3.3) and Setpoint Low Limit (see Subsection 4.3.3.4).

4.3.3.2 SETPOINT RAMP RATE {P} = ^

This parameter may be modified/interrogated using a Type 2 message or a Type 3/4 message sequence. It defines the rate at which the current setpoint can be made to ramp and can be set to a value in the range 1 - 9999 increments per hour. If it is desired to switch setpoint ramping OFF, a Type 3/4 message sequence should be used in which the {DATA} element of the Type 3 message should be set to 00000. If setpoint ramping is OFF, the {DATA} element in the response to an interrogation will be set to 00000.

4.3.3.3 SETPOINT HIGH LIMIT {P} = A

This parameter may be modified/interrogated using a Type 2 message or a Type 3/4 message sequence. It defines the maximum value which may be assigned to the setpoint. The default value is Input Range Maximum. The permissible range is between the current setpoint value and Input Range Maximum. The decimal point position is as for the input range.

4.3.3.4 SETPOINT LOW LIMIT {P} = T

This parameter may be modified/interrogated using a Type 2 message or a Type 3/4 message sequence. It defines the minimum value which may be assigned to the setpoint. The default value is Input Range Minimum. It may be set to a value between Input Range Minimum and the current value of the setpoint. The decimal point position is as for the input range.

4.3.4 Alarm Parameters

4.3.4.1 ALARM 1 VALUE {P} = C

This parameter may be modified/interrogated using a Type 2 message or a Type 3/4 message sequence. It defines the level at which Alarm 1 will go active. The decimal point position is as for the input range.

4.3.4.2 ALARM 2 VALUE {P} = E

This parameter may be modified/interrogated using a Type 2 message or a Type 3/4 message sequence. It defines the level at which Alarm 2 will go active. The decimal point position is as for the input range.

4.3.5 Tuning Parameters

4.3.5.1 RATE (DERIVATIVE TIME CONSTANT) {P} = D

This parameter may be modified/interrogated using a Type 2 message or a Type 3/4 message sequence. It defines the derivative time constant for the control algorithm. The {DATA} element is in a format in which the first two digits represent minutes and the second two digits represent seconds. The decimal point is used as the separator between the minutes and seconds digits (i.e. set to 2 decimal places); the decimal point position must be as described, otherwise modification will not occur.

4.3.5.2 RESET (INTEGRAL TIME CONSTANT) {P} = I

This parameter may be modified/interrogated using a Type 2 message or a Type 3/4 message sequence. The {DATA} element is in a format in which the first two digits represent minutes and the second two digits represent seconds. The decimal point position complies with this format and the decimal point is used as a separator between the minutes digits and the seconds digits. The decimal point must be in the correct position for modification to occur.

4.3.5.3 PROPORTIONAL BAND VALUE {P} = P

This parameter may be modified/interrogated using a Type 2 message or a Type 3/4 message sequence. This may be set to a value in the range 0.5% - 999.9% of Output 1 power range. The decimal point position is set to 1.

4.3.6 Status Parameters

4.3.6.1 CONTROLLER STATUS {P} = L

This parameter may be interrogated only, using a Type 2 message. The status information is encoded in the four digits as the decimal representation of a binary number. Each bit in the binary number has a particular significance (see NOTES ON TABLE 4-2).

4.3.6.2 ARITHMETIC DEVIATION {P} = V
(PROCESS VARIABLE - SETPOINT) VALUE

This parameter may be interrogated only, using a Type 2 message. It is the difference between the current process variable value and the current setpoint value.

4.3.6.3 SCAN TABLES {P} =]

The Scan Tables operation takes the form of a Type 2 interrogation command which accesses a set of information (held in the {DATA} element in the response). The response would be in the form:

L {N}] 20 aaaaa bbbbb ccccc ddddd A *

where 20 is the number of data digits in the {DATA} element to follow. These digits are as described in Table 4-2 and may comprise:

aaaaa	The current setpoint value
bbbbb	The current process variable value
ccccc	The current valve movement
ddddd	The Controller Status (see Note 2 on Table 4-2).

4.4 ERROR RESPONSE

The circumstances under which a message received from the master device is ignored are:

Parity error detected
Syntax error detected
Timeout elapsed
Receipt of a Type 4 message without a preceding Type 3 command message.

Negative acknowledgements will be returned if, in spite of the received message being notionally correct, the Controller cannot supply the requested information or perform the requested operation. The {DATA} element of a negative acknowledgement will be indeterminate.

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$\frac{1}{4}$-DIN, $\frac{1}{8}$-DIN & $\frac{1}{16}$-DIN OPEN LOOP VALVE MOTOR DRIVE CONTROLLERS

PRODUCT MANUAL

VOLUME II INSTALLATION AND CONFIGURATION INSTRUCTIONS

The procedures described in this Volume must be undertaken by technically-competent servicing personnel.

Contents

Appendices

SECTION 1
INSTALLATION

1.1 UNPACKING PROCEDURE

1. Remove the Controller from its packing. The Controller is supplied with a panel gasket and push-fit fixing strap. Retain the packing for future use, should it be necessary to transport the Controller to a different site or to return it to the supplier for repair/testing.

2. Examine the delivered items for damage or deficiencies. If any is found, notify the carrier immediately.

1.2 PANEL-MOUNTING THE CONTROLLER

The panel on which the Controller is to be mounted must be rigid and may be up to 6.0mm (0.25 inches) thick. The cut-out required for a single Controller is as shown in Figure 1-1.

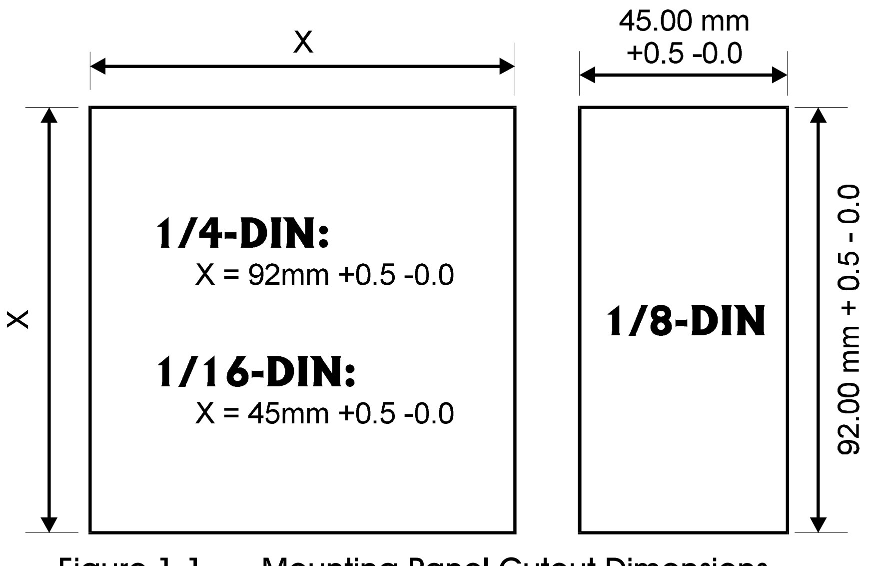


Figure 1-1 Mounting Panel Cutout Dimensions

Several controllers may be installed in a single cut-out, side-by-side. For n Controllers mounted side-by-side, the width of the cut-out would be:

$\frac{1}{4}$-DIN:	(96n - 4) millimetres or (7.56n - 0.16) inches
$\frac{1}{8}$-DIN & $\frac{1}{16}$-DIN:	(48n - 4) millimetres or (3.78n - 0.16) inches.

The main dimensions of the Controllers are shown in Figure 1-2.

The procedure to panel-mount the Controller is shown in Figure 1-3.

Once the Controller is installed in its mounting panel, it may be subsequently removed from its housing, if necessary, as described in Subsection 2.1.

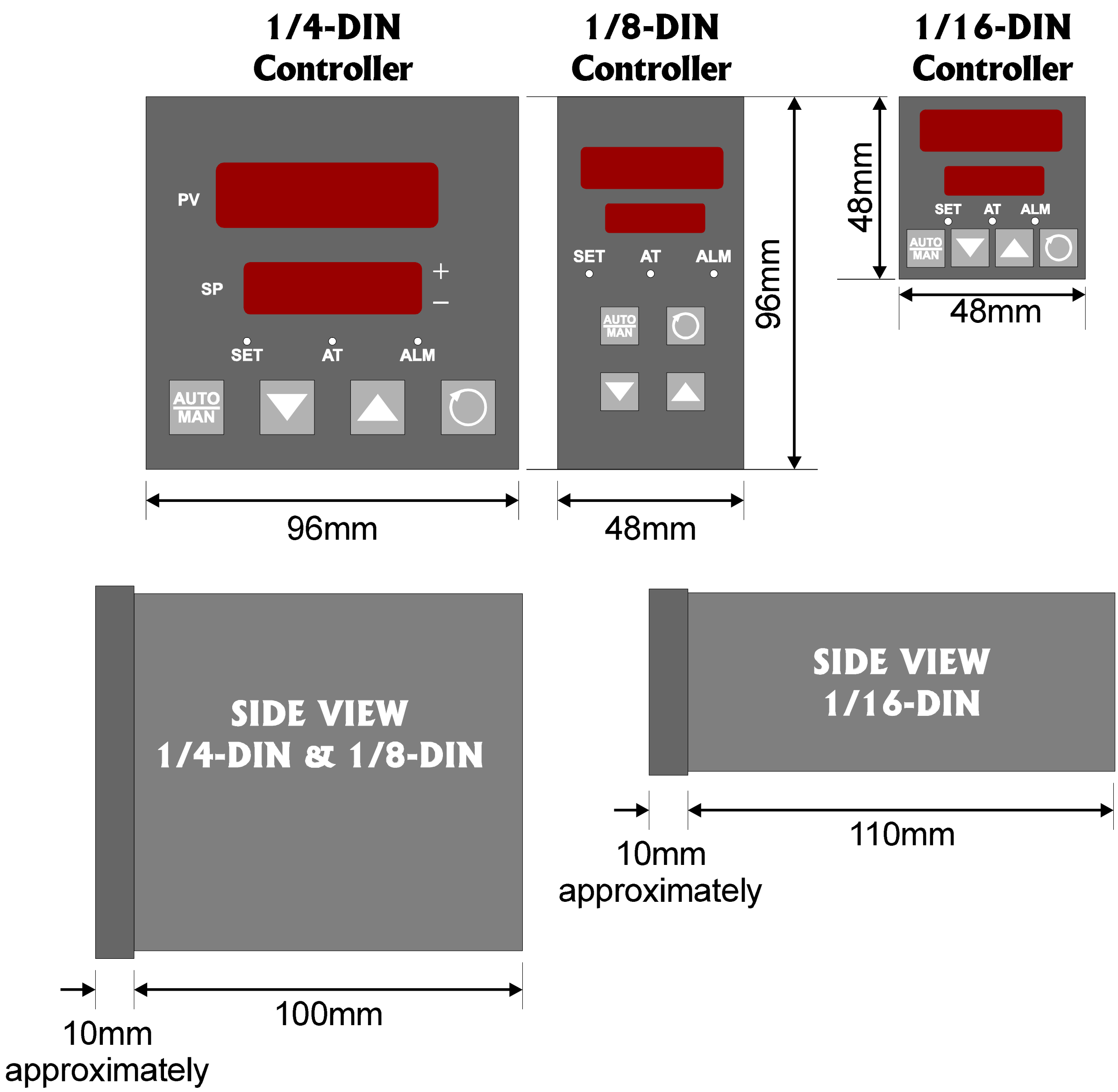


Figure 1-2 Principal Dimensions

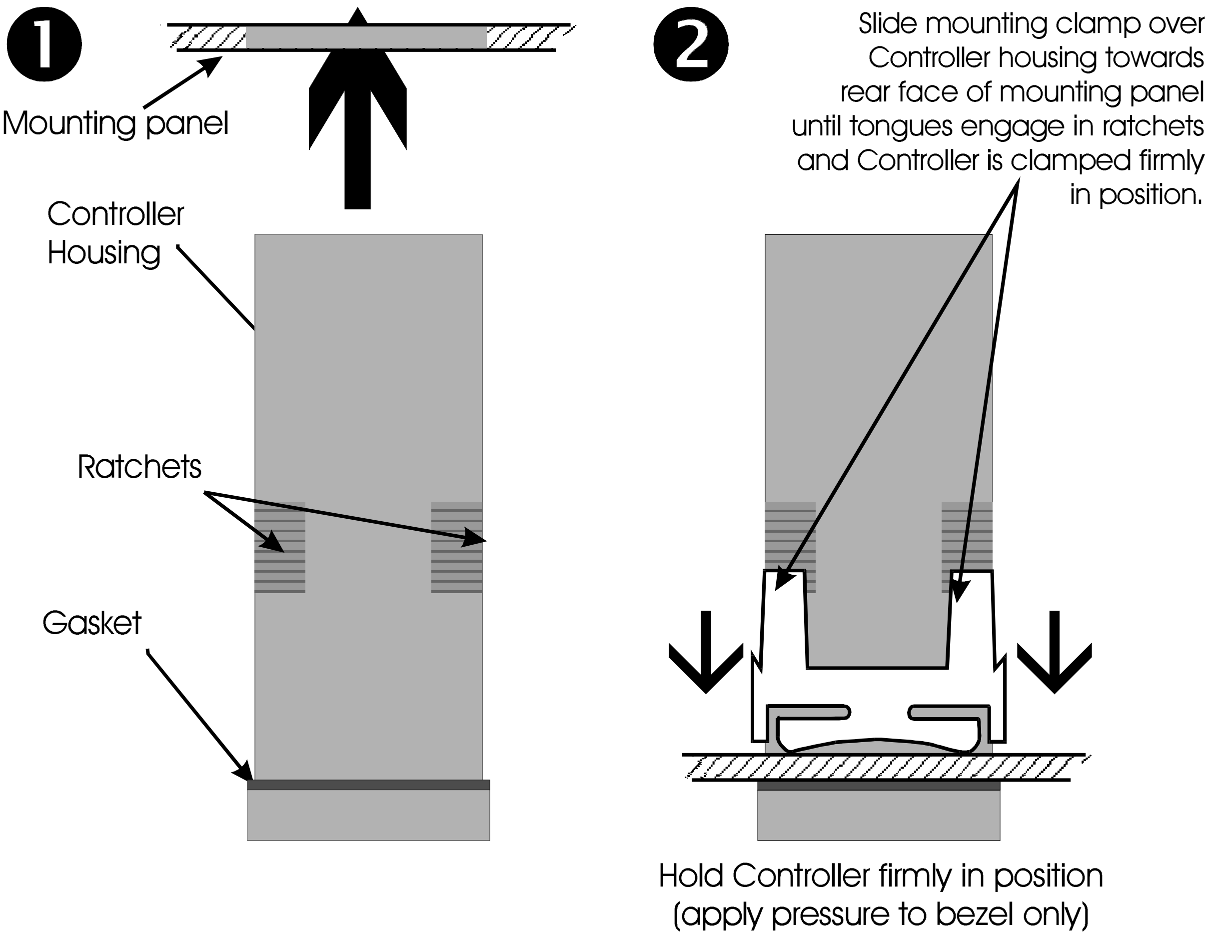


Figure 1-3 Panel-mounting the Controller

1.3 CONNECTIONS AND WIRING

Refer to Figure 1-4 ($\frac{1}{4}$-DIN and $\frac{1}{8}$-DIN Controllers) or Figure 1-5 ($\frac{1}{16}$-DIN Controller).

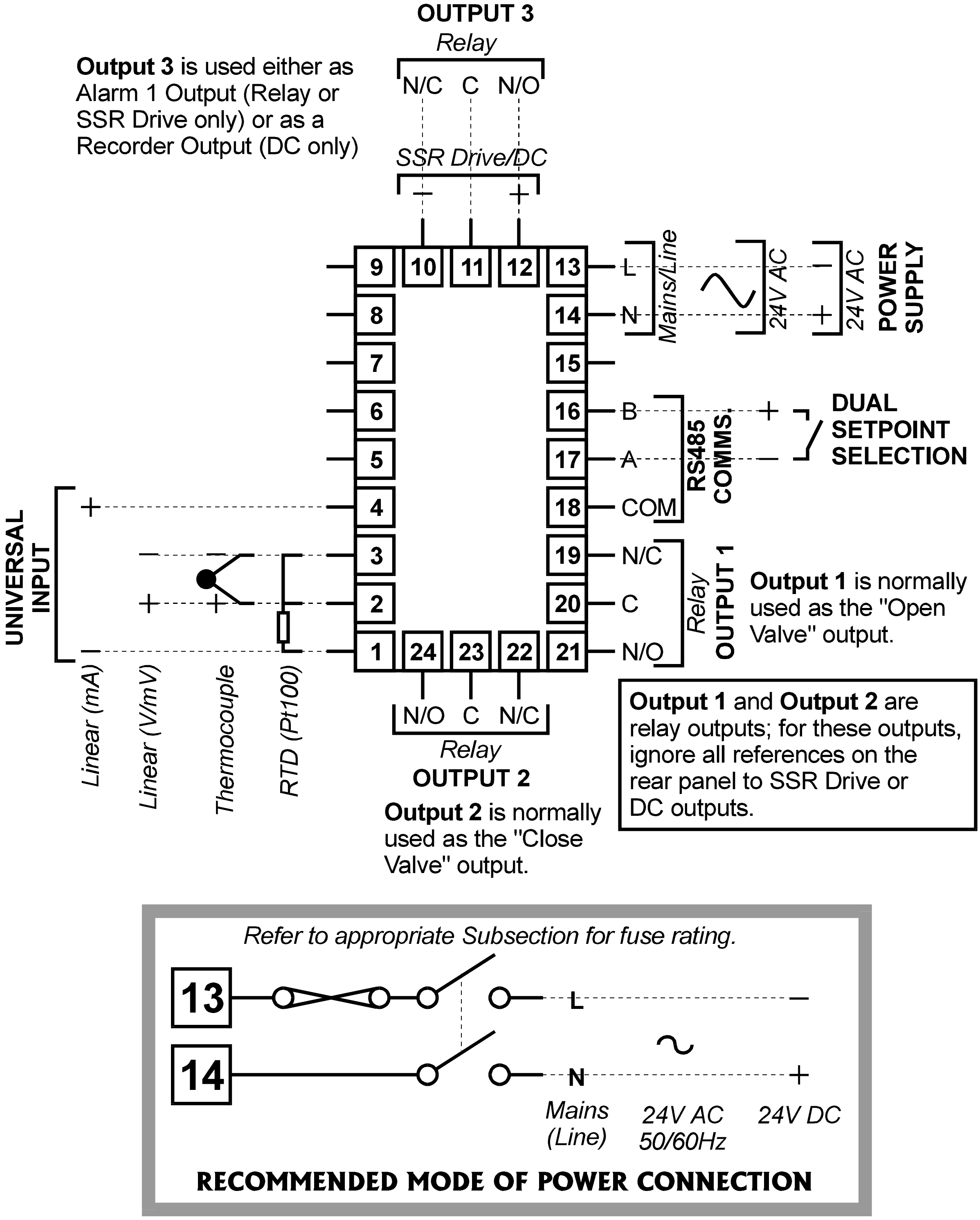
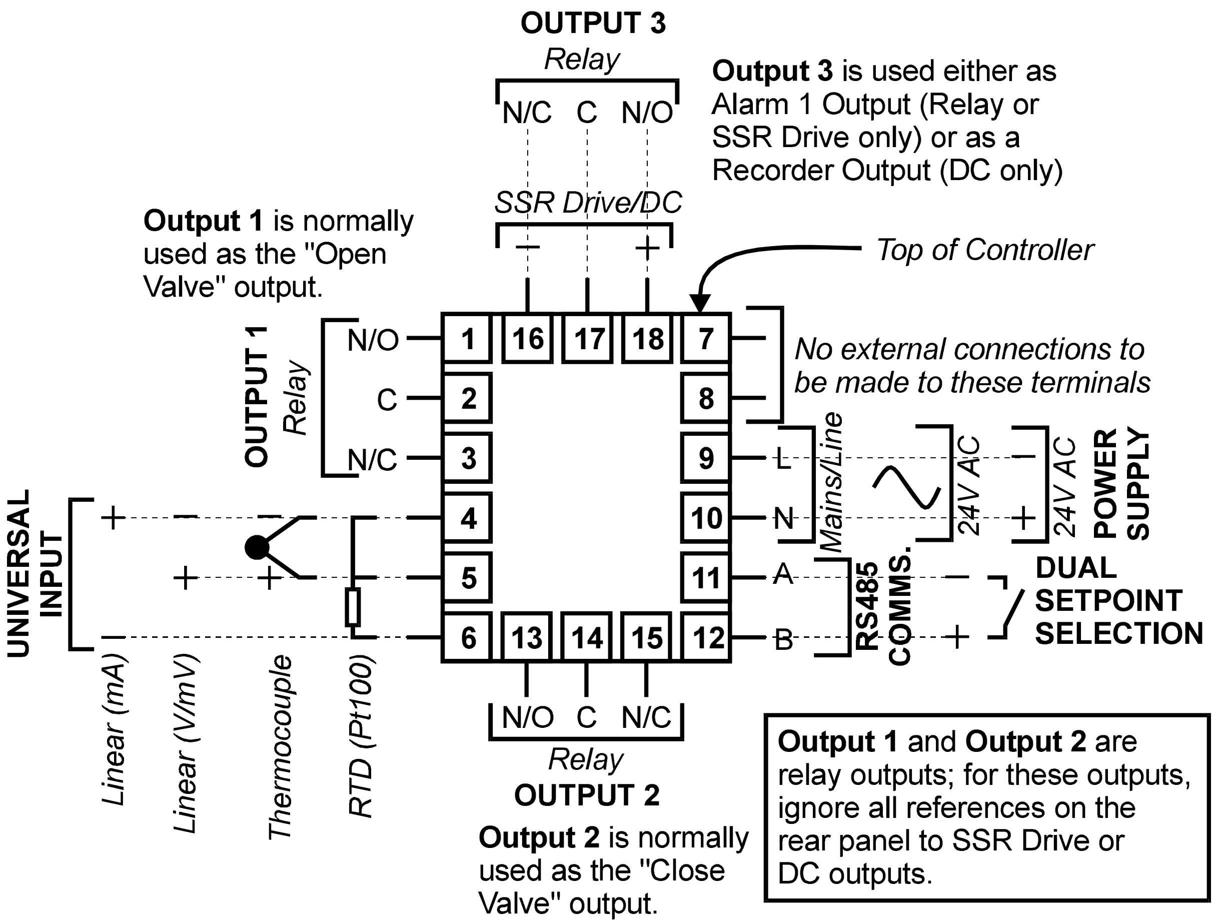


Figure 1-4 Rear Terminals ($\frac{1}{4}$-DIN & $\frac{1}{8}$-DIN Controllers)



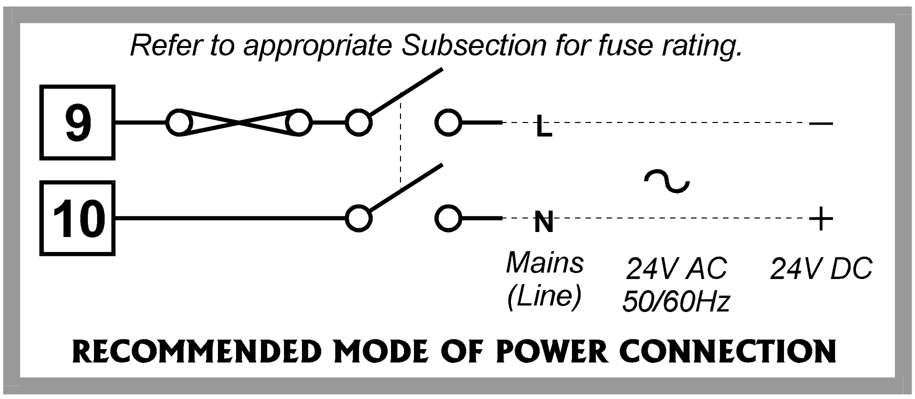


Figure 1-5 Rear Terminals ($\frac{1}{16}$-DIN Controller)

1.3.1 Mains (Line) Input

The Controller will operate on 96 - 264V AC 50/60Hz mains (line) supply. The power consumption is approximately 4 VA.

CAUTION: This equipment is designed for installation in an enclosure which provides 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 unauthorised personnel. Power should be connected via a two-pole isolating switch (preferably situated near the equipment) and a 1A fuse

If the contacts of the relay outputs 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 Controller mains (line) supply.

1.3.2 24V AC/DC Supply

Power should be connected via a two-pole isolating switch and a 315mA slow-blow fuse (anti-surge Type T). The nominal 24V supply may be in the following ranges:

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

1.3.3 Thermocouple Input

The correct type of thermocouple extension leadwire or compensating cable must be used for the entire distance between the Controller and the thermocouple, ensuring that the correct polarity is observed throughout. Joints in the cable should be avoided, if possible. The Controller's CJC facility must be enabled (normal conditions) for this input (see Subsection 3.3.9).

NOTE: Do not run thermocouple cables adjacent to power-carrying conductors. If the wiring is run in a conduit, use a separate conduit for the thermocouple wiring. If the thermocouple is grounded, this must be done at one point only. If the thermocouple extension lead is shielded, the shield must be grounded at one point only.

The colour codes used on thermocouple extension leads are shown in Table 1-1.

Table 1-1 Thermocouple Cable Colour Codes

Thermocouple Type	Cable Material	British (BS1843: 1952)	British (BS4937: Part 30: 1993)	American (ASTM)	German (DIN)	French (NFE)
T	Copper Constantan	+ White − Blue * Blue	+ Brown − White * Brown	+ Blue − Red * Blue	+ Red − Brown * Brown	+ Yellow − Blue * Blue
J	Iron/Constantan	+ Yellow − Blue * Black	+ Black − White * Black	+ White − Red * Black	+ Red − Blue * Blue	+ Yellow − Black * Black
K	Nickel Chromium Nickel Aluminium	+ Brown − Blue * Red	+ Green − White * Green	+ Yellow − Red * Yellow	+ Red − Green * Green	+ Yellow − Purple * Yellow
R S	13% Copper 10% Copper Nickel	+ White − Blue * Green	+ Orange − White * Orange	+ Black − Red * Green	+ Red − White * White	+ Yellow − Green * Green
B	Platinum/Rhodium		+ Grey − White * Grey	+ Grey − Red * Grey		

* Colour of overall sheath.

1.3.4 RTD Inputs

The compensating lead should be connected to Terminal 3 ($\frac{1}{4}$-DIN or $\frac{1}{8}$-DIN Controller) or Terminal 4 ($\frac{1}{16}$-DIN Controller). For two-wire RTD inputs, Terminals 2 and 3 ($\frac{1}{4}$-DIN or $\frac{1}{8}$-DIN Controller) or Terminals 4 and 5 ($\frac{1}{16}$-DIN Controller) should be linked. The extension leads should be of copper and the resistance of the wires connecting the resistance element should not exceed 5 ohms per lead (the leads should be of equal resistance).

1.3.5 Linear Inputs

For linear nput ranges, connection is made as shown shown in Figure 1-4 ($\frac{1}{4}$-DIN or $\frac{1}{8}$-DIN Controller) or Figure 1-5 ($\frac{1}{16}$-DIN Controller). For details of the linear input ranges available, refer to Appendix A.

1.3.6 Dual Setpoint Selection

With the Dual Setpoint option fitted, these terminals are used for external selection of the active setpoint. These terminals may be connected to (a) the voltage-free contacts of a switch or relay, or (b) a TTL-compatible voltage. Setpoint selection is as follows:

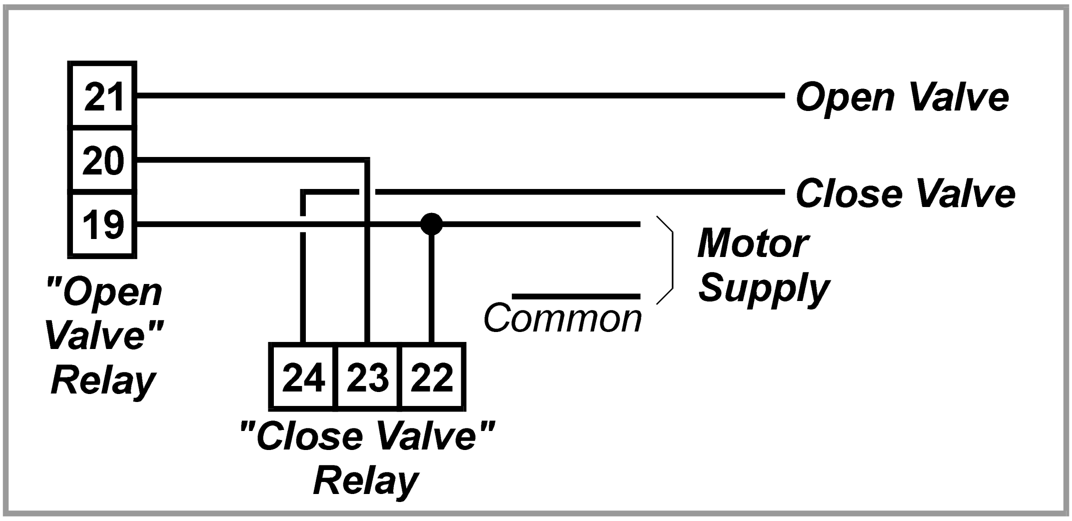
Voltage-Free:	Contacts open - Setpoint 1 selected Contacts closed - Setpoint 2 selected
TTL-compatible:	>2.0V - Setpoint 1 selected <0.8V - Setpoint 2 selected

NOTE: The Dual Setpoint option and the RS485 Serial Communications option are mutually exclusive.

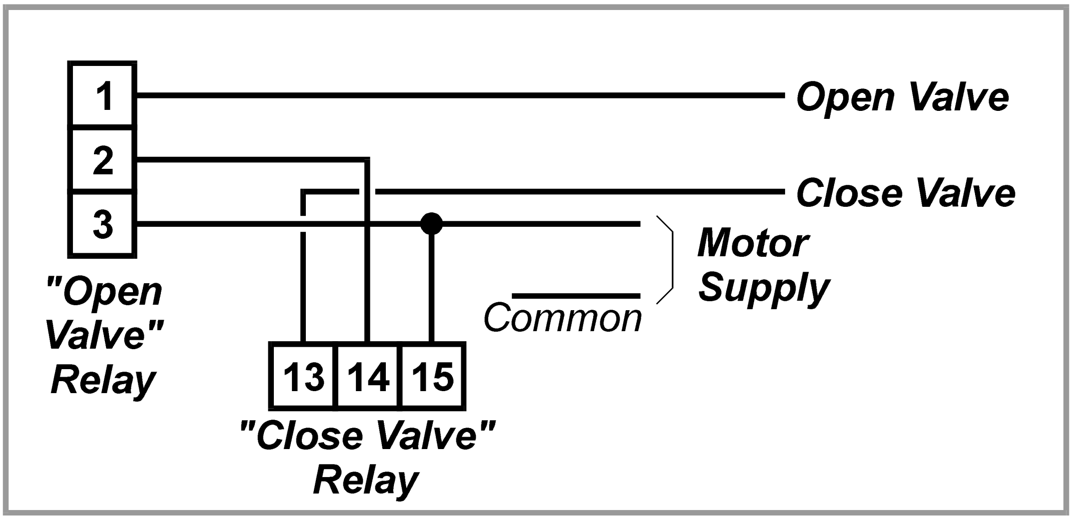
1.3.7 Relay Outputs

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

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 1-6).



1/4-DIN & 1/8-DIN Controllers



1/16-DIN Controller

Figure 1-6 Valve Motor Drive Outputs with Interlock

1.3.8 SSR Drive Output

This output produces a non-isolated DC signal:

$\frac{1}{4}$-DIN & $\frac{1}{8}$-DIN Controllers - 0 - 4.3V nominal, output impedance 250Ω
$\frac{1}{16}$-DIN Controllers - 0 - 4.2V nominal, output impedance 1kΩ.

1.3.9 DC Output

See Figure 1-4 ($\frac{1}{4}$-DIN & $\frac{1}{8}$-DIN Controllers) or Figure 1-5 ($\frac{1}{16}$-DIN Controller) and Appendix A.

1.3.10 RS485 Serial Communications Link

The RS485 serial communications connections are as shown in Figure 1-4 ($\frac{1}{4}$-DIN & $\frac{1}{8}$-DIN Controllers) or Figure 1-5 ($\frac{1}{16}$-DIN Controller). Where several Controllers are connected to one master port, the master port transceiver in the active state should be capable of driving a load of 12kΩ per Controller; the master port transceiver in the passive state must have pull-up/pull-down resistors of sufficiently low impedance to ensure that it remains in the quiescent state whilst supplying up to $\pm$100μA each to the Controller transceivers in the high impedance state.

SECTION 2
INTERNAL LINKS AND SWITCHES

2.1 REMOVING THE CONTROLLER FROM ITS HOUSING

To withdraw the Controller from its housing, simply grip the side edges of the front panel (there is a finger grip on each edge) and pull the Controller forwards. This will release the Controller from its rear connectors in the housing and will give access to the Controller PCBs. Take note of the orientation of the Controller for subsequent replacement into the housing.The positions of the PCBs in the Controller are shown in Figure 2-1.

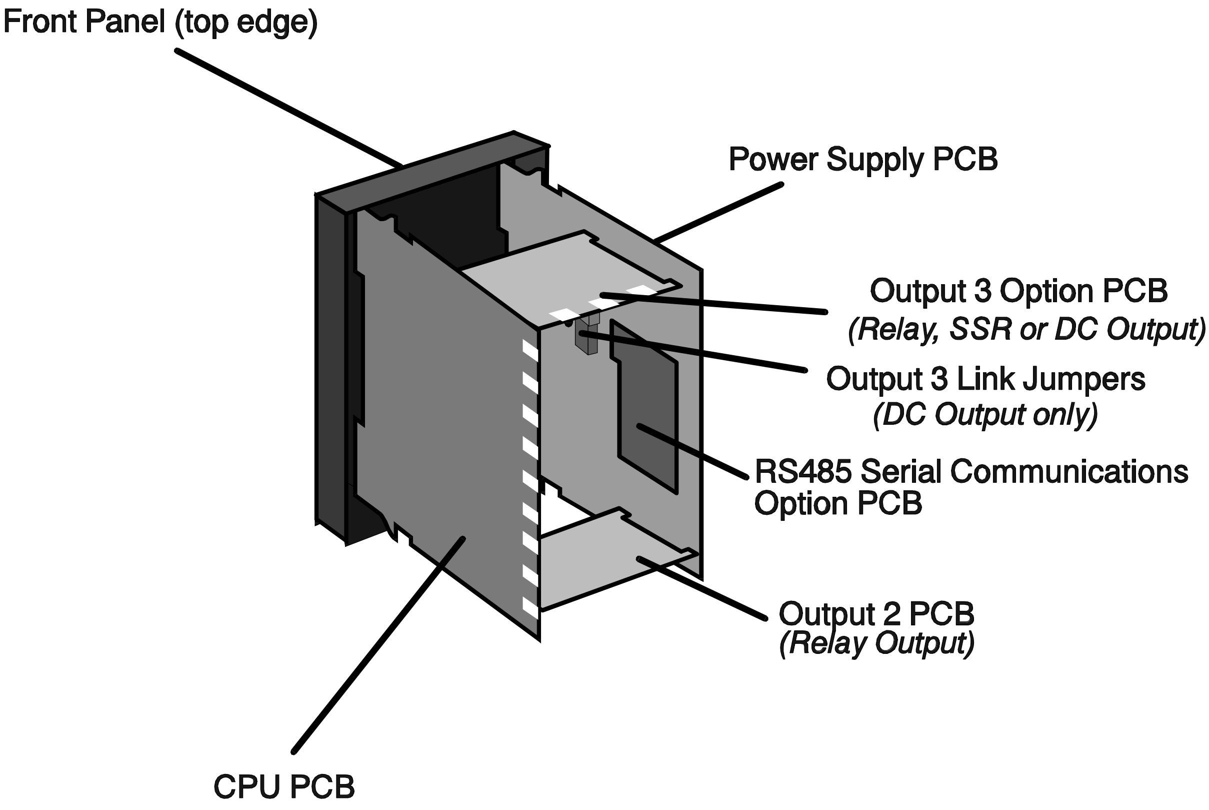


Figure 2-1 PCB Positions

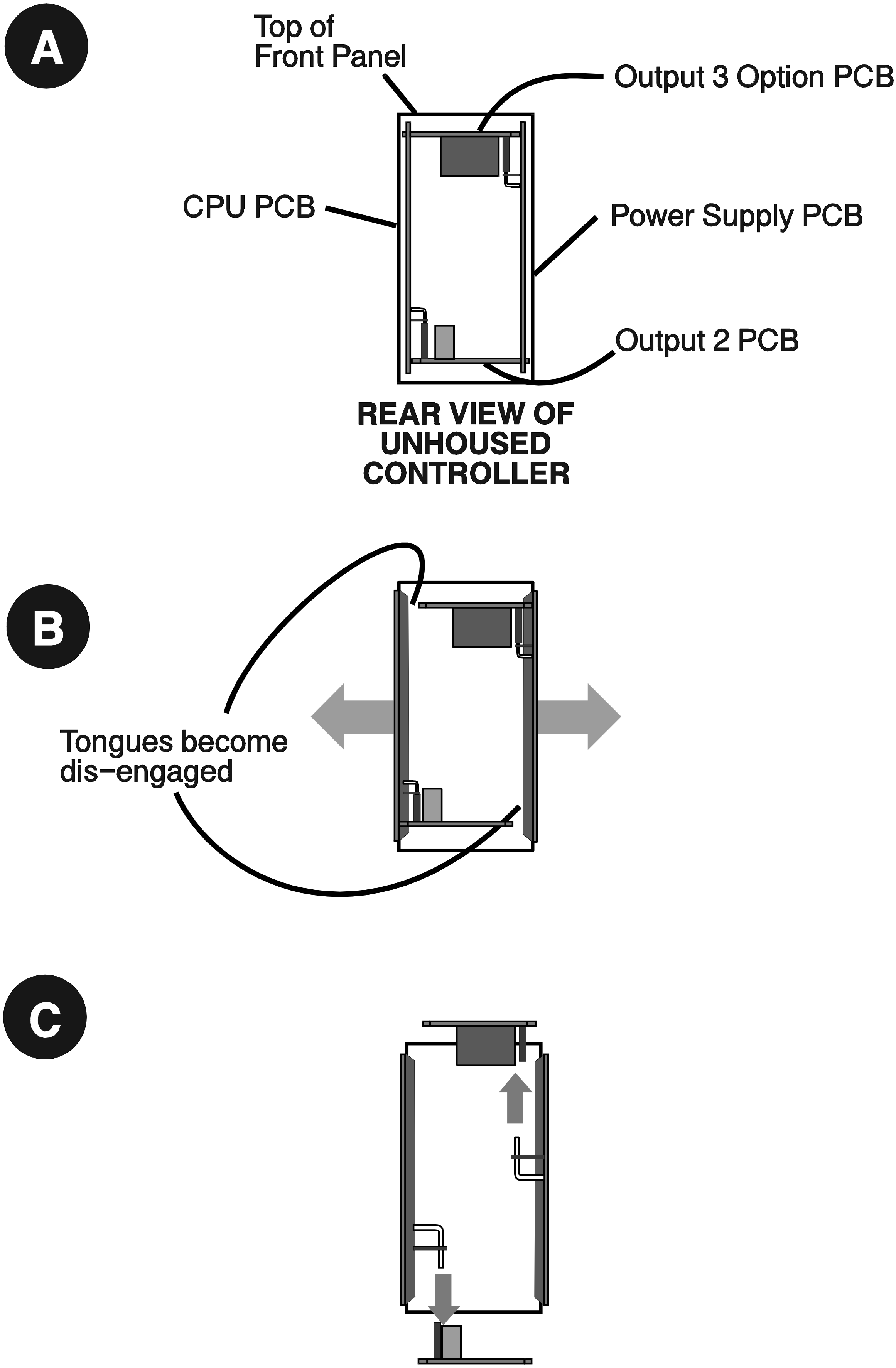


Figure 2-2 Removing the Output 2 PCB/Output 3 Option PCB

2.2 REMOVING/REPLACING THE OUTPUT 2 PCB/OUTPUT 3 OPTION PCB

With the Controller removed from its housing:

1. Gently push the rear ends of the CPU PCB and Power Supply PCB apart slightly, until the two tongues on each of the Output 2 PCB/Output 3 Option PCB become dis-engaged - see Figure 2-2B; The Output 2 PCB tongues engage in holes in the Power Supply PCB and the Output 3 Option PCB tongues engage in holes on the CPU PCB.

2. Carefully pull the required PCB (Output 2 PCB or Output 3 Option PCB) from its connector (Output 2 PCB is connected to the CPU PCB and Output 3 Option PCB is connected to the Power Supply PCB) - see Figure 2-2C. Note the orientation of the PCB in preparation for its replacement.

Adjustments may now be made to the link jumpers on the CPU PCB and the Output 3 Option PCB (if DC output). The replacement procedure is a simple reversal of the removal procedure.

2.3 REMOVING/REPLACING THE RS485 COMMUNICATIONS OPTION PCB OR DUAL SETPOINT OPTION PCB

The RS485 Communications Option PCB or Dual Setpoint Option PCB is mounted on the inner surface of the Power Supply PCB and can be removed when the Controller is removed from its housing (see Subsection 2.1) Figure 2-3 illustrates the removal/replacement procedure. *It is not necessary to remove the Output 2/Output 3 Option PCBs to perform this procedure.*

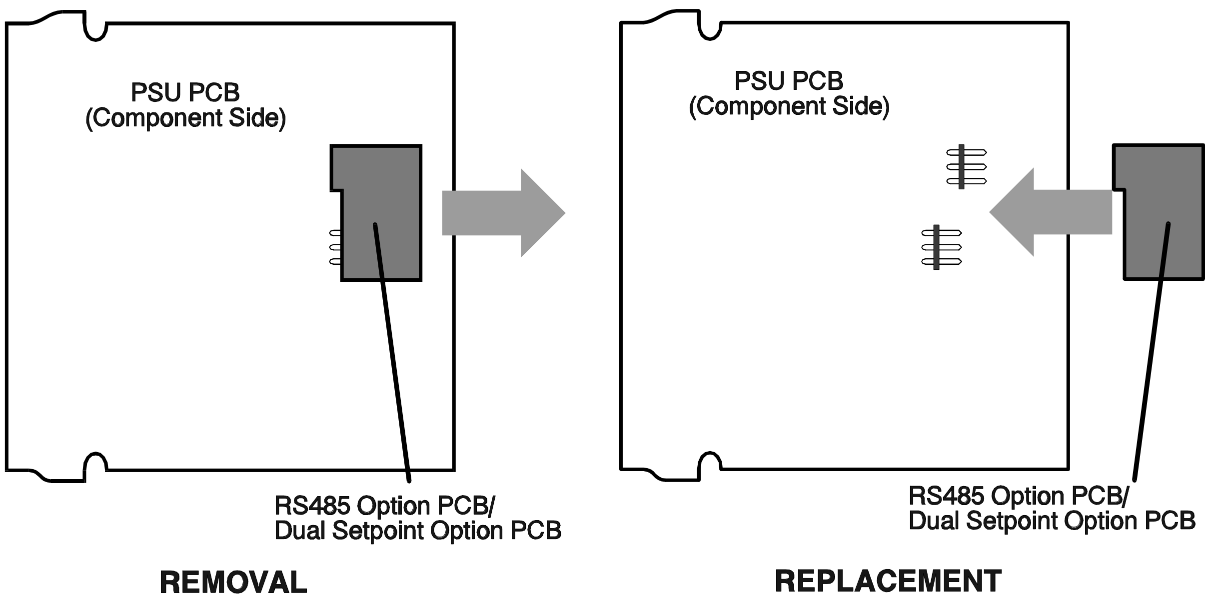


Figure 2-3 Removing/Replacing the RS485 Communications Option PCB or the Dual Setpoint Option PCB

2.4 REPLACING THE CONTROLLER IN ITS HOUSING

To replace the Controller, simply align the CPU PCB and Power Supply PCB with their guides and connectors in the housing and slowly but firmly push the Controller into position.

CAUTION: Ensure that the instrument is correctly orientated. A stop will operate if an attempt is made to insert the instrument in the wrong orientation (e.g. upside-down). *This stop must not be over-ridden.*

2.5 SELECTION OF INPUT TYPE

The selection of input type is accomplished on link jumpers on the CPU PCB - see Table 2-1 and Figure 2-4 ($\frac{1}{4}$-DIN and $\frac{1}{8}$-DIN Controllers) or Figure 2-5 ($\frac{1}{16}$-DIN Controller).

Table 2-1 Input Type Selection

Input Type	Link Jumper Fitted
RTD or DC (mV)	None (Parked)
Thermocouple	LJ3
DC (mA)	LJ2
DC (V)	LJ1

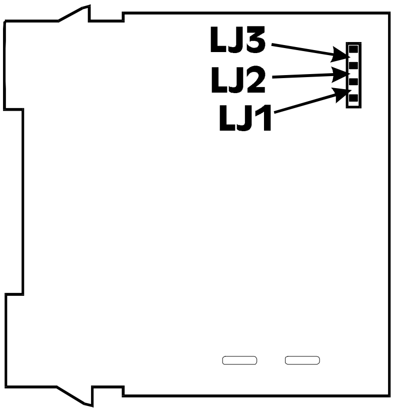


Figure 2-4 CPU PCB Link Jumpers ($\frac{1}{4}$-DIN & $\frac{1}{8}$-DIN Controllers)

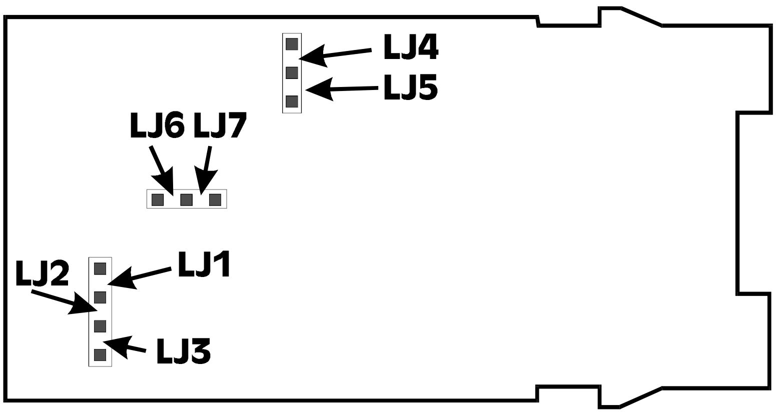


Figure 2-5 CPU PCB Link Jumpers ($\frac{1}{16}$-DIN Controller)

2.6 OUTPUT 3 TYPE

The type of output for Output 3 is determined by the Output 3 Option PCB fitted (see Figure 2-1) and, in the case of the DC Output Option PCB being fitted, the setting of Link Jumpers LJ8 and LJ9 on the Option PCB (see Figure 2-6 and Table 2-2). There are three types of option PCB which may be used for Output 3:

1. Relay Output Option PCB (no link jumpers)
2. SSR Output Option PCB (no link jumpers)
3. DC Output Option PCB (link jumpers as shown in Figure 2-6)

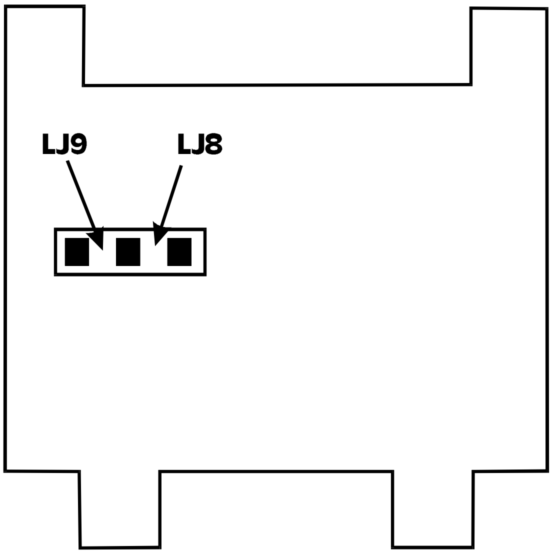


Figure 2-6 DC Output 3 Option PCB

Table 2-2 DC Output 3 Type Selection

Output 3 Type	Link Jumper Fitted
DC (0 - 10V)	LJ8
DC (0 - 20mA)	LJ9
DC (0 - 5V)	LJ8
DC (4 - 20mA)	LJ9

SECTION 3
CONFIGURATION MODE

3.1 ENTRY INTO CONFIGURATION MODE

To enter Configuration Mode:

1. Ensure that the Controller is powered-down.

2. Power-up the Controller and, within 30 seconds of power-up, hold down the Raise and Function keys simultaneously for approximately five seconds.

NOTE: This must be the first key action after power-up.

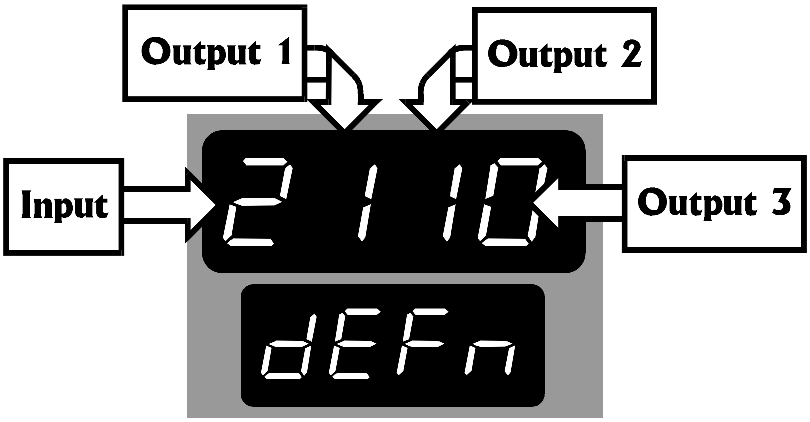
The Controller will then enter Configuration Mode and the initial displays will be of the form:

showing the current input code selected. The user may then step through the Configuration Mode parameters using the Function key. For each parameter, the lower display will show a mnemonic identifying that parameter and the upper display will show the current value/setting of that parameter. The value/setting may be adjusted using the Raise/Lower keys. As soon as the value/setting is changed, the upper display will flash, indicating that the new value/setting has yet to be confirmed (this flashing is inhibited during actual adjustment). When the value/setting is as required, it may be confirmed by depressing the Auto/Manual key, whereupon the upper display will become static.

NOTE: Changes to the value/setting of certain Configuration Mode parameters (e.g. input range, output use and type) will cause the Set Up Mode parameters to be automatically set to their default values the next time Set Up Mode is entered (see also Volume I, beginning of Section 3).

3.2 HARDWARE DEFINITION CODE

This parameter is a special facility in Configuration Mode,which is used to represent the hardware fitted (input type, Output 1 type, Output 2 type and Output 3 type); this must be compatible with the hardware actually fitted. It can be accessed, with the Controller in Configuration Mode, by simultaneously depressing the Lower and Function keys. The displays will then be of the form:



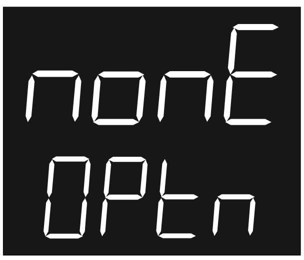
Value	0	1	2	3	4	5	7
Input		RTD/Linear DC (mV)	T'couple	Linear DC (mA)	Linear DC (V)		
Output 1		Relay					
Output 2		Relay					
Output 3	Not fitted	Relay	SSR Drive	DC (0 - 10mA)	DC (0 - 20mA)	DC (0 - 5V)	DC (4 - 20mA)

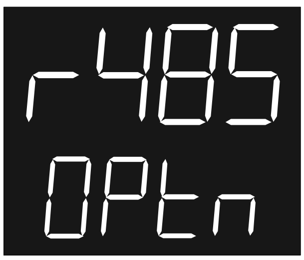
The displayed code may be incremented/decremented using the Raise/Lower keys as required. The maximum setting available for this code is 4117. For example, the code for a thermocouple input, DC 0 - 5V Output 3 would be 2115. When the code is first altered, the code display will flash, until the desired value is displayed and confirmed by depression of the Auto/Manual key.

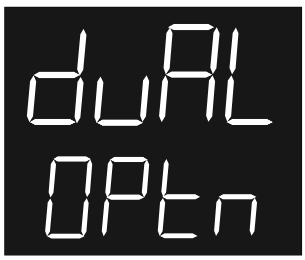
> NOTE: It is essential that this code is changed promptly whenever there is a change to the Controller's hardware configuration (change of input/output type, alarm/recorder output added/removed etc.). The Controller software depends upon this code to ensure that the Controller operates correctly.

This code may be viewed as a Read Only display in Operator Mode (see Volume I, Subsection 2.10).

Whilst the Hardware Definition Code is displayed, depression of the Function key will cause the display to change to one of the following:







This indicates the option fitted (if any). The upper display may be set to **nonE** (no option fitted), **r485** (Communications Option fitted) or **duAL** (Dual Setpoint Option fitted), using the Raise/Lower keys. If the Dual Setpoint Option is selected, the digital input used for selection of the setpoint must be fitted.

NOTE: The RS485 Serial Communications Option and the Dual Setpoint Option are mutually exclusive.

To return to the Hardware Definition Code display, depress the Function key.

To exit from the Hardware Definition Code display, depress the Lower and Function keys simultaneously (which will cause a return to the normal Configuration Mode). Alternatively, either of the methods of exit from Configuration Mode (see Subsection 3.4) may be used here.

3.3 CONFIGURATION MODE PARAMETERS

3.3.1 Input Range

When Configuration Mode is first entered, this parameter will be displayed in the form:

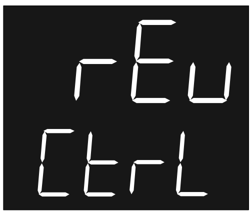
The default setting is dependent upon the input hardware fitted, as indicated by the first (left-most) digit of the Hardware Definition Code (see Subsection 3.2):

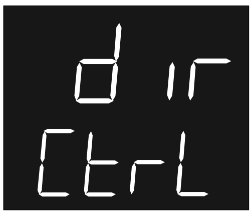
Input Hardware Fitted	Default Setting
Thermocouple	1419 (Type “J”, 0 to 760°C)
RTD/Linear mV)	7220 (RTD Pt100, 0 to 800°C)
Linear mA	3414 (4 to 20mA)
Linear V	4446 (0 to 10V)

If the Hardware Definition Code is at its default setting, input code 1419 will be displayed. The input ranges and codes available are listed in Appendix A.

3.3.2 Control Action

When this item is selected, the displays will be either of:



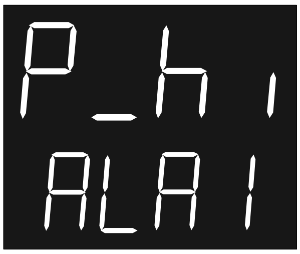


indicating that control is either reverse-acting or direct-acting. The setting can be changed and confirmed as previously described. The default setting is reverse-acting.

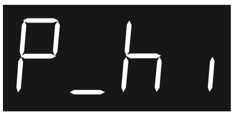
NOTE: It is assumed that output connections are such that Output 1 opens the valve and Output 2 closes the valve.

3.3.3 Alarm 1 Type

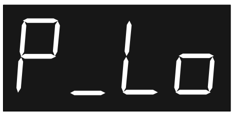
When this item is selected, the displays will be of the form:



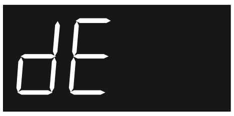
the upper display indicating the current Alarm 1 type, which may be one of:



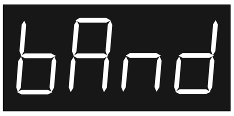
Process High Alarm



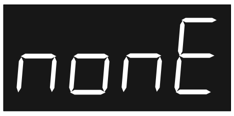
Process Low Alarm



Deviation Alarm



Band Alarm

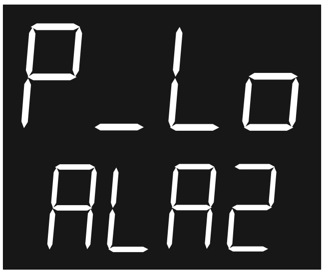


No alarm

The setting can be changed and confirmed as previously described. The default setting is Process High alarm. The operation of the different alarm types is shown in Volume I, Figure 3-2.

3.3.4 Alarm 2 Type

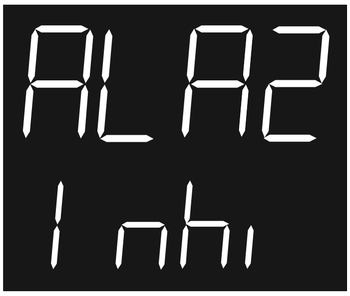
When this item is selected, the displays will be of the form:



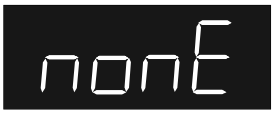
the upper display indicating the current Alarm 2 type. The alarm types available are as for Alarm 1 (see Subsection 3.3.3). The setting can be changed and confirmed as previously described. The default setting is Process Low alarm. The operation of the different alarm types is shown in Volume 1, Figure 3-2.

3.3.5 Alarm Inhibit

When this item is selected, the displays will be of the form:



where the upper display can be one of:



No alarms inhibited

Alarm 1 inhibited

Alarm 2 inhibited

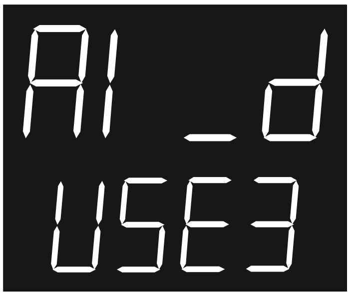
Both alarms inhibited

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” conditon 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.

3.3.6 Output 3 Usage

The displays for this item are of the form:



in which the upper display indicates the usage, which will be one of the following:

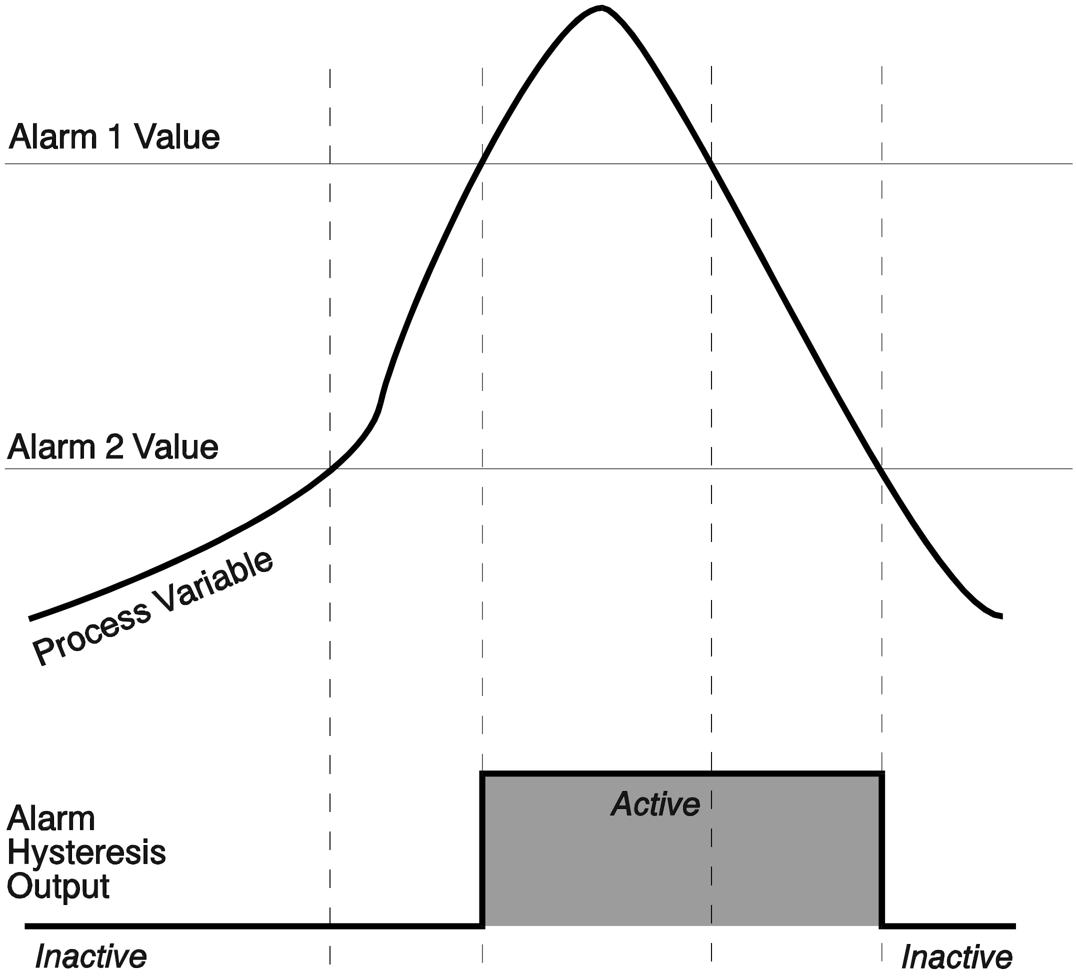
A1_d	Alarm 1 hardware output, direct-acting (Relay/SSR Drive output only)
A1_r	Alarm 1 hardware output, reverse-acting (Relay/SSR Drive output only)
Or_d	Direct-acting output of Logical OR of Alarm 1 with Alarm 2 (Relay/SSR Drive output only)
Or_r	Reverse-acting output of Logical OR of Alarm 1 with Alarm 2 (Relay/SSR Drive output only)
Ad_d	Direct-acting output of Logical AND of Alarm 1 with Alarm 2 (Relay/SSR Drive output only)
Ad_r	Reverse-acting output of Logical AND of Alarm 1 with Alarm 2 (Relay/SSR Drive output only)
LP_d	Loop Alarm, direct-acting (Relay/SSR Drive output only)
LP_r	Loop Alarm, reverse-acting (Relay/SSR Drive output only)
rEcS	Recorder Output - Setpoint (DC output only)
rEcP	Recorder Output - Process Variable (DC output only)
HY_d	Alarm Hysteresis Output, direct-acting (Relay/SSR Drive output only)
HY_r	Alarm Hysteresis Output, reverse-acting (Relay/SSR Drive output only)

Example of Logical Combination of Alarms: Logical AND of Alarm 1 with Alarm 2					
Direct-acting			**Reverse-acting**		
AL1	**AL2**	**Relay State**	**AL1**	**AL2**	**Relay State**
OFF	OFF	De-energised	OFF	OFF	Energised
ON	OFF	De-energised	ON	OFF	Energised
OFF	ON	De-energised	OFF	ON	Energised
ON	ON	Energised	ON	ON	De-energised

This setting can be changed and confirmed in the manner previously described. The default setting is Alarm 1, direct-acting (for a relay/SSR output) or Process Variable Recorder Output (for a DC output).

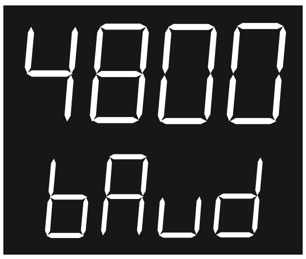
The operation of the different alarm types is illustrated in Volume I, Figure 3-2. The operation of logically-combined (AND/OR) alarms is explained in the table above. The operation of the Loop Alarm output is explained in Volume I, Subsection 3.2.20.

The Alarm Hysteresis output is active only when both alarms are active; it becomes subsequently inactive only when both alarms become inactive. Thus, the status of the alarm hysteresis output when one alarm is active and the other alarm is inactive depends upon the alarm status immediately prior to that alarm being activated; thus:



3.3.7 Communications Link Baud Rate

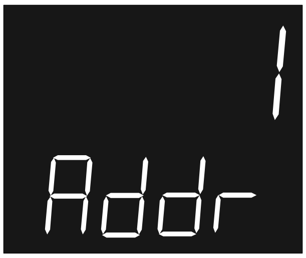
When this item is selected, the initial display is of the form:



The Baud rate may be selected and confirmed as described earlier in this Subsection. The Baud rates available are 1200, 2400, 4800 and 9600.

3.3.8 Communications Address

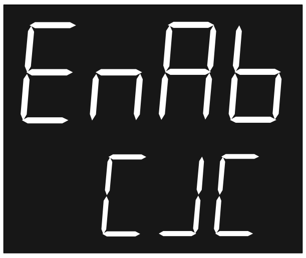
The unique communications address assigned to the Controller can be selected using this item, for which the displays are of the form:



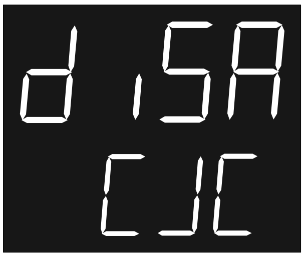
The address can be selected and confirmed in the manner previously described. Any value in the range 1 - 32 can be used.

3.3.9 Cold Junction Compensation Enable/Disable

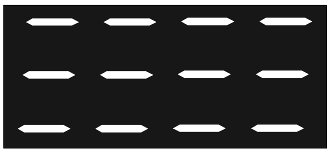
The displays for this item are:



if the CJC facility is currently enabled or:



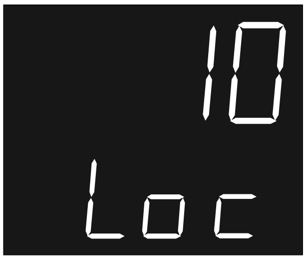
if the CJC facility is currently disabled. This setting can be changed and confirmed in the manner previously described. The default setting is Enabled. This parameter is omitted from the Configuration Mode display sequence if the input type selected is not thermocouple (see Subsection 3.2). If the CJC facility is disabled, the initial Operator Mode display will show:



flashing in the lower display.

3.3.10 Lock Code

When this item is selected, the displays will be of the form:



where the upper display shows the current Set Up Mode Lock Code (a Read Only display - it cannot be edited in Configuration Mode). This serves as a reminder in case the Lock Code has been forgotten (see also Volume I, Subsection 3.2.29).

3.4 EXIT FROM CONFIGURATION MODE

To leave Configuration Mode, depress the Raise and Function keys simultaneously. This will cause a return to the Operator Mode to be made.

> NOTE: An automatic exit to Operator Mode will be made if, in Configuration Mode, there is no front panel key activity for two minutes.

The exit is made via the power-up self-test routines which include a lamp test.

APPENDIX A
PRODUCT SPECIFICATION

UNIVERSAL INPUT

General

Maximum per Controller: One

Input Sample Rate: Four samples/second

Digital Input Filter: Time constant selectable from front panel - 0.0 (i.e. OFF), 0.5 to 100.0 seconds in 0.5-second increments.

Input Resolution: 14 bits approximately; always four times better than display resolution.

Input Impedance: Greater than 100MΩ resistive (except for DC mA and V inputs).

Isolation: Universal input isolated from all outputs except SSR at 240V AC.

Process Variable Offset: Adjustable ±input span.

Thermocouple: Ranges selectable from front panel (with displayed code):

Type	Input Range	Code	Type	Input Range	Code
R	0 - 1650°C	1127	K	–200 - 760°C	6726
R	32 - 3002°F	1128	K	–328 - 1399°F	6727
S	0 - 1649°C	1227	K	–200 - 1373°C	6709
S	32 - 3000°F	1228	K	–328 - 2503°F	6710
J	0.0 - 205.4°C	1415	L	0.0 - 205.7°C	1815
J	32.0 - 401.7°F	1416	L	32.0 - 402.2°F	1816
J	0 - 450°C	1417	L	0 - 450°C	1817
J	32 - 842°F	1418	L	32 - 841°F	1818
J	0 - 761°C *	1419	L	0 - 762°C	1819
J	32 - 1401°F	1420	L	32 - 1403°F	1820
T	–200 - 262°C	1525	B	211 - 3315°F	1934
T	–328 - 503°F	1526	B	100 - 1824°C	1938
T	0.0 - 260.6°C	1541	N	0 - 1399°C	5371
T	32.0 - 501.0°	1542	N	32 - 2550°F	5324

* Default

Calibration: Complies with BS4937, NBS125 and IEC584.

Sensor Break Protection: Break detected within two seconds. “Close Valve” output set to ON; Alarms operate as if the process variable has gone over-range.

Resistance Temperature Detector (RTD) and DC mV: Ranges selectable from front panel (with the displayed code):

Range	Code	Range	Code	Range	Code
0 - 800°C *	7220	0 - 300°C	2251	–100.9 - 537.3°C	7222
32 - 1471°F	7221	0.0 - 100.9°C	2295	–149.7 - 999.1°F	7223
32 - 571°F	2229	32.0 - 213.6°F	2296	0 - 50mV	4443
–100.9 - 100.0°C	2230	–200 - 206°C	2297	10 - 50mV	4499
–149.7 - 211.9°F	2231	–328 - 402°F	2298		

* Default

Type and Connection: Three-wire Pt100

Calibration: Complies with BS1904 and DIN43760.

Lead Compensation: Automatic scheme.

RTD Sensor Current: 150μA (approximately)

Sensor Break Protection: Break detected within two seconds. “Close Valve” output set to ON; Alarms operate as if process variable has gone over-range.

DC Linear: Ranges Selectable from Front Panel (with displayed codes):

Range	Code	Range	Code	Range	Code
0 - 20mA	3413	0 - 5V	4445	0 - 10V	4446
4 - 20mA	3414	1 - 5V	4434	2 - 10V	4450

* Default

(Changes may also be required to the CPU PCB link jumpers - see Subsection 2.5.)

Scale Range Maximum: –1999 to 9999. Decimal point as required.

Scale Range Minimum: –1999 to 9999. Decimal point as for Scale Range Maximum.

Minimum Span: 1 display LSD.

Sensor Break Protection: Applicable to 4 - 20mA, 1 - 5V and 2 - 10V ranges only. Break detected within two 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, TTL-compatible

To select Setpoint 1:

Maximum Contact Resistance (Closure): 50Ω

Maximum Voltage (TTL) for "0":	0.8V
Minimum Voltage (TTL) for "0":	–0.6V

To select Setpoint 2

Minimum Contact Resistance (Open):	5000Ω
Minimum Voltage (TTL) for "1":	2.0V
Maximum Voltage (TTL) for "1":	24.0V
Maximum Input Delay (OFF - ON):	1 second
Minimum input delay (ON - OFF):	1 second

OUTPUTS 1 & 2

Types Available:	Relay only (Output 1 - open valve, Output 2 - close valve).
Contact Type:	Single pole double throw (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, DC linear (Recorder Output only)

Relay

Contact Type:	Single pole double throw (SPDT).

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

SSR/TTL

Drive Capability:	SSR > 4.3V DC into 250Ω 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:	Every control algorithm execution.
Ranges:	0 - 20mA 4 - 20mA 0 - 10V 0 - 5V

(Changes between V and mA require link jumper movement.)

Load Impedance:	0 - 20mA: 500Ω maximum 4 - 20mA: 500Ω maximum 0 - 10V: 500Ω minimum 0 - 5V: 500Ω minimum
Isolation:	Isolated from all other inputs and outputs.
Range Selection Method:	Link jumper or DIP.

LOOP CONTROL

Automatic Tuning Types:	Pre-Tune and Self-Tune.
Proportional Bands:	0.5% - 999.9% of input span at 0.1% increments.
Reset (Integral Time Constant):	1s - 99min 59s
Rate (Derivative Time Constant):	0 (OFF) - 99 min 59 s.
Auto/Manual Control:	User-selectable.

Setpoint Range:	Limited by Setpoint Maximum and Setpoint Minimum.
Setpoint Maximum:	Limited by Setpoint and Range Maximum.
Setpoint Minimum:	Limited by Range Minimum and Setpoint.
Setpoint Ramp:	Ramp rate selectable 1 - 9999 LSDs per hour and infinite. Number displayed is decimal-point-aligned with selected range.

ALARM CONTROL

Maximum Number of Alarms:	Two “soft” alarms plus Loop Alarm
Max. No. of Outputs Available:	One output can be utilised for alarm purposes.
Combinatorial Alarms:	Logical OR or AND of alarms to an individual hardware output is available.

PERFORMANCE

Reference Conditions: Generally as BS5558.

Ambient Temperature:	20°C±2°C
Relative Humidity:	60 - 70%
Supply Voltage:	90 - 264V AC 50Hz±1%
Source Resistance:	<10Ω for thermocouple input
Lead Resistance:	<0.1Ω/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 ±1LSD.

Thermocouple Inputs

Measurement Accuracy:	±0.25% of span ±1LSD. NOTE: Reduced performance with Type "B" Thermocouple between 100 - 600°C (212 - 1112°F).
Linearisation 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 ±1LSD
Linearisation 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 - Accuracy

Output 3 (Recorder Output):	±0.25% (mA @ 250Ω, V @ 2kΩ); Degrades linearly to ±0.5% for increasing burden (to specification limits).

Operating Conditions

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

Performance Under Operating Conditions

Temperature Stability:	0.01% of span/°C change in ambient temperature.

Cold Junction Compensation (thermocouple Only):	Better than ±1°C.
Supply Voltage Influence:	Negligible.
Relative Humidity Influence:	Negligible
Sensor Resistance Influence:	Thermocouple 100Ω: <0.1% of span error Thermocouple 1000Ω: <0.5% of span error RTD Pt100 50Ω/lead: <0.5% of span error

ENVIRONMENTAL

Operating Conditions:	See **PERFORMANCE**.
EMI Susceptibility:	Designed to meet EN50082 Part 2.
EMI Emissions:	Designed to meet EN50081 Part 2.
Safety Considerations:	Designed to comply with IEC 1010-1 in as far as it is applicable.
Supply Voltage:	90 - 264V AC 50/60Hz (standard) 20 - 50V AC 50/60Hz or 22 - 65V DC (option)
Power Consumption:	4 watts approximately.
Front Panel Sealing:	To IP65 (similar to NEMA 4).

PHYSICAL

Dimensions:

	$\frac{1}{4}$-DIN	$\frac{1}{8}$-DIN	$\frac{1}{16}$-DIN
Height	96mm	96mm	48mm
Width	96mm	48mm	48mm
Depth	100mm	100mm	110mm

Mounting:	Plug-in with panel mounting fixing strap. Panel cut-out 45mm x 92mm ($\frac{1}{8}$-DIN) or 92mm x 92mm ($\frac{1}{4}$-DIN).
Terminals:	Screw type (combination head).
Weight:	0.48kg (1.06lb) maximum

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