1/16 and 1/8 eCAL series Controllers

User Guide

Manual Part Number: 59468-1

Price: £12.00

$20.00

€18.00

This manual supplements the Concise Product manual supplied with each instrument at the time of shipment. Information in this installation, wiring and operation manual is subject to change without notice.

Copies of this manual are available in electronic format on the West Control Solutions web site (www.west-cs.com) Printed versions are available from West or its agents at the price published on the front cover.

Note:

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

WARNING:

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.

Products covered by this manual are suitable for Indoor use, Installation Category II, Pollution category 2 environments.

This user guide covers the eCAL series product range.
Products covered in this issue of the manual:

eCAL E6C and E8C Temperature & Process Controllers

Contents

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How to use this manual

This manual is structured to give easy access to the information required for all aspects of the installation and use and of the products:

Section 1: **Introduction** - A brief description of the product range.

Section 2: **Installation** - Unpacking, installing and panel mounting instructions.

Section 3: **Wiring Guidelines** - Guidance on good wiring practice, noise avoidance, wiring diagrams and input/output connections.

Section 4: **Getting Started** - Powering up procedure, configuration and tuning. Also describes displays & switches.

Section 5: **Messages & Error Indications** - Display Messages and fault indications.

Section 6: **Instrument Operation Modes** - Describes unique operating features of these process controllers. It covers the Configuration, Setup & Operator menus, Communications parameters, adjusting Setpoint, use of Manual Control and PID auto-tuning.

Section 7: **Modbus Serial Communications** - Details the physical layer and message formats used for the Modbus communications protocol common to all products in the range.

Section 8: **Manually Tuning Controllers** - Advice on manually adjusting the Process and Valve Controllers tuning parameters.

Section 9: **Calibration Mode** - Step-by-step instructions to calibrate the instrument. This section is intended for use by suitably qualified personnel.

Appendix 1: **Glossary** - Explanations of the terms used and product features.

Appendix 2: **Specification** - Technical specifications for all products in the range.

Appendix 3: **Product Coding** - Product model/ordering codes.

1 Introduction

These instruments are microprocessor based indicators, process and valve controllers, and indicators. They can measure, display or control process variables such as temperature, pressure, flow and level from a variety of inputs. These controllers combine functionality, flexibility and ease of control to give you the best in comprehensive process control. The EC6 1/16 - DIN Controller (48 x 48 mm) and EC8 1/8 – format Controller (96 x 48 mm) offer similar functionality in two DIN sizes.

The main features include:

Heat/Cool PID operation	Loop alarm
Auto/Manual Tuning	
Two process alarms	RS485 Modbus option
Ramping Setpoint	Profiler function

The operating voltage is either 100-240V at 50/60 Hz or 24V-48V AC/DC depending on the model purchased. EEPROM technology protects against data or configuration loss during power outages.

Inputs are user configurable for connection to thermocouple and RTD probes, as well as linear process signal types such as mVDC, VDC or mADC. Output options include relays, SSR drivers or linear mA/V/mV. These can be used for process control, valve control, alarms or retransmission of the process variable or Setpoint to external devices such as data recorders or PLC's.

Alarm indication is standard on all instruments and may be set as process high or low, deviation (active above or below controller Setpoint), band (active both above and below Setpoint), or control loop types. These alarms can be linked to any suitable output. For high visibility alarm status is indicated on 7 segment display.

Controllers can be programmed for on-off, time proportioning, or current proportioning control implementations, depending on the outputs fitted, and feature manual or automatic tuning of the PID parameters. A secondary control output can be configured on all units

2 Installation

2.1 Unpacking

1. Remove the product from its packing. Retain the packing for future use, in case it is necessary to transport the instrument to a different site or to return it to the supplier for repair/testing.

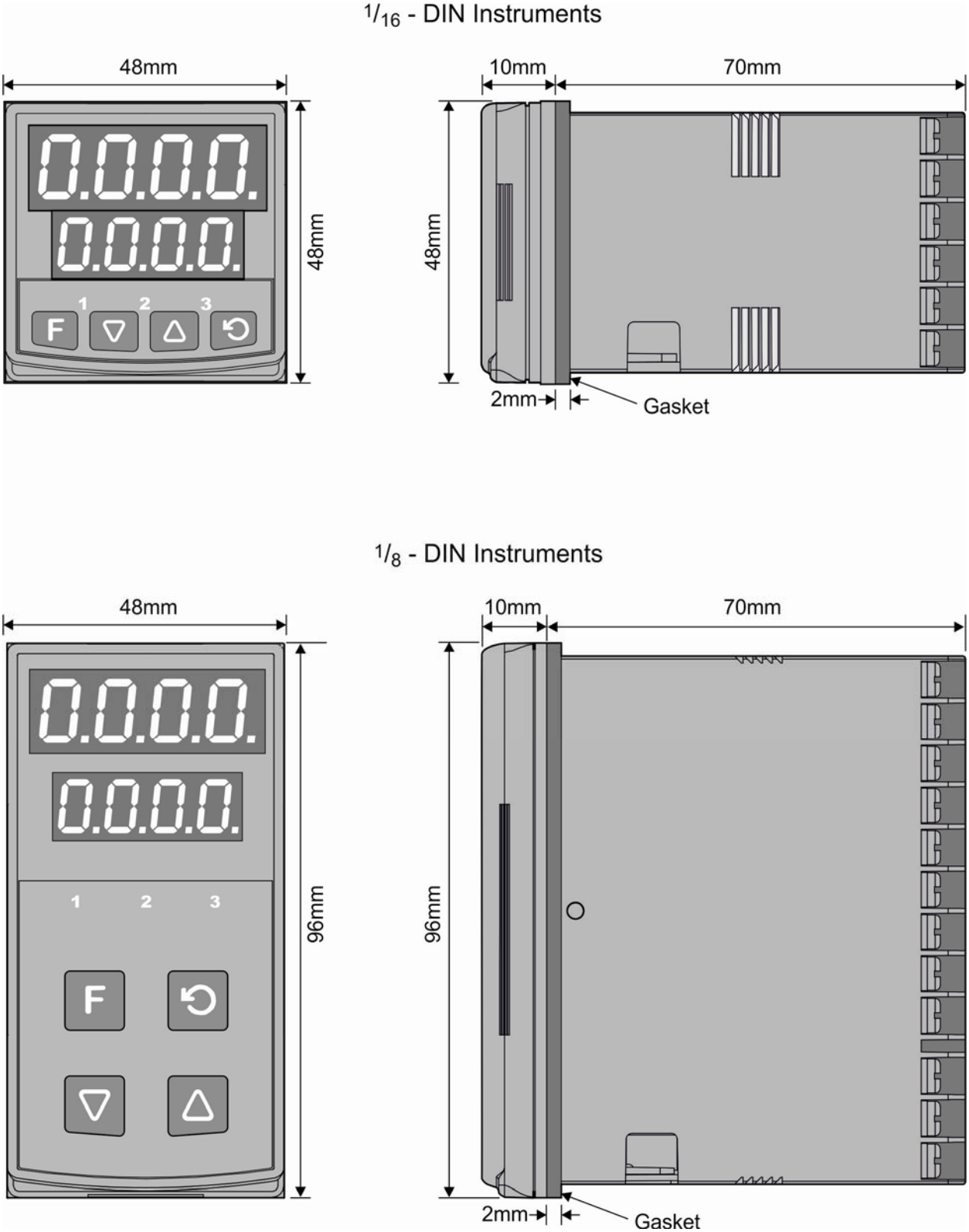
2. The instrument is supplied with a panel gasket and push fit fixing strap. A single sheet concise manual is also supplied in one or more languages. Examine the delivered items for damage or defects. If any are found, contact your supplier immediately.

2.2 Installation

CAUTION:

Installation and configuration should be performed only by personnel who are technically competent and authorised to do so. Local regulations regarding electrical installation and safety must be observed.

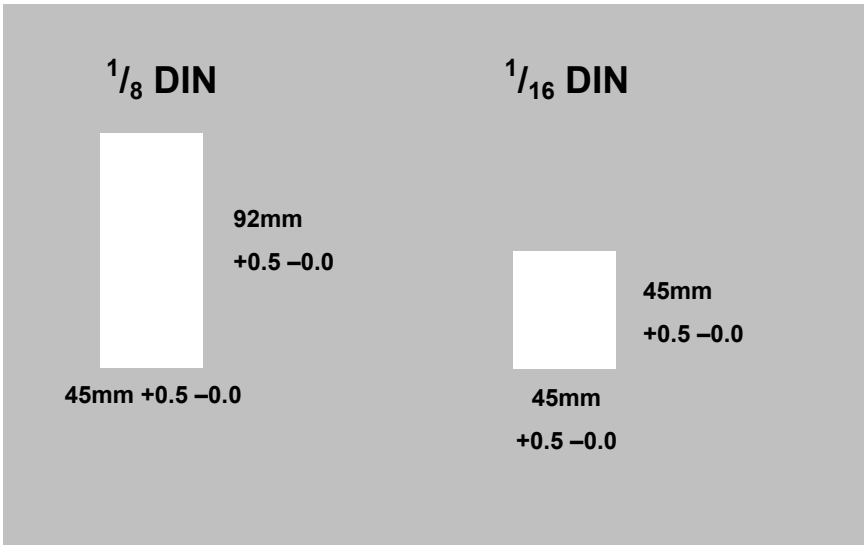
Figure 1. Main dimensions



2.3 Panel Cut-outs

The mounting panel must be rigid and may be up to 6.0mm (0.25 inches) thick. The cut-outs required for the instruments are shown below.

Figure 2. Panel cut-out sizes

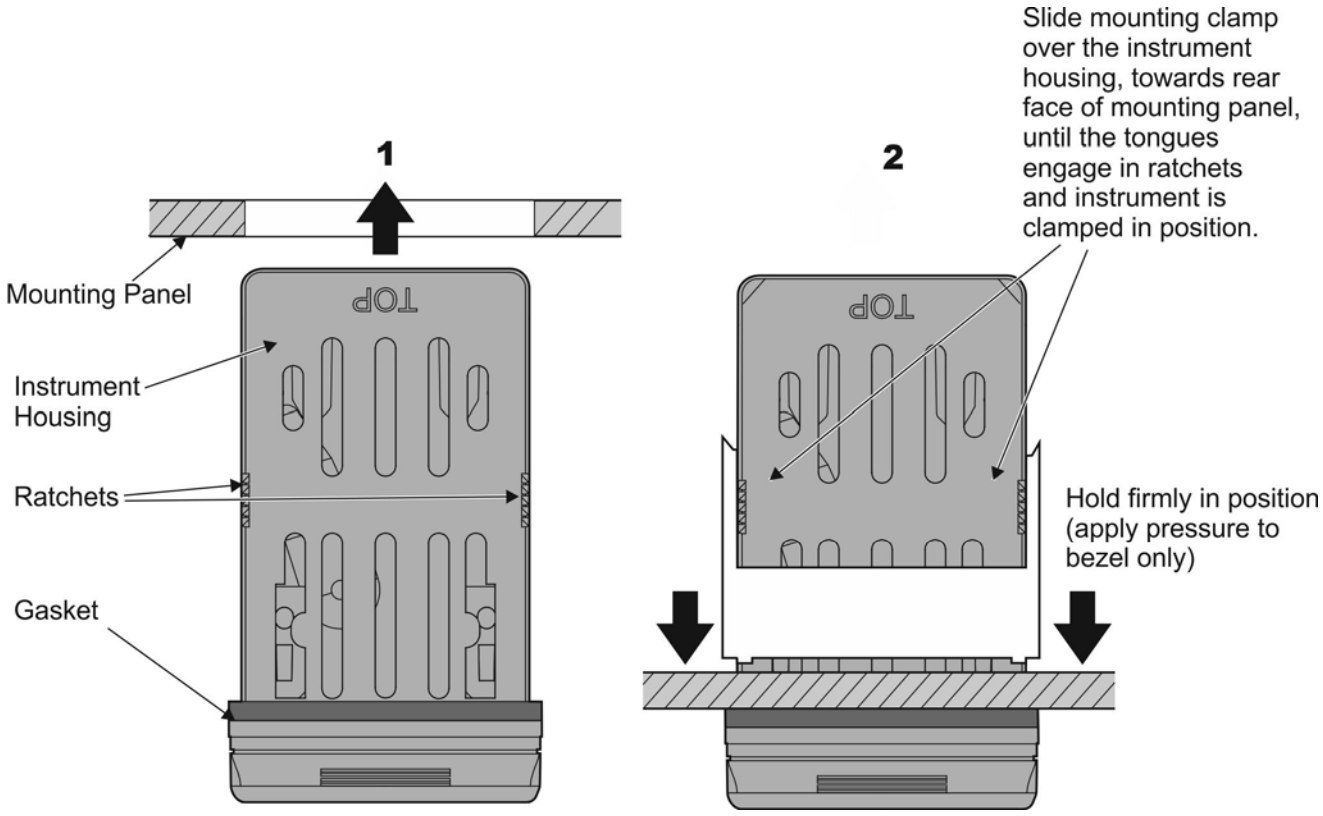


2.4 Panel-Mounting

CAUTION:

Ensure the inside of the panel is with the instruments operating temperature and that there is adequate air flow to prevent overheating.

Figure 3. Panel-Mounting the instrument



CAUTION:

Do not remove the panel gasket, as this may result in inadequate clamping and sealing of the instrument to the panel.

Once the instrument is installed in its mounting panel, it may be subsequently removed from it's housing, if necessary.

3 Wiring Instructions

Electrical noise is a phenomenon typical of industrial environments. As with any instrumentation, these guidelines should be followed to minimize the effect of noise.

3.1 Installation Considerations

Ignition transformers, arc welders, mechanical contact relays and solenoids are all common sources of electrical noise in an industrial environment and therefore the following guidelines MUST be followed.

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

Noise-generating devices such as those listed should be mounted in a separate enclosure. If this is not possible, separate them from the instrument, by the largest distance possible.

If possible, eliminate mechanical contact relays and replace with solid-state relays. If a mechanical relay being powered by an output of this instrument cannot be replaced, a solid-state relay can be used to isolate the instrument.

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

3.2 AC Power Wiring - Neutral (for 100 to 240V AC versions)

It is good practice to ensure that the AC neutral is at or near ground (earth) potential. A proper neutral will help ensure maximum performance from the instrument.

3.3 Wire Isolation

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

Analogue input or output (for example thermocouple, RTD, VDC, mVDC or mADC)

Relays outputs

SSR Driver outputs

AC power

CAUTION:

The only wires that should run together are those of the same category.

If any wires need to run parallel with any other lines, maintain a minimum space of 150mm between them.

If wires MUST cross each other, ensure they do so at 90 degrees to minimise interference.

3.4 Use of Shielded Cable

All analogue signals must use shielded cable. This will help eliminate electrical noise induction on the wires. Connection lead length must 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 at the sensor, transmitter or transducer.

3.5 Noise Suppression at 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 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, Resistance-Capacitance (RC) networks and/or Metal Oxide Varistors (MOV) may be added.

Inductive coils:- MOVs are recommended for transient suppression in inductive coils, connected in parallel and as close as possible to the coil. Additional protection may be provided by adding an RC network across the MOV.

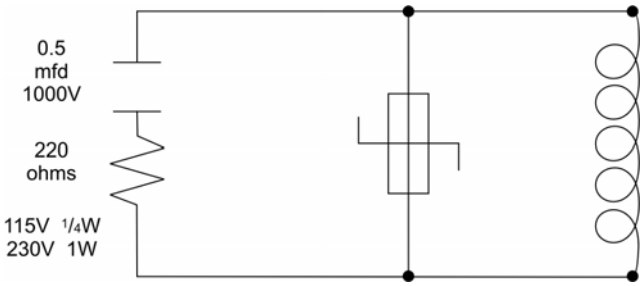


Figure 4. Transient suppression with inductive coils

Contacts:- Arcing may occur across contacts when they open and close. This results in electrical noise as well as damage to the contacts. Connecting a properly sized RC network 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 two of these in parallel.

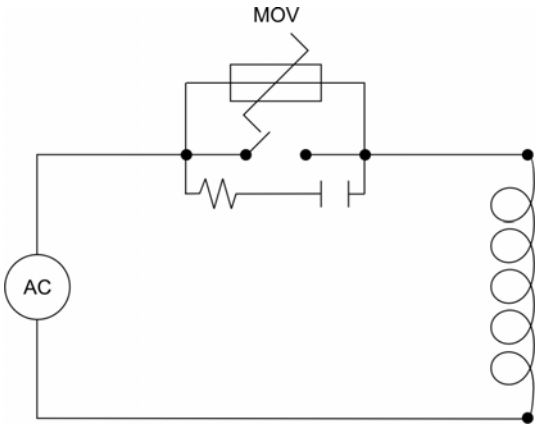


Figure 5. Contact noise suppression

3.6 Sensor Placement (Thermocouple or RTD)

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

3. In a liquid media - the most agitated area
4. In air - the best circulated area

CAUTION:

The placement of probes into pipe work some distance from the heating vessel leads to transport delay, which results in poor control.

For a two wire RTD a wire link should be used in place of the third wire. Two wire RTDs must only be used with lead lengths less than 3 metres. Use of three wire RTDs is strongly recommended.

3.7 Thermocouple Wire Identification Chart

The different thermocouple types are identified by their wires colour, and where possible, the outer insulation as well. There are several standards in use throughout the world.

The table below shows the wire and sheath colours used for most common thermocouple types. The format used in this table is:

Table 1. Thermocouple Extension Wire Colours

Type		International IEC584-3	USA ANSI MC 96.1	British BS1843	French NFC 42-324	German DIN 43710
J	+ *	Black / Black	White / Black	Yellow / Black	Yellow / Black	Red / Blue
	-	White	Red	Blue	Black	Blue
T	+	Brown / Brown	Blue / Blue	White / Blue	Yellow / Blue	Red / Brown
	-	White	Red	Blue	Blue	Brown
K	+	Green / Green	Yellow / Yellow	Brown / Red	Yellow / Yellow	Red / Green
	-*	White	Red	Blue	Purple	Green
N	+	Pink / Pink	Orange / Orange	Orange / Orange		
	-	White	Red	Blue		
B	+	Grey / Grey	Grey / Grey			Red / Grey
	-	White	Red			Grey
R & S	+	Orange / Orange	Black / Green	White / Green	Yellow / Green	Red / White
	-	White	Red	Blue	Green	White
C (W5)	+		White / White			
	-		Red			

Note:

***** = *Wire is magnetic*

3.8 Connections and Wiring

The rear terminal connections for 1/16 DIN & 1/8 DIN instruments are illustrated in the following diagrams.

In general, all wiring connections are made to the instrument after it is installed. Copper wires must be used for all connections (except thermocouple signal wires).

WARNING:

TO AVOID ELECTRICAL SHOCK, AC POWER WIRING MUST NOT BE CONNECTED TO THE SOURCE DISTRIBUTION PANEL UNTIL ALL WIRING PROCEDURES ARE COMPLETED.

WARNING:

CHECK THE INFORMATION LABEL ON THE CASE TO DETERMINE THE CORRECT VOLTAGE BEFORE CONNECTING TO A LIVE SUPPLY.

Note:

The wiring diagram below shows all possible combinations. The actual connections required depend upon the features available on the model and the options fitted.

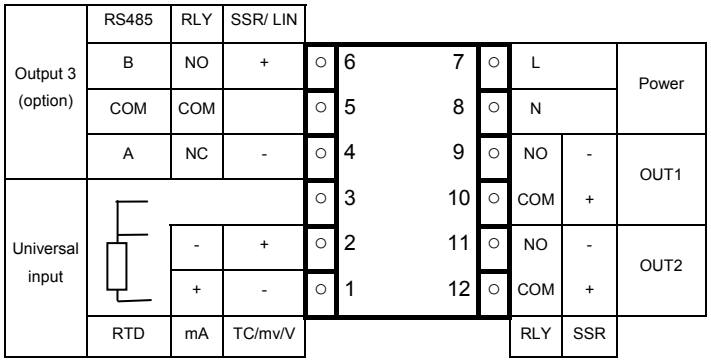


Figure 6. Rear terminals (1/16-DIN Instruments)

WARNING:

TO AVOID ELECTRICAL SHOCK, AC POWER WIRING MUST NOT BE CONNECTED TO THE SOURCE DISTRIBUTION PANEL UNTIL ALL WIRING PROCEDURES ARE COMPLETED.

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CHECK THE INFORMATION LABEL ON THE CASE TO DETERMINE THE CORRECT VOLTAGE BEFORE CONNECTING TO A LIVE SUPPLY.

Note:

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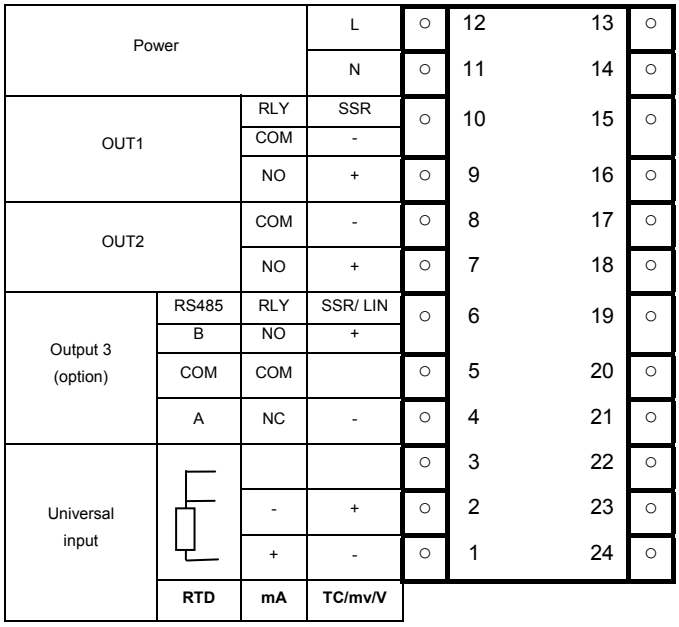


Figure 7. Rear terminals (1/8-DIN Instruments)

Power Connections - Mains Powered Instruments

Mains powered instruments operate from a 100 to 240V (±10%) 50/60Hz supply. Power consumption is 7.5VA. Connect the line voltage (live and neutral) as illustrated via a two-pole isolating switch (preferably located near the equipment) and a 1amp anti-surge fuse. If the instrument has relay outputs with contacts carrying mains voltage, it is recommended that the relay contacts supply should be switched and fused in a similar manner, but should be separate from the instruments mains supply.

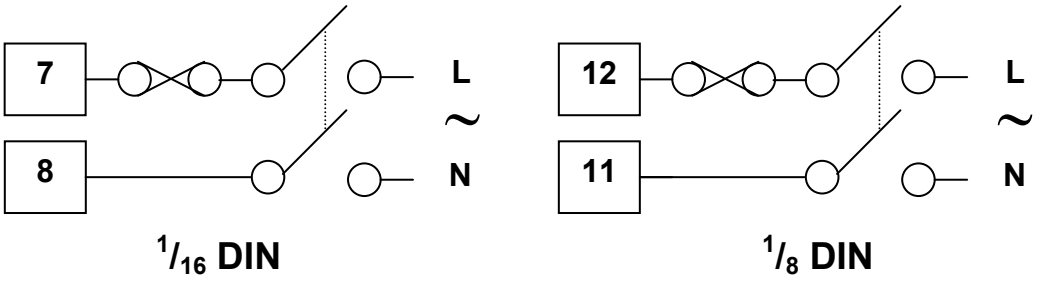


Figure 8. Mains Power Connections

WARNING:

CHECK THE INFORMATION LABEL ON THE CASE TO DETERMINE THE CORRECT VOLTAGE BEFORE CONNECTING TO A LIVE SUPPLY.

CAUTION:

This equipment is designed for installation in an enclosure that provides adequate protection against electric shock

Power Connections - 24/48V AC/DC Powered Instruments

24/48V AD/DC powered instruments will operate from a 20 to 48V AC or 22 to 55V DC supply. AC power consumption is 7.5VA max, DC power consumption is 5 watts max. Connection should be via a two-pole isolating switch (preferably located near the equipment) and a 315mA slow-blow (anti-surge type T) fuse.

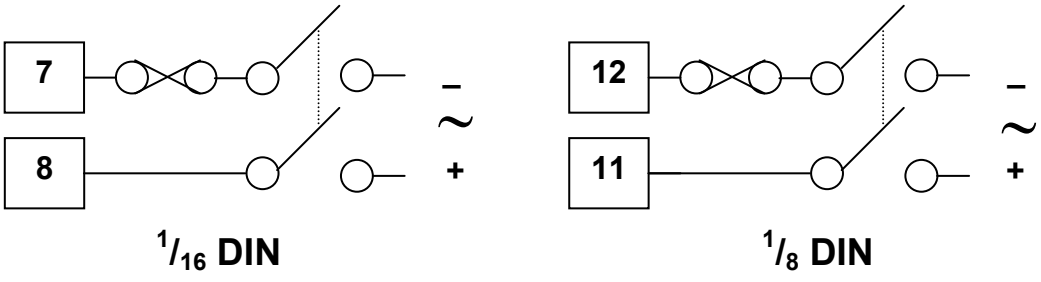


Figure 9. 24/48V AC/DC Power Connections

WARNING:

CHECK THE INFORMATION LABEL ON THE CASE TO DETERMINE THE CORRECT VOLTAGE BEFORE CONNECTING TO A LIVE SUPPLY.

Universal Input Connections - Thermocouple (T/C)

Use only the correct thermocouple wire or compensating cable from the probe to the instrument terminals avoiding joints in the cable if possible. Failure to use the correct wire type will lead to inaccurate readings. Ensure correct polarity of the wires by cross-referencing the colours with a thermocouple reference table.

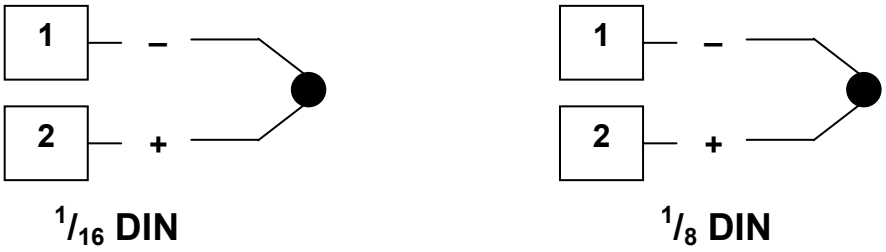


Figure 10. Thermocouple Input Connections

Universal Input Connections – PT100 (RTD) input

For three wire RTDs, connect the resistive leg and the common legs of the RTD as illustrated. For a two wire RTD a wire link should be used in place of the third wire (shown by dotted line). Two wire RTDs should only be used when the leads are less than 3 metres long. Avoid cable joints.

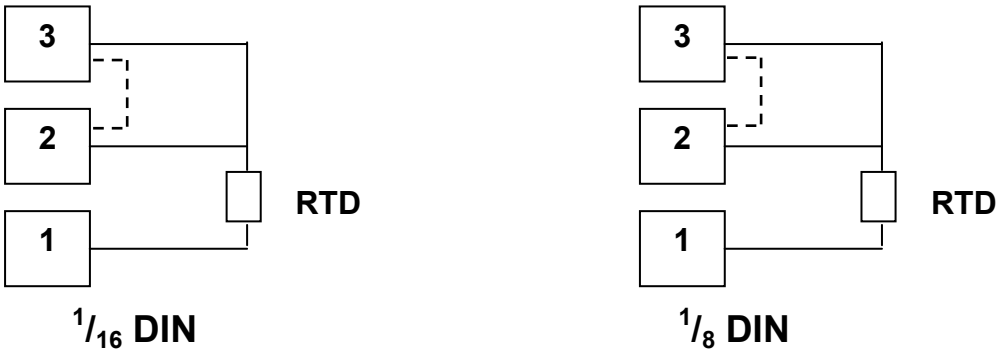


Figure 11. RTD Input Connections

Four wire RTDs can be used, provided that the fourth wire is left unconnected. This wire should be cut short or tied back so that it cannot contact any of the terminals on the rear of the instrument.

Universal Input Connections - Linear Volt, mV or mA input

Linear DC voltage, millivolt or milliamp input connections are made as illustrated. Carefully observe the polarity of the connections.

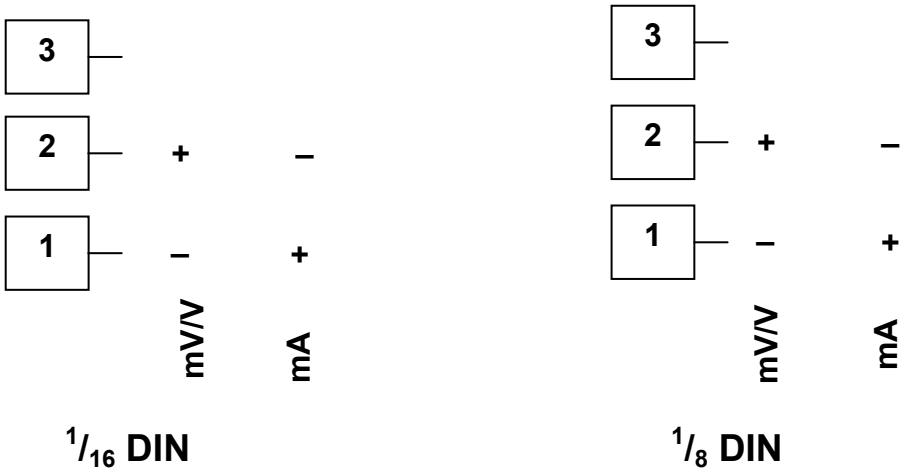


Figure 12. DC Volt, mV & mA Input Connections

Option 1 – Relay Output

If option 1 is fitted with a relay output, make connections as illustrated. The relay contacts are rated at 2 amps resistive, 240 VAC.

Figure 13. Output 1 – Relay

Option 1 - SSR Driver Output

If option 1 is fitted with an SSR driver output, make connections as illustrated. The solid-state relay driver is a 0-10V DC signal, load impedance must be no less than 500 ohms. SSR driver outputs are not isolated from the signal input or other SSR driver outputs.

Figure 14. Output 1 - SSR Driver

Output 2 - Relay Output

If output 2 is fitted with a relay output, make connections as illustrated. The relay contacts are rated at 2 amps resistive, 240 VAC

Figure 15. Output 2 - Relay

Output 2 - SSR Driver Output

If option 2 is fitted with an SSR driver output, make connections as illustrated. The solid-state relay driver is a 0-10V DC signal, load impedance must be no less than 500 ohms. SSR driver outputs are not isolated from the signal input or other SSR driver outputs.

Figure 16. Output 2 - SSR Driver

Output 3 - Relay Output

If option 3 is fitted with a relay output, make connections as illustrated. The relay contacts are rated at 2 amps resistive, 240 VAC (120V max for direct Valve Motor control).

Figure 17. Output 3 - Relay

Output 3 - SSR Driver Output

If output 3 is fitted with an SSR driver output, make connections as illustrated. The solid-state relay driver is a 0-10V DC signal; load impedance must be no less than 500 ohms. SSR driver outputs are not isolated from the signal input or other SSR driver outputs.

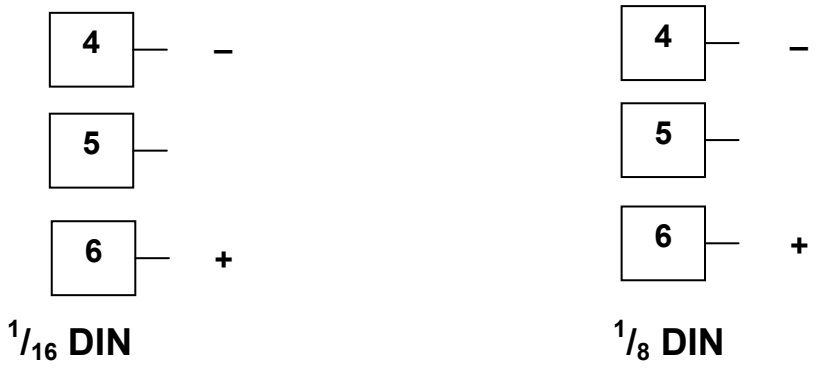


Figure 18. Output 3 - SSR Driver

Output 3 - Linear Voltage or mADC output

If option 3 is fitted with a DC linear output, make connections as illustrated.

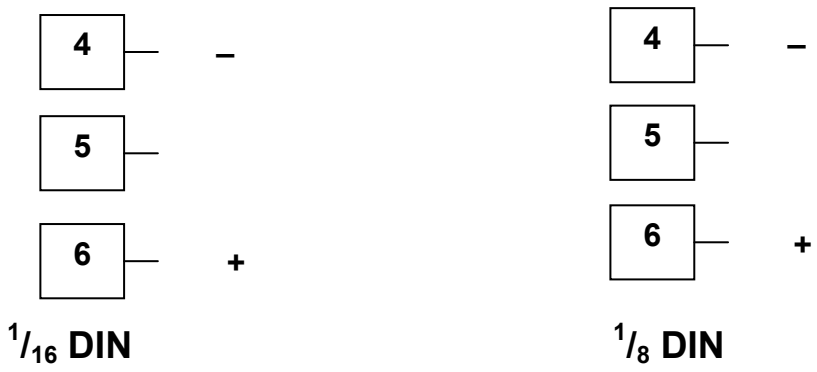


Figure 19. Output 3 - Linear Voltage & mADC

Output 3 - RS485 Serial Communications

If option A is fitted with the RS485 serial communication, connections are as illustrated. Carefully observe the polarity of the A (Rx/Tx +ve) and B (Rx/Tx -ve) connections.

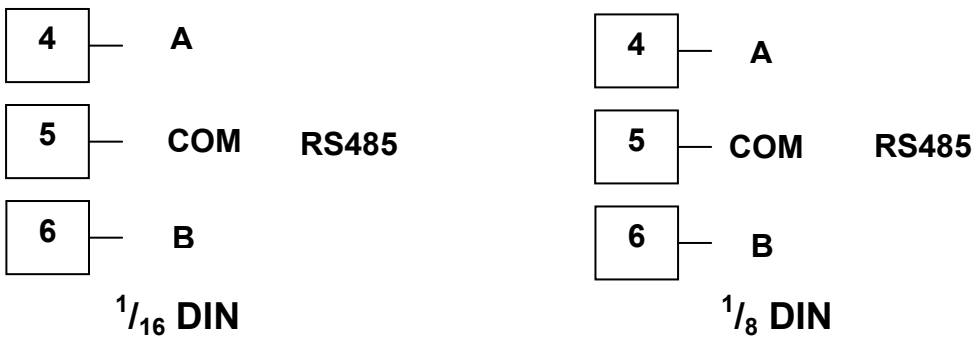


Figure 20. Output 3 – RS485 Serial Communications

4 Getting Started

WARNING:

ENSURE SAFE WIRING PRACTICES ARE FOLLOWED

The instrument must be powered from a supply according to the wiring label on the side of the unit. The supply will be either 100 to 240V AC, or 24/48V AC/DC powered. Check carefully the supply voltage and connections before applying power.

CAUTION:

When powering up for the first time, disconnect the output connections.

4.1 Powering Up Procedure

At power up, a self-test procedure is automatically started, during which all LED segments and indicators are lit. At the first power up from new, or if the options are changed, GotoConF will be displayed, indicating configuration is required *(refer to section 6)*. At all other times, the instrument returns to operator mode once the self-test procedure is complete.

4.2 Controller Configuration

Set up the inputs, outputs, alarms and function key operation via the 'configuration mode' menu, see Section 6.

Note:
The controller must be configured before changes can be made using the set-up mode or any other mode.

4.3 Application Set-up

Change application specific settings in 'set-up' mode, see Section 6.

4.4 Tune controller

If PID control is required, tune the controller via 'Auto-tuning mode' in the mode menu.

Note:
Auto-tuning will not engage if the proportional band = 0, the Setpoint is ramping or if PV is within 5% of input span away from Setpoint.

4.5 Operation mode

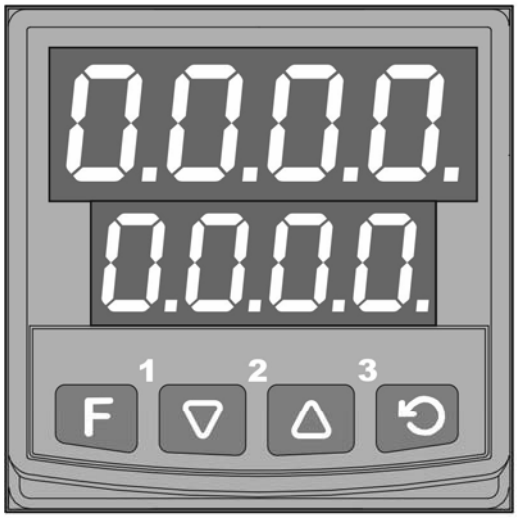
Return to the operation mode, the controller will now auto-tune.

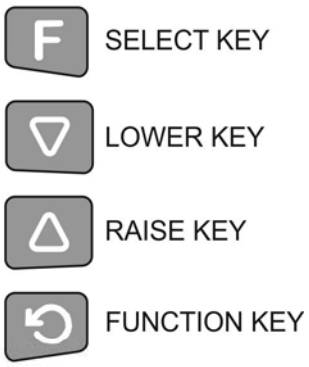
4.6 Overview of Front Panel

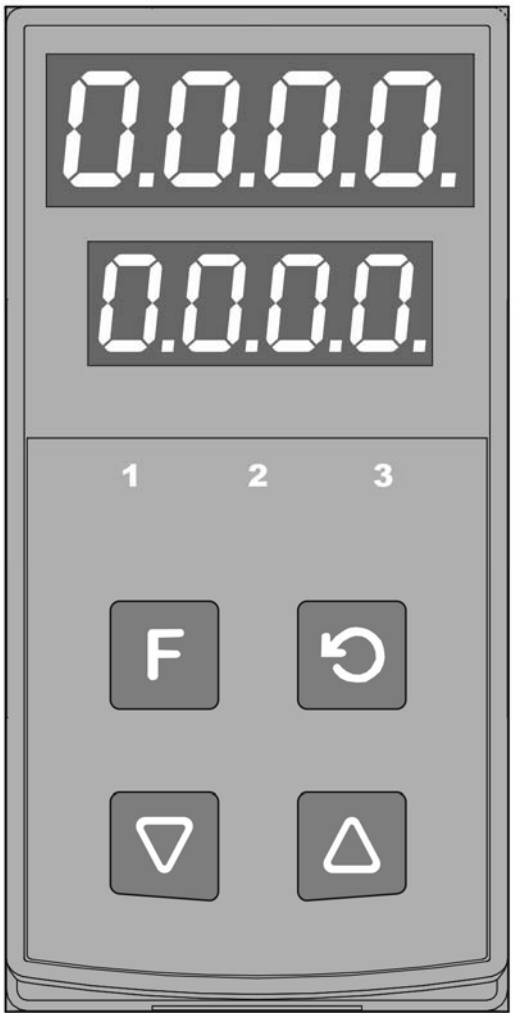
The illustration below shows a typical instrument front panel. Refer to the following table – Typical LED functions for a description of the front panel indicators. Each model in the range will vary slightly from the example shown.

Figure 21. Typical front panel and keys

1/16 - DIN







4.7 Displays

Controllers are provided with a dual line display and LED indicators for mode, automatic tune, alarm and output status. The upper display shows the process variable value during normal operation, whilst the lower display shows the Setpoint value. See the preceding diagram - Typical front panel and keys.

4.8 Keypad

Each instrument has either three or four switches, which are used to navigate through the user menus and make adjustment to the parameter values. See - Overview Of Front Panel above

4.9 LED Functions

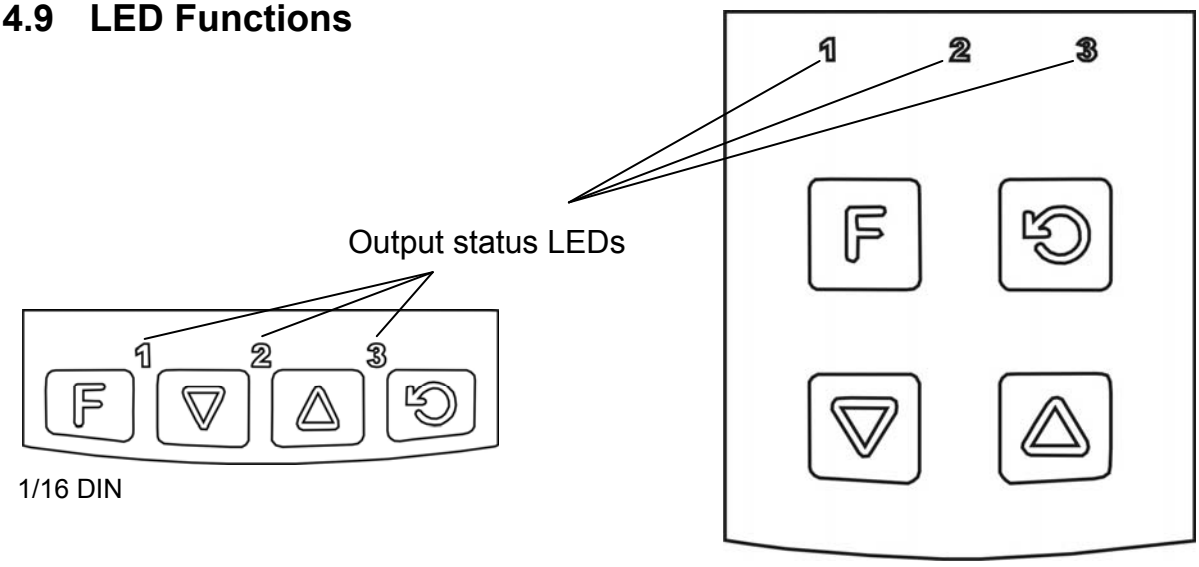


Table 2. Typical LED functions

LED	Function
1	**OUTPUT 1 STATUS** **ON** indicates output 1 is active, **OFF** indicates output 1 is inactive.
2	**OUTPUT 2 STATUS** **ON** indicates output 2 is active, **OFF** indicates output 2 is inactive.
3	**OUTPUT 3 STATUS** **ON** indicates output 3 is active, **OFF** indicates output 3 is inactive.

5 Messages and Error Indications

The following displays are shown when an error occurs or a hardware change is detected.

Table 3. Error/Faults conditions

Error/Faults Conditions	Upper Display	Lower Display	Description
Instrument parameters are in default conditions	Goto	Conf	Configuration & Setup required. This screen is seen at first turn on, or if hardware configuration has been changed. Press ↺ to enter the Configuration Mode, next press △ or ▽ to enter the unlock code number, then press ↺ to proceed
Input Over Range	[HH]	Normal	Process variable input > 5% over-range
Input Under Range	[LL]	Normal	Process variable input > 5% under-range
Input Sensor Break	OPEn	Normal	Break detected in process variable input sensor or wiring
Warning Alarm	ALM1	Normal	Standard alarm, output latched alarm or diagnostic alarm active
Auto-tune running status	tunE	Normal	Indicates tuning is active
Profiler not running warning	n.run	Normal	Profiler not running because a segment target Setpoint is not within the Setpoint upper and lower limits.
Profiler running warning	CL iP	Normal	Profiler running and the Setpoint upper or lower limit has been adjusted and the profiler active Setpoint is now not within the Setpoint upper and lower limits.
Profiler hold activated	ho ld	Normal	Profiler hold activated
Profiler Segment type	SGrt	Normal	Ramp time
Profiler Segment type	SGrP	Normal	Ramp rate
Profiler Segment type	SGdt	Normal	Dwell time
Profiler Segment type	StEP	Normal	Step
Profiler segment type	End	Normal	End

*** Note**

Input sensor and Auxiliary over/under-range or break indications will be seen wherever these values would normally be displayed.

6 Instrument Operation Modes

All instruments in the range share a similar user interface. Indicator models (single 4-digit display) the legend shown in the “Lower Display” column will be shown for approx 1 second before the “Upper Display” value is shown.

6.1 Select Mode

This mode is used to gain entry to each of the modes available in the instrument.

Entry into the Select Mode

Hold down ↺ and press △ in any mode to force the unit to enter Select Mode.

Navigating in Select Mode

Once in Select Mode, press △ or ▽ to select the required mode, then press ↺ to enter the chosen mode.

To prevent unauthorised entry to Configuration, Setup and Automatic Tuning modes, an unlock code is required to access the menu.

Mode	Upper Display	Lower Display	Description	Default Unlock Codes
Operator	OPtr	SLCt	Normal operation	None
Set Up	SEtP	SLCt	Tailor the instrument to the application, adjustment of tuning terms etc.	10
Configuration	Conf	SLCt	Configure the instrument for first time use or on re-installation.	20
User Calibration	USrC	SLCt	Adjust unit calibration to the application	30
Product Info	inFo	SLCt	Check the hardware, firmware and manufacturing information of the instrument.	None
Auto-Tuning	Atun	SLCt	Invoke pre-tune or self-tune on controllers	0
Profile Configuration	P .cnF	SLCt	Configure profiles	0
Profile Setup	P .StP	SLCt	Setup profile to run	None
Profile control	P .ct l	SLCt	Profile control	None
Diagnostics	d iAG	SLCt	Configure Built in Application Diagnostics	40

Table 4. Instrument

***Note:**
On Indicators, this legend is shown for approx 1 second before the Main display value.

6.2 Unlock Codes

The ULoc screen is seen before entry is allowed to Configuration, Setup and Automatic Tuning modes.

An unlock code must be correctly selected using the ▽ or △ keys to enter the required mode. An incorrect entry results in a return to Select Mode. The value of the lock codes only can be changed from within the modes that they apply to.

6.3 Automatic Tune Mode

Automatic Tune Mode is selected when it is desired to use the Pre-tune facilities on a controller to assist the user in setting up Proportional band, Integral and Derivative parameter values. Refer to the following Automatic Tune Mode table.

Pre-tune can be used to set Controller PID parameters approximately. Pre-tune can be set to run automatically after every power-up using the Auto Pre-Tune APt parameter in Setup Mode.

The **lower seven-segment display** will flash tunE while pre-tune is operating. One the pre-tune is complete the display will return to normal operation

Navigating in Automatic Tune Mode

Press ↺ to select the next parameter in the table and ▽ or △ to set the value required.

Hold down ↺ and press △ to return to Select Mode.

Note:
If there is no key activity for 2 minutes the controller automatically returns to operator mode

Table 5. Automatic Tune Mode Parameters

Parameter	Upper Display Adjustment Range	Lower Display	Default Value
Pre-tune	On or OFF. Indication remains OFF if Pre-Tune cannot be used at this time. This applies if: a). The Setpoint is ramping b). The process variable is less than 5% of span from the Setpoint c). The primary or secondary output proportional bands = 0	Ptun	OFF
Automatic tune mode lock code	0 to 9999	tLoc	0

6.4 Product Information Mode

This is a read only mode describing the instrument and the options fitted to it.

Navigating in the Product Information Mode

Press  to view each parameter in turn.

Hold Down  and press  to return to Select Mode.

Note:
If there is no key activity for 2 minutes the controller automatically returns to operator mode

Table 6. Product Information Mode Parameters

Parameter	Lower Display	Upper Display	Description
Input type	In_1	Un i	Universal input
Option 1 type	OPn 1	rLY	Relay output
		SSr	SSR drive output
Option 2 type	OPn2		As Option 1
Option 3 type	OPn3	nonE	Not fitted
		rLY	Relay output
		SSr	SSR drive output
		L in	Linear DC voltage / current output
		r485	RS485 communications
Firmware type	FUJ		Value displayed is firmware type number
Firmware issue	ISS		Value displayed is firmware issue number
Product Revision Level	PrL		Value displayed is Product Revision level
Date of manufacture	dOM		Manufacturing date code *(mmyy)*
Serial number 1	Sn 1		First four digits of serial number
Serial number 2	Sn2		Middle four digits of serial number
Serial number 3	Sn3		Last four digits of serial number

6.5 Lock Code View

In the event that a lock code is forgotten, the instrument lock code values can be seen in the lock code view. In this view the codes are read only, the codes can be changed from the mode to which they apply.

Entry and Navigating in Lock Code View Mode

Press △ and ↺ together whilst the instrument is powering up until the CLoc display is shown.

Once in this mode

Press ↺ to step between lock codes.

Note:
If there is no key activity for 2 minutes the instrument returns to Operator Mode. To forcefully exit this view, switch off the instrument.

Table 7. Lock Code View Menu

Lock Code Name	Description	Upper/Main Display	Lower Display (or 1st Legend)*
Configuration Lock Code	Read only view of configuration lock code.	Current lock code value	CLoc
Setup Lock Code	Read only view of setup mode lock code.	Current lock code value	SLoc
Automatic Tune Lock Code	Read only view of Automatic tune lock code.	Current lock code value	tLoc
Calibration Lock code	Read only view of calibration lock code	Current lock code value	u loc
Diagnostics Lock code	Read only view of diagnostics lock code	Current lock code value	d loc
Profile configuration lock code	Read only view of profile configuration lock code	Current lock code value	P loc

6.6 Configuration Mode

This mode is normally used only when the instrument is configured for the first time or when a major change is made to the instruments characteristics. The Configuration Mode parameters must be set as required before adjusting parameters in Setup Mode, or attempting to use the instrument in an application.

Entry into the Configuration Mode

CAUTION:

Adjustments to these parameters should only be performed by personnel competent and authorised to do so.

Configuration is entered from Select Mode

Hold down ↺ and press △ to force the controller into the Select Mode.

then

Press △ or ▽ to navigate to the Configuration Mode option, then press ↺.

Note:
Entry into this mode is security-protected by the Configuration Mode Lock Code. Refer to the Unlock Code section for more details.

Scrolling through Parameters and Values

Press ↺ to scroll through the parameters (parameters are described below).

Note:
Only parameters that are applicable to the hardware options chosen will be displayed.

Changing Parameter Values

Press ↺ to navigate to the required parameter, then press △ or ▽ to set the value as required.

Once the value is changed, the display will flash to indicate that confirmation of the change is required. The value will revert back if not confirmed within 10 seconds.

Press F to accept the change.

Or

Press ↺ to reject the change and to move onto the next parameter.

Hold down ↺ and press △ to return to Select Mode.

Note:
If there is no key activity for 2 minutes the instrument returns to the operator mode.

Table 8. E6C & E8C Configuration Mode Parameters

Parameter	Lower Display	Upper Display	Adjustment range & Description	Default Value
Input Range/Type	inPt	See the following table for possible codes		JC

Code	Input Type & Range	Code	Input Type & Range	Code	Input Type & Range
bC	B: 100 - 1824 ºC	LC	L: 0 - 762 ºC	P24C	PtRh20% vs. 40%: 0 - 1850 ºC
bF	B: 211 - 3315 ºF	L F	L: 32 - 1403 ºF	P24F	PtRh20% vs 40%: 32 - 3362 ºF
CC	C: 0 - 2320 ºC	L .C	L: 0.0 - 537.7 ºC	PtC	Pt100: –199 - 800 ºC
CF	C: 32 - 4208 ºF	L .F	L: 32.0 - 999.9 ºF	PtF	Pt100: –328 - 1472 ºF
dC	D: 0 - 2315 ºC	nC	N: 0 - 1399 ºC	Pt .C	Pt100: –128.8 - 537.7 ºC
dF	D: 32 - 4199 ºF	nF	N: 32 - 2551 ºF	Pt .F	Pt100: –199.9 - 999.9 ºF
JC	J: –200 - 1200 ºC	rC	R: 0 - 1759 ºC	0_20	0 - 20 mA DC
JF	J: –328 - 2192 ºF	rF	R: 32 - 3198 ºF	4_20	4 - 20 mA DC
J .C	J: –128.8 - 537.7 ºC	SC	S: 0 - 1762 ºC	0_50	0 - 50 mV DC
J .F	J: –199.9 - 999.9 ºF	SF	S: 32 - 3204 ºF	10 .50	10 - 50 mV DC
KC	K: –240 - 1373 ºC	t .C	T: –240 - 400 ºC	0_5	0 - 5 V DC
KF	K: –400 - 2503 ºF	tF	T: –400 - 752 ºF	1_5	1 - 5 V DC
K .C	K: –128.8 - 537.7 ºC	t .C	T: –128.8 - 400.0 ºC	0_10	0 - 10 V DC
K .F	K: –199.9 - 999.9 ºF	t .F	T: –199.9 - 752.0 ºF	2_10	2 - 10 V DC

Scale Range Upper Limit	rUL	Scale Range Lower Limit +100 to Range Maximum		Range max (Lin=100.0)
Scale Range Lower Limit	rLL	Range Minimum to Scale Range Upper Limit -100		Range min (Linear=0.0)
Decimal point position	dPoS	0=XXXX, 1=XXX.X, 2=XX.XX, 3=X.XXX (non-temperature ranges only)		1
Control Type	CtyP	SnGL	Primary only	SnGL
		duAL	Primary & Secondary (e.g. heat & cool)	
Primary Output Control Action	CtrL	rEu	Reverse Acting	rEu
		d ir	Direct Acting	
Alarm 1Type	AlA1	P_H1	Process High Alarm	P_H1

Parameter	Lower Display	Upper Display	Adjustment range & Description	Default Value
		P_Lo	Process Low Alarm	
		dE	Deviation Alarm	
		bAnd	Band Alarm	
		nonE	No alarm	
High Alarm 1 value*	PhA 1	Range Minimum to Range Maximum in display units		Range Max
Low Alarm 1 value*	PLA 1			Range Min
Band Alarm 1 value*	bAL 1	1 LSD to span from Setpoint in display units		5
Dev. Alarm 1 value*	dAL 1	+/- Span from Setpoint in display units		5
Alarm 1 Hysteresis*	AHy 1	1 LSD to full span in display units		1
Alarm 2 Type*	ALA2	Options as for alarm 1		P_Lo
High Alarm 2 value*	PhA2			Range Max
Low Alarm 2 value*	PLA2			Range Min
Band Alarm 2 value*	bAL2			5
Dev. Alarm 2 Value*	dAL2	Options as for alarm 1		5
Alarm 2 Hysteresis*	AHy2			1
Loop Alarm	LAEn	d iSA (disabled) or EnAb (enabled)		d iSA
Loop Alarm Time*	LAt i	1 sec to 99 mins. 59secs		99 .59
Alarm Inhibit	Inh i	nonE	No alarms Inhibited	nonE
		ALA 1	Alarm 1 inhibited	
		ALA2	Alarm 2 inhibited	
		both	Alarm 1 and alarm 2 inhibited	
Output 1 Usage	USE 1	Pr i	Primary Power	Pr i
		SEc	Secondary Power	
		A 1_d	Alarm 1, Direct	
		A 1_r	Alarm 1, Reverse	

Parameter	Lower Display	Upper Display	Adjustment range & Description	Default Value
		A2_d	Alarm 2, Direct	
		A2_r	Alarm 2, Reverse	
		LP_d	Loop Alarm, Direct	
		LP_r	Loop Alarm, Reverse	
		Or_d	Logical Alarm 1 OR 2, Direct	
		Or_r	Logical Alarm 1 OR 2, Reverse	
		Ad_d	Logical Alarm 1 AND 2, Direct	
		Ad_r	Logical Alarm 1 AND 2, Reverse	
		A 1Ld	Alarm 1, Direct Latching	
		A 1Lr	Alarm 1, Reverse Latching	
		A2Ld	Alarm 2, Direct Latching	
		A2Lr	Alarm 2, Reverse Latching	
		Evn 1	Event 1	
		Evn2	Event 2	
Output 2 Usage	USE2	Options same as Output 1 Usage		A 1_d
Output 3 Usage	USE3			A2_d
Linear Output 3 Usage	USE3	Pr 1	Primary Power	rEtP
		SEc	Secondary Power	
		rEtS	Recorder SP	
		rEtP	Recorder PV	
Linear Output 3 Range	tYP3	0_5	0 to 5 V DC output	0_10
		0_10	0 to 10 V DC output	
		2_10	2 to 10 V DC output	
		0_20	0 to 20 mA DC output	
		4_20	4 to 20 mA DC output	
Retransmit Output 3 Scale maximum	ro3H	-1999 to 9999 (display value at which output will be maximum)		Range max

Parameter	Lower Display	Upper Display	Adjustment range & Description	Default Value
Retransmit Output 3 Scale minimum	ro3L	-1999 to 9999 (display value at which output will be minimum)		Range min
Function key	Func	nonE	No function	nonE
		MAN	Function key enables manual power	
		Pct1	Profiler control	
		Ptun	Pre-tune	
Latch power down save	LtPS	d iSA	Do not save the latching alarm status on power-down	d iSA
		EnAb	Save the latching alarm status on power-down	
Display Strategy	d iSP		1, 2, 3, 4, 5 or 6 (refer to section 14)	1
Serial Communications Protocol	Prot	Mbn	Modbus with no parity	Mbn
		MbE	Modbus with Even Parity	
		Mbo	Modbus with Odd Parity	
Serial Communications Bit Rate	bAud	1.2	1.2 kbps	4.8
		2.4	2.4 kbps	
		4.8	4.8 kbps	
		9.6	9.6 kbps	
		19.2	19.2 kbps	
		38.4	38.4 kbps	
Comms Address	Addr	1	1 to 255	1
Comms Write	CoEn	r_Wd	Read/Write	r_Wd
Configuration Lock Code	CLoc	0 to 9999		20

***Note:**

*Alarm parameters marked * are repeated in Setup Mode.*

6.7 Setup Mode

This mode is normally selected only after Configuration Mode has been completed, and is used when a change to the process set up is required. It can affect the range of adjustments available in Operator Mode.

Note:
Entry into Setup Mode is security-protected by the Setup Mode lock code.

Entry into the Setup Mode

Hold down ↺ and press △ to enter the Select Mode

Press △ or ▽ to navigate to the Setup Mode option, then press ↺ to enter Setup Mode.

Scrolling through Parameters & Values

Press ↺ to scroll through the parameters (refer to the table below) and their values.

Changing Parameter Values

Press ↺ to select the required parameter, then press △ or ▽ to set the value as required.

Once the displayed value is changed the effect is immediate. No confirmation of the change is required.

Note:
If there is no key activity for two minutes the instrument returns to the operator mode.

Table 9. E6C & E8C Set Up Mode Parameters

Parameter	Lower Display	Upper Display Adjustment range & Description		Default Value
Control Select	CntL	Auto	Automatic control	Auto
		MAN	Manual control	
Input Filter Time Constant	F ILt	OFF or 0.5 to 100.0 secs		2.0
Primary Power	PPUJ	Current power levels (read only)		N/A
Secondary Power	SPUJ			
Primary Proportional Band	Pb_P	0 (ON/OFF) and 0.5% to 999.9% of input span in range units – defaults to 10% of range span		140
Secondary Proportional Band	Pb_S			
Automatic Reset (Integral Time)	Ar5t	1 sec to 99 mins 59 secs and OFF		5.00
Rate (Derivative Time)	rAtE	00 secs to 99 mins 59 secs		1.15
Overlap/Deadband	OL	-20 to +20% of Primary and Secondary Proportional Band		0
Manual Reset (Bias)	b IAS	0%(-100% if dual control) to 100%		25
Primary ON/OFF Differential	d IFP	0.1% to 10.0% of input span centred about the Setpoint. Entered in range units – defaults to 0.5% of range span.		7
Secondary ON/OFF Diff.	d IFS			
Prim. & Sec. ON/OFF Differential	d IFF			
Setpoint Upper Limit	SPuL	Current Setpoint to Range max		R/max
Setpoint Lower limit	SPLL	Range min to Current Setpoint		R/min
Primary Output Power Limit	OPuL	0% to 100% of full power		100
Output 1 Cycle Time	Ct 1	0.1 to 512 secs in 0.1 second increments for SSR 0.5 to 512 secs in 0.1 second increments for Relay		32.0
Output 2 Cycle Time	Ct2			
Output 3 Cycle Time	Ct3			
High Alarm 1 value	PhA 1	Range Minimum to Range Maximum		R/max
Low Alarm 1 value	PLA 1			R/min
Deviation Alarm 1 Value	dAL 1	Span from SP in display units		5
Band Alarm 1 value	bAL 1	1 LSD to span from Setpoint		5

Parameter	Lower Display	Upper Display Adjustment range & Description	Default Value
Alarm 1 Hysteresis	AHY 1	1 LSD to full span in display units	1
High Alarm 2 value	PhA2	Range Minimum to Range Maximum	R/max
Low Alarm 2 value	PLA2		R/min
Deviation Alarm 2 Value	dAL2	Span from SP in display units	5
Band Alarm 2 value	bAL2	1 LSD to span from Setpoint	5
Alarm 2 Hysteresis	AHY2	1 LSD to full span in display units	1
Loop Alarm Time	LAt ı	1 sec to 99 mins. 59secs	99 .59
Auto Pre-tune	APt	d ıSA (disabled) or EnAb (enabled)	d ıSA
SP Ramp Rate Value	rP	1 to 9999 units/hour or Off	Off
Setpoint Value	SP	Scale range upper to lower limits.	Scale Range Minimum
Setup Lock Code	SLoc	0 to 9999	10

Note:
*Alarm parameters marked * are repeated in Configuration Mode.*

Note:
***Once the complete list of Set Up Mode parameters has been displayed, the first Operator Mode display is shown without exiting from Set Up Mode. Display seen is dependant on the Display Strategy and status of Auto/Manual mode selection.*

6.8 Operator Mode

This is the mode used during normal operation of the instrument. It can be accessed from Select Mode, and is the usual mode entered at power-up. The available displays are dependent upon whether Dual or Remote Setpoint modes are being used, whether Setpoint Ramping is enabled and the setting of the Display Strategy parameter in Configuration Mode.

WARNING:

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.

CAUTION:

Set all Configuration Mode parameters and Set Up Mode parameters as required before starting normal operations.

Navigating in Operator Mode

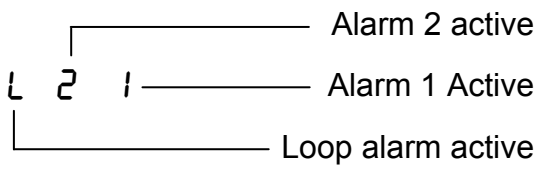
Press  to move between displays.

When a display value can be adjusted, use  or  to change its value.

Note:

The operator can freely view the parameters in this mode, but alteration depends on the settings in the Configuration and Set Up Modes. All parameters in Display strategy 6 are read only, and can only be adjusted via Setup mode.

Table 10. E6C & E8C Operator Mode Display

Upper Display	Lower Display	Display Strategy and When Visible	Description
PV Value	Active SP Value	1 & 2 (initial screen)	PV and target value of selected SP Local Setpoints are adjustable in Strategy 2
PV Value	Actual SP Value	3 & 6 (initial screen)	PV and actual value of selected SP (e.g. ramping SP value). Read only
PV Value	*(Blank)*	4 (initial screen)	Process variable only Read only
Active SP Value	*(Blank)*	5 (initial screen)	Target value of selected Setpoint only. Read only
SP Value	SP	1, 3, 4, 5 & 6	Target value of SP Adjustable except in Strategy 6
Active Alarm Status	ALSt	When one or more alarms are active. ALM indicator will also show on the upper display on the process variable screen.	
Warning alarm active	ALdG	These are the diagnostic alarms.	123i 1 = If output 1 actuations alarm active 2 = If output 2 actuations alarm active 3 = If output 3 actuations alarm active i = If Input is over ambient temperature
Latching output alarm active	ALOL	These are the output latching alarms.	OL1_ = Latching alarm 1 active OL_2 = Latching alarm 2 active OL12 = Latching alarm 1 and 2 active
Segment Number	SGnb	If Profile running	Current Segment number of active profile. *Read only.*
Target SP value	SGtS	If Profile Running	Target Setpoint of current Segment. *Read only.*
Time remaining	SGtr	If Profile Running	Time remaining for current segment. *Read only.* *Format: MM.SS or HH.MM*
Cycles Remaining	cYcL	If Profile Running	Cycles remaining or INF for infinite. *Read only.*
Delay time remaining	dELY	If profiler started but not yet running.	Start delay time remaining. *Read only.*
Profiler reset	P .rSt	If profiler has ended and PrrE = COFF or PrrE = MMSP. or	Profiler reset. YES no When the display shows End a YES will reset

Upper Display	Lower Display	Display Strategy and When Visible	Description
		PrEA = CoFF or PrEA = nnSP or the user has stopped the profile from profiler control or the function key.	the profiler and restore control or SP to the controller If PrEA = GCSP or PrrE = GCSP then End will only be shown for 30 seconds and this screen will not be shown. If the Func is set to Pct I then the user can use the function key as well to reset the profiler.
Events Active	SGEA	If Profile Running and any events active.	Shows numbers of Events Active.

6.9 Adjusting the Local Setpoint(s)

Setpoints can be adjusted within the limits set by the Setpoint Upper and Lower Limit parameters in Setup. Operator Mode adjustment of Setpoint is not possible if Display Strategy 6 has been selected on Configuration Mode.

Press ↺ to select the adjustable Setpoint display

Press △ or ▽ to adjust the Setpoint to the required value.

6.10 Adjusting the Setpoint Ramp Rate

The ramp rate may be adjusted in the range 1 to 9999 and OFF. Increasing the ramp rate 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 ramp rate to 9999 or less.

Press ↺ to select the adjustable Setpoint display

Press △ or ▽ to adjust the Setpoint to the required value.

WARNING:

THE SETPOINT RAMP FEATURE DISABLES THE PRE-TUNE FACILITY.

6.11 Manual Control Mode

To allow manual control to be selected in Operator Mode, PoEn must be enabled in Set Up Mode. Manual Mode can be selected using the front keys or by use of a digital input if one has been fitted and configured for this function.

Selecting/deselecting Manual Control Mode via Keypad

If Func is set to MAN then manual control can be selected/de-selected by pressing F in the Operator mode or change Cnt I to MAN in setup mode

While in Manual Control mode, the lower display will show P*xxx* (where *xxx* is the current manual power level). Switching to/from manual mode is via Bumpless Transfer.

Press △ or ▽ to adjust the output power to the required value

Note: To exit manual control press F again or change Cnt I to Auto

CAUTION:

The Manual Mode power level can be adjusted from 0 to 100% (-100 to +100% for dual output). It is not restricted by the Output Power Limit parameter OPuL.

Note:

Disabling PoEn in Set Up Mode whilst manual control mode is active will lock the controller into manual mode. Pressing the F key will no longer cause a return to automatic control. To exit from Manual Mode, PoEn must temporarily be re-enabled.

Important

Manual mode can also be accessed with Cnt I function in the setup mode menu see page 39.

6.12 Profile Configuration Mode

The controller features a profiler function which has the capability for two user defined profiles to be configured with up to 16 individual segments incorporating delay timer, auto holdback for guaranteed dwell and ramps. Once configured, the profile can be easily controlled via a single press of the function key.

Typically a profile can be configured with any combination of the following segment types:

Ramp (Time)

This segment is used to reach a target Setpoint in a specific time. The ramp rate is automatically calculated by the controller.

Ramp (Rate)

This segment is used to reach a target Setpoint by applying a specific ramp rate defined in units per hour.

Dwell

This segment is used to maintain the Setpoint for a specific duration.

Step

This segment is used to increase the Setpoint instantaneously.

End

This segment is used to end the profile. Each profile must contain this type of segment.

An example profile is shown below:

Segment No	Segment Type
1.	Ramp (Rate)
2.	Ramp (Time)
3.	Dwell
4.	Step
5.	Ramp (Time)
6.	Dwell

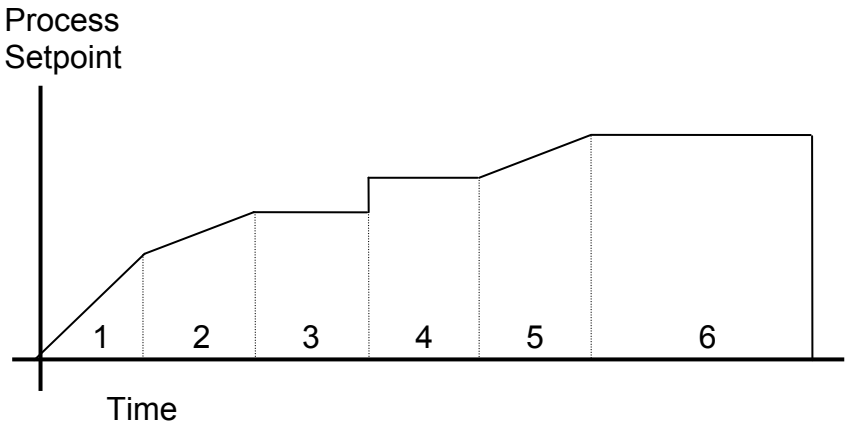


Figure 22. Example Profile

6.13 Profiler Control

The profiler can be controlled using the F key. Set the Func parameter to Pct I in Configuration mode (see section 6) to enable this feature.

The profiler can be controlled as follows:

Press F to run the profile.

If the profiler is running, press F to hold the profile.

If the profiler is running or in hold, press and hold F for 5 seconds. The profile will stop.

If the upper display shows End , press F to remove the message and reset the profiler. This will restore control or SP to the controller if PrrE = COFF or PrrE = rMSP or PrEA= CoFF or PrEA = rMSP or the user has stopped the profile from profiler control or the function key. If PrEA = GCSP or PrrE = GCSP then End will only be shown for 30 seconds and the key will clear if pressed but no profiler reset is activated.

Alternatively the profiles can be controlled via profile control mode.

6.14 Profile Control Mode

This mode is used to run, hold or stop a profile.

Entry into the Profile Control Mode

Hold down ↺ and press △ to enter the Select Mode.

Press △ or ▽ to navigate to the Profile Control Mode option, then press ↺.

Scrolling through Parameters and Values

Press ↺ to scroll through the parameters (refer to the table below) and their values.

Changing Parameter Values

Press ↺ to select the required parameter, then press △ or ▽ to set the value as required.

Once the value is changed, the display will flash to indicate that confirmation of the change is required. The value will revert back if not confirmed within 10 seconds.

Press F to accept the change.

Or

Press ↺ to reject the change and to move onto the next parameter.

Note:
If there is no key activity for 2 minutes the instrument returns to the operator mode.

Table 11. E6C & E8C Profile Control Mode Parameters.

Parameter	Lower Display	Upper Display	Adjustment range & Description	Default Value
Profiler control action	Pct I	run	Run the profiler	c_SP
		ho ld	Hold profile running - Option when profiler running	
		StoP	Stop profile running	

6.15 Entry into the Profile Configuration Mode

Hold down and press to enter the Select Mode.

Press or to navigate to the Profile Configuration Mode option, then press .

Note:
Entry into this mode is security-protected by the Profile Configuration Mode Lock Code. Refer to the Unlock Code section for more details.

Scrolling through Parameters and Values

Press to scroll through the parameters (refer to the table below) and their values.

Changing Parameter Values

Press to select the required parameter, then press or to set the value as required.

Once the displayed value is changed, the display will flash to indicate that confirmation of the change is required. The value will revert back if not confirmed within 10 seconds.

Press to accept the change.

Press to reject the change and to move onto the next parameter.

Note:
If there is no key activity for 2 minutes the instrument returns to the operator mode.

Table 12. E6C & E8C Profile Configuration Mode Parameters.

Parameter	Lower Display	Upper Display	Adjustment range & Description	Default Value
Profile Number	ProG	Select Profile: 1 or 2		1
Profile: Start Point	PrSP	c_SP	Start at Current Setpoint	c_SP
		c_PU	Start at Current PV	
Profile: Recovery method	PrrE	CoFF	Controller Off	CoFF
		rPrF	Restart Profiler	
		MSP	Maintain last profile SP	
		GCSP	Goto ControllerSP	
		CPrF	Continue Profile	
Profile: End Action	PrEA	CoFF	Controller Off	CoFF
		MSP	Maintain last profile SP	
		GCSP	Goto ControllerSP	
Profile: Timebase	bASE	Hour	Hours/Minutes	Hour

Parameter	Lower Display	Upper Display	Adjustment range & Description	Default Value
		mn.SC	Minutes/Seconds	
Profile: Auto hold type	Hold	none	No auto hold	none
		H iG	Above Setpoint, hold if too high	
		LOW	Low Setpoint, hold if too low	
		bAd	Band, hold if too high or low	
Profile: Auto hold valid type	HoLP	ALL	Auto hold in all segments	SGdt
		SGdt	Auto hold Only on dwell segments	
Profile: Auto hold band value	bAd	The distance from the Setpoint 1-99 with range decimal point		5
Segment Number	SGnb	Indicates Segment being configured		
Segment: Type	SGtP	SGrt	Ramp time	SGrt
		SGrP	Ramp Rate	
		SGdt	Dwell time	
		StEP	Step	
		End	End	
Segment: Target SP	SGtS	-1999 to +9999 with range decimal point.		0
Segment: Ramp time	SGrt	00.01 to 99.59		00.01
Segment: ramp rate	SGrP	1 to 9999 units per hour with range decimal point		1
Segment: Dwell time	SGdt	00.01 to 99.59		00.01
Segment: Event Active	SGEt	E___	No Events	E___
		E 1__	Event 1 Active	
		E_2_	Event 2 Active	
		E 12_	Events 1 and 2 Active	
Profile Lock Code	PLoc	0 to 9999		0

6.16 Profile Setup Mode

This mode is used to define the run cycle for a pre-configured profile.

Entry into the Profile Setup Mode

Hold down  *and press*  *to enter the Select Mode.*

Press  or  to navigate to the Profile Setup Mode option, then press  .

Scrolling through Parameters and Values

Press  to scroll through the parameters (refer to the table below) and their values.

Changing Parameter Values

Press  to select the required parameter, then press  or  to set the value as required.

Once the displayed value is changed the effect is immediate. No confirmation of the change is required.

Note:
If there is no key activity for 2 minutes the instrument returns to the operator mode.

Table 13. E6C & E8C Profile Setup Mode Parameters.

Parameter	Lower Display	Upper Display Upper Display Adjustment range & Description	Default Value
Profile to run	ProG	1 or 2	1
Profile cycles	cYc 1	1 to 9999 then INF for an infinite loop - number of times to repeat the profile	1
Profile start delay	dELY	00.00 to 99.59 (HH:MM)	00 .00

6.17 Diagnostics Mode

This mode is used to configure the diagnostic options for the controller.

Entry into the Diagnostics Mode

Hold down and press to enter the Select Mode.

Press or to navigate to the Diagnostics Mode option, then press .

Note:

Entry into this mode is security-protected by the Diagnostics Mode Lock Code. Refer to the Unlock Code section for more details.

Scrolling through Parameters and Values

Press to scroll through the parameters (refer to the table below) and their values.

Changing Parameter Values

Press to select the required parameter, then press or to set the value as required.

Once the value is changed, the display will flash to indicate that confirmation of the change is required. The value will revert back if not confirmed within 10 seconds.

Press to accept the change.

Or

Press to reject the change and to move onto the next parameter.

Note:
If there is no key activity for 2 minutes the instrument returns to the operator mode.

Table 14. E6C & E8C Diagnostics Mode Parameters.

Parameter	Lower Display	Upper Display Upper Display Adjustment range & Description	Default Value
Actuator Life Warning Enable	ActE	d iSA (disabled) or EnAb (enabled)	d iSA
Output 1 Count Reset	OP 1r	YES or no	no
Output 1 Actuations	OP 1c	Count of output 1 actuations (1000's) Read only	
Actuator Warning Level Output 1	OP 1A	Number (1000's) of actuations before warning for output 1	150
Output 2 Count Reset	OP2r	YES or no	no

Parameter	Lower Display	Upper Display Upper Display Adjustment range & Description	Default Value
Output 2 Actuations	OP2c	Count of output 2 actuations (1000's) Read only	
Actuator Warning Level Output 2	OP2A	Number (1000's) of actuations before warning for output 2	150
Output 3 Count Reset	OP3r	YES or no	no
Output 3 Actuations	OP3c	Count of output 3 actuations (1000's) Read only	
Actuator Warning Level Output 3	OP3A	Number (1000's) of actuations before warning for output 3	150
Ambient Over-temperature Alarm Enable	OtEn	d iSA (disabled) or EnAb (enabled)	d iSA
Diagnostics lock code	dLOC	0 to 9999	40

7 Modbus Serial Communications

eCAL models support the Modbus RTU communication protocol. Units with RS485 Communications must be selected at time of purchasing, this function is an integral part of the controller and is not a retrofit option.

For a complete description of the Modbus protocol refer to the description provided at http://www.modbus.org/

Physical Layer

The Base address, bit rate and character format are configured via the front panel in Configuration Mode or by using the PC Configurator software.

Physical layer configuration settings possible are:

Data rate: 1200, 2400, 4800 (default), 9600, 19200 & 38400 bps

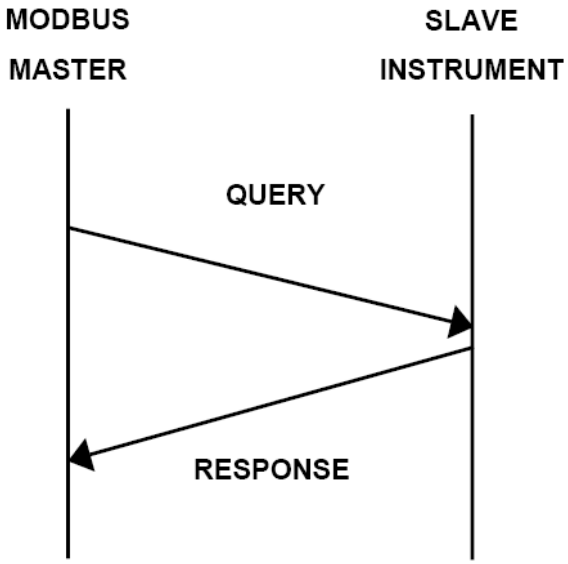
Parity: None (default), Even, Odd

Character format: Always 8 bits per character.

7.1 Link Layer

A Query (or command) is transmitted from the Modbus Master to the Modbus Slave. The slave instrument assembles the reply to the master. All of the instruments covered by this manual are slave devices, and cannot act as a Modbus Master

Figure 23. Modbus Link Layer



A message for either a QUERY or RESPONSE is made up of an inter-message gap followed by a sequence of data characters. The inter-message gap is at least 3.5 data character times.

Data is encoded for each character as binary data, transmitted LSB first.

For a QUERY the address field contains the address of the slave destination. The slave address is given together with the Function and Data fields by the Application layer. The CRC is generated from the given address, function and data characters.

For a RESPONSE the address field contains the address of the responding slave. The Function and Data fields are generated by the slave application. The CRC is generated from the address, function and data characters.

The standard MODBUS RTU CRC-16 calculation employing the polynomial $2^{16}+2^{15}+2^{2}+1$ is used.

Inter-message gap	Address 1 character	Function 1 character	Data *n* characters	CRC Check 2 characters

7.2 Device Addressing

The instrument is assigned a unique device address by the user in the range 1 (default) to 255 using the Addr parameter in Configuration Mode. This address is used to recognise Modbus Queries intended for this instrument. The instrument does not respond to Modbus Queries that do not match the address that has been assigned to it.

The instrument will also accept global Queries using device address 0 no matter what device address is assigned. No responses are returned for globally addressed Queries.

7.3 Supported Modbus Functions

Modbus defines several function types; these instruments support the following types:

Table 15. Supported Modbus Functions

Function Code (decimal)	Modbus Meaning	Description
01 / 02	Read Coil/Input Status	Read output/input status bits at given address.
03 / 04	Read Holding/Input registers	Read current binary value of specified number of parameters at given address. Up to 64 parameters can be accessed with one Query.
05	Force single Coil	Writes a single binary bit to the Specified Slave Bit address.
06	Pre-set Single Register	Writes two bytes to a specified word address.
08	Diagnostics	Used for loopback test.
16	Pre-set Multiple Registers	Writes up to 1 word parameter values to the specified address range.

7.4 Function Descriptions

The following is interpreted from the Modbus Protocol Description obtainable from http://www.modicon.com/ or http://www.modbus.org/. Refer to that document if clarification is required.

In the function descriptions below, the preceding device address value is assumed, as is the correctly formed two-byte CRC value at the end of the QUERY and RESPONSE frames.

Read Coil/Input Status (Function 01 / 02)

Reads the content of instruments output/input status bits at the specified bit address.

Table 16. Read Coil/Input Status (Modbus Function 01/02)

QUERY

Function	Address of 1st Bit		Number of Bits	
01 / 02	HI	LO	HI	LO

RESPONSE

Function	Number of Bytes	First 8 bits	2nd 8 Bits
01 / 02			

In the response the “Number of Bytes” indicates the number of data bytes read from the instrument. E.g. if 16 bits of data are returned then the count will be 2. The maximum number of bits that can be read is 16 in one transaction. The first bit read is returned in the least significant bit of the first 8 bits returned.

Read Holding/Input Registers (Function 03 / 04)

Reads current binary value of data at the specified word addresses.

Table 17. Read Holding/Input Registers (Modbus Function 03/04)

QUERY

Function	Address of 1st Word		Number of Words	
03 / 04	HI	LO	HI	LO

RESPONSE

Function	Number of Bytes	First Word		Last Word	
03 / 04		HI	LO	HI	LO

In the response the “Number of Bytes” indicates the number of data bytes read from the instrument. E.g. if 5 words are read, the count will be 10 (A hex). The maximum number of words that can be read is 64. If a parameter does not exist at one of the addresses read, then a value of 0000h is returned for that word.

Force Single Coil (Function 05)

Writes a single binary value to the Specified Instrument Bit address.

Table 18. Force Single Coil (Modbus Function 05)

QUERY

Function	Address of Bit		State to write	
05	HI	LO	FF/00	00

RESPONSE

Function	Address of Bit		State written	
05	HI	LO	FF/00	00

The address specifies the address of the bit to be written to. The State to write is FF when the bit is to be SET and 00 if the bit is to be RESET.

Note:
The Response normally returns the same data as the Query.

Pre-Set Single Register (Function 06)

Writes two bytes to a specified word address.

Table 19. Pre-Set Single Register (Modbus Function 06)

QUERY

Function	Address of Word		Value to write	
06	HI	LO	HI	LO

RESPONSE

Function	Address of Word		Value written	
06	HI	LO	HI	LO

Note:
The Response normally returns the same data as the Query.

Loopback Diagnostic Test (Function 08)

Table 20. Loopback Diagnostic Test (Modbus Function 08)

QUERY

Function	Diagnostic Code		Value	
08	HI =00	LO=00	HI	LO

RESPONSE

Function	Sub-function		Value	
08	HI=00	LO=00	HI	LO

Note:
The Response normally returns the same data as the Query.

Pre-Set Multiple Registers (Function 10 Hex)

Writes a consecutive word (two-byte) value to the specified address range.

Table 21. Pre-Set Multiple Registers (Modbus Function 10 Hex)

QUERY

Function	1st Word Address		Number of Words		Number of Query Bytes	First value to write	
10	HI	LO	HI	LO		HI	LO

RESPONSE

Function	1st Word Address		Number of Words	
10	HI	LO	HI	LO

Note:
The number of consecutive words that can be written is limited to 1.

Exception Responses

When a QUERY is sent that the instrument cannot interpret then an Exception RESPONSE is returned. Possible exception responses are:

Table 22. Modbus Exception Responses

Exception Code	Error Condition	Interpretation
00	Unused	None.
01	Illegal function	Function number out of range.
02	Illegal Data Address	Write functions: Parameter number out of range or not supported. (for write functions only). Read Functions: Start parameter does not exist or end parameter greater than 65536.
03	Illegal Data Value	Attempt to write invalid data / required action not executed.

The format of an exception response is:

RESPONSE

Function	Exception Code
Original Function code with its Most Significant Bit (MSB) set.	*as detailed above*

Note:
In the case of multiple exception codes for a single QUERY the Exception code returned is the one corresponding to the first parameter in error.

7.5 Communications Parameters

The Modbus parameter addresses for the E6C & E8C Controllers are detailed below. RO indicates a parameter is read only, R/W indicates it can also be written to. Communications writes will not implemented if the Communications Write Parameter is disabled. Refer to the Modbus and ASCII Communications sections of this manual for details of the protocols used.

Bit Parameters

Table 23. E6C & E8C Communications - Bit Parameters

Information

Parameter Name	Address	Access	Description	Default
Manufacturer ID	500	R/O		
Equipment ID	501	R/O	450 for ECAL base product	
Serial Number Low	502	R/O	Bits 0-15 BCD	
Serial Number Mid	503	R/O	Bits 16-31 BCD	
Serial Number High	504	R/O	Bits 32-47 BCD	
Date of manufacture	505	R/O	Encoding eg. 0403 for April 2003 is returned as 193 hex.	
Product Revision	506	R/O		
Firmware Version	507	R/O	Value from 0 to 999 for ECAL base product.	

Options

Parameter Name	Address	Access	Description		Default
Option 1 Type	600	R/O	0	None	Build Option
			1	Relay	
			3	SSR	
Option 2 Type	601	R/O	0	None	Build Option
			1	Relay	
			3	SSR	
Option 3 Type	602	R/O	0	None	Build Option
			1	Relay	
			3	SSR	
			5	Linear	
			8	RS485	

Input

Input table

Value	Range	Value	Range	Value	Range
0	B:100-1824C	18	N:0-1399C	36	0-50mV
1	B:211-3315F	19	N:32-2551F	37	10-50mV
2	C:0-2320C	20	R:0-1759C	38	0-5V
3	C:32-4208F	21	R:32-3198F	39	1-5V
4	D:0-0-2315C	22	S:0-1762C	40	0-10V
5	D:32-4199F	23	S:32-3204F	41	2-10V
6	J:-200-1200C	24	T:-240-400C		
7	J:-328-2192F	25	T:-400-752F		
8	J:-128.8-537.7C	26	T:-128.8-400.0C		
9	J:-199.9-999.9F	27	T:-199.9-752.0F		
10	K:-240-1373C	28	P24:0-1850C		
11	K:-400-2503F	29	P24:32-3362F		
12	K:-128.8-537.7C	30	PT100:-199-800C		
13	K:-199.9-999.9F	31	PT100:-328-1472F		
14	L:0-762C	32	PT100:-128.8-537.7C		
15	L:32-1403F	33	PT100:-199.9-999.9F		
16	L:0.0-537.7	34	0-20mA		
17	L:32.0-999.9F	35	4-20mA		

Input parameters

Parameter Name	Address	Access	Description		Default
Universal Input Range	1000	R/W	See input table 0.		6
Scale Range Upper Limit	1001	R/W	TC/RTD: Scale Range Lower Limit + 100 to Range Max. LINEAR: Scale Range Lower Limit to Range Max. Scale Range Upper Limit can cross Scale Range Lower Limit.		Range Max
Scale Range Lower Limit	1002	R/W	TC/RTD: Range Min. to Scale range Upper Limit – 100. LINEAR: Range Min. to Scale Range Upper Limit. Scale Range Lower Limit can cross Scale Range Upper Limit.		Range Min
Decimal point position	1003	R/W	0	xxxx	1
			1	xxx.x	
			2	xx.xx	
			3	x.xxx	
Filter time constant	1004	R/W	OFF or 0.5 to 100.0 seconds. Raw Values(0 to 200)		4 (2 sec)

Process Variable	1070	R/O			
Input status	1071	R/O	Bit 0	Sensor break	0
			Bit 1	Under Range	
			Bit 2	Over Range	
Sensor break alarm status	1072	R/O	0	Not Active	0
			1	Active	
Under Range alarm status	1073	R/O	0	Not Active	0
			1	Active	
Over Range alarm Status	1074	R/O	0	Not Active	0
			1	Active	

Outputs

Usages table

Value	Description
0	Primary Power (Supported on RLY/SSR and LIN builds.)
1	Secondary Power (Supported on RLY/SSR and LIN builds.)
2	Alarm 1 Direct (Supported on RLY and SSR builds.)
3	Alarm 1 Reverse (Supported on RLY and SSR builds.)
4	Alarm 2 Direct (Supported on RLY and SSR builds.)
5	Alarm 2 Reverse (Supported on RLY and SSR builds.)
6	Loop Alarm Direct (Supported on RLY and SSR builds.)
7	Loop Alarm Reverse (Supported on RLY and SSR builds.)
8	Alarm 1 or Alarm 2 Direct (Supported on RLY and SSR builds.)
9	Alarm 1 or Alarm 2 Reverse (Supported on RLY and SSR builds.)
10	Alarm 1 and Alarm 2 Direct (Supported on RLY and SSR builds.)
11	Alarm 1 and Alarm 2 Reverse (Supported on RLY and SSR builds.)
12	Recorder SP (Supported on LIN builds.)
13	Recorder PV (Supported on LIN builds.)
14	Alarm 1 Direct latching (Supported on RLY and SSR builds.)
15	Alarm 1 Reverse latching (Supported on RLY and SSR builds.)
16	Alarm 2 Direct latching (Supported on RLY and SSR builds.)
17	Alarm 2 Reverse latching (Supported on RLY and SSR builds.)
18	Profiler event 1 alarm (Supported on RLY and SSR builds.)
19	Profiler event 2 alarm (Supported on RLY and SSR builds.)

Output parameters

Parameter Name	Address	Access	Description		Default
Output 1 Use	1100	R/W	See Output Usages		0
Output 1 Cycle time	1101	R/W	0.1 to 512 seconds in 0.1 increments for SSR Raw Values(1 to 512) 0.5 to 512 seconds in 0.1 Increments for Relay Raw Values(5 to 512)		320 (32secs)
Output 2 Use	1120	R/W	See Output Usages		2
Output 2 Cycle time	1121	R/W	0.1 to 512 seconds in 0.1 increments for SSR Raw Values(1 to 512) 0.5 to 512 seconds in 0.1 Increments for Relay Raw Values(5 to 512)		320 (32secs)
Output 3 Use	1130	R/W	See Output Usages		4 (RLY/SSR) 14 (LIN build.)
Output 3 Cycle time	1131	R/W	0.1 to 512 seconds in 0.1 increments for SSR Raw Values(1 to 512) 0.5 to 512 seconds in 0.1 Increments for Relay Raw Values(5 to 512)		320 (32secs)
Output 3 Range	1140	R/W	0	0-5V	1
			1	0-10V	
			2	2-10V	
			3	0-20mA	
			4	4-20mA	
Output 3 RTX Max	1141	R/W	-1999 to 9999		Range Max
Output 3 RTX Min	1142	R/W	-1999 to 9999		Range min
Output Latch Power down save	1150	R/W	0	Do not save	0
			1	Save output latch status on power down	
Output latch reset.	1151	W/O	0	No reset	0
			1	Reset all outputs latched.	

Output Latching Alarm status	1170	R/O	Bit 0	Latching Alarm 1 Active	0
			Bit 1	Latching Alarm Active	
Output Latch 1 status	1171	R/O	0	Not Active	0
			1	Active	
Output Latch 2 status	1172	R/O	0	Not Active	0
			1	Active	
Output 1 status	1175	R/O	0	Output OFF	0
			1	Output ON	
Output 2 status	1178	R/O	0	Output OFF	0
			1	Output ON	
Output 3 status	1181	R/O	0	Output OFF	0
			1	Output ON	

Setpoint

Parameter Name	Address	Access	Description		Default
Setpoint 1	1200	R/W	Setpoint Lower limit to Setpoint Upper limit		Range Min
Setpoint Upper limit	1201	R/W	Current Setpoint to Scale Range Upper Limit		Range Max
Setpoint Lower limit	1202	R/W	Scale Range Lower Limit to Current Setpoint		Range Min
Setpoint Ramp Enable	1203	R/W	0	Disabled	0
			1	Enabled	
Setpoint Ramp Rate	1204	R/W	1 to 9999 units then OFF		10000 = OFF
Actual Setpoint	1270	R/O			N/A
Currently Active Setpoint	1271	R/O	1 = Setpoint 1 4 = Profiler Setpoint`		

Control

Parameter Name	Address	Access	Description		Default
Reverse/Direct Acting	1300	R/W	0	Reverse	0
			1	Direct	
Control Type	1301	R/W	0	Single	0
			1	Dual	
Primary Output Proportional Band	1302	R/W	0.5% to 999.9% of input span in default units. Defaults to 10% of range span. Raw values (0,5 to 9999)		140
Secondary Output Proportional Band	1303	R/W	0.5% to 999.9% of input span in default units. Defaults to 10% of range span. Raw Values (0,5 to 9999)		140

Integral time constant(reset)	1304	R/W	1 sec to 99 mins 59 secs and OFF Raw values (1 to 5999) and 6000 = OFF		300 Seconds
Derivative time constant(rate)	1305	R/W	0 sec to 99 mins 59 secs Raw values (0 to 5999)		75 seconds
Overlap/deadband	1306	R/W	-20 to +20 of primary and secondary proportional band		0
Manual Reset(bias)	1307	R/W	0% (-100% if dual control) to 100%		25
Primary and Secondary Output Differential	1308	R/W	0.1% to 10% of input span centred around the Setpoint. Entered in range units –defaults to 0.5% of range Raw values (1 to 100)		7
Loop Alarm Enable	1309	R/W	0	Disabled	0
			1	Enabled	
Loop Alarm Time	1310	R/W	1 sec to 99 mins. 59 secs Raw Values (1 to 5999)		5999 seconds
Primary power limit	1311	R/W	0% to 100% of full power		100%
Auto pre-tune enable	1312	R/W	0	Disabled	0
			1	Enabled	
Pre-tune enable	1313	R/W	0	Disabled	0
			1	Enabled	
Manual power enable	1315	R/W	0	Disabled	0
			1	Enabled	
Combined power	1316	R/W	0% (-100% if dual control) to 100% Write accepted when Manual power enable = enabled.		0
Primary power value	1370	R/O	0 to 100		0
Secondary power value	1371	R/O	0 to 100		
Loop Alarm status	1372	R/O	0	Not Active	0
			1	Active	
Pre-tune status	1373	R/O	0	Not active	0
			1	Active	

Alarms

Parameter Name	Address	Access	Description		Default
Alarm 1 Type	1400	R/W	0	None	1
			1	Process High	
			2	Process Low	
			3	Deviation	

			4	Band	
Alarm 1 Inhibit	1401	R/W	0	Don't inhibit	0
			1	Inhibit	
Alarm 1 Value High	1402	R/W	Scale Range Upper limit to Scale Range Lower Limit		Range Max
Alarm 1 Value Low	1402	R/W	Scale Range Upper limit to Scale Range Lower Limit		Range Min
Alarm 1 Value Deviation	1402	R/W	+-Span from Setpoint in display units.		5
Alarm 1 Value Band	1402	R/W	1 LSD to span from Setpoint in display units.		5
Alarm 1 Hysteresis	1403	R/W	1 LSD to full span in display units.		1
Alarm 2 Type	1404	R/W	0	None	2
			1	Process High	
			2	Process Low	
			3	Deviation	
			4	Band	
Alarm 2 Inhibit	1405	R/W	0	Don't inhibit	0
			1	Inhibit	
Alarm 2 Value High	1406	R/W	Scale Range Upper limit to Scale Range Lower Limit		Range Max
Alarm 2 Value Low	1406	R/W	Scale Range Upper limit to Scale Range Lower Limit		Range Min
Alarm 2 Value Deviation	1406	R/W	+-Span from Setpoint in display units.		5
Alarm 2 Value Band	1406	R/W	1 LSD to span from Setpoint in display units.		5
Alarm 2 Hysteresis	1407	R/W	1 LSD to full span in display units.		1
Alarm 1 Status	1470	R/O	0	Not Active	0
			1	Active	
Alarm 2 Status	1471	R/O	0	Not Active	0
			1	Active	

Communications

Parameter Name	Address	Access	Description		Default
Modbus address	1500	R/W	1 to 255		1
Modbus parity	1501	R/W	0	None	0
			1	Even	
			2	Odd	
Modbus baud rate	1502	R/W	0	1.2kbps	2
			1	2.4kbps	
			2	4.8kbps	
			3	9.6kbps	
			4	19.2kbps	
			5	38.4kbps	
Comms Enable	1503	R/W	0	R/O	1
			1	R/W	

User Input Calibration

Parameter Name	Address	Access	Description		Default
Calibration Type	1600	R/W	0	None	0
			1	Single offset	
			2	Two point	
Calibration Single Offset	1601	R/W	+- Span of controller		0
Calibration Dual Low Temperature	1602	R/W	Set range point to apply low offset		Range Min
Calibration Dual Low Offset	1603	R/W	+-100		0
Calibration Dual High Temperature	1604	R/W	Set range point to apply high offset		Range Min
Calibration Dual High Offset	1605	R/W	+-100		0

Universal input Calibration

Parameter Name	Address	Access	Description	Default
50mV Calibration	1700	W/O	Write CAFÉ to start calibration.	N/A
10V Calibration	1701	W/O	Write CAFÉ to start calibration.	N/A
20mA Calibration	1702	W/O	Write CAFÉ to start calibration.	N/A
RTD Calibration	1703	W/O	Write CAFÉ to start calibration.	N/A
CJC Calibration	1704	WO	Write CAFÉ to start calibration.	N/A
Calibration Status	1770	R/O	0x0000 = Calibration Fail 0xCAFE = Calibration Busy 0xFFFF = Calibration Pass	N/A

Human Interface

Parameter Name	Address	Access	Description		Default
Function Key	1800	R/W	0	None	0
			1	Manual	
			2	Profiler	
			3	Pre-tune	
Display Strategy	1801	R/W	1,2,3,4,5 or 6		1
Enable Goto Configuration	1802	R/W	0	User disable	1
			1	User enable	
Configuration lock code	1803	R/W	0 to 9999		0
Setup lock code	1804	R/W	0 to 9999		10
Tune lock code	1805	R/W	0 to 9999		0
User Calibration lock code	1806	R/W	0 to 9999		30
Profiler lock code	1807	R/W	0 to 9999		0
Diagnostics lock code	1808	R/W	0 to 9999		40

Diagnostics

Parameter Name	Address	Access	Description		Default
Actuator life warn enable	1900	R/W	0	Disabled	0
			1	Enabled	
Output 1 Count reset	1910	R/W	0	No	0
			1	Yes	
Output 1 Actuations Warning Level	1911	R/W	Number (1000's) of actuations before warning. 0 to 9999		150
Output 2 Count reset	1920	R/W	0	No	0
			1	Yes	
Output 2 Actuations Warning Level	1921	R/W	Number (1000's) of actuations before warning. 0 to 9999		150
Output 3 Count reset	1930	R/W	0	No	0
			1	Yes	
Output 3 Actuations Warning Level	1931	R/W	Number (1000's) of actuations before warning. 0 to 9999		150
Ambient Over-temperature alarm enable	1932	R/W	0	Disable	0
			1	Enable	
Output 1 Actuations Count (1000's)	1970	R/O	0 to 9999		0
Output 2 Actuations Count (1000's)	1973	R/O	0 to 9999		0
Output 3 Actuations Count (1000's)	1976	R/O	0 to 9999		0

Diagnostic alarm status	1979	R/O	Bit 0	Output 1 Warning Active	0
			Bit 1	Output 2 Warning Active	
			Bit 2	Output 3 Warning Active	
			Bit 3	Input over-temperature Warning Active	
Diagnostic Output 1 alarm warning status	1980	R/O	0	Not Active	0
			1	Active	
Diagnostic Output 2 alarm warning status	1983	R/O	0	Not Active	0
			1	Active	
Diagnostic Output 3 alarm warning status	1986	R/O	0	Not Active	0
			1	Active	
Diagnostic Input over-temperature warning status	1989	R/O	0	Not Active	0
			1	Active	

Profiler Control

Parameter Name	Address	Access	Description		Default
Profile to run	2000	R/W	0	Profile 1	0
			1	Profile 2	
Profile cycles	2001	R/W	1 to 9999 and 10000 = infinite This can also be edited when the profiler is running.		1
Profile delay	2002	R/W	to 99.59 (HH:MM) Raw Values (0 to 5999) This can also be edited when the profiler is running.		0
Profile control action	2003	R/W	0	Run	2
			1	Hold	
			2	Stop	
Profiler reset clear	2004	R/W	Write 0 to clear reset which will remove “End” from the display.		0
Profiler running	2070	R/O	0	Not running	0
			1	Running/Hold	
Profiler status	2071	R/O	0	Running	N/A
			1	Holding	
			2	Stopped	
Segment type	2072	R/O	Current segment type		N/A
Segment number	2073	R/O	Current segment number		N/A
Active SP	2074	R/O	Current profile Setpoint		N/A
Target SP	2075	R/O	Current target Setpoint		N/A

Time remaining	2076	R/O	Time remaining in the current segment		N/A
Profiler cycles remaining	2077	R/O	Current cycles remaining		N/A
Profiler delay remaining	2078	R/O	Current delay remaining		N/A
Events active	2079	R/O	Bit 0	Event 1	0
			Bit 1	Event 2	
Event 1 active	2080	R/O	0	Not Active	0
			1	Active	
Event 2 active	2081	R/O	0	Not Active	0
			1	Active	
Profile Error Status	2090	R/O	0	No Error	0
			1	Not running	
			2	Need to Clip	

Profiler segment type table

Value	Description
0	Segment type = ramp time
1	Segment type = ramp rate
2	Segment type = dwell time
3	Segment type = step time
4	Segment type = end

Profiler event type table

Value	Description
0	No events selected.
1	Event 1 selected.
2	Event 2 selected
3	Event 1 and 2 selected.

Profile configuration

Profile 1 Configuration

Parameter Name	Address	Access	Description		Default
Start point	2200	R/W	0	Start at current SP	0
			1	Start at current PV	
Recovery method	2201	R/W	0	Controller OFF	0
			1	Restart profiler	
			2	Maintain last profiler SP	
			3	Goto Controller SP	
			4	Continue profiler	
End action	2202	R/W	0	Controller OFF	0
			1	Maintain last profiler SP	
			2	Goto Controller SP	
Timebase	2203	R/W	0	Hours/Minutes	0
			1	Minutes/Seconds	
Auto hold type	2204	R/W	0	No auto hold	0
			1	Above Setpoint, hold if too high.	
			2	Below Setpoint, hold if too low.	
			3	Band, hold if too high or low.	
Auto hold valid type	2205	R/W	0	Auto hold in all segments.	1
			1	Auto hold only on dwell segments.	
Auto hold band value	2206	R/W	The distance from the Setpoint 1-99		
Segment 1 – Type	2220	R/W	See segment type table		4
Segment 1 – Target SP	2221	R/W	Scale range upper to scale range lower.		Range Min
Segment 1 – Time	2222	R/W	00.01 to 99.59 Raw Values (1 to 5999)		1
Segment 1 – Ramp rate	2223	R/W	1 to 9999 units per hour		1
Segment 1 – Events	2224	R/W	See segment events table		0
Segment 2 – Type	2230	R/W	See segment type table		4
Segment 2 – Target SP	2231	R/W	Scale range upper to scale range lower.		Range Min
Segment 2 – Time	2232	R/W	00.01 to 99.59 Raw Values (1 to 5999)		1

Segment 2 – Ramp rate	2233	R/W	1 to 9999 units per hour	1
Segment 2 – Events	2234	R/W	See segment events table	0
Segment 3 – Type	2240	R/W	See segment type table	4
Segment 3 – Target SP	2241	R/W	Scale range upper to scale range lower.	Range Min
Segment 3 – Time	2242	R/W	00.01 to 99.59 Raw Values (1 to 5999)	1
Segment 3 – Ramp rate	2243	R/W	1 to 9999 units per hour	1
Segment 3 – Events	2244	R/W	See segment events table	0
Segment 4 – Type	2250	R/W	See segment type table	4
Segment 4 – Target SP	2251	R/W	Scale range upper to scale range lower.	Range Min
Segment 4 – Time	2252	R/W	00.01 to 99.59 Raw Values (1 to 5999)	1
Segment 4 – Ramp rate	2253	R/W	1 to 9999 units per hour	1
Segment 4 – Events	2254	R/W	See segment events table	0
Segment 5 – Type	2260	R/W	See segment type table	4
Segment 5 – Target SP	2261	R/W	Scale range upper to scale range lower.	Range Min
Segment 5 – Time	2262	R/W	00.01 to 99.59 Raw Values (1 to 5999)	1
Segment 5 – Ramp rate	2263	R/W	1 to 9999 units per hour	1
Segment 5 – Events	2264	R/W	See segment events table	0
Segment 6 – Type	2270	R/W	See segment type table	4
Segment 6 – Target SP	2271	R/W	Scale range upper to scale range lower.	Range Min
Segment 6 – Time	2272	R/W	00.01 to 99.59 Raw Values (1 to 5999)	1
Segment 6 – Ramp rate	2273	R/W	1 to 9999 units per hour	1
Segment 6 – Events	2274	R/W	See segment events table	0
Segment 7 – Type	2280	R/W	See segment type table	4
Segment 7 – Target SP	2281	R/W	Scale range upper to scale range lower.	Range Min
Segment 7 – Time	2282	R/W	00.01 to 99.59 Raw Values (1 to 5999)	1
Segment 7 – Ramp rate	2283	R/W	1 to 9999 units per hour	1
Segment 7 – Events	2284	R/W	See segment events table	0

Segment 8 – Type	2290	R/W	See segment type table	4
Segment 8 – Target SP	2291	R/W	Scale range upper to scale range lower.	Range Min
Segment 8 – Time	2292	R/W	00.01 to 99.59 Raw Values (1 to 5999)	1
Segment 8 – Ramp rate	2293	R/W	1 to 9999 units per hour	1
Segment 8 – Events	2294	R/W	See segment events table	0
Segment 9 – Type	2300	R/W	See segment type table	4
Segment 9 – Target SP	2301	R/W	Scale range upper to scale range lower.	Range Min
Segment 9 – Time	2302	R/W	00.01 to 99.59 Raw Values (1 to 5999)	1
Segment 9 – Ramp rate	2303	R/W	1 to 9999 units per hour	1
Segment 9 – Events	2304	R/W	See segment events table	0
Segment 10 – Type	2310	R/W	See segment type table	4
Segment 10 – Target SP	2311	R/W	Scale range upper to scale range lower.	Range Min
Segment 10 – Time	2312	R/W	00.01 to 99.59 Raw Values (1 to 5999)	1
Segment 10 – Ramp rate	2313	R/W	1 to 9999 units per hour	1
Segment 10 – Events	2314	R/W	See segment events table	0
Segment 11 – Type	2320	R/W	See segment type table	4
Segment 11 – Target SP	2321	R/W	Scale range upper to scale range lower.	Range Min
Segment 11 – Time	2322	R/W	00.01 to 99.59 Raw Values (1 to 5999)	1
Segment 11 – Ramp rate	2323	R/W	1 to 9999 units per hour	1
Segment 11 – Events	2324	R/W	See segment events table	0
Segment 12 – Type	2330	R/W	See segment type table	4
Segment 12 – Target SP	2331	R/W	Scale range upper to scale range lower.	Range Min
Segment 12 – Time	2332	R/W	00.01 to 99.59 Raw Values (1 to 5999)	1
Segment 12 – Ramp rate	2333	R/W	1 to 9999 units per hour	1
Segment 12 – Events	2334	R/W	See segment events table	0
Segment 13 – Type	2340	R/W	See segment type table	4
Segment 13 – Target SP	2341	R/W	Scale range upper to scale range lower.	Range Min

Segment 13 – Time	2342	R/W	00.01 to 99.59 Raw Values (1 to 5999)	1
Segment 13 – Ramp rate	2343	R/W	1 to 9999 units per hour	1
Segment 13 – Events	2344	R/W	See segment events table	0
Segment 14 – Type	2350	R/W	See segment type table	4
Segment 14 – Target SP	2351	R/W	Scale range upper to scale range lower.	Range Min
Segment 14 – Time	2352	R/W	00.01 to 99.59 Raw Values (1 to 5999)	1
Segment 14 – Ramp rate	2353	R/W	1 to 9999 units per hour	1
Segment 14 – Events	2354	R/W	See segment events table	0
Segment 15 – Type	2360	R/W	See segment type table	4
Segment 15 – Target SP	2361	R/W	Scale range upper to scale range lower.	Range Min
Segment 15 – Time	2362	R/W	00.01 to 99.59 Raw Values (1 to 5999)	1
Segment 15 – Ramp rate	2363	R/W	1 to 9999 units per hour	1
Segment 15 – Events	2364	R/W	See segment events table	0
Segment 16 – Type	2370	R/W	See segment type table	4
Segment 16 – Target SP	2371	R/W	Scale range upper to scale range lower.	Range Min
Segment 16 – Time	2372	R/W	00.01 to 99.59 Raw Values (1 to 5999)	1
Segment 16 – Ramp rate	2373	R/W	1 to 9999 units per hour	1
Segment 16 – Events	2374	R/W	See segment events table	0

Profile 2 Configuration

Parameter Name	Address	Access	Description		Default
Start point	3200	R/W	0	Start at current SP	0
			1	Start at current PV	
Recovery method	3201	R/W	0	Controller OFF	0
			1	Restart profiler	
			2	Maintain last profiler SP	
			3	Got Controller SP	
			4	Continue profiler	
End action	3202	R/W	0	Controller OFF	0
			1	Maintain last profiler SP	
			2	Goto Controller SP	
Timebase	3203	R/W	0	Hours/Minutes	0
			1	Minutes/Seconds	
Auto hold type	3204	R/W	0	No auto hold	0
			1	Above Setpoint, hold if too high.	
			2	Below Setpoint, hold if too low.	
			3	Band, hold if too high or low.	
Auto hold valid type	3205	R/W	0	Auto hold in all segments.	1
			1	Auto hold only on dwell segments.	
Auto hold band value	3206	R/W	The distance from the Setpoint 1-99		
Segment 1 – Type	3220	R/W	See segment type table		4
Segment 1 – Target SP	3221	R/W	Scale range upper to scale range lower.		Range Min
Segment 1 – Time	3222	R/W	00.01 to 99.59 Raw Values (1 to 5999)		1
Segment 1 – Ramp rate	3223	R/W	1 to 9999 units per hour		1
Segment 1 – Events	3224	R/W	See segment events table		0
Segment 2 – Type	3230	R/W	See segment type table		4
Segment 2 – Target SP	3231	R/W	Scale range upper to scale range lower.		Range Min
Segment 2 – Time	3232	R/W	00.01 to 99.59 Raw Values (1 to 5999)		1
Segment 2 – Ramp rate	3233	R/W	1 to 9999 units per hour		1

Segment 2 – Events	3234	R/W	See segment events table	0
Segment 3 – Type	3240	R/W	See segment type table	4
Segment 3 – Target SP	3241	R/W	Scale range upper to scale range lower.	Range Min
Segment 3 – Time	3242	R/W	00.01 to 99.59 Raw Values (1 to 5999)	1
Segment 3 – Ramp rate	3243	R/W	1 to 9999 units per hour	1
Segment 3 – Events	3244	R/W	See segment events table	0
Segment 4 – Type	3250	R/W	See segment type table	4
Segment 4 – Target SP	3251	R/W	Scale range upper to scale range lower.	Range Min
Segment 4 – Time	3252	R/W	00.01 to 99.59 Raw Values (1 to 5999)	1
Segment 4 – Ramp rate	3253	R/W	1 to 9999 units per hour	1
Segment 4 – Events	3254	R/W	See segment events table	0
Segment 5 – Type	3260	R/W	See segment type table	4
Segment 5 – Target SP	3261	R/W	Scale range upper to scale range lower.	Range Min
Segment 5 – Time	3262	R/W	00.01 to 99.59 Raw Values (1 to 5999)	1
Segment 5 – Ramp rate	3263	R/W	1 to 9999 units per hour	1
Segment 5 – Events	3264	R/W	See segment events table	0
Segment 6 – Type	3270	R/W	See segment type table	4
Segment 6 – Target SP	3271	R/W	Scale range upper to scale range lower.	Range Min
Segment 6 – Time	3272	R/W	00.01 to 99.59 Raw Values (1 to 5999)	1
Segment 6 – Ramp rate	3273	R/W	1 to 9999 units per hour	1
Segment 6 – Events	3274	R/W	See segment events table	0
Segment 7 – Type	3280	R/W	See segment type table	4
Segment 7 – Target SP	3281	R/W	Scale range upper to scale range lower.	Range Min
Segment 7 – Time	3282	R/W	00.01 to 99.59 Raw Values (1 to 5999)	1
Segment 7 – Ramp rate	3283	R/W	1 to 9999 units per hour	1
Segment 7 – Events	3284	R/W	See segment events table	0
Segment 8 – Type	3290	R/W	See segment type table	4
Segment 8 – Target SP	3291	R/W	Scale range upper to scale	Range Min

			range lower.	
Segment 8 – Ramp time	3292	R/W	00.01 to 99.59 Raw Values (1 to 5999)	1
Segment 8 – Ramp rate	3293	R/W	1 to 9999 units per hour	1
Segment 8 – Events	3294	R/W	See segment events table	0
Segment 9 – Type	3300	R/W	See segment type table	4
Segment 9 – Target SP	3301	R/W	Scale range upper to scale range lower.	Range Min
Segment 9 – Time	3302	R/W	00.01 to 99.59 Raw Values (1 to 5999)	1
Segment 9 – Ramp rate	3303	R/W	1 to 9999 units per hour	1
Segment 9 – Events	3304	R/W	See segment events table	0
Segment 10 – Type	3310	R/W	See segment type table	4
Segment 10 – Target SP	3311	R/W	Scale range upper to scale range lower.	Range Min
Segment 10 – Time	3312	R/W	00.01 to 99.59 Raw Values (1 to 5999)	1
Segment 10 – Ramp rate	3313	R/W	1 to 9999 units per hour	1
Segment 10 – Events	3314	R/W	See segment events table	0
Segment 11 – Type	3320	R/W	See segment type table	4
Segment 11 – Target SP	3321	R/W	Scale range upper to scale range lower.	Range Min
Segment 11 – Time	3322	R/W	00.01 to 99.59 Raw Values (1 to 5999)	1
Segment 11 – Ramp rate	3323	R/W	1 to 9999 units per hour	1
Segment 11 – Events	3324	R/W	See segment events table	0
Segment 12 – Type	3330	R/W	See segment type table	4
Segment 12 – Target SP	3331	R/W	Scale range upper to scale range lower.	Range Min
Segment 12 – Time	3332	R/W	00.01 to 99.59 Raw Values (1 to 5999)	1
Segment 12 – Ramp rate	3333	R/W	1 to 9999 units per hour	1
Segment 12 – Events	3334	R/W	See segment events table	0
Segment 13 – Type	3340	R/W	See segment type table	4
Segment 13 – Target SP	3341	R/W	Scale range upper to scale range lower.	Range Min
Segment 13 – Time	3342	R/W	00.01 to 99.59 Raw Values (1 to 5999)	1

Segment 13 – Ramp rate	3343	R/W	1 to 9999 units per hour	1
Segment 13 – Events	3344	R/W	See segment events table	0
Segment 14 – Type	3350	R/W	See segment type table	0
Segment 14 – Target SP	3351	R/W	Scale range upper to scale range lower.	Range Min
Segment 14 – Time	3352	R/W	00.01 to 99.59 Raw Values (1 to 5999)	1
Segment 14 – Ramp rate	3353	R/W	1 to 9999 units per hour	1
Segment 14 – Events	3354	R/W	See segment events table	0
Segment 15 – Type	3360	R/W	See segment type table	4
Segment 15 – Target SP	3361	R/W	Scale range upper to scale range lower.	Range Min
Segment 15 – Time	3362	R/W	00.01 to 99.59 Raw Values (1 to 5999)	1
Segment 15 – Ramp rate	3363	R/W	1 to 9999 units per hour	1
Segment 15 – Events	3364	R/W	See segment events table	0
Segment 16 – Type	3370	R/W	See segment type table	4
Segment 16 – Target SP	3371	R/W	Scale range upper to scale range lower.	Range Min
Segment 16 – Time	3372	R/W	00.01 to 99.59 Raw Values (1 to 5999)	1
Segment 16 – Ramp rate	3373	R/W	1 to 9999 units per hour	1
Segment 16 – Events	3374	R/W	See segment events table 0	0

Note:

Some of the parameters that do not apply for a particular configuration will accept reads and writes (e.g. attempting to scale a Linear output which has not been fitted). Read only parameters will return an exception if an attempt is made to write values to them.

8 Manually Tuning Controllers

8.1 Single Control Tuning (PID with Primary Output only)

This simple technique balances the need to reach Setpoint quickly, with the wish to limit Setpoint overshoot at start-up or during process changes. It determines values for the Primary Proportional Band (Pb_P), Integral Time Constant (Ar_St) and Derivative Time Constant (rAtE) that allow the PID control algorithm to give acceptable results in most applications that use a single control device.

CAUTION:

This technique is suitable only for processes that are not harmed by large fluctuations in the process variable.

5. Check that the Setpoint Upper Limit (SPuL) and Setpoint Lower Limit (SPLL) are set to safe levels for your process. Adjust if required.

6. Set the Setpoint to the normal operating value for the process (or to a lower value if overshoots beyond this value might cause damage).

7. Select On-Off control (i.e. set Pb_P = 0).

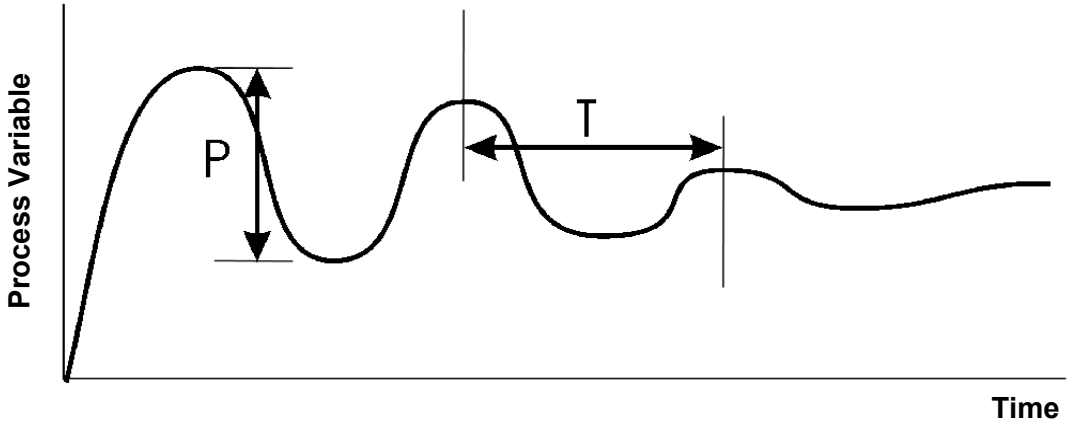
8. Switch on the process. The process variable will oscillate about the Setpoint. Record the Peak-to-Peak variation (**P**) of the first cycle (i.e. the difference between the highest value of the first overshoot and the lowest value of the first undershoot), and the time period of the oscillation (**T**) in minutes. See the example diagram below - Manually Tuning PID.

9. Calculate the PID control parameters using the formula below. Input Span is the difference between Scale Range Lower Limit and Scale Range Upper Limit:

$$Pb\_P = \frac{P}{\text{Input Span}} \times 100$$

Ar_St = T minutes

$$rAtE = \frac{T}{6} \text{ minutes}$$



8.2 Manually Tuning PID

Dual Control Tuning (PID with Primary and Secondary Outputs)

This simple tuning technique balances the need to reach Setpoint quickly, with the wish to limit Setpoint overshoot at start-up and during process changes. It determines values for the Primary Proportional Band (Pb_P), Secondary Proportional Band (Pb_S), Integral Time Constant (ArSt) and Derivative Time Constant (rAtE) that allow the PID control algorithm to give acceptable results in most applications that use dual control (e.g. Heat & Cool).

CAUTION:

This technique is suitable only for processes that are not harmed by large fluctuations in the process variable.

10. Tune the controller using only the Primary Control output as described in the Single Control Tuning section above.

11. Set Pb_S to the same value as Pb_P and monitor the operation of the controller in dual control mode. If there is a tendency to oscillate as the control passes into the Secondary Proportional Band, increase the value of Pb_S. If the process appears to be over-damped in the region of the Secondary Proportional Band, decrease the value of Pb_S.

12. When the PID tuning values have been determined, if there is a kick to the process variable as control passes from one output to the other, set the Overlap/Deadband parameter to a positive value to introduce some overlap. Adjust this value by trial and error until satisfactory results are obtained.

8.3 Manually Fine Tuning

A separate cycle time adjustment parameter is provided for each time proportioning control output.

Note:
Adjusting the cycle time affects the controllers operation; a shorter cycle time gives more accurate control but electromechanical components such as relays have a reduced life span.

13. Increase the width of the proportional band if the process overshoots or oscillates excessively.

14. Decrease the width of the proportional band if the process responds slowly or fails to reach Setpoint.

15. Increase the automatic reset until the process becomes unstable, then decrease until stability has been restored.

Note:
Allow enough time for the controller and process to adjust.

16. Initially add rate at a value between 1/4th and 1/10th of the automatic reset value.

17. Decrease Rate if the process overshoots/undershoots or oscillates excessively.

Note:
When controlling a modulating valve, it is recommended that Rate (Derivative) is set to 0 seconds (OFF) to avoid excessive valve activity.
Rate can cause process instability.

18. After making all other adjustments, if an offset exists between the Setpoint and the process variable use the Bias (manual reset) to eliminate the error:
Below Setpoint - use a larger bias value
Above Setpoint - use a smaller bias value.

9 Calibration Mode

The controller is designed to be integrated as part of a larger system comprising of individual process equipment and their associated sensors. When used as part of a system, the controller may receive sensor data errors due to tolerences. This combined with any inherent inaccuracies generated by the controller may prevent the desired setpoints being reached and maintained.

In these circumstances, it is possible to calibrate the controller to compensate for these errors. This is achieved using the calibration mode.

The calibration mode allows an offset to be applied in one of two ways. The method used will be dependent on the process application.

9.1 Single point calibration (PV Offset)

This method of calibration is particularly applicable to applications with a static Setpoint where it is essential to maintain a value consistently through the process.

It involves comparing the known value of a calibrated source with an actual sensor reading at a specific value (normally the required process Setpoint). The difference can then be calculated and applied as an offset. Once entered into the controller, the offset is applied globally to all readings over the full span of the controller.

Example:

Calibrated Reading:	210 units
Controller Reading:	212 Units
Error:	2 Units

In this example, an offset of 2 units would be added to any sensor reading received by the controller.

9.2 2 point calibration (High and Low PV Offset)

This method of calibration should be utilised when controlling a dynamic process i.e. the Setpoint changes multiple times over its duration.

It involves comparing the known value of a calibrated source with controller readings at two specific values. These values are normally the high and low limits of a specific process. The differences for the high and low values are entered into the controller as offsets and are used to calculate how much each reading should rescaled.

Example:

Calibrated Reading (High):	200 Units
Controller Reading (High):	212 Units
Calibrated Reading (Low):	100 Units
Controller Reading (Low):	101 Units
Difference (High):	12 units
Difference (Low):	1 unit

In this example, a dynamic offset between 1 and 12 units would be applied to the reading depending on its relative position along the controller span.

9.3 Entry into the User Calibration Mode

Hold down  and press  to enter the Select Mode.

Press  or  to navigate to the User Calibration Mode option, then press  .

9.4 Scrolling through Parameters and Values

Press  to scroll through the parameters (refer to the table below) and their values.

9.5 Changing Parameter Values

Press  to select the required parameter, then press  or  to set the value as required.

Once the displayed value is changed the effect is immediate. No confirmation of the change is required.

Note:
If there is no key activity for 2 minutes the instrument returns to the operator mode.

Table 24. E6C & E8C User Calibration Mode Parameters.

Parameter	Lower Display	Upper Display Adjustment Range & Description		Default Value
User Calibration Type	CALt	nonE	No user adjustment	nonE
		SnGL	Single (PV offset)	
		duAL	Dual (High and low PV offset)	
Process Variable Offset	OFFS	+/- Span of controller		0
Low Calibration Point	L .CAL	Set range point to apply Low offset		R/min
Low Offset	L .OFF	+/- Span of controller		0
High Calibration Point	H .CAL	Set range point to apply High offset		R/min
High Offset	H .OFF	+/- Span of controller		0
User Calibration Lock Code	U .loc	0 to 9999		30

10 Appendix 1 – Glossary

This Glossary explains the technical terms and parameters used in this manual. The entry type is also shown:

Definition: Terms normally applicable all models.

Parameter: Parameters applicable to Controller models only.

Active Setpoint Type: *Definition*

The Active Setpoint is the Setpoint used as the current target Setpoint Value. Some controllers can have more than one Setpoint (e.g. Setpoint 1 and 2 or Local and Remote Setpoints), but only one of these is active at any time.
Also refer to Actual Setpoint, Remote Setpoint, Setpoint, Setpoint Select and Setpoint Select Enable.

Actual Setpoint Type: *Definition*

Actual Setpoint is the current value of the Setpoint. This may be different to the Active Setpoint's target value if the Setpoint is currently ramping. The actual Setpoint will rise or fall at the ramp-rate set, until it reaches the target Setpoint value.
Also refer to Active Setpoint, Setpoint, Setpoint Ramp Enable and Setpoint Select.

Actuator Life Warning Enable Type: *Parameter*

Enables or disables the Actuator Life Warning. When enabled, the Actuator Warning Level Output 1, Actuator Warning Level Output 2 and Actuator Warning Level Output 3 features are enabled.
Display code = ACtE, default setting = d iSA.
Also refer to Actuator Warning Level Output 1, Actuator Warning Level Output 2, Actuator Warning Level Output 3.

Ambient Over-Temperature Alarm Enable Type: *Parameter*

Enables or disables the Ambient Over-Temperature Alarm.

The Ambient Over-Temperature sensor constantly monitors the ambient environmental temperature relative to the Controller. If the ambient temperature exceeds the predefined limits, control errors may occur due to the sensitive electronics used within the Controller. The Ambient Over-Temperature Alarm protects against this by warning the Operator.
Display code = OtEn, default setting = d iSA.

Actuator Warning Level Output 1 Type: *Parameter*

This parameter defines the number of output 1 actuations (1000's) that must occur before a warning is displayed in the Upper Display of the Controller.
Display code = OP 1A, default setting = 150.
Also refer to Actuator Life Warning Enable, Output 1 Actuations.

Actuator Warning Level Output 2 Type: *Parameter*

This parameter defines the number of output 2 actuations (1000's) that must occur before a warning is displayed in the Upper Display of the Controller.
Display code = OP2A, default setting = 150.
Also refer to Actuator Life Warning Enable, Output 2 Actuations.

Actuator Warning Level Output 3 Type: *Parameter*

This parameter defines the number of output 3 actuations (1000's) that must occur before a warning is displayed in the Upper Display of the Controller.
Display code = OP3A, default setting = 150.
Also refer to Actuator Life Warning Enable, Output 3 Actuations.

Alarm Hysteresis Type: *Parameter*

An adjustable band on the “safe” side of an alarm point, through which the process variable must pass before the alarm will change state, as shown in the diagram below. E.g. a high alarm’s hysteresis band is below the high alarm value, and a low alarm’s hysteresis is above the low alarm value.
Also refer to *Alarm Operation*.

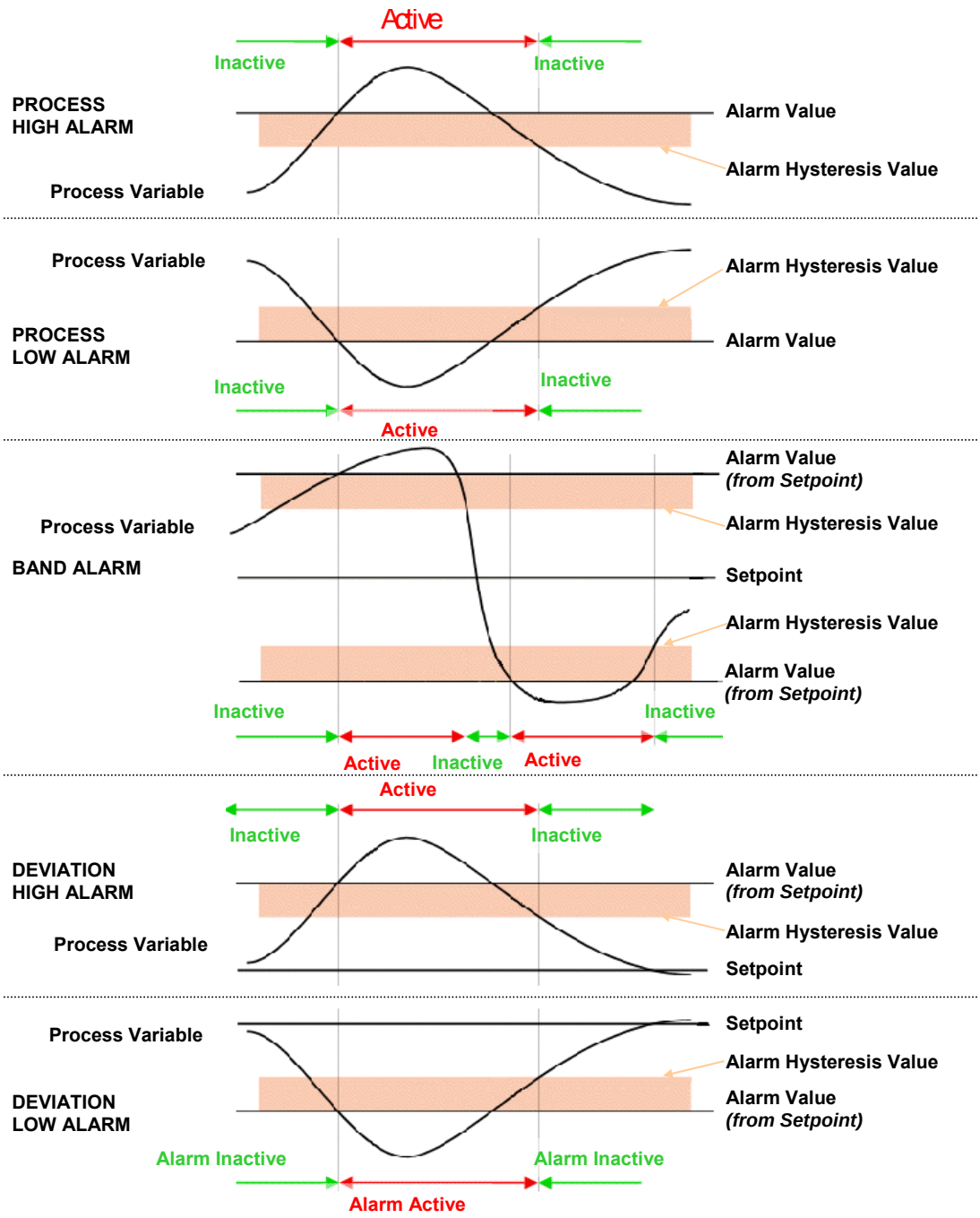


Figure 25. Alarm Hysteresis Operation

Alarm Operation

Type: *Definition*

The different alarm types are shown below, together with the action of any outputs. Also refer to *Alarm Hysteresis*, *Alarm Inhibit*, *Band Alarm*, *Deviation Alarm*, *Latching Relay*, *Logical Alarm Combinations*, *Loop Alarm*, *Process High Alarm* and *Process Low Alarm*.

Figure 26. Alarm Operation

Alarm Inhibit Type: *Parameter*

Inhibits an alarm at power-up or when the controller Setpoint is switched, until that alarm goes inactive. The alarm operates normally from that point onwards.
Also refer to Alarm Operation.

Annunciator Type: *Definition*

A special type of alarm output that is linked to a Limit Controllers main Limit Output. An Annunciator output will activate when an Exceed condition occurs, and will remain active until a reset instruction is received, or the Exceed condition has passed. Unlike the Limit Output, an Annunciator can be reset even if the Exceed condition is present
Also refer to Exceed Condition, Latching Relay, Limit Controller, Limit Hysteresis and Limit Setpoint

Automatic Reset (Integral) Type: *Parameter*

Used to automatically bias the proportional output(s) to compensate for process load variations. It is adjustable in the range 1 seconds to 99 minutes 59 seconds per repeat and OFF (value greater than 99 minutes 59 seconds - display shows OFF). Decreasing the time increases the Integral action. This parameter is not available if the primary output is set to On-Off.

Display code = ArSt, default value = five minutes and zero seconds (5.00).
Also refer to Primary Proportional Band, Secondary Proportional Band, Rate, PID, and Tuning.

Auto Pre-Tune Type: *Parameter*

Determines whether the Auto Pre-Tune feature is activated on power up (d iSA = disabled, EnAb = enabled). Auto Pre-Tune is useful when the process to be controlled varies significantly each time it is run. Auto Pre-Tune ensures that tuning occurs at the start of the process. Self-Tune may also be engaged to fine tune the controller.

Display code = APt, default setting = d iSA.
Also refer to Pre-Tune, Self-Tune and Tuning.

Auxiliary Input Type: *Definition*

A secondary linear input option. It can be used as a Remote Setpoint input or for Valve Position Indication. Signals can be mA, mV, VDC or Potentiometer.
Also refer to Remote Setpoint, and Valve Position Indication.

Band Alarm 1 Value Type: *Parameter*

This parameter is applicable only if Alarm 1 is selected to be a Band Alarm. It defines a band of process variable values, centred on the current actual Setpoint value. If the process variable value is outside this band, the alarm will be active. This parameter may be adjusted from 1 to full span from the Setpoint.

Display code = bAL 1, default value = 5.
Also refer to Alarm Operation, Band Alarm 2 Value and Input Span.

Band Alarm 2 Value Type: *Parameter*

This parameter, is similar to the Band Alarm 1 Value. It is applicable only if Alarm 2 is selected to be a Band Alarm.

Display code = bAL2, default value = 5.
Also refer to Alarm Operation, Band Alarm 1 Value and Input Span.

Bias (Manual Reset) Type: *Parameter*

Used to manually bias the proportional output(s) to compensate for process load variations. Bias is expressed as a percentage of output power and is adjustable in the range 0% to 100% (for Primary Output alone) or -100% to +100% (for both Primary and Secondary Outputs). This parameter is not applicable if the Primary output is set to ON/OFF control mode. If the process settles below Setpoint use a higher Bias value to remove the error, if the process variable settles above the Setpoint use a lower Bias value. Lower Bias values will also help to reduce overshoot at process start up.

Display code = b iAS, default value = 25%.

Also refer to ON/OFF Control and PID.

Bumpless Transfer Type: *Definition*

A method used prevent sudden changes to the output power level when switching between Automatic and Manual control modes. During a transition from Automatic to Manual, the initial Manual Power value will be set to equal the previous automatic mode value. The operator can then adjust the value as required. During a transition from Manual to Automatic, the initial Automatic Power value will be set to equal the previous manual mode value. The correct power level will gradually applied by the control algorithm at a rate dependant on the integral action resulting from the Automatic Reset time. Since integral action is essential to Bumpless Transfer, this feature is not available if Automatic Reset is turned off.

Also refer to Automatic Rest and Manual Mode

Calibration - 2 Point (High/Low PV Offset) Type: *Definition*

Two point calibration uses two separate points of reference, usually at the process high and low operating limits to determine the required offsets. These offsets are used to rescale all readings over the full range of the controller minimising the likelyhood of errors at any chosen setpoint.

Also refer to User Calibration Type.

Calibration - Single Point (PV Offset) Type: *Definition*

Single point calibration uses a single point of reference, usually at the operating process value to determine the required calibration offset. This offset is then applied to all measurements throughout the span of the controller.

Also refer to User Calibration Type.

Communications Write Enable Type: *Definition*

Enables/disables the changing of parameter values via the RS485 communications link, if the communications option is installed. Possible settings are read only or read/write.
Display code = CoEn, default setting = r_ Ud (read/write).

Control Type Type: *Parameter*

Defines if a controller has one or two control outputs. Single outputs can drive the PV in one direction only (e.g. heat only, cool only, increase humidity etc). Dual outputs can force the PV to increase or decrease (e.g heat & cool, humidify and dehumidify etc). Dual control is not possible on Valve Motor Drive controllers
Display codes = SnGL and duAL, default value = SnGL.
Also refer to PID, Primary Proportional Band, Process Variable, Secondary Proportional Band and Valve Motor Control.

Controller Type: *Definition*

An instrument that can control a Process Variable, using either PID or On-Off control methods. Alarm outputs are also available that will activate at preset PV values, as are other options such as PV retransmission and Serial Communications.
Also refer to Alarm Operation, Indicator, Limit Controller, On-Off Control, PID, Process Variable, Retransmit Output and Serial Communications.

CPU Type: *Definition*

This stands for Central Processing Unit and refers to the onboard microprocessor that controls all of the measuring, alarm and control functions of the instrument.

Current Proportioning Control Type: *Definition*

Current proportioning control can be implemented on units configured with linear current or voltage output(s). It provides a 4 to 20mA, 0-20mA, 0 to 5V, 0 to 10V or 2 - 10V DC PID output. On-Off control should not be used with Current proportioning control.
Also refer to On-Off Control, PID, Primary Proportional Band, Rate, Secondary Proportional Band and Time Proportional Control.

Cycle Time Type: *Definition*

For time proportioning outputs, it is used to define time period over which the average on vs. off time is equal to the required PID output level. Ct 1, Ct2 and Ct3 are available when options 1, 2 or 3 are defined as time proportioning output types. The permitted range of value is 0.5, 1, 2, 4, 8, 16, 32, 64, 128, 256 or 512 seconds. Shorter cycle times will give better control, but at the expense of reduce life when used with an electromechanical control device (e.g. relays or solenoid valves).
Display codes = Ct 1, Ct2 and Ct3, default value = 32.
Also refer to PID and Time Proportioning.

Deadband Type: *Parameter*

- Refer to *Overlap/Deadband*.

Derivative Type: *Parameter*

Refer to *Rate*.

Deviation Alarm 1 Value Type Type: *Parameter*

This is applicable only if Alarm 1 is selected to be Deviation Alarm. A positive value (Deviation High) sets the alarm point above the current actual Setpoint, a negative value (Deviation Low) sets it below. If the process variable deviates from the Setpoint by a margin greater than this value, alarm 1 becomes active.

Display code = dAL 1, Default value = 5.

Also refer to Alarm Operation and Deviation Alarm 2 Value.

Deviation Alarm 2 Value Type: *Parameter*

Applicable only if Alarm 2 is selected as a Deviation Alarm. It is similar to Deviation Alarm 1 Value.

Display code = dAL2. Default value = 5.

Also refer to Alarm Operation and Deviation Alarm 1 Value.

Differential (On-Off Hysteresis) Type: *Parameter*

A switching differential used when one or both control outputs have been set to On-Off. This parameter is adjustable within the range 0.1% to 10.0% of input span; the default value is 0.5%. The differential band is centred about the Setpoint.

Relay chatter can be eliminated by proper adjustment of this parameter. Too large a value for this parameter will increase amplitude of oscillation in this process variable.

Display code = d iFP for primary only differential, d iFS for secondary only differential & d iFF for primary and secondary differential.

Also refer to Input Span and On-Off Control.

Direct/Reverse Action of Control Outputs Type: *Definition*

Direct action is typically used with cooling applications; On-Off direct outputs will turn on when the process variable exceeds Setpoint. Proportional direct outputs will increase the percentage of output as the process value increases within the proportional band.

Reverse action is typically used with heating applications; On-Off reverse outputs will turn off when the process variable exceeds Setpoint. Proportional reverse outputs will decrease the percentage of output as the process value increases within the proportional band. The Secondary Output will be direct whenever the Primary Output is selected as reverse. The Secondary Output will be reverse whenever the Primary Output is selected as direct.

Also refer to Control Type, On-Off Control, PID, Primary Proportional Band and Secondary Proportional Band

Display Strategy **Type: Parameter**

Alters the parameters displayed in normal operator mode. For example a controller could display PV + SP, PV + adjustable SP, PV + Ramping SP, PV only or SP only. Display strategy 6 will allow read only access to the Setpoint values in Operator Mode, Setup Mode must then be entered to change the Setpoint.

Display code = d iSP

Also refer to Process Variable, Setpoint and Setpoint Ramping.

Elapsed Time Type: *Indicator Definition*

The total accumulated time that Alarm 1 has been active on an Indicator since this parameter was last reset. This does not include the time when the alarm condition has cleared. The Elapsed Time is not affected by the Alarm 2 and Alarm 3 status.

Also refer to Alarm Operation, Exceed Time and Indicator.

Exceed Condition Type: *Definition*

A state that occurs when the Process Variable exceeds the Limit Setpoint value. E.g. if the PV is above the Limit SP when set for high limit action, or below the Limit SP for low limit action. The Limit Controller will shut down the process when this condition occurs, and cannot be reset until the Exceed Condition has passed.

Also refer to Annunciator, Exceed Time, Latching Relay, Limit Controller, Limit Hysteresis and Limit Setpoint.

Exceed Time Type: *Definition*

The total accumulated time that a Limit Controller has been in the Exceed Condition since this parameter was last reset.

Also refer to *Elapsed Time*, *Exceed Condition* and *Limit Controller*.

High Calibration Point Type: *Parameter*

This parameter is used to define the high calibration point when the two point calibration method is used to calibrate the controller.

Display code = H .CAL, default setting = N/A.

Also refer to Two Point Calibration, High Offset.

High Offset Type: *Parameter*

This parameter is used to define the high point offset value when the two point calibration method is used to calibrate the controller. This value is applied to the high calibration point.

Display code = H .OFF, default setting = 0.

Also refer to Two Point Calibration, High Calibration Point.

Indicator Type: *Definition*

An instrument that can display a Process Variable. Alarm outputs are available that will activate at preset PV values. Relay outputs can be selected to have a Latching function similar to a Limit Controller output, but indicators do not have the necessary approvals for safety critical applications. Other options are PV retransmission and Serial Communications. Process control functions are not available.

Also refer to Alarm Operation, Controller, Elapsed Time, Latching Relay, Limit Controller, Multi-Point Scaling, Process Variable, Retransmit Output, Serial Communications, Tare.

Input Filter Time Constant Type: *Parameter*

This parameter is used to filter out extraneous impulses on the process variable. The filtered PV is used for all PV-dependent functions (display control, alarm etc). The time constant is adjustable from 0.0 seconds (off) to 100.0 seconds in 0.5 second increments. Display code = F iLt, Default value = 2.0 seconds.
Also refer to Process Variable.

Input Range Type: *Definition*

This is the overall process variable input range and type as selected by the InPt parameter in Configuration Mode.
Also refer to Input Span.

Input Span Type: *Definition*

The measuring limits, as defined by the Scale Range Lower and Scale Range Upper Limits. The trimmed span value is also used as the basis for calculations that relate to the span of the instrument (E.g. controller proportional bands)
Also refer to Input Range, Scale Range Lower Limit and Scale Range Upper Limit.

Integral Type: *Parameter*

Refer to *Automatic Reset*.

Latching Relay Type: *Definition*

A type of relay that, once it becomes active, requires a reset signal before it will deactivate. This output is available on Limit controllers and indicator alarms. To successfully deactivate a latched relay, the alarm or limit condition that caused the relay to become active must first be removed, then a reset signal can be applied. This signal may be applied from the instrument keypad, Digital Input or command via Serial Communication.
Also refer to Alarm Operation, Indicator, Limit Controller, Limit Hysteresis, Serial Communications.

LED Type: *Definition*

Light Emitting Diode. LED's are used as indicator lights (e.g. for the alarm indication). The upper and lower 7-segment displays are also LED's.

Limit Controller Type: *Definition*

A protective device that will shut down a process at a preset Exceed Condition, in order to prevent possible damage to equipment or products. A fail-safe latching relay is used, which cannot be reset by the operator until the process is back in a safe condition. This signal may be applied from the instrument keypad, Digital Input or command via Serial Communication. Limit controllers work independently of the normal process controller. Limit Controllers have specific approvals for safety critical applications. They are recommended for any process that could potentially become hazardous under fault conditions.
Also refer to Annunciator, Controller, Exceed Condition, Exceed Time, Latching Relay, Limit Hysteresis, Limit Setpoint and Serial Communications.

Limit Hysteresis Type: *Definition*

An adjustable band on the “safe” side of the Limit Setpoint. For a high limit, the hysteresis band is below the limit Setpoint value, for a low limit, the hysteresis is above the limit Setpoint value. The latching limit relay cannot be reset by the operator until the process has passed through this band

Also refer to Exceed Condition, Latching Relay, Limit Controller and Limit Setpoint.

Lock Codes Type: *Parameter*

Defines the four-digit codes required to enter Operator (10), Configuration (20), User Calibration (30), Auto Tuning (0), Profile Configuration (0) and Diagnostics (40) modes. Display codes = SLoc, C loc, ULoc, tLoc, P loc and dLoc, default values shown above in brackets.

Logical Combination of Alarms **Type: Definition**

Two alarms may be combined logically to create an AND/OR situation. Any suitable output may be assigned as a Logical Alarm Output, configured for Reverse-acting or Direct action.

Also refer to Alarm Operation

Table 25. Logical Alarm Outputs

Logical OR: Alarm 1 OR Alarm 2											
Direct Acting						Reverse-Acting					
ALARM 1	ALARM 2	OUTPUT				ALARM 1	ALARM 2	OUTPUT			
OFF	OFF	OFF				OFF	OFF	ON			
ON	OFF	ON				ON	OFF	OFF			
OFF	ON	ON				OFF	ON	OFF			
ON	ON	ON				ON	ON	OFF			

Logical AND: Alarm 1 AND Alarm 2											
Direct Acting						Reverse-Acting					
ALARM 1	ALARM 2	OUTPUT				ALARM 1	ALARM 2	OUTPUT			
OFF	OFF	OFF				OFF	OFF	ON			
ON	OFF	OFF				ON	OFF	ON			
OFF	ON	OFF				OFF	ON	ON			
ON	ON	ON				ON	ON	OFF			

Loop Alarm Enable Type: *Parameter*

Enables or disables a loop alarm. A 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 can be tied to any suitable output. When enabled, the loop alarm repeatedly checks if the control output(s) are at the maximum or minimum limit. If an output is at the limit, an internal timer is started: thereafter, if the high output has not caused the process variable to be corrected by a predetermined amount 'V' after time 'T' has elapsed, the loop alarm becomes active. Subsequently, the loop alarm mode repeatedly checks the process variable and the control output(s). When the process variable starts to change value in the correct sense or when the output is no longer at the limit, the loop alarm is deactivated.

For PID control, the loop alarm time 'T' is always twice the Automatic Reset parameter value. For On-Off control, a user defined value for the Loop Alarm Time parameter is used.

The value of 'V' is dependent upon the input type. For Temperature inputs, V = 2°C or 3°F. For Linear inputs, V = 10 least significant display units

Control output limits are 0% for Single output (Primary only) controllers and -100% for Dual output (Primary and Secondary) controllers.

Correct operation of the loop alarm depends upon reasonably accurate PID tuning. 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.

Display code = LAEn, default value = d iSA,

Also refer to Loop Alarm Time, Manual Mode, On-Off Control, Pre-Tune, and Process Variable.

Loop Alarm Time Type: *Parameter*

When On-Off control is selected and loop alarm is enabled, this parameter determines the duration of the limit condition after which the loop alarm will be activated. It may be adjusted within the range of 1 second to 99 minutes 59 seconds. This parameter is omitted from the Set-up mode display sequence if On-Off control is not selected or loop alarm is disabled.

Display code = LAt i, Default setting is 99:59.

Also refer to Loop Alarm Enable.

Low Calibration Point Type: *Parameter*

This parameter is used to define the low calibration point when the two point calibration method is used to calibrate the controller.

Display code = L .CAL, default setting = N/A.

Also refer to Two Point Calibration, Low Offset.

Low Offset Type: *Parameter*

This parameter is used to define the low point offset value when the two point calibration method is used to calibrate the controller. This value is applied to the low calibration point.

Display code = L .OFF, default setting = 0.

Also refer to Two Point Calibration, Low Calibration Point.

mADC Type: Definition

This stands for milliamp DC. It is used in reference to the DC milliamp input ranges and the linear DC milliamp outputs. Typically, these will be 0 to 20mA or 4 to 20mA.

Manual Mode Type: *Definition*

If Manual Mode is enabled in Set-Up mode, pressing the **F** key in operator mode, or MAN selected (Auto for normal control) as CntL setting in setup mode will cause a controller to enter or leave manual control mode. Switching between automatic and manual modes is achieved using bumpless transfer.

Mode operates as follows:
The upper display shows the current process value, and the lower display shows the output power in the form - P*xxx* (where *xxx* is equal to the percentage output power). This value may be adjusted using the **UP** or **DOWN** keys to increase/decrease the power output. The value can be varied between 0% to 100% for controllers using primary control only, and -100% to +100% for controllers using primary and secondary control (e.g. full heat power to full cool power).

Manual Mode should be used with care because the power output level is set by the operator, therefore the PID algorithm is no longer in control of the process. The operator MUST maintain the process as the desired level manually. Manual power is not limited by the Primary Power Output Limit.
Also refer to Bumpless Transfer, Manual Mode Enable, PID, and *Primary Output Power Limit.*

Manual Mode Enable Type: *Parameter*

Determines whether operator selection and de-selection of manual control is enabled. If the mode is enabled in Set-Up mode, pressing the **F** key in Operator Mode will normally activate or deactivate manual control mode. However, disabling PoEn in whilst manual control mode is active will lock the controller into Manual Mode and pressing the Auto/Man key will no longer cause a return to PID (automatic) control. To exit from Manual Mode, PoEn must temporarily be re-enabled to allow PID control to be re-established. PoEn can then be safely disabled.
It is possible to use a controller as a permanent “Manual Station” by disabling PoEn to deliberately lock it into Manual Mode.

Manual mode can also be selected by changing CntL from Auto to MAN in setup mode, PID control can be resumed by returning to the Auto setting .

Display code = PoEn, default setting = d iSA .
Also refer to *Manual Mode* and *PID*

Master & Slave Type: *Definition*

The terms master & slave are used to describe the controllers in applications where one instrument controls the Setpoint of another. The master controller can transmit the Setpoint to the slave using an analogue DC linear signal. The slave controller must have a matching a remote Setpoint input. Some Profile Controllers can transmit their Setpoint via serial communications serial communications. For this method, the Profiler must be able to act as a communications master device and the slave must have a compatible communications option fitted.

Also refer to Cascade Control, Retransmit Output, Remote Setpoint, Serial Communications, Setpoint

Offset Type: *Parameter*

Offset is used to modify the measured process variable value and is adjustable in the range ±input span. Use this parameter to compensate for errors in the displayed process variable. Positive values are added to the process variable reading, negative values are subtracted. This parameter is in effect, a calibration adjustment; it MUST be used with care. Injudicious use could lead to the displayed value bearing no meaningful relationship to the actual process variable. There is no front panel indication of when this parameter is in use.

Display value = OFFS, default value = 0.

Also refer to Input Span, Process Variable and Tare.

On-Off Control Type: *Definition*

When operating in On-Off control, the output(s) will turn on or off as the process variable crosses the Setpoint in a manner similar to a central heating thermostat. Some oscillation of the process variable is inevitable when using On-Off control.

On-Off control can be implemented only with Time Proportioning Control (Relay, Triac or SSR driver output), by setting the corresponding proportional band(s) to zero. On-Off operation can be assigned to the Primary output alone (secondary output not present), Primary and Secondary outputs or Secondary output only (with the primary Output set for time proportional or current proportional control).

On-Off control cannot be used on Valve Motor Drive controllers.

Also refer to Differential, PID, Process Variable, Primary Proportional Band, Secondary Proportional Band, Setpoint, Time Proportioning Control and Valve Motor Drive Control.

On-Off Differential (Hysteresis) Type: *Parameter*

Refer to *Differential*.

Overlap/Deadband Type: *Parameter*

Defines the portion of the primary and secondary proportional bands (Pb_P + Pb_S) over which both outputs are active (Overlap), or neither is active (Deadband). It is adjustable in the range -20% to +20% of the two proportional bands added together. Positive values = Overlap, negative values = Deadband.
This parameter is not applicable if the primary output is set for On-Off control or there is no Secondary Output. If the Secondary Output is set for On-Off, this parameter has the effect of moving the Differential band of the Secondary Output to create the overlap or deadband. When Overlap/Deadband = 0, the “OFF” edge of the Secondary Output Differential band coincides with the point at which the Primary Output = 0%.).
Display code = OL, default value = 0%.
Also refer to *Differential*, *On-Off Control*, *Primary Proportional Band* and *Secondary Proportional Band*.

Output 1 Actuations Type: *Parameter*

This is a read only parameter that displays the current number of actuations for output 1.
Display code = OP 1c, default setting = N/A.

Output 1 Count Reset Type: *Parameter*

This is used to reset the current Output 1 Actuations count. If the YES value is selected, the count is reset.
Display code = OP 1r, default setting = no.
Also refer to Output 1 Actuations.

Output 2 Actuations Type: *Parameter*

This is a read only parameter that displays the current number of actuations for output 2.
Display code = OP2c, default setting = N/A.

Output 2 Count Reset Type: *Parameter*

This is used to reset the current Output 2 Actuations count. If the YES value is selected, the count is reset.
Display code = OP2r, default setting = no.
Also refer to Output 2 Actuations.

Output 3 Actuations Type: *Parameter*

This is a read only parameter that displays the current number of actuations for output 3.
Display code = OP3c, default setting = N/A.

Output 3 Count Reset

Type: *Parameter*

This is used to reset the current Output 3 Actuations count. If the YES value is selected, the count is reset.

Display code = OP3r, default setting = no.

Also refer to Output 3 Actuations.

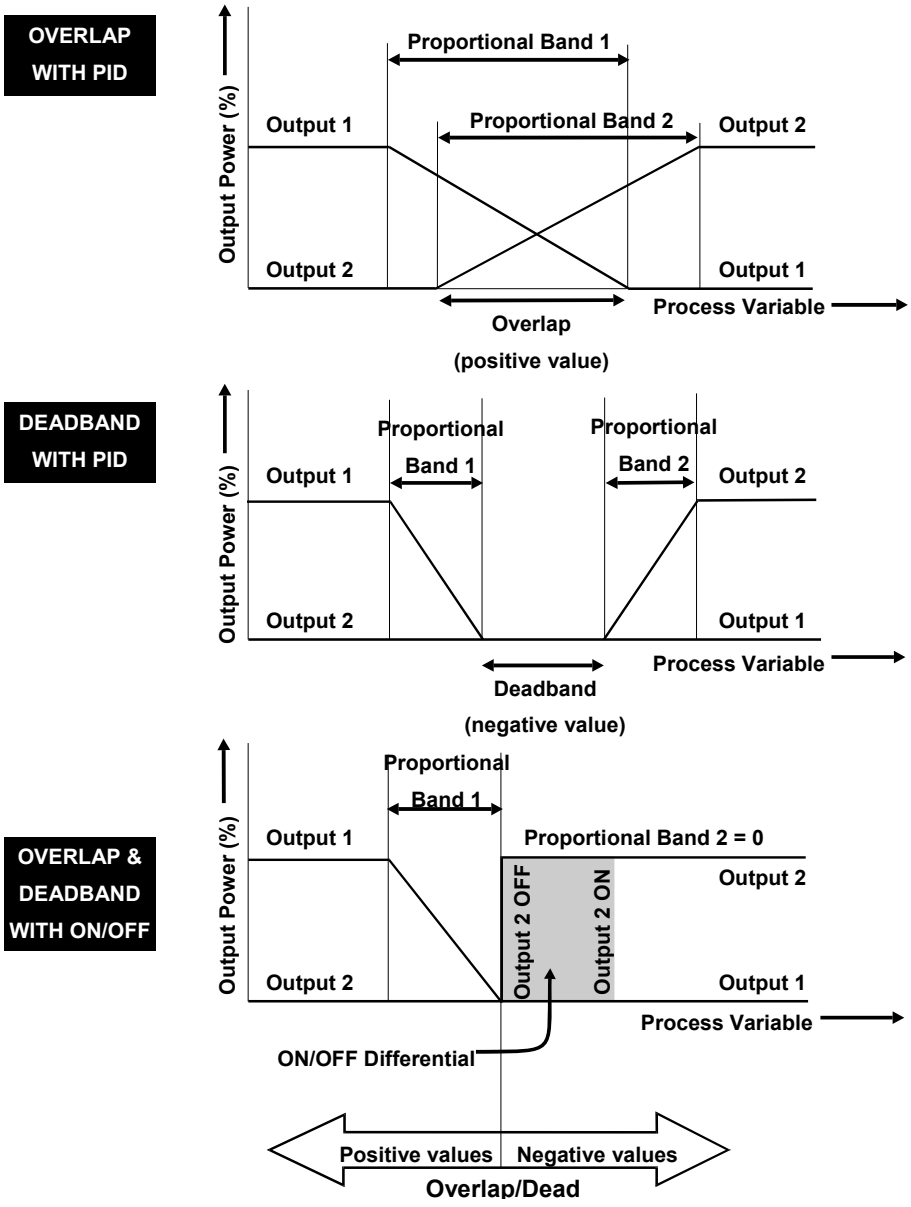


Figure 27. Overlap/Deadband

PI Control

Type: *Definition*

Proportional and Integral (PI) Control is used to control Modulating Valves. It is similar to PID Control, but without Derivative (Rate) action that causes excessive valve movement. Also refer to *Modulating Valve, PID Control, Rate, Tuning*

PID Control Type: *Definition*

Proportional Integral and Derivative control maintains accurate and stable levels in a process (e.g. temperature control). It avoids the oscillation characteristic of On-Off control by continuously adjusting the output to keep the process variable stable at the desired Setpoint.

Also refer to *Control Action, Control Type, Automatic Reset, Controller, Manual Mode, On-Off Control, PI Control, Primary Proportional Band, Process Variable, Rate, Secondary Proportional Band, Setpoint, Tuning*

PLC Type: *Definition*

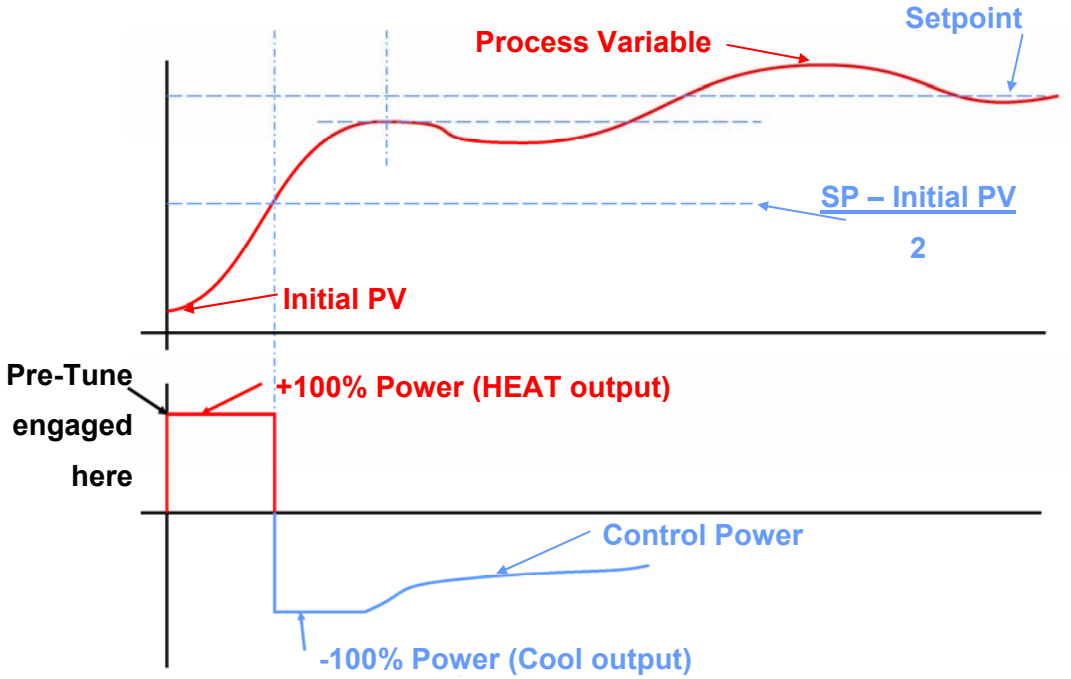
This stands for Programmable Logic Controller. A microprocessor based device used in machine control. It is particularly suited to sequential control applications, and uses "Ladder Logic" programming techniques. Some PLC's are capable of basic PID control, but tend to be expensive and often give inferior levels of control.

Also refer to PID.

Pre-Tune **Type: Definition**

The Pre-Tune facility artificially disturbs the start-up pattern so that a first approximation of the PID values can be made prior to the Setpoint being reached. During Pre-Tune, the controller outputs full Primary Power until the process value has moved approximately halfway to the Setpoint. At that point, power is removed (or outputs full Secondary Power for Dual Control), thereby introducing an oscillation. Once the oscillation peak has passed, the Pre-Tune algorithm calculates an approximation of the optimum PID tuning terms proportional band(s), automatic reset and rate. The process is shown in the diagram below.

When Pre-Tune is completed, the PID control output power is applied using the calculated values. Pre-Tune limits the possibility of Setpoint overshoot when the controller is new or the application has been changed. As a single-shot operation, it will automatically disengage once complete, but can be configured to run at every power up using the Auto Pre-Tune function.



The Pre-Tune feature on Valve Motor Drive controllers always sets the Rate parameter to zero (OFF) because derivative action is not usually desirable in these applications. Pre-Tune will not engage if either primary or secondary outputs on a controller are set for On-Off control, during Setpoint ramping or if the process variable is less than 5% of the input span from the Setpoint. Pre-Tune Operation

Also refer to *Auto Pre-Tune*, *Automatic Reset*, *Control Type*, *On-Off Control*, *Input Span*, *PID*, *Primary Proportional Band*, *Process Variable*, *Rate*, *Secondary Proportional Band*, *Self-Tune*, *Setpoint*, *Setpoint Ramping*, *Tuning* and *Valve Motor Drive Control*.

Primary Output Power Limit Type: *Parameter*

Used to limit the power level of the Primary Output and may be used to protect the process being controlled. It may be adjusted between 0% and 100%. This parameter is not applicable if the primary output is set for On-Off control.

Display code is OPh 1, default value = 100%

Also refer to On-Off Control.

Primary Proportional Band Type: *Parameter*

The portion of the input span over which the Primary Output power level is proportional to the process variable value. It may be adjusted in the range 0.0% (ON/OFF) to 999.9%. Applicable if Control Type is Single or Dual. For dual control a Secondary Proportional band is used for the second output. The Control Action can be Direct or Reverse acting.
The Display value = Pb_P, default value = 5.0%.
Also refer to Control Action, Control Type, On-Off Control, Input Span, Overlap/Deadband, PID, Secondary Proportional Band, and Tuning.

Process High Alarm 1 Value Type: *Parameter*

This parameter, applicable only when Alarm 1 is selected to be a Process High alarm, defines the process variable value above which Alarm 1 will be active. Its value may be adjusted between Scale Range Upper Limit and Scale Range Lower Limit.
Display code = PHA 1, Default value = Scale Range Upper Limit.
Also refer to Alarm Operation, Process High Alarm 2 Value, Process Variable, Scale Range Lower Limit and Scale Range Upper Limit.

Process High Alarm 2 Value Type: *Parameter*

This parameter, applicable only when Alarm 2 is selected to be a Process High alarm. It is similar to the Process High Alarm 1 Value.
Display code = PHA2, Default value = Scale Range Upper Limit.
Also refer to Alarm Operation, Process High Alarm 1 Value, Process Variable, Scale Range Lower Limit and Scale Range Upper Limit.

Process Low Alarm 1 Value Type: *Parameter*

This parameter, applicable only when Alarm 1 is selected to be a Process low alarm, defines the process variable value below which Alarm 1 will be active. Its value may be adjusted between Scale Range Upper Limit and Scale Range Lower Limit.
Display code = PLA 1, Default value = Scale Range Lower Limit.
Also refer to Alarm Operation, Process Low Alarm 2 Value, Process Variable, Scale Range Lower Limit and Scale Range Upper Limit.

Process Low Alarm 2 Value Type: *Parameter*

This parameter, applicable only when Alarm 2 is selected to be a Process low alarm. It is similar to the Process Low Alarm 1 Value.
Display code = PLA2, default value = Scale Range Lower Limit.
Also refer to Alarm Operation, Process Low Alarm 1 Value, Process Variable, Scale Range Lower Limit and Scale Range Upper Limit.

Process Variable (PV) Type: *Definition*

Process Variable is the variable to be measured by the primary input of the instrument. The PV can be any parameter that can be converted into a electronic signal suitable for the input. Common types are Thermocouple or PT100 temperature probes, or pressure, level, flow etc from transducers which convert these parameters into linear DC signals (e.g. 4 to 20mA). Linear signals can be scaled into engineering units using the Scale Range Lower Limit and Scale Range Upper Limit parameters.
Also refer to Input Span, Offset, Scale Range Lower Limit and Scale Range Upper Limit.

Process Variable Offset Type: *Parameter*

This parameter defines the offset required when the single point method is used to calibrate the controller.

Display code = OFFS, default setting = 0.
Also refer to Single Point Calibration.

Profile Type: *Definition*

A profile is used to vary the process value over a period of time by means of a moving setpoint. Each profile is built from one or more segments which are used to define a Setpoint, how it is reached (ramp or step), its duration and any events which should occur during the segment.

Within the profile configuration you can set how the controller may react to unplanned situations such as loss of power etc.
Also refer to Setpoint.

Profile: Auto Hold Band Value Type: *Parameter*

This defines the high and low limits when the Auto Hold feature is enabled within a profile. If the process value exceeds these high and low limits in relation to the current setpoint, the Auto Hold feature is instigated. This holds the moving setpoint value or dwell time until the process value again falls within limits. The high and low limits will not affect the target Setpoint only the ramp or dwell process values used to achieve the Setpoint.
Display code = bAd, default setting = 5.
Also refer to Profile: Auto Hold Valid Type, Profile: Auto Hold Type, Setpoint.

Profile: Auto Hold Type Type: *Parameter*

While running a profile, the Auto Hold feature can be applied if the current process value exceeds the limits defined in the Profile: Auto Hold Band Value parameter. This parameter defines when the auto hold feature should be applied. You can configure the controller to apply auto hold if a high limit is exceed, a low limit is exceeded or both.

Display code = Ho Id, default setting = nonE.
Also refer to Profile: Auto Hold Band Value, Profile: Auto Hold Valid Type, Setpoint.

Profile: Auto Hold Valid Type Type: *Parameter*

If the profile Auto Hold feature is enabled, this parameter defines to which types of segments the feature is applied.
Display code = HoLP, default setting = SGdt.
Also refer to Profile: Auto Hold Band Value, Profile: Auto Hold Type, Setpoint.

Profile Cycles Type: *Parameter*

This parameter is used to define the number of times in succession that the profile should be run consecutively. The profile can be configured to run a specific number of times or infinitely.
Display code = cYc 1, default setting = 1.
Also refer to Profile to Run, Profile Number, Profile.

Profile: End Action Type: *Parameter*

Used to terminate a profile when all other segments are completed. This is the final action within a profile. No further segments can be added after this segment.

Display code = PrEA, default setting = CoFF.

Profile Number Type: *Parameter*

The profile number selected for configuration when in Profile Configuration Mode. Once a profile number is selected, only the current or default values for that profile number will be displayed for configuration. To run a profile, the relevant number must be selected from the Profile to run parameter in the Profile Setup Mode.

Display code = ProG, default setting = 1.

Also refer to Profile to Run, Profile.

Profile: Recovery Method Type: *Parameter*

In the event of power being removed from the controller, this parameter determines if and how the controller profiler should be restarted when power is re-applied. The controller can be set to remain off, restart the profile or continue from running the profile from various Setpoints.

Display code = PrrE, default setting = CoFF.

Profile Start Delay Type: *Parameter*

A specific time delay can be applied to a profile before running. This is defined by this parameter in a HH: MM format.

Display code = dELY, default setting = 00 .00.

Also refer to Profile.

Profile: Start Point Type: *Parameter*

This parameter is used to determine the profile start point, actual setpoint or process value.

Display code = PrSP, default setting = c_SP.

Also refer to Setpoint, Process Variable.

Profile: Timebase Type: *Parameter*

This parameter defines the timebase units in relation to the profile, hours or minutes. The selected value for this parameter will be used when configuring timed events within profile segments. This parameter is only applicable to ramp and dwell segments within a profile.

Display code = bASE, default setting = Hour.

Also refer to Segment: Ramp Time, Segment: Dwell Time.

Profile To Run Type: *Parameter*

The selected profile number. Once selected, the profile run cycle can be defined.

Display code = ProG, default setting = 1.

Also refer to Profile Number, Profile.

Rate (Derivative) Type: *Parameter*

Rate is adjustable in the range 0 seconds (OFF) to 99 minutes 59 seconds. It defines how the control action responds to the rate of change in the process variable. This parameter should not be used in modulating value applications as it can cause premature wear due to constant small adjustments to the valve position. The Rate parameter is not available if primary control output is set to On-Off.

The Rate parameter is normally set to 0 seconds (OFF) on Valve Motor Drive controllers because derivative action is not usually desirable in these applications.

Display code = rAtE, default value = 1.15.

Also refer to On-Off Control, PID, Process Variable, Tuning and Valve Motor Drive Control.

Retransmit Output Type: *Definition*

A linear DC voltage or mA output signal, proportional to the Process Variable or Setpoint, for use by slave controllers or external devices, such as a Data Recorder or PLC. The output can be scaled to transmit any portion of the input or Setpoint span.

Also refer to Input Span, Master & Slave, Process Variable and Setpoint.

Retransmit Output Scale Maximum (only on output 3) Type: *Parameter*

Defines the value of the process variable, or Setpoint, at which Retransmit Output will be at its maximum value.

Display code = ro3H, default value = Scale Range Upper Limit.

Also refer to Process Variable, Retransmit Output, Retransmit Output 3 Scale Minimum, Scale Range Upper Limit and Setpoint.

Retransmit Output Scale Minimum (only on output 3) Type: *Parameter*

Defines the value of the process variable, or Setpoint, at which Retransmit Output will be at its minimum value.

Display code = ro3L, default value = Scale Range Lower Limit.

Also refer to Process Variable, Retransmit Output, Retransmit Output 3 Scale Maximum, Scale Range Lower Limit and Setpoint.

Reset Type: *Parameter*

Refer to *Automatic Reset*.

Reverse Acting Type: *Definition*

- Refer to *Direct/Reverse Action of Control Output*

Scale Range Upper Limit Type: *Parameter*

For linear inputs, this parameter is used to scale the process variable into engineering units. It defines the displayed value when the process variable input is at its maximum value. It is adjustable from -1999 to 9999 and can be set to a value less than (but not within 100 units of) the Scale Range Lower Limit, in which case the sense of the input is reversed.

For thermocouple and RTD inputs, this parameter is used to reduce the effective range of the input. All span related functions work from the trimmed input span. The parameter can be adjusted within the limits of the range selected by Configuration Mode parameter inPt. It is adjustable to within 100 degrees of the Scale Range Lower Limit.

Display code = rUL, default value = 1000 for linear inputs or range maximum for temperature inputs.

Also refer to Input Span, Process Variable and Scale Range Lower Limit.

Scale Range Lower Limit Type: *Parameter*

For linear inputs, this parameter can be used to display the process variable in engineering units. It defines the displayed value when the process variable input is at its minimum value. It is adjustable from -1999 to 9999 and can be set to a value more than (but not within 100 units of) the Scale Range Upper Limit, in which case the sense of the input is reversed.

For thermocouple and RTD inputs, this parameter is used to reduce the effective range of the input. All span related functions, work from the trimmed span. The parameter can be adjusted within the limits of the range selected by Configuration Mode parameter inPt. It is adjustable to within 100 degrees of the Scale Range Upper Limit.

Display code = rUL, default value = 0 for linear inputs, or range minimum for temperature inputs.

Also refer to Input Span, Process Variable and Scale Range Upper Limit.

Secondary Proportional Band Type: *Parameter*

The portion of the input span over which the Secondary Output power level is proportional to the process variable value. It may be adjusted in the range 0.0% (ON/OFF) to 999.9% in range units. The Control action for the Secondary Output is always the opposite of the Primary output.

The Secondary Proportional Band is only applicable when Dual Control Type is used.

Display value = Pb_S, default value = 5.0% of range in units.

Also refer to Control Action, Control Type, On-Off Control, Input Span, Overlap/Deadband, PID, Primary Proportional Band and Tuning.

Segment Type: *Definition*

A segment is an individual control element used to configure a profile. Each segment is used to define a Setpoint, how it is reached (ramp or step), its duration and any events which should occur during the segment

Also refer to Profile, Segment: Type, Segment: Target SP, Segment: Ramp Time, Segment: Ramp Rate, Segment: Dwell Time, Segment: Event Active.

Segment: Dwell Time Type: *Parameter*

If the Segment: Type is set to Dwell Time, this parameter defines the duration of the dwell. The controller will maintain the Setpoint for this duration. Once elapsed, the controller will start to run the next segment in the profile. If at any point during the dwell segment, the Auto Hold feature is instigated, this segment will be held until the process value falls within the predefined limits. It should be noted the dwell segment will be extended by the amount of time the Auto Hold feature is active.

Display code = SGdt, default setting = 00.01.

Also refer to Profile: Auto Hold Band Value, Segment, Segment: Type, Setpoint.

Segment: Event Active Type: *Parameter*

Segments can be configured to activate an event when the segment starts. Events are when the controller sends a control signal to an external device, for example a fan, to turn on or off.

Display code = SGEt, default setting = E___.

Also refer to Segment.

Segment Number Type: *Parameter*

The segment number selected for configuration when in Profile Configuration Mode. Once a segment number is selected, only the current or default values for that segment number will be displayed for configuration.

Display code = SGnb, default setting = N/A.

Also refer to Segment.

Segment: Ramp Rate Type: *Parameter*

If the Segment: Type is set to Ramp Rate, this parameter defines the ramp rate in units per hour or minute. The controller uses this ramp rate to change from the current Setpoint to the target Setpoint for the selected segment. Once the Setpoint is reached, the controller will start the run the next segment in the profile.

Display code = SGrP, default setting = 1.

Also refer to Segment, Segment: Type, Setpoint.

Segment: Ramp Time Type: *Parameter*

If the Segment: Type is set to Ramp Time, this parameter defines the time duration over which a Setpoint must be reached. The controller automatically calculates the difference between the current Setpoint and the target Setpoint to determine the required ramp rate. Once the Setpoint is reached, the controller will start the run the next segment in the profile.

Display code = SGrt, default setting = 00.01.

Also refer to Segment, Segment: Type, Setpoint, Setpoint Ramp Rate

Segment: Target SP Type: *Parameter*

This parameter is used to define the target Setpoint for a segment when configuring a profile.

Display code = SGtS, default setting = 0.

Also refer to Segment, Setpoint, Profile

Segment: Type Type: *Parameter*

Each segment must be configured to perform a given type of action. This parameter sets what action is to be performed. The available actions are Ramp (Time), Ramp (Rate), Dwell, Step or End. Up to 16 segments can be programmed in a profile with any combination of segment types. An End segment must be used to terminate a profile and is considered to be one of the 16 available segments.

Display code = SGtP, default setting = SGrt.

Also refer to Segment, Segment: Target SP, Segment: Ramp Time, Segment: Ramp Rate, Segment: Dwell Time, Segment: Step, Setpoint.

Serial Communications Option Type: *Definition*

A feature that allows other devices such as PC's, PLC's or a master controller to read or change an instruments parameters via an RS485 Serial link. Full details can be found in the Serial Communications sections of this manual.

Also refer to Controller, Indicator, Master & Slave, Limit Controller and PLC

Setpoint Type: *Definition*

The target value at which a controller will attempt to maintain the process variable by adjusting its power output level. Controllers can have either one or two setpoints. These can be one or two local internal setpoints (SP or SP 1 and SP2), or one local internal Setpoint (LSP) and one externally adjusted remote (rSP) Setpoint, if a Remote Setpoint is fitted. The value of the setpoints can be adjusted between the Setpoint Upper Limit and Setpoint Lower Limits. The active Setpoint is defined by the status of the Setpoint Select parameter or a digital input.

Also refer to Limit Setpoint, Process Variable, Remote Setpoint, Scale Range Lower Limit, Setpoint Lower Limit, Setpoint Upper Limit and Setpoint Select

Setpoint Upper Limit Type: *Parameter*

The maximum limit allowed for operator Setpoint adjustments. It should be set to keep the Setpoint below a value that might cause damage to the process. The adjustment range is between Scale Range Upper Limit and Scale Range Lower Limit. The value cannot be moved below the current value of the Setpoint.

Display code = SPuL, default value is Scale Range Upper Limit.

Also refer to Scale Range Lower Limit, Scale Range Upper Limit, Setpoint and Setpoint Lower Limit.

Setpoint Lower Limit Type: *Parameter*

The minimum limit allowed for operator Setpoint adjustments. It should be set to keep the Setpoint above a value that might cause damage to the process. The adjustment range is between Scale Range Lowe Limit and Scale Range Upper Limit. The value cannot be moved above the current value of the Setpoint.

Display code = SPLL, default value = Scale Range Lower Limit.

Also refer to Scale Range Lower Limit, Scale Range Upper Limit, Setpoint and Setpoint Upper Limit.

Setpoint Ramping Enable Type: *Parameter*

Enables or disables the viewing and adjustment of the Setpoint Ramp Rate in Operator Mode. This parameter does not disable the ramping SP feature; it merely removes it from Operator Mode. It can still be viewed and adjusted in Setup Mode. To turn off ramping, the ramp rate must be set to OFF (*blank*).

Display code = SPr, default setting = Disabled.

Also refer to Process Variable, Setpoint and Setpoint Ramp Rate.

Setpoint Ramp Rate Type: *Parameter*

The rate at which the actual Setpoint value will move towards its target value, when the Setpoint value is adjusted or the active Setpoint is changed. With ramping in use, the initial value of the actual Setpoint at power up, or when switching back to automatic mode from manual control, will be equal to the current process variable value. The actual Setpoint will rise/fall at the ramp rate set, until it reaches the target Setpoint value. Setpoint ramping is used to protect the process from sudden changes in the Setpoint, which would result in a rapid rise in the process variable.

Display code = rP, default setting = OFF (*blank*).

Also refer to Manual Mode, Setpoint, Setpoint Ramp Enable and Setpoint Select.

Setpoint Select Type: *Parameter*

This Operator Mode parameter is available if the remote Setpoint feature is in use and Setpoint select is enabled, Setpoint Select defines whether the local or the remote Setpoint will be the Active Setpoint. It can be set to diG i, LSP, or rSP.. The active Setpoint is indicated by prefixing its legend with the "-" character. E.g. the local Setpoint legend is -LSP, when it is active and LSP when it is inactive.

If a digital input has been configured to select local/remote SP, setting Setpoint Select to LSP, or rSP will override the digital input and the active SP indication changes to -.

Display code = SPS.

Also refer to Active Setpoint, Remote Setpoint, Setpoint and Setpoint Select Enable.

Setpoint Select Enable Type: *Parameter*

If the remote Setpoint feature is in use, this determines whether operator selection of setpoints is enabled or disabled. If enabled, the Setpoint Select parameter is available in operator mode. If Setpoint Select is disabled again, the active Setpoint will remain at its current status.

Display code = SSEn, default setting = diSA (disabled).

Also refer to Remote Setpoint and Setpoint.

Solid State Relay (SSR) Type: *Definition*

An external device manufactured using two Silicone Controlled Rectifiers, which can be used to replace mechanical relays in most AC power applications. As a solid state device, an SSR does not suffer from contact degradation when switching electrical current. Much faster switching cycle times are also possible, leading to superior control. The instrument's SSR Driver output is a time proportioned 10VDC pulse, which causes conduction of current to the load when the pulse is on.

Also refer to Cycle Time, Time Proportioning Control, and Triac.

Solenoid Valve Type: *Definition*

An electromechanical device to control gas or liquid flow. It has just two states, open or closed. A spring holds the valve closed until a current is passed through the solenoid coil forces it open. Standard Process Controllers with Time Proportioned outputs are used to control solenoid valves.

Solenoid valves are often used with high/low flame gas burners. A bypass supplies some gas at all times, but not enough to heat the process more than a nominal amount (low flame). A controller output opens the solenoid valve when the process requires additional heat (high flame)..

Also refer to Modulating Valves and Time Proportioning Control.

Time Proportioning Control Type: *Definition*

Time proportioning control is accomplished by cycling the output on and off, during the prescribed cycle time, whenever the process variable is within the proportional band. The control algorithm determines the ratio of time (on vs. off) to achieve the level of output power required to correct any error between the process value and Setpoint. E.g. for a 32 second cycle time, 25% power would result in the output turning on for 8 seconds, then off to 24 seconds. This type of output might be used with electrical contactors, Solid State Relays Time proportioning control can be implemented with Relay, Triac or SSR Driver outputs for either primary (Heat) or secondary (Cool) outputs depending on hardware configuration.

Also refer to Current Proportioning Control, Cycle Time, PID, Primary Proportional Band, Process Variable, Secondary Proportional Band, Setpoint, SSR and Triac.

Tuning Type: *Definition*

PID Controllers must be tuned to the process in order for them to attain the optimum level of control. Adjustment is made to the tuning terms either manually, or by utilising the controller's automatic tuning facilities. Tuning is not required if the controller is configured for On-Off Control.

Also refer to Automatic Reset, Auto Pre-Tune, On-Off control, PID, Pre-Tune, Primary Proportional Band, Rate, Self-Tune and Secondary Proportional Band.

User Calibration Type Type: *Parameter*

Calibration of the controller may be required to offset the factory settings of the controller to a particular reference standard or to suite a specific process transducer / sensor. This can be used to minimise reading errors.

This parameter defines which type of calibration, if any, is to be used to calibrate the controller.

Display code = CALt, default setting = nonE.

Also refer to Low Offset, High Offset, Setpoint, Single Point Calibration, Two Point Calibration, Process Variable.

11 Appendix 2 - Specification

UNIVERSAL INPUT	
Thermocouple Calibration:	±0.1% of full range, ±1LSD (±1°C for Thermocouple CJC). BS4937, NBS125 & IEC584.
PT100 Calibration:	±0.1% of full range, ±1LSD. BS1904 & DIN43760 *(0.00385Ω/Ω/°C).*
DC Calibration:	±0.1% of full range, ±1LSD.
Sampling Rate:	4 per second.
Impedance:	>10MΩ resistive, except DC mA (5Ω) and V (47kΩ).
Sensor Break Detection:	Thermocouple, RTD, 4 to 20 mA, 2 to 10V and 1 to 5V ranges only. *Control outputs turn off.*
Isolation:	Isolated from all outputs (except SSR driver) by at least BASIC isolation. Universal input must not be connected to operator accessible circuits if relay outputs are connected to a hazardous voltage source. Supplementary insulation or input grounding would then be required. Isolated from Mains Power Input by Re-inforced Safety Isolation.
OUTPUTS	Output 1 and 2 are available as SPST relay or SSR Driver. Output 3 is available as not fitted, SPDT relay, SSR Driver, DC Linear or RS485 variant.
RELAY 1 or 2	
Contacts:	Single pole single throw (SPST); 2A resistive at 120/240VAC.
Lifetime:	>300,000 operations at rated voltage/current.
Isolation:	Basic Isolation from universal input and SSR outputs.
RELAY 3 (OPTION)	
Contacts:	Single pole double throw (SPDT); 2A resistive at 120/240VAC.
Lifetime:	>500,000 operations at rated voltage/current.
Isolation:	Reinforced Isolation from universal input and SSR outputs.
SSR Driver 1, 2 or 3(OPTION)	
Drive Capability:	SSR drive voltage >10V into 500Ω min.
Isolation:	Not isolated from universal input or other SSR driver outputs.
DC LINEAR OUTPUT 3	
Resolution:	8 bits in 250mS (10 bits in 1s typical, >10 bits in >1s typical).
Isolation:	Basic safety isolation from Universal input and SSR. Reinforced safety isolation to Mains and Relay Circuits.
SERIAL COMMUNICATIONS	
Physical:	RS485, at 1200, 2400, 4800, 9600, 19200 or 38400 bps.
Protocols:	ModbusRTU.
Isolation:	Basic safety isolation from Universal input and SSR. Reinforced safety isolation to Mains and Relay Circuits.
OPERATING CONDITIONS (FOR INDOOR USE)	
Ambient Temperature:	0°C to 55°C (Operating), –20°C to 80°C (Storage).
Relative Humidity:	20% to 95% non-condensing.
Supply Voltage and Power:	100 to 240VAC ±10%, 50/60Hz, 7.5VA (*for mains powered versions*), or 20 to 48VAC 50/60Hz 7.5VA or 22 to 65VDC 5W (*for low voltage versions*).
ENVIRONMENTAL	
Standards:	CE, (UL, ULC subject to approval)
EMI:	Complies with EN61326 (Susceptibility & Emissions).
Safety Considerations:	Complies with EN61010-1 & UL3121. Pollution Degree 2, Installation Category II.
Front Panel Sealing:	To IP66 (IP20 behind the panel).
PHYSICAL	
Front Bezel Size:	1/16 Din = 48 x 48 mm, 1/8 Din = 48 x 96 mm
Depth Behind Panel:	70mm with sealing gasket fitted.
Weight:	0.21kg maximum.

11.1 Thermocouple

Digital Input Filter time constant	0.0 (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:	10V DC:	47KΩ
	20mA DC:	5Ω
	Other ranges:	Greater than 10MΩ resistive
Isolation:	Isolated from all outputs (except SSR driver) by at least BASIC isolation. Universal input must not be connected to operator accessible circuits if relay outputs are connected to a hazardous voltage source. Supplementary insulation or input grounding would then be required. Isolated from Mains Power Input by Re-inforced Safety Isolation.	
PV Offset:	Adjustable ±input span or 2 point offset (high and low calibration points)	
PV Display:	Displays process variable up to 5% over and 5% under span.	

Thermocouple Ranges Available

Sensor Type	Range Min in °C	Range Max in °C	Range Min in °F	Range Max in °F	Resolution
J (default)	-200	1200	-328	2192	1°
J	-128.8	537.7	-199.9	999.9	0.1°
T	-240	400	-400	752	1°
T	-128.8	400.0	-199.9	752.0	0.1°
K	-240	1373	-400	2503	1°
K	-128.8	537.7	-199.9	999.9	0.1°
L	0	762	32	1403	1°
L	0.0	537.7	32.0	999.9	0.1°
N	0	1399	32	2551	1°
B	100	1824	211	3315	1°
R	0	1759	32	3198	1°
S	0	1762	32	3204	1°
C	0	2320	32	4208	1°
PtRh20%: PtRh40%	0	1850	32	3362	1°

Note:

Defaults to °F for USA units. Defaults to °C for non-USA units.
The Configuration Mode parameters, Scale Range Upper Limit and Scale Range Lower Limit, can be used to restrict range.

Thermocouple Performance

Calibration:	Complies with BS4937, NBS125 and IEC584.
Measurement Accuracy:	±0.1% of full range span ±1LSD. NOTE: Reduced performance for B Thermocouple from 100 to 600°C. NOTE: PtRh 20% vs PtRh 40% Thermocouple accuracy is 0.25% and has reduced performance below 800°C.
Linearisation Accuracy:	Better than ±0.2°C any point, for 0.1° resolution ranges (±0.05°C typical). Better than ±0.5°C any point, for 1° resolution ranges.
Cold Junction Compensation:	Better than ±0.7°C under reference conditions. Better than ±1°C under operating conditions.
Temperature Stability:	0.01% of span/°C change in ambient temperature.
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.
Sensor Break Protection:	As break detected process Control outputs turn OFF (0% power); Alarms operate as if the process variable has gone over-range.

Resistance Temperature Detector (RTD)

RTD Ranges Available

Range Min in °C	Range Max in °C	Range Min in °F	Range Max in °F	Resolution
-128.8	537.7	-199.9	999.9	0.1°
-199	800	-328	1472	1° (default)

Note:

Scale Range Upper Limit and Scale Range Lower Limit Configuration Mode parameters can be used to restrict range.

RTD Performance

Type:	Three-wire Pt100.
Calibration:	Complies with BS1904 and DIN43760 *(0.00385Ω/Ω/°C).*
Measurement Accuracy:	±0.1% 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.
Temperature Stability:	0.01% of span/°C change in ambient temperature.
Supply Voltage Influence:	Negligible.
Relative Humidity Influence:	Negligible.
Sensor Resistance Influence:	Pt100 50Ω/lead: <0.5% of span error.
Lead Compensation:	Automatic scheme.
RTD Sensor Current:	150μA (approximately).
Sensor Break Protection:	As break detected process Control outputs turn OFF (0% power); Alarms operate as if the process variable has gone over-range.

DC Linear

DC Linear Ranges Available

0 to 20mA	0 to 50mV	0 to 5V
4 to 20mA (default)	10 to 50mV	1 to 5V
		0 to 10V
		2 to 10V

DC Linear Performance

Scale Range Upper Limit:	–1999 to 9999. Decimal point as required.
Scale Range Lower Limit:	–1999 to 9999. Decimal point as for Scale Range Upper Limit.
Minimum Span:	1 display LSD.
Measurement Accuracy:	±0.1% of span ±1LSD.
Temperature stability:	0.01% of span/°C change in ambient temperature.
Supply Voltage Influence:	Negligible.
Relative Humidity Influence:	Negligible.
Input Protection:	Up to 10 times maximum span of selected input connection.
Sensor Break Protection:	**Applicable for 4 to 20mA, 1 to 5V and 2 to 10V ranges only.** As break detected process Control outputs turn OFF (0% power); Alarms operate as if the process variable has gone over-range.

11.2 Output Specifications

Output Types (Preconfigured)

Output 1 Options:	Relay, SSR drive,
Output 2 Options:	Relay, SSR drive,
Output 3 Options:	Relay, SSR drive, DC Linear or RS485 communications.

Specifications of Output Types

Single Relay: (output 1 & 2 only)	Contact Type:	Single pole single throw (SPST).
	Rating:	2A resistive at 120/240V AC
	Control/Alarm Lifetime:	>300,000 operations at rated voltage/current.
	Isolation:	Basic Isolation from universal input and SSR outputs.
Single Relay: (output 3 only)	Contact Type:	Single pole double throw (SPDT).
	Rating:	2A resistive at 120/240V AC
	Control/Alarm Lifetime:	>500,000 operations at rated voltage/current.
	Isolation:	Reinforced Isolation from universal input and SSR outputs.
SSR Driver: (outputs 1,2 &3)	Drive Capability:	10V minimum at up to 20mA load.
	Isolation:	Not isolated from universal input or other SSR driver outputs.

Linear DC: (output 3 only)	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 to 10V 0 to 5V 2 to 10V 0 to 20mA 4 to 20mA (default)
	Load Impedance:	0 to 20mA & 4 to 20mA: 500Ω maximum. 0 to 5V, 0 to 10V & 2 to 10V: 500Ω minimum. Short circuit protected.
	Accuracy:	±0.25% (mA @ 250Ω, V @ 2kΩ). Degrades linearly to ±0.5% for increasing burden (to specification limits).
	When used as control output:	For 4 to 20mA and 2 to 10V a 2% over/underdrive is applied (3.68 to 20.32mA and 1.84 to 10.16V).
	Isolation:	Basic safety isolation from inputs and SSR outputs.
RS485 Communications (output 3 only)	**Type:**	Asynchronous Serial.
	Protocols Supported:	Modbus RTU
	Physical Layer:	RS485.
	Address range:	1 to 255
	Bit rate:	1200, 2400, 4800, 9600, 19200 & 38400 bps.
	Stop bits:	1
	Parity:	None, even or odd (selectable).
	Isolation:	Basic safety isolation from inputs and SSR outputs.

11.3 Control Specifications

Automatic Tuning Types:	Pre-Tune,
Proportional Bands:	0 (ON/OFF control), 0.5% to 999.9% of input span in range units. *Defaults to 10% of range span*
Automatic Reset (Integral Time Constant):	1s to 99min 59s and OFF.
Rate (Derivative Time Constant):	0 (OFF) to 99 min 59 s.
Manual Reset (Bias):	Added each control algorithm execution. Adjustable in the range 0 to 100% of output power (single output) or -100% to +100% of output power (dual output).
Deadband/Overlap:	-20% to +20% of Proportional Band 1 + Proportional Band 2.
ON/OFF Differential:	0.1% to 10.0% of input span. Entered in range units.
Auto/Manual Control:	User-selectable with “bumpless” transfer into and out of Manual Control.
Cycle Times:	Selectable from 0.1s to 512 seconds in binary steps for SSR outputs (0.5s minimum for relay outputs)
Setpoint Range:	Limited by Setpoint Upper Limit and Setpoint Lower Limit.
Setpoint Maximum:	Limited by Setpoint and Scale Range Upper Limit.
Setpoint Minimum:	Limited by Scale Range Lower Limit and Setpoint.
Setpoint Ramp:	Ramp rate selectable 1 to 9999 LSD’s per hour and infinite. Number displayed is decimal-point-aligned with display.

11.4 Process Alarms

Maximum Number of Alarms (*Controllers*):	Two “soft” process alarms (high, low, deviation or band) plus Loop Alarm.
Maximum Number of Alarms (*Indicators*):	Five “soft” alarms (process high or low)
Combinatorial Alarms:	Logical OR or AND of alarms to any suitable output.

11.5 Reference Conditions

Ambient Temperature:	20°C ±2°C.
Relative Humidity:	60 to 70%.
Supply Voltage:	100 to 240V AC 50Hz ±1%.
Source Resistance:	<10Ω for thermocouple input.
Lead Resistance:	<0.1Ω/lead balanced (Pt100).

11.6 Operating Conditions

Ambient Temperature (operating):	0°C to 55°C.
Ambient Temperature (storage):	-20°C to 80°C.
Relative Humidity:	20% to 95% non-condensing.
Altitude:	Up to 2000m above sea level.
Supply Voltage:	Either 100 to 240V ±10% AC 50/60Hz or 20 to 48V AC 50/60Hz & 22 to 55V DC
Power Consumption:	5W / 7.5 VA maximum.
Source Resistance:	1000Ω maximum (thermocouple).
PT100 Input Lead Resistance:	50Ω per lead maximum, balanced

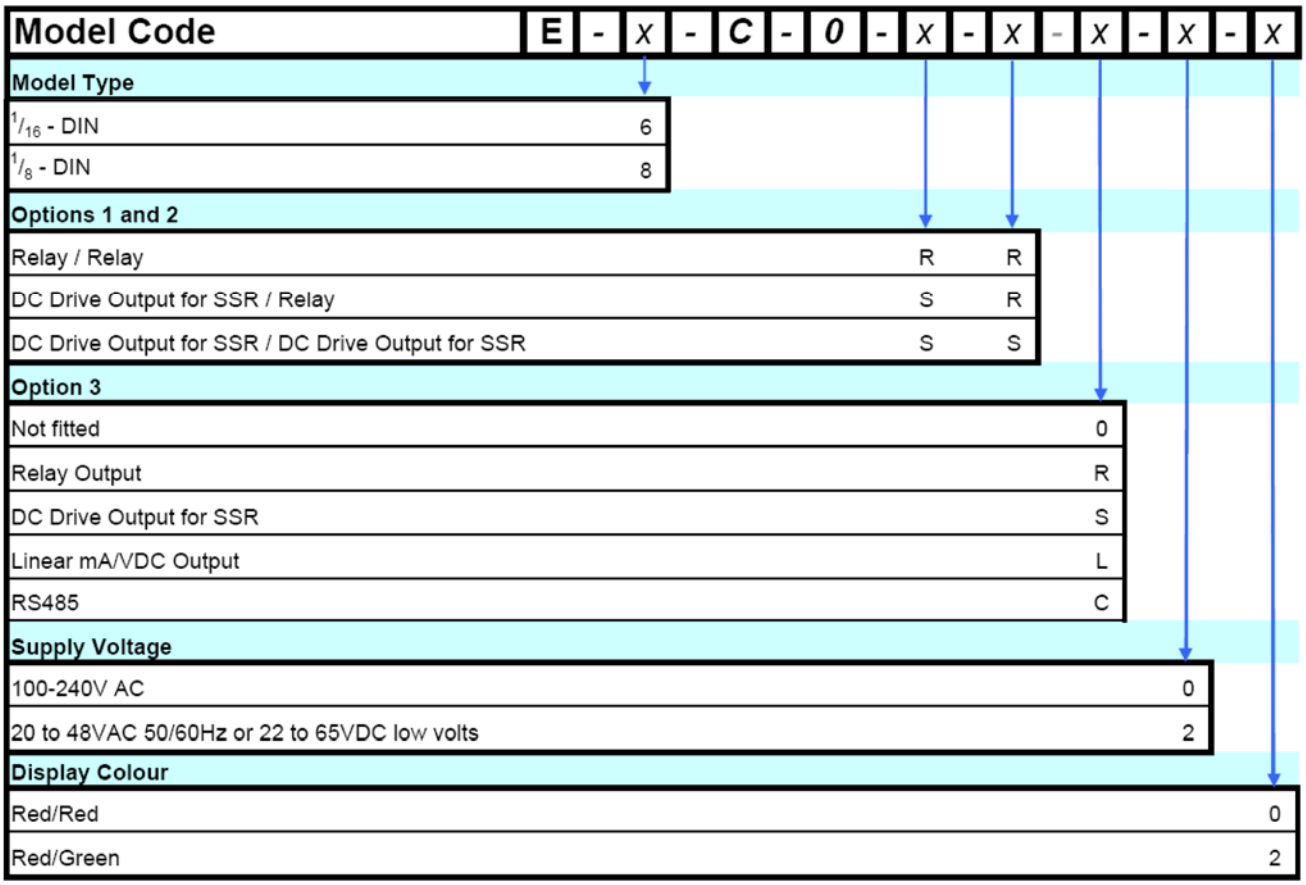
11.7 Standards

Conformance Norms:	CE, UL, ULC.
EMI standards:	EN61326
Safety Standards:	EN61010 and UL3121. Pollution Degree 2, Installation Category II.
Front Panel Sealing:	IP66 (IP 20 behind panel)

11.8 Physical Specifications

Dimensions:	**Depth behind panel:**	70mm with sealing gasket fitted
	Front bezel size (*w x h*):	48 x 48mm (1/16 DIN instruments).
Mounting:		Plug-in with panel mounting fixing strap.
Panel cut-out size (*w x h*)::		45mm x 45mm (1/16 DIN instruments).
Terminals:		Screw type (combination head).
Weight:		0.21kg maximum.

12 Appendix 3 - Product Coding



Model Code	E	-	X	-	C	-	0	-	X	-	X	-	X	-	X	-	X
Model Type																	
1/16 - DIN			6														
1/8 - DIN			8														
Options 1 and 2																	
Relay / Relay									R		R						
DC Drive Output for SSR / Relay									S		R						
DC Drive Output for SSR / DC Drive Output for SSR									S		S						
Option 3																	
Not fitted													0				
Relay Output													R				
DC Drive Output for SSR													S				
Linear mA/VDC Output													L				
RS485													C				
Supply Voltage																	
100-240V AC															0		
20 to 48VAC 50/60Hz or 22 to 65VDC low volts															2		
Display Colour																	
Red/Red																	0
Red/Green																	2

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