User Guide
IM/C351_9

1/4 DIN Process Controller

C351

ABB

GETTING STARTED

The COMMANDER 350 can be configured and made ready for operation in three easy steps. This 'Getting Started' guide provides an overview of these steps and, where necessary, refers to the relevant section of the manual.

Step 1 – Decide on the Application Template and the Output Configuration required

Step 2 – Connect the process inputs and outputs

Step 3 – Power up the instrument, set the template number and the output configuration details

Your COMMANDER 350 is now ready for operation

Step 1 – Application Template and Output Configuration

- Choose the Template which best suits your application from the list in Table A, located on the rear fold-out.
- Choose the Control Output Type required from the list of options in Table B on the rear foldout.

Step 2 – Electrical Connections

Using the labels on the back of the instrument as a guide, connect the process inputs, outputs and power supplies. Refer to Section 5.2 of this manual (Electrical Installation) for more information.

Continued…

Step 3 – Setting the Parameters (Fig. GS.1)

Ⓐ Power-up the instrument. Press the ↵ and △ keys simultaneously and hold for 3 seconds to advance directly to Level 6 – Basic Configuration.

Ⓑ Set the appropriate application template, output type and control action. Use the ↵ key to advance between frames and upper ▲ and ▼ keys to adjust the default values – see Section 4.2 for further information.

Note. When the output type has been selected, the available inputs and outputs default to the settings shown in Table B on the rear fold-out.

Ⓒ If you are not using 4 to 20mA inputs, then select Level 7 using the upper ▲ and ▼ keys and set up Analog Inputs I/P1 to I/P3 to suit your process – see Section 4.3.

Ⓓ Controller templates only:

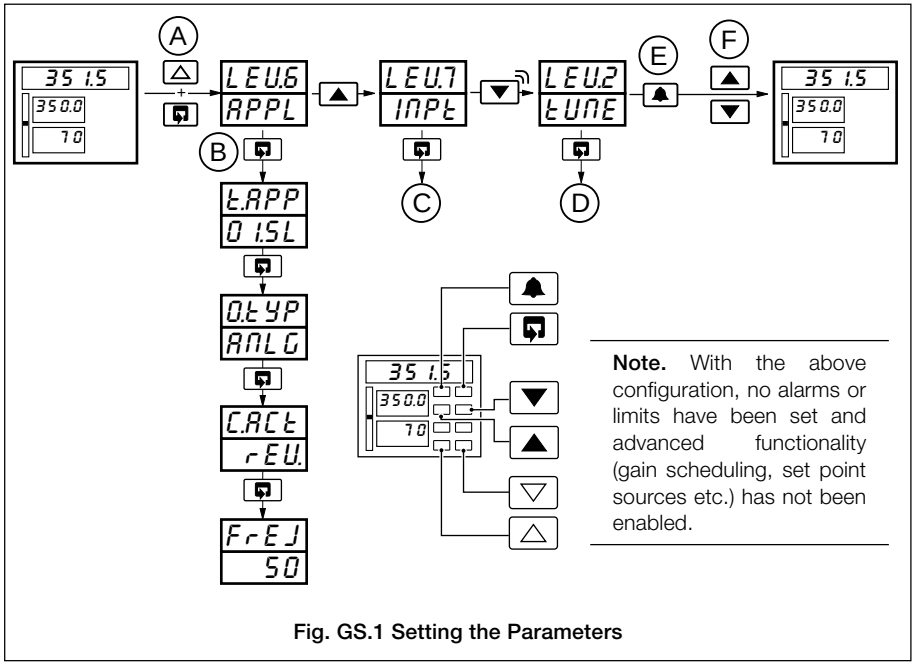
Select Level 2 using the upper ▲ and ▼ keys and set the tune parameters:

- **Analog or Motorized Valve Control** – set the Proportional, Integral and Derivative terms.
- **Time Proportioning Control** – set the Cycle Time, Hysteresis and P, I & D Terms
- **Heat/Cool Outputs** – set the points at which the Output 1 and Output 2 become active.

Ⓔ Press 🔔 to return to the Operating displays.

Ⓕ Adjust the set point to the required value.

Your COMMANDER 350 is now in operation



Note. With the above configuration, no alarms or limits have been set and advanced functionality (gain scheduling, set point sources etc.) has not been enabled.

Fig. GS.1 Setting the Parameters

ABB

The Company

We are an established world force in the design and manufacture of instrumentation for industrial process control, flow measurement, gas and liquid analysis and environmental applications.

As a part of ABB, a world leader in process automation technology, we offer customers application expertise, service and support worldwide.

We are committed to teamwork, high quality manufacturing, advanced technology and unrivalled service and support.

The quality, accuracy and performance of the Company's products result from over 100 years experience, combined with a continuous program of innovative design and development to incorporate the latest technology.

The UKAS Calibration Laboratory (No. 0255) is just one of ten flow calibration plants operated by the Company, and is indicative of our dedication to quality and accuracy.

EN ISO 9001:2000

Cert. No. Q 05907

EN 29001 (ISO 9001)

Lenno, Italy – Cert. No. 9/90A

Electrical Safety

This equipment complies with the requirements of CEI/IEC 61010-1:1993 "Safety requirements for electrical equipment for measurement, control, and laboratory use". If the equipment is used in a manner NOT specified by the Company, the protection provided by the equipment may be impaired.

Symbols

One or more of the following symbols may appear on the equipment labelling:

⚠	**Warning** – Refer to the manual for instructions
⚠	**Caution** – Risk of electric shock
⏚	Protective earth (ground) terminal
⏚	Earth (ground) terminal

⎓	Direct current supply only
~	Alternating current supply only
≂	Both direct and alternating current supply
▣	The equipment is protected through double insulation

Health and Safety

To ensure that our products are safe and without risk to health, the following points must be noted:

1. The relevant sections of these instructions must be read carefully before proceeding.
2. Warning labels on containers and packages must be observed.
3. Installation, operation, maintenance and servicing must only be carried out by suitably trained personnel and in accordance with the information given.
4. Normal safety precautions must be taken to avoid the possibility of an accident occurring when operating in conditions of high pressure and/or temperature.
5. Chemicals must be stored away from heat, protected from temperature extremes and powders kept dry. Normal safe handling procedures must be used.
6. When disposing of chemicals ensure that no two chemicals are mixed.

Safety advice concerning the use of the equipment described in this manual or any relevant hazard data sheets (where applicable) may be obtained from the Company address on the back cover, together with servicing and spares information.

OVERVIEW

This manual is divided into 5 sections which contain all the information needed to install, configure, commission and operate the COMMANDER 351. Each section is identified clearly by a symbol as shown in Fig. 1.

Displays and Controls
- Displays and Function Keys
- LED Indication
- Error Messages

Operator Mode (Level 1)
- Single Loop Controller
- Motorized Valve Controller
- Auto/Manual & Backup Stations

Set Up Mode (Levels 2 to 5)

Level 2	Tuning
Level 3	Set Points
Level 4	Alarm Trip Points
Level 5	Valve Setup

Configuration Mode (Levels 6 to E)

Level 6	Basic Configuration
Level 7	Input Configuration
Level 8	Alarm Configuration
Level 9	Set Point Configuration
Level A	Control Configuration
Level B	Operator Configuration
Level C	Output Configuration
Level D	Serial Communications
Level E	System Calibration

Installation
- Siting
- Mounting
- Electrical Connections

Fig. 1 Overview of Contents

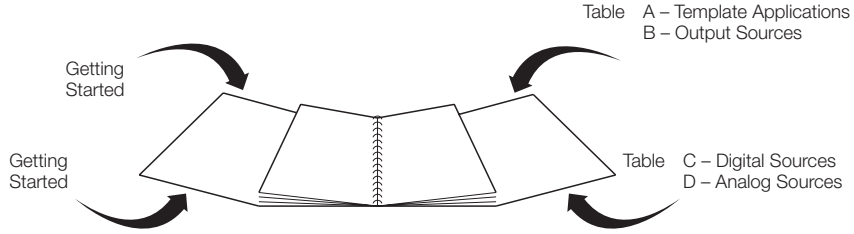
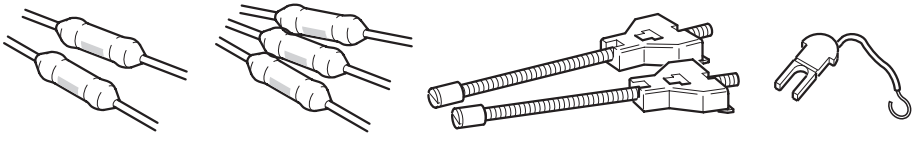


Fig. 2 Foldouts



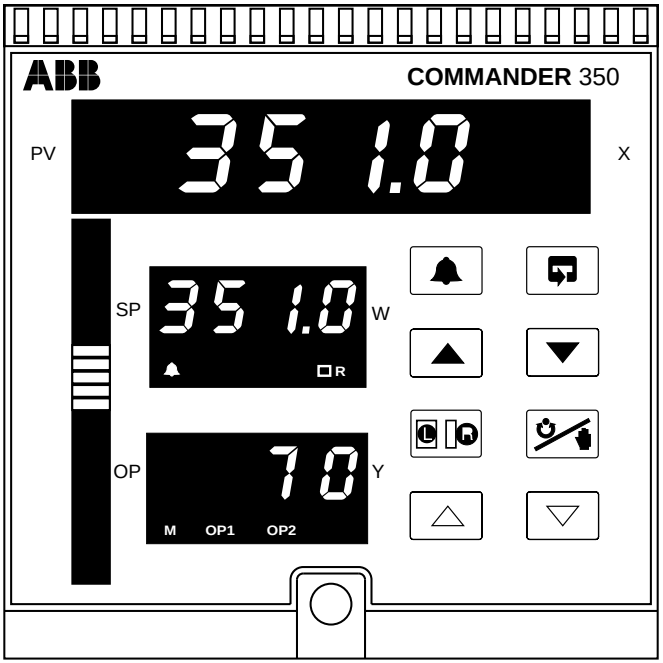
Pull-up Resistors 2 x 100kΩ | **Shunt Resistors 3 x 100Ω** | **Panel Clamps x2** | **CJ Sensor x2**

Fig. 3 Accessories

CONTENTS

1.1 Introduction

The COMMANDER 351 front panel displays, function keys and l.e.d. indicators are shown in Fig. 1.1.



Function Keys

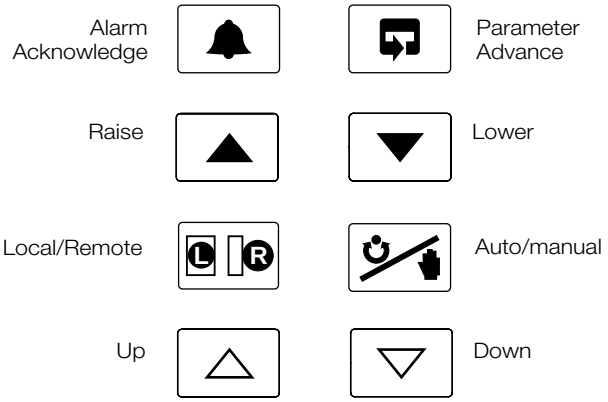
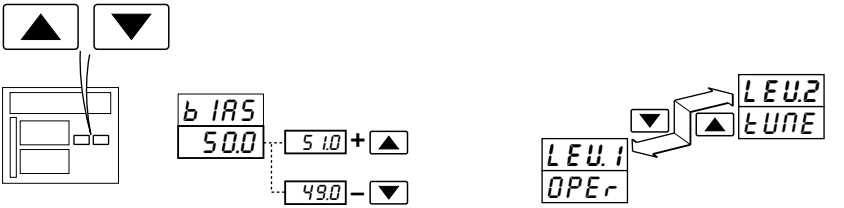


Fig. 1.1 Front Panel Displays and Function Keys

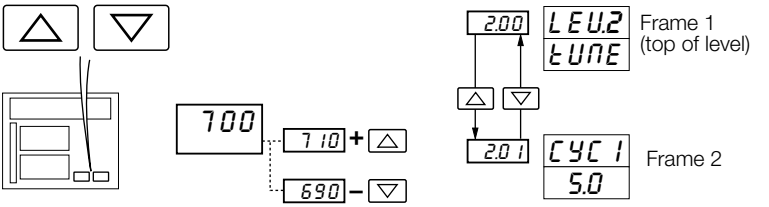
1.2 Use of Function Keys

A – Raise and Lower Keys



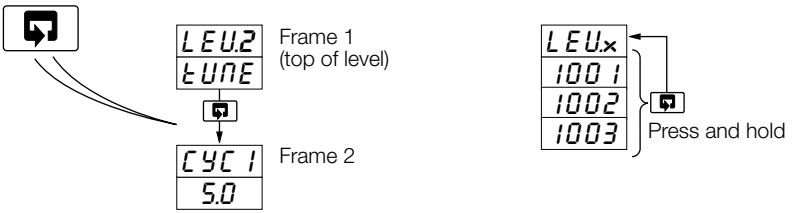
Use to change/set a parameter value… and… …move between levels

B – Up and Down Keys



Use to adjust the output value… and… …move between frames within a Setup or Configuration level. Any changes made in the current frame are stored when the next frame is selected.

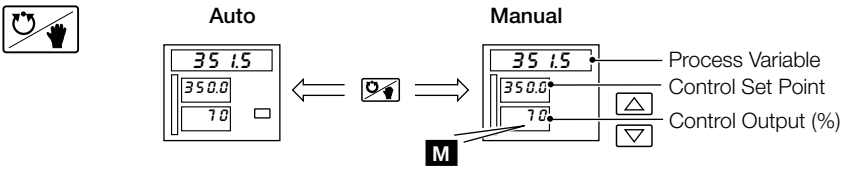
C – Parameter Advance Key



Use to advance to the next frame within a level… **or…** …select the top (LEV.x) frame from within a level

Note. This key also stores any changes made in the previous frame

D – Auto/Manual Key

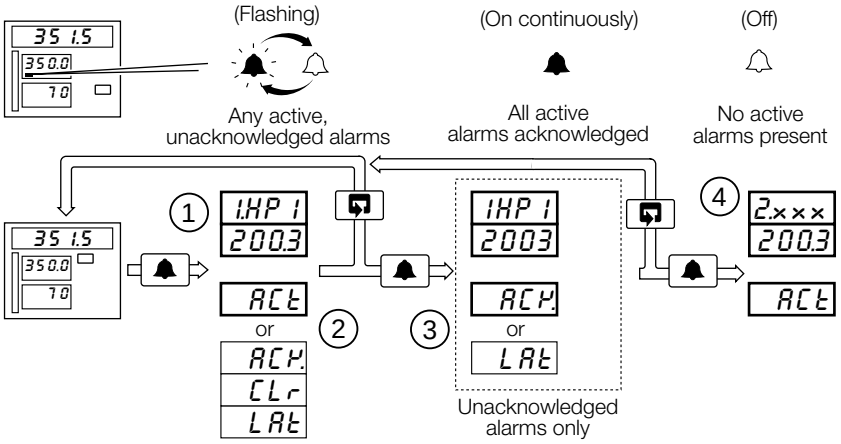


Use to select Auto or Manual control mode

Fig. 1.2a Use of Function Keys

...1.2 Use of Function Keys

E – Alarm Acknowledgement



Note. If no alarms have been enabled in the Set Up level, pressing the [🔔] key has no effect.

(1) The first active and unacknowledged alarm is displayed (or if no alarms are active, the first enabled alarm is displayed)

HPU.	High Process, PV	HO	High Output
LPU.	Low Process, PV	LO	Low Output
HLP	High Latch, PV	PF.t	Power Failure Time – see Note below.
LLP	Low Latch, PV	Hb1	Math Block 1 High
Hd	High Deviation	Lb1	Math Block 1 Low
Ld	Low Deviation	Hb2	Math Block 2 High
HP1	High Process I/P1	Lb2	Math Block 2 Low
LP1	Low Process I/P1	Hb3	Math Block 3 High
HP2	High Process I/P2	Lb3	Math Block 3 Low
LP2	Low Process I/P2	Hb4	Math Block 4 High
HP3	High Process I/P3	Lb4	Math Block 4 Low
LP3	Low Process I/P3		

Note. The time of the power failure, PF.t, is shown in the set point display.

(2) The lower display shows alarm status:

ACt	Alarm active and unacknowledged
ACK.	Alarm active and acknowledged
CLr	Cleared or Inactive alarm
LAt	Unacknowledged latched alarm

(3) Pressing [🔔] again acknowledges the displayed alarm. Lower display changes to reflect new status.

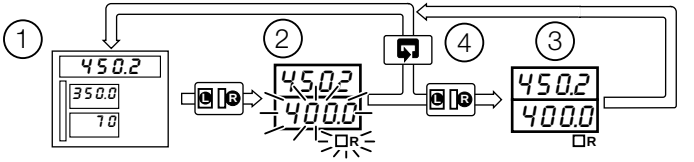
(4) Next active and unacknowledged alarm is displayed. If no alarms are active, the next enabled alarm is displayed.

Fig. 1.2b Use of Function Keys

...1.2 Use of Function Keys

F – Local / Remote Key

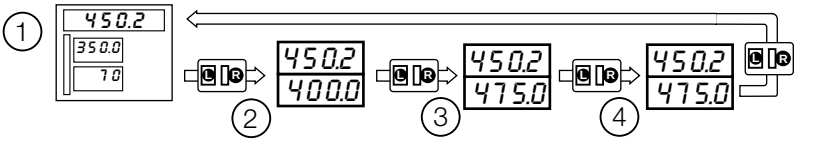
Changing between Local and Remote Set Points



1. Process variable and local set point displayed on red and green displays.
2. Remote set point value is displayed. The value and R symbol flash to indicate local set point still selected.
3. Remote set point selected.
4. Remote selection aborted.

Note. When an Analog Backup template is selected, the L/R key is used to switch between local and remote mode – see Sections 2.4 and 4.2.

Selecting Local Set Points 1 to 4

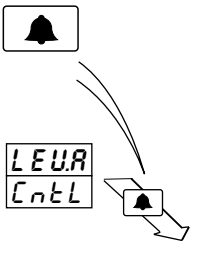


1. Process variable and local set point 1 displayed.
2. Process variable and local set point 2 displayed
3. Process variable and local set point 3 displayed
4. Process variable and local set point 4 displayed

Fig. 1.2c Use of Function Keys

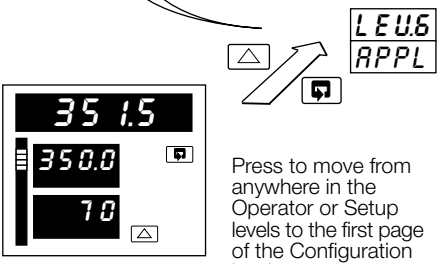
...1.2 Use of Function Keys

G – Short-cut Keys



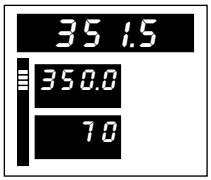
Press to move from anywhere in the Configuration level to the first frame in the Operator level

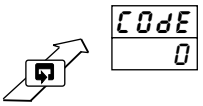
Press simultaneously and hold for 3 seconds – see Note



Press to move from anywhere in the Operator or Setup levels to the first page of the Configuration level

Note. This Short-cut key combination operates only when the Configuration password is set to '0'.



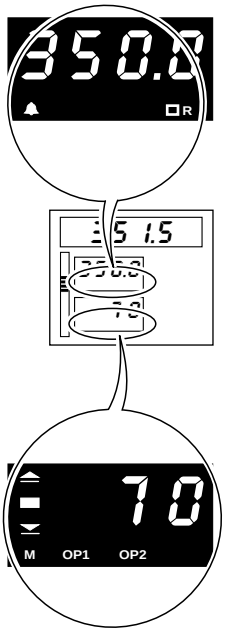


Press to move from the Operator Level to the Security Code Frame and then to other levels:

Tune Level – See Section 2.13.3
Set Up Level – See Fig. 3.1
Configuration Level – See Fig. 4.1

Fig. 1.2d Use of Function Keys

1.3 Secret-til-Lit Indicators



	Flashing	ON	OFF
🔔	One or more alarms active and unacknowledged	All active alarms acknowledged	No alarms active
R		Remote or Cascade set point in use	Local set point in use

A – Upper Display

	Flashing	ON	OFF
M	Autotune in progress	Manual control selected	Auto control selected
OP1		Output 1 (heat) value displayed	
OP2		Output 2 (cool) value displayed	
⏏		Valve opening	
■		Valve stopped	
⏬		Valve closing	

B – Lower Display

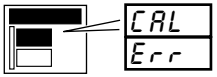
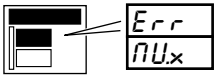
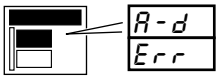
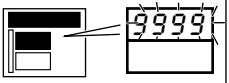
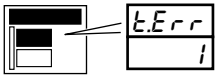
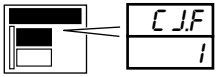
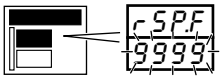
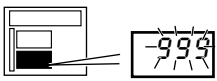
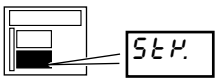
Fig. 1.3 Secret-til-lit Indicators

1.4 Character Set – Fig. 1.4

A	A	I	I	R	r
B	b	J	J	S	S
C	C	K	K	T	t
D	D	L	L	U	U
E	E	M	-	V	V
F	F	N	n	Y	y
G	G	O	O		
H	H	P	P		

Fig. 1.4 Character Set

1.5 Error Messages

Display	Error/Action	To clear the display:
	**Calibration Error** Turn mains power off and on again (if the error persists contact the Customer Support Organization).	Press the [A] key
	**Non-volatile Memory Error** x = 1: Processor Board Memory x = 3: Power Supply Board Memory Turn mains power off and on again (if the error persists, check configuration/setup settings).	Press the [A] key
	**A to D Converter Fault** The analog to digital converter is not communicating correctly.	Contact the Customer Support Organization
	**Input Value Over/Under Range**	Restore valid input
	**Auto-tune Error** Number displayed indicates the type of error – see Table 2.1, page 30.	Press the [A] key
	**Cold Junction Failed** Cold junction sensor is faulty or has not been fitted correctly.	Check connections or replace if faulty.
	**Remote Set Point Failed** Input value is over or under-range. Only appears if the remote set point is displayed or in use.	Restore valid input
	**Position Feedback Fail** Input value is over- or under-range. Only appears if output type set to 'PFb' – motorized valve with feeback.	Restore valid input
	**Valve Sticking** Motorized valve not moving at the speed expected. Valve may be sticking.	Check that the correct Regulator Travel Time has been set – see Section 3.5. Check the valve.

1.6 Processor Watchdog

The instrument's processor activity is monitored by an independent watchdog device. When the output of the watchdog is assigned to a relay or digital output, the relay/digital output de-energizes if the instrument fails to function correctly.

1.7 Loop Break Monitor

Analog output 1 is monitored continuously to detect a loop break. A warning signal or other action can be initiated by assigning the loop break signal to relays or digital outputs.

1.8 Glossary of Abbreviations

Abbreviation	Description	Abbreviation	Description
PV	Process Variable	I/P1	Analog Input 1
LSPt	Local Set Point Value	I/P2	Analog Input 2
LSP1	Local Set Point 1 Value	I/P3	Analog Input 3
LSP2	Local Set Point 2 Value	di1	Digital Input 1
LSP3	Local Set Point 3 Value	di2	Digital Input 2
LSP4	Local Set Point 4 Value	di3	Digital Input 3
CSPt	Control Set Point Value	di4	Digital Input 4
RSPt	Remote Set Point Value	ao1	Analog Output 1
PID O/P	Output of the PID Algorithm	ao2	Analog Output 2
OP1	Controller Output 1 (heat)	do1	Digital Output 1
OP2	Controller Output 2 (cool)		

Table 1.1 Glossary of Abbreviations

2.1 Introduction

The Operator level (Level 1) is the normal day-to-day mode of the COMMANDER 351. This section describes the operator facilities available on each frame depending on the control template and output type selected.

The template types detailed in this section are:

- Single loop controller
- Auto/Manual station
- Analog backup station
- Indicator/manual loader station

Note. Only the frames relevant to the selected template are displayed – see Section 4.

In addition, frames used to view the Control Efficiency Monitor and operate motorized valve and heat/cool output types are also described.

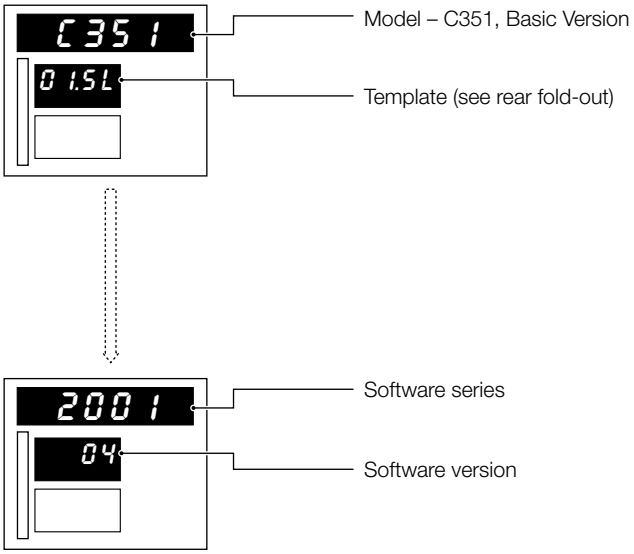


Fig. 2.1 Power-up Displays

2.2 Single Loop Controller (Templates 1 and 2)

The single loop controller is a basic feedback control system using three-term PID or on/off control with either a local set point (template 1) or remote set point (template 2).

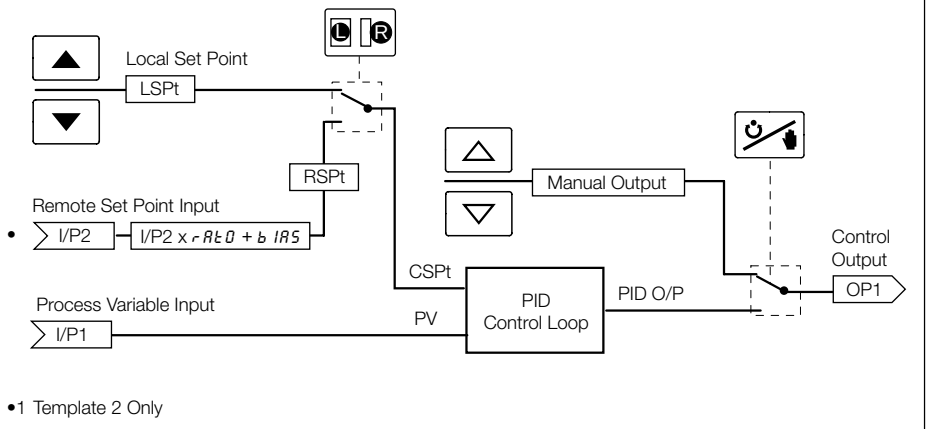
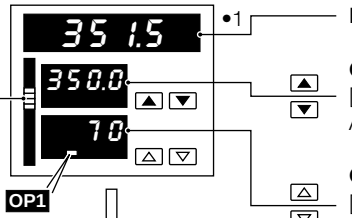


Fig. 2.2 Single Loop Controller

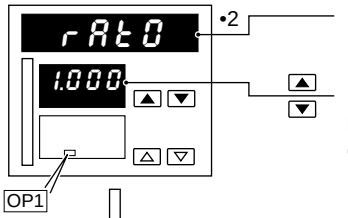
...2.2 Single Loop Controller (Templates 1 and 2)



Process Variable

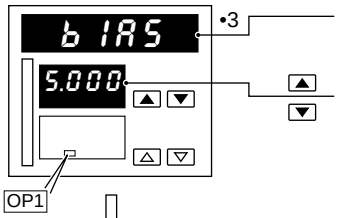
Control Set Point
['SPLO' to 'SPHI' – see Section 4.5]
Adjustable in Local Control Only

Control Output
[0 to 100% (digital/relay outputs),
–10 to 110% (analog outputs)]
Adjustable in manual mode only. With on/off control selected, 0% = control output off, 100% = control output on. In manual mode, intermediate values can be selected. These use 'time proportioning' with a 60s cycle time, e.g. 25% = 15s on, 45s off.



Remote Set Point Ratio

[0.001 to 9.999]
Remote set point value =
(ratio x remote set point input) + bias



Remote Set Point Bias

[In engineering units]

Return to top of page

•1 With the Ramping Set Point function enabled (see Section 3.3, Set Points/ Ramp Rate), the bargraph shows the actual (ramping) set point value and the digital display shows the target set point value.

•2 Displayed only if template 2 selected and Ratio Display is enabled – see Section 4.2, Basic Configuration and Section 4.7, Operator Configuration.

•3 Displayed only if template 2 selected and Bias Display is enabled – see Section 4.2, Basic Configuration and Section 4.7, Operator Configuration.

2.3 Auto/Manual Station (Templates 3 and 4)

Note. Refer also to Appendix A2.1 – Series and Parallel Operation.

The auto/manual station provides a backup for a master controller. In normal operation the COMMANDER 350's analog output follows the master controller's output value. A fault in the master system can be identified either by detecting a low signal on the master output (template 3) or via a digital signal (template 4). When a fault is detected the COMMANDER 350 goes into manual mode with its output either set to the last valid master output value or to a configured output value – see Section 4.6, Control Configuration/ Configured Output 1. When the master output is restored or the digital input returns to its inactive state, the COMMANDER 350 switches back to auto mode.

Note. The Alarm A1 Trip value must be set when using template 3.

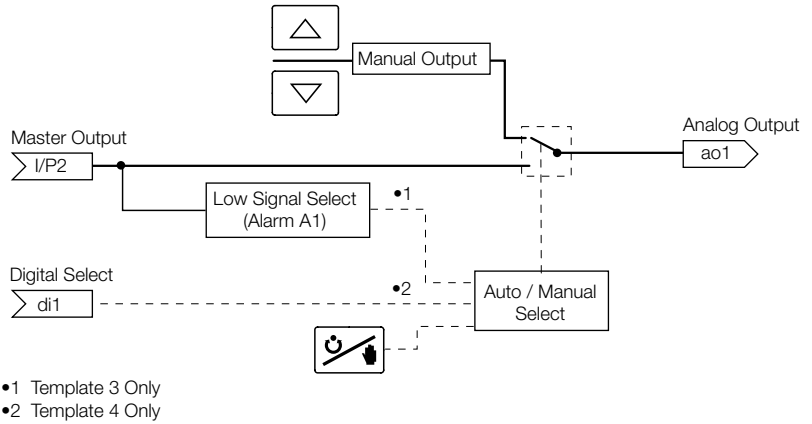
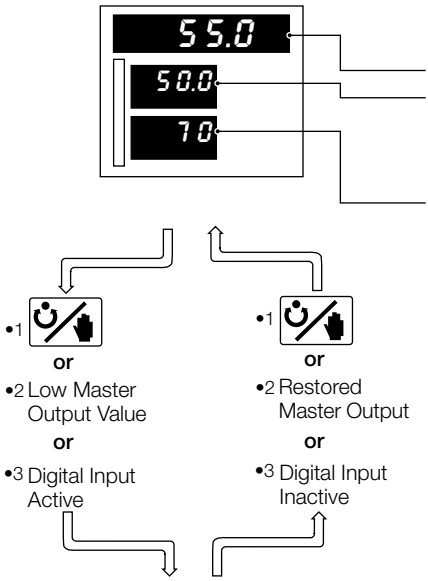


Fig. 2.3 Auto/Manual Station

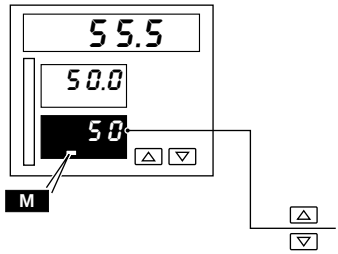
...2.3 Auto/Manual Station (Templates 3 and 4)



Auto Mode

Process Variable
Master Output (I/P2)

Control Output = Master Output
[Master Output, 0 to 100%]



Manual Mode

Control Output (under COMMANDER 350 control)
[0 to 100%]

•1 In template 4 the Auto/Manual key is overridden by the digital input signal.

•2 Template 3 only – see Section 4.2, Basic Configuration/ Template Application.

•3 Template 4 only – see Section 4.2, Basic Configuration/ Template Application.

2.4 Analog Backup (Templates 5 and 6)

Note. Refer also to Appendix A2.1 – Series and Parallel Operation.

The analog backup station provides a backup for a master controller. In normal operation (remote control mode selected) the COMMANDER 350's current output follows the master controller's output value. A fault in the master system can be identified either by detecting a low signal on the master output (template 5) or via a digital signal (template 6). When a fault is detected the COMMANDER 350 switches into local control mode and the process is controlled by the PID output of the COMMANDER 350. The COMMANDER 350 PID algorithm tracks the master output value continuously, in order to ensure bumpless transfer from remote to local mode operation. When the master output is restored or the digital input returns to its inactive state, the COMMANDER 350 switches back to remote control mode.

Note. The Alarm A1 Trip value must be set when using template 5.

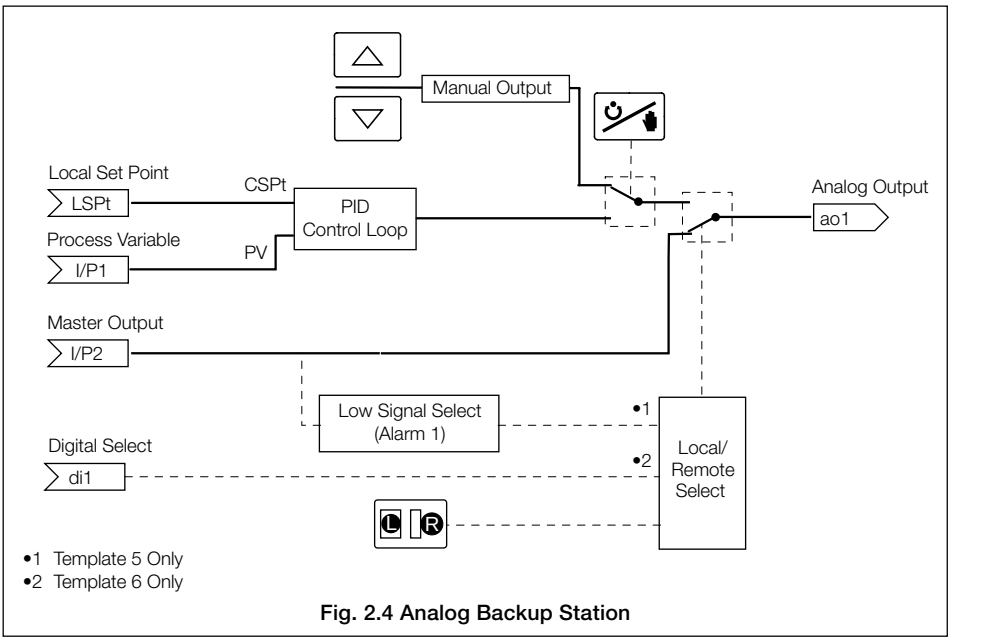
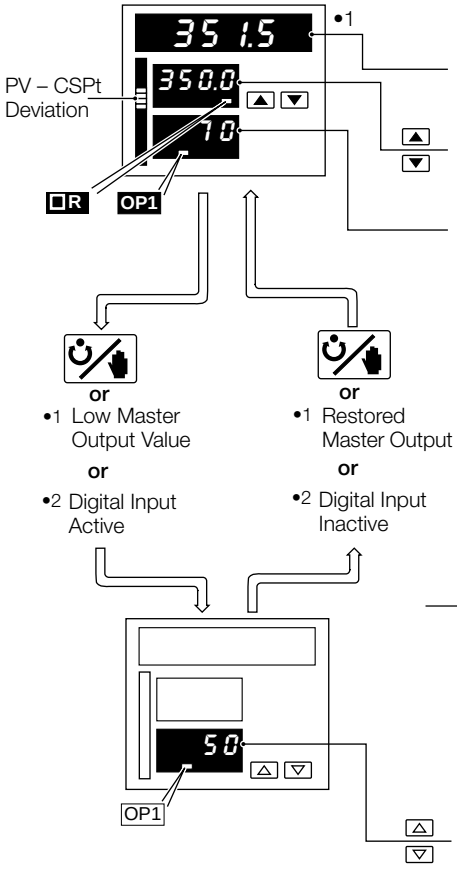


Fig. 2.4 Analog Backup Station

...2.4 Analog Backup (Templates 5 and 6)



Remote Mode

Process Variable

Set Point
['SPLO' to 'SPHI' – see Section 4.5]

Control Output = Master Output
[Master Output, 0 to 100%]

Local Mode

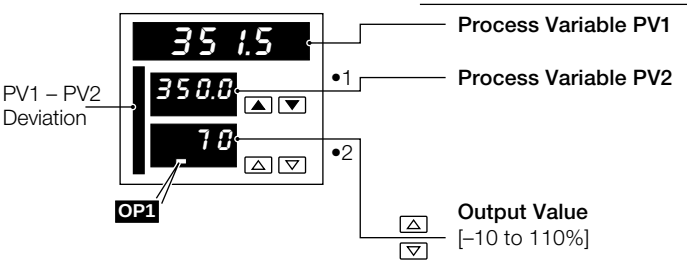
Control Output (under COMMANDER 350 control)
[0 to 100%]
Adjustable in Manual Mode only.

•1 Template 5 only – see Section 4.2, Basic Configuration/ Template Application.

•2 Template 6 only – see Section 4.2, Basic Configuration/ Template Application.

2.5 Indicator/Manual Loader Station (Templates 7 and 8)

One or two process variables can be displayed on the digital and bargraph displays. If the control output is assigned to an analog output, the lower display indicates its value which can be adjusted by the user.



•1 Displayed only if template 8 selected – see Section 4.2, Basic Configuration/ Template Application.

•2 Displayed only if control output type is 'analog' (output is assigned to Analog Output 1).

2.6 Heat/Cool Output Types

2.6.1 Reverse (Heat)/Direct (Cool) or Direct (Heat)/Reverse (Cool)

The active output, either OP1 (Heat) or OP2 (Cool) is displayed and may be adjusted in manual mode. The OP1 and OP2 l.e.d.s indicate which output is changing.

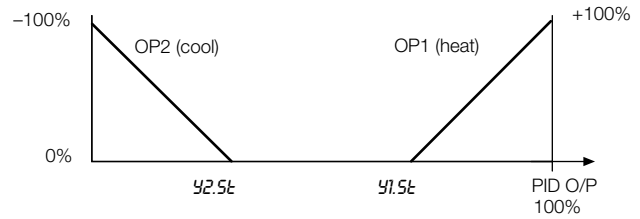
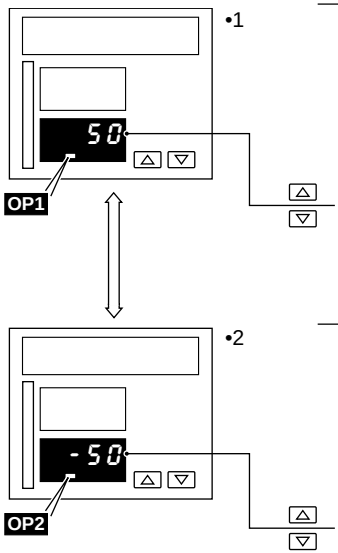


Fig. 2.5 Typical Response – Reverse/Direct or Direct/Reverse Control Action



Output Positive (Heat Output Active)

Heat Output
[0 to 100% (0 to 110% in manual mode with analog outputs)]. Adjustable in manual mode only.

Output Negative (Cool Output Active)

Cool Output
[–100 to 0% (–110 to 0% in manual mode with analog outputs)]. Adjustable in manual mode only.

2.6.2 Reverse (Heat)/Reverse (Cool) or Direct (Heat)/Direct (Cool)

It is not possible to view or adjust the heat/cool outputs directly. The PID output (0 to 100%), used to calculate the heat (OP1) and cool (OP2) outputs, is displayed and may be adjusted in manual mode. The OP1 and OP2 l.e.d.s indicate which output is changing.

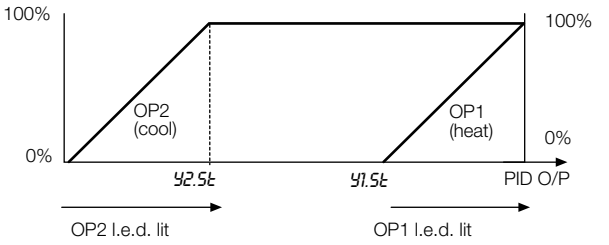
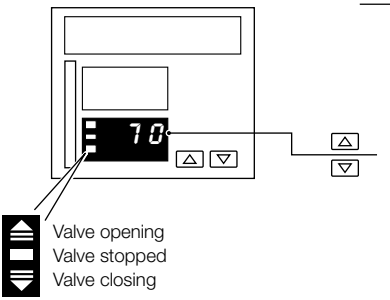


Fig. 2.6 Typical Response – Reverse/Reverse or Direct/Direct Control Action

2.7 Motorized Valve Output Types

2.7.1 Motorized Valve with Feedback

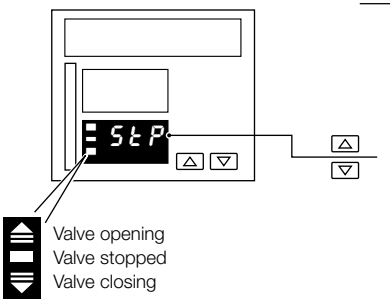


Valve Position Display

[0 to 100% of travel]

Note. In manual mode, the ▲ and ▼ keys can be used to drive the valve open and valve close relays directly.

2.7.2 Motorized Valve without Feedback (Boundless)



Valve State Display

OPn	Valve opening
StP	Valve stopped
CLS	Valve closing

Note. In manual mode, the ▲ and ▼ keys can be used to drive the valve open and valve close relays directly.

2.8 Auto-tune

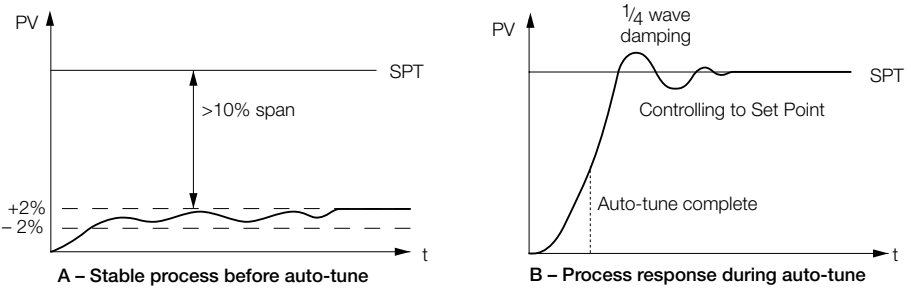
Notes.

- Auto-tune is not available for Auto/Manual Station or Indicator templates, or when boundless or heat/cool control types are selected.
- Auto-tune optimizes process control by manipulating the COMMANDER 350 output and then monitoring the process response.
- At the end of an auto-tune, the control parameters are updated automatically.
- Before starting auto-tune, the process variable must be stable.
- The COMMANDER 350 monitors the noise level of the process variable for 30 seconds and if it is greater than 2% of the engineering range the auto-tune is aborted.
- The COMMANDER 350 selects either 'start-up' or 'at set point' tuning automatically, depending upon the level of the process variable relative to the control set point.

2.8.1 Start-up Auto-tune

If the process variable is more than ±10% from the set point, 'start-up' tuning is carried out.

- 'Start-up' tuning – steps the output to drive the process towards the set point. The process response to this step change is monitored and PID parameters are calculated.
- The output step applied = % deviation from the set point x 1.5.
- If no errors exist, the COMMANDER 350 enters auto mode and begins to control the process using the new PID parameters.
- If an error occurs during the auto-tune, the COMMANDER 350 reverts to manual mode with the control output set to the default output value. An error message is displayed in the operator level – see Table 2.1.



A – Stable process before auto-tune

B – Process response during auto-tune

Fig 2.7a Typical 'Start-up' Auto-tune Cycles

Error	Description	Error	Description
1	PV failed during auto-tune	7	A resultant P, I or D value was calculated out of range
2	Auto-tune has timed out during an auto-tune step	8	PV limit exceeded ('Start up' auto-tune)
3	Process too noisy to auto-tune	9	Controller put into configuration mode
4	Process too fast to auto-tune	10	Auto-tune terminated by user
5	Process too slow to auto-tune (max 12 hours between half-cycles).	11	PV is changing in the wrong direction during step test
6	PV deviated from set point by >25% eng. span during frequency response test		

Table 2.1 Auto-tune Error Codes

2.8.2 'At Set Point' Auto-tune

If the process variable is within 10% of the set point, 'at set point' tuning is carried out.

- 'At set point' tuning – manipulates the control output to produce a controlled oscillation of the process.
- A step change of ±10% of the starting output value is applied initially. This is adjusted to give an amplitude of oscillation 3 times the noise level.
- Once the amplitude and period of oscillation are consistent (minimum 2 cycles, maximum 4 cycles) PID parameters are calculated.
- If no errors exist the controller enters auto mode and begins to control the process using the new PID parameters.
- If an error occurs during the auto-tune, the controller reverts to manual mode with the control output set to the default output value. An error message is displayed in the operator level – see Table 2.1.

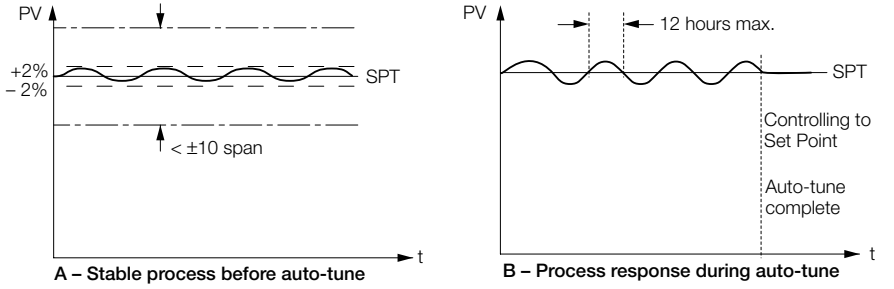
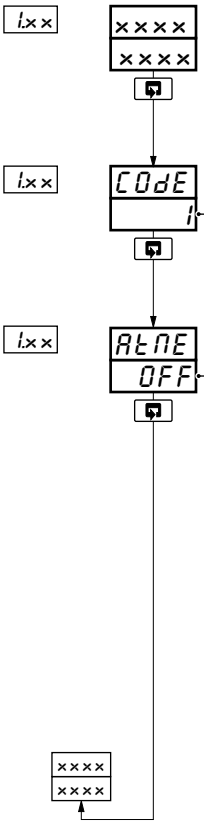


Fig 2.7b Typical 'At Set Point' Auto-tune Cycles

Note 1. The time taken to complete auto-tune depends upon the system response time.

Note 2. Time Proportioning – the cycle time must be set prior to running an auto-tune. The cycle time is not changed by the auto-tune.

2.8.3 Auto-tune



Accessing the Auto-tune Facility

From any operating frame, press and hold the ↺ key until the '*CodE*' frame is displayed.

Set the correct auto-tune password.

Auto-tune Enable

Select the type of auto-tune required.

Single Loop Templates

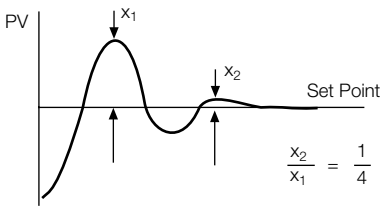
OFF – Off
A – Type A
b – Type B

Auto-tune is started automatically when the ↺ key is pressed.

Auto-tune can be stopped at any time by pressing the ⏻ key.

Note. P + I control only – set the derivative term to 'OFF' in the Tuning Level – see Section 3.2.

Return to the Operating Level.



Type A – 1/4 wave damping

Type B – Minimum Overshoot

Fig. 2.8 Autotune Types

2.9 Control Efficiency Monitor

The Control Efficiency Monitor can be used either to compare the relative performance with different tuning parameters, or when fine tuning the PID settings, to give optimum control.

When the set point is changed, auto mode is selected or following a power failure, input failure or a large load disturbance, the control monitor performs a series of measurements to indicate the effectiveness of the current control parameters.

General guidelines are shown in Table 2.2.

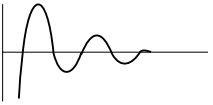
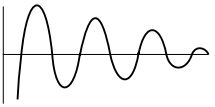
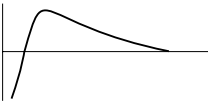
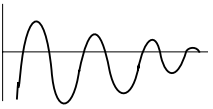
Parameter	Ideal Setting	Actual Setting	Effect on Response	Action
Rate of Approach	Fast	Too slow		• Decrease proportional band • Decrease integral time • Increase derivative time
Overshoot	Small	Too large		• Increase proportional band • Increase derivative time
Decay Ratio	Small	Too large (Oscill-atory)		• Increase proportional band • Increase integral time
Settling Time	Short	Too long		• Increase proportional band • Decrease integral time
Error Integral	Small	Too large	 	If large overshoot and oscillatory then: • Increase proportional band • Increase integral time • Increase derivative time If slow approach and overdamped then: • Decrease proportional band • Decrease integral time

Table 2.2 Control Efficiency Monitor Settings

...2.9 Control Efficiency Monitor

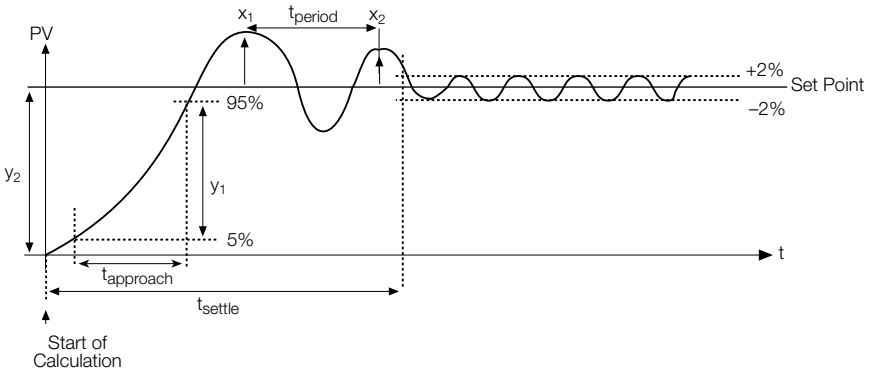


Fig. 2.9 Control Efficiency Monitor Parameters

2.9.1 Manual Tuning

The Control Efficiency Monitor may be used for manually tuning the PID parameters. The following method describes how to tune the controller for 1/4 wave damping:

a) Set the integral and derivative action times to OFF.

b) Set the proportional band (PB) to a low setting.

c) Apply a small set point change.

d) Use the Control Efficiency Monitor to note the decay ratio.

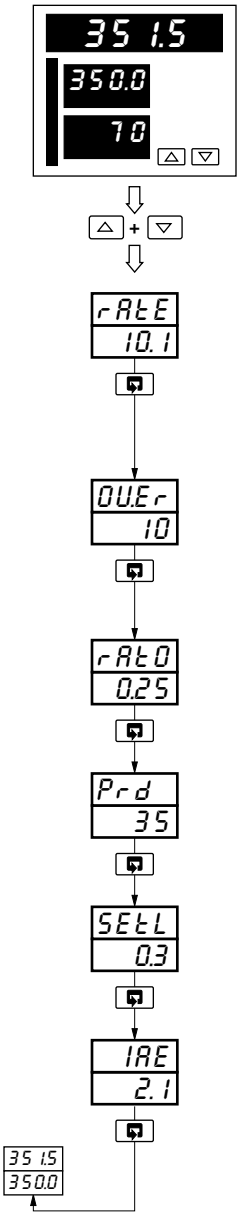
e) If the decay ratio > 0.25, increase the Proportional Band until decay ratio = 0.25
If the decay ratio < 0.25, decrease the Proportional Band until decay ratio = 0.25

f) Leave the proportional band at the setting which gives 0.25 decay ratio and, using the Control Efficiency Monitor, note the period between peaks.

g) Calculate and set the following parameters:
Integral action time = Period/1.5
Derivative action time = Period/6

Note. The manual tuning facility must not be used with boundless motorized valve control, as an Integral Action Time is required for these applications.

2.9.2 Using the Control Efficiency Monitor



Press and hold the △ and ▽ keys for 2 seconds.

Note.
If the front panel keys are not operated for 60 seconds whilst any Control Efficiency Monitor frame is being displayed, the instrument reverts to the first operating frame.

Rate of Approach to Set Point
The rate of change of the process variable between 5 and 95% of the step change (Y_2), measured in engineering units per minute.

$$\text{Rate of approach} = \frac{Y_1}{t_{approach}}$$

Overshoot
The maximum error, expressed as a percentage of the set point.

$$\text{Overshoot} = \frac{X_1}{\text{Set Point}} \times 100$$

Decay Ratio
The ratio of the amplitude of the first and second overshoots.

$$\text{Ratio} = \frac{X_2}{X_1}$$

Period
The time (in seconds) between the first two peaks (t_{period}).

Settling Time
The time taken (in minutes) for the process variable to settle within ±2% of the set point value (t_{settle}).

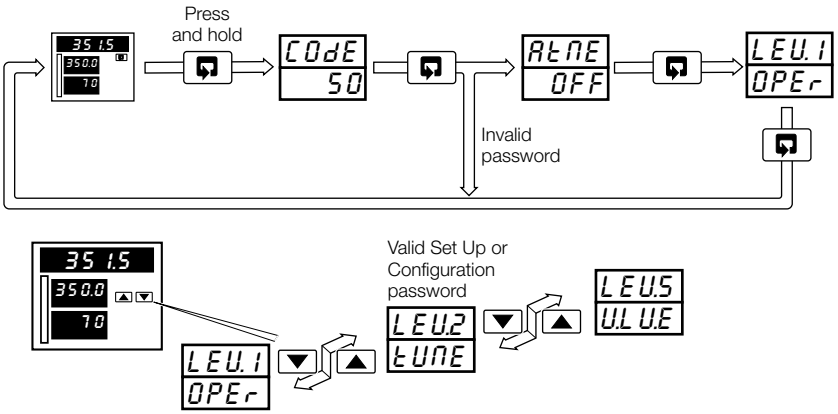
Error Integral
The integral of the error value until the process variable settles to within ±2% of the set point value in 'engineering-unit hours'.

$$\text{Error integral} = \int_0^{t_{settle}} |PV - SP| dt$$

Return to the first operating frame.

3.1 Introduction

To access the Set Up mode (Levels 2 to 5) the correct password must be entered in the security code frame.



LEU.2 **Tuning**
Cycle time, output 1 & 2
On/off hysteresis values
Proportional bands 1 to 4
Integral action times 1 to 4
Derivative action times 1 & 2
Manual reset value
Control deadband
Heat Cool Output 1 & 2 Start

LEU.3 **Set Points**
Local set point values 1 to 4
Slave set point value
Remote set point ratio/bias
Ramp rate

LEU.4 **Alarm Trip Points**
Alarm 1 to 8 trip points

LEU.5 **Motorized Valve Set Up**
With feedback:
Feedback ratio/bias
Deadband
Regulator travel time
Boundless:
Deadband
Regulator travel time

Fig. 3.1 Set Up Mode – Overview

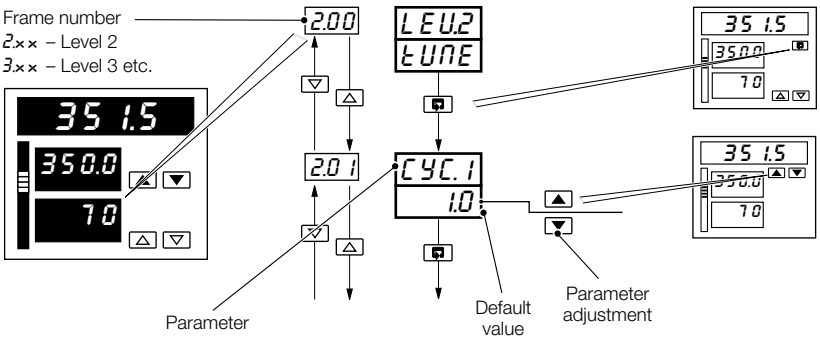


Fig. 3.2 – Scroll Display Overview

3.2 Level 2 – Tune

2.00...2.04

Note. Level 2 is not applicable if an Auto/Manual Station or Indicator template is selected.

2.00 LEU.2 / tUNE

Level 2 – Tune

Note. To select this frame from anywhere in this page, press and hold the [⟳] key for a few seconds.

2.01 CYC.1 •1 / 1.0

Cycle Time Output 1

[1.0 to 300.0 seconds for time proportioning or 'OnOF' for on/off control]

2.02 CYC.2 •1 •2 / 1.0

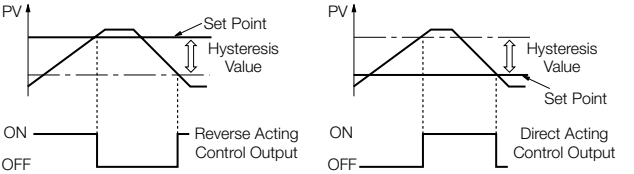
Cycle Time Output 2 (Cool)

[1.0 to 300.0 seconds for time proportioning or 'OnOF' for on/off control]

2.03 HYS 1 •3 / 0

Output 1 On/Off Hysteresis Value

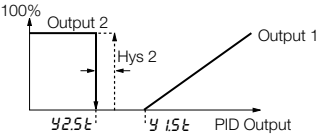
[In engineering units]



2.04 HYS2 •4 / 0

Output 2 On/Off Hysteresis Value

[0% to (Y1.St – Y2.St)%] – see parameters 2.22 and 2.23



Continued on next page

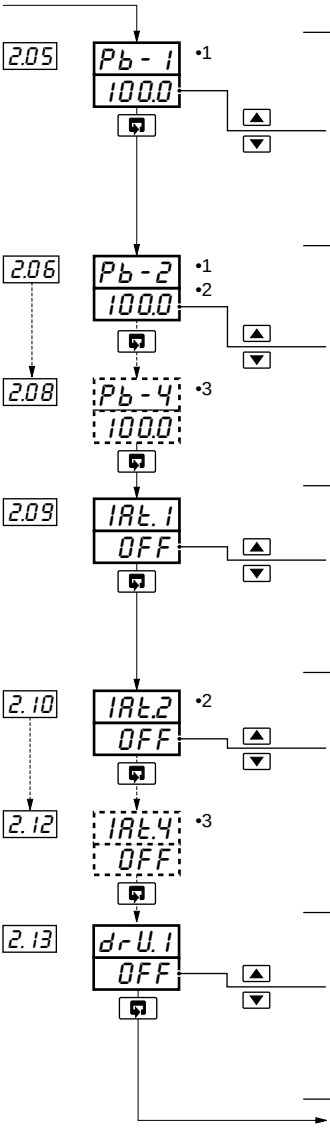
•1 Displayed only if Relay or Digital output type is selected – see Section 4.2, Basic Configuration/ Output Type.

•2 Displayed only if Heat/Cool output type is selected.

•3 Only if On/Off control is selected – see parameters 2.01 and 2.02 above.

•4 Displayed only if Heat/Cool output type is select and the 'CYC.2' parameter is set to 'OnOF'.

...3.2 Level 2 – Tune



Proportional Band 1

Enter the value for Proportional Band 1.
[0.1% to 999.9%]

'Pb - 1' is the default proportional band

Proportional Band 2, 3 and 4

Enter the value for Proportional Band 2, 3 and/or 4.
[0.1% to 999.9%]

Integral Action Time 1

[1 to 7200 seconds or 'OFF']

' IAt. 1' is the default integral action time.

Integral Action Time 2, 3 and 4

[1 to 7200 seconds or 'OFF']

Derivative Action Time 1

[0.1 to 999.9 seconds or 'OFF']

Continued on next page.

•1 Heat/cool outputs use a common proportional band. The default is 'Pb - 1'.

•2 Displayed only if a tune parameter source is selected – see Section 4.2, Basic Configuration/ Template Application and Section 4.6, Control Configuration/ Tune Parameter Source.

•3 Displayed only if a tune parameter source is selected – see Section 4.6, Control Configuration/ Tune Parameter Source.

...3.2 Level 2 – Tune

2.15 Ab.1 1.0 •1

Approach Band 1

[0.1 to 3.0 proportional bands]

This parameter limits when derivative action time 1 is applied. When the process variable is outside the approach band, derivative action is not applied.

2.17 rSt.1 50.0 •2

Manual Reset Value 1

The value applied to bring the master control output to the zero error point under normal load conditions (integral action disabled) or the offset applied to the control output (integral action enabled).

[0.0 to 100%]

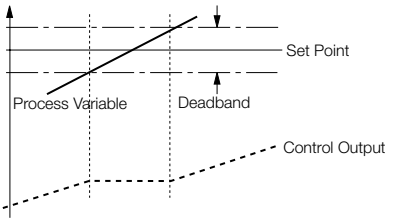
Note. Manual reset is applied whether or not an integral action time is set.

2.21 Cbnd OFF

Control Deadband

When the process variable is in the deadband, changes to the control output due to proportional and integral action are suppressed. When a cascade template is selected, the control deadband is applied to the master output only.

[In engineering units or 'OFF']

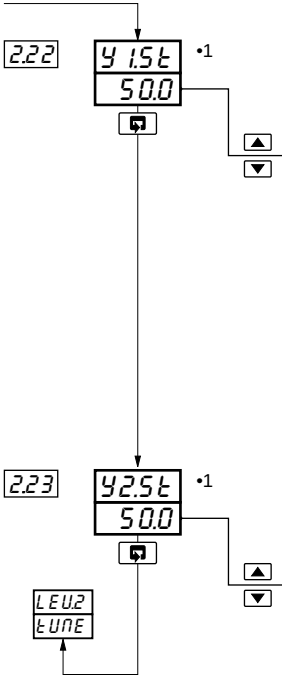


Continued on next page.

•1 Not displayed if the associated derivative action time is set to OFF.

•2 If manual control is selected and no integral action time is set, the manual reset value is calculated automatically to give bumpless transfer into auto control.

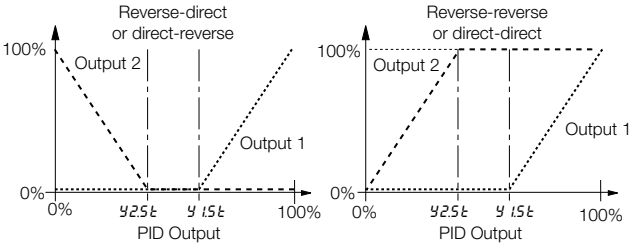
...3.2 Level 2 – Tune



Heat/Cool Output 1 Start

This parameter defines the PID output value above which Output 1 (heat) becomes active.

[0.0 to 100.0%]



Heat/Cool Output 2 Start

This parameter defines the PID output value below which Output 2 (cool) becomes active.

[0.0 to ≤ Y1st %] – see Heat/Cool Output 1

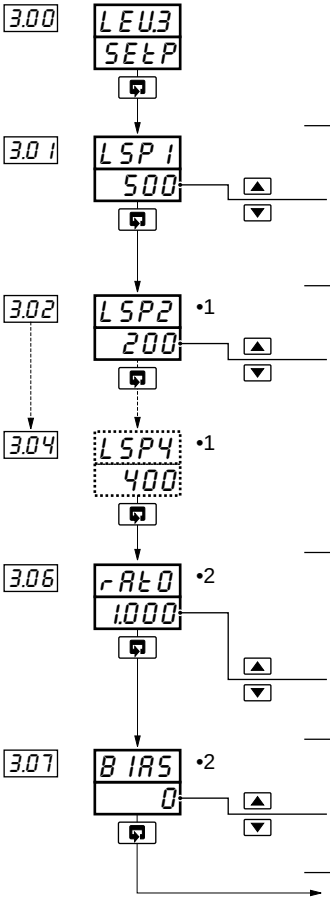
Return to top of page

•1 Displayed only if a Heat/Cool output type is selected – see Section 4.2, Basic Configuration/ Output Type.

3.3 Level 3 – Set Points

3.00...3.07

Note. Level 3 is not applicable if Auto/Manual Station or Indicator templates are selected.



Level 3 – Set Points

Note. To select this frame from anywhere in this page, press and hold the [key] key for a few seconds.

Local Set Point Value 1
Set the default local set point value.
[Within set point high and low limits, in engineering units – see Level 9]

Local Set Point Values 2 to 4

[Within set point high and low limits, in engineering units – see Level 9]

Remote Set Point Ratio
The remote set point value is
(ratio x remote set point input) + bias.

[0.001 to 9.999]

Remote Set Point Bias

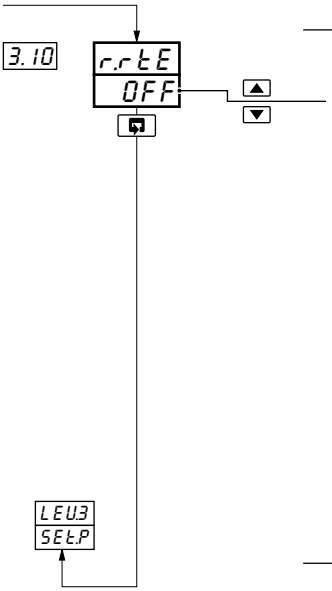
[In engineering units]

Continued…

•1 Displayed only if a local set point source is selected – see Section 4.5/ Set Point Configuration/ Local/Remote Set Point Source.

•2 Displayed only for templates with a remote set point.

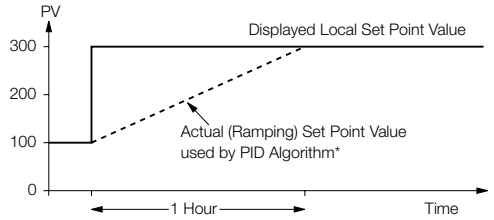
...3.3 Level 3 – Set Points



Ramp Rate

[1 to 9999 engineering units per hour, or OFF]

The Ramping Set Point facility can be used to prevent a large disturbance to the control output when the set point value is changed. The rate set applies to both the local and the remote set points.



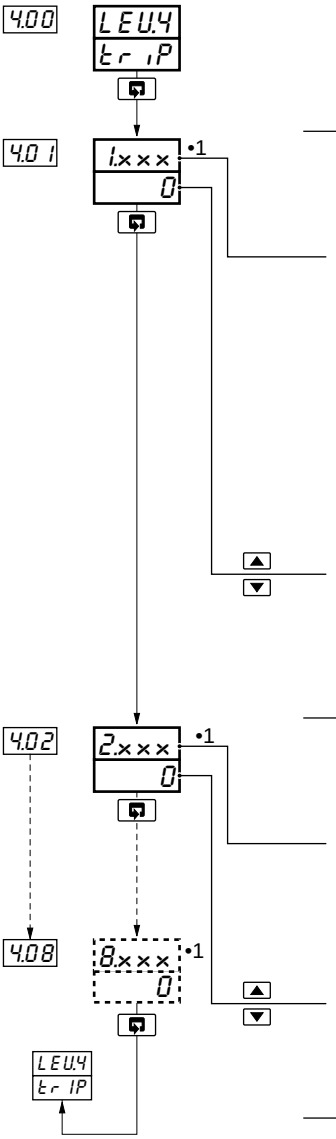
* e.g. Ramp Rate = 200 Increments/Hour

Return to top of page.

3.4 Level 4 – Alarm Trip Points

4.00...4.08

Note. Level 4 is not applicable if all alarm types are set to 'None' – see Section 4.4, Alarms/ Alarm Type.



Level 4 – Alarm Trip Points

Note. To select this frame from anywhere in this page, press and hold the ↺ key for a few seconds.

Alarm 1 Trip

Alarm Number and Type

Display	Description	Display	Description	
NONE	None	LP3	Low Process I/P3	
HPU.	High Process, PV	HO	High Output	•2
LPU.	Low Process, PV	LO	Low Output	•2
HLP	High Latch, PV	Hb1	Math Block 1 High	
LLP	Low Latch, PV	Lb1	Math Block 1 Low	
Hd	High Deviation	Hb2	Math Block 2 High	
Ld	Low Deviation	Lb2	Math Block 2 Low	
HP1	High Process I/P1	Hb3	Math Block 3 High	
LP1	Low Process I/P1	Lb3	Math Block 3 Low	
HP2	High Process I/P2	Hb4	Math Block 4 High	
LP2	Low Process I/P2	Lb4	Math Block 4 Low	
HP3	High Process I/P3			

Trip Value
[In engineering units]

Note. When an auto/manual station template or analog backup template is selected, Alarm 1 is set automatically as a low process alarm on Analog Input 2.

Alarm 2 to Alarm 8 Trip

Alarm Number and Type

See Alarm 1.

Trip Value

[In engineering units]

Return to top of page.

•1 Not displayed if alarm type set to 'None' – see Section 4.4, Alarms/ Alarm Type.

•2 Applies to PID output with single or heat/cool outputs.

3.5 Level 5 – Valve Setup

5.00...5.04

Note. Level 5 is applicable only for a motorized valve output type – see Section 4.2, Basic Configuration/ Output Type.

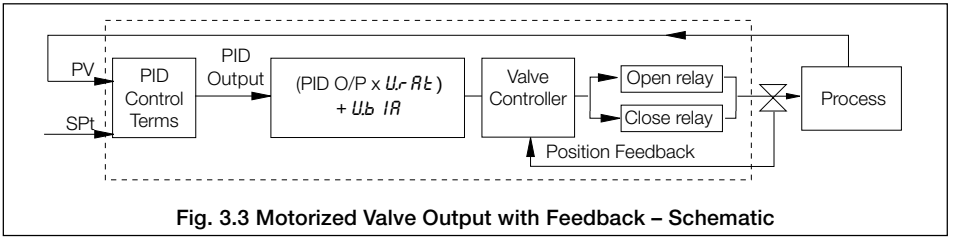
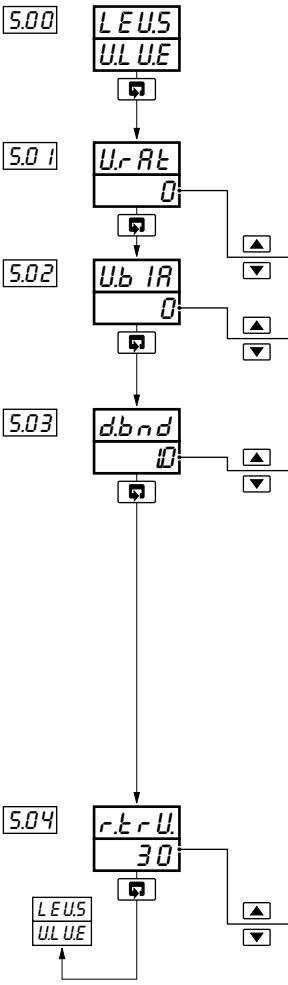


Fig. 3.3 Motorized Valve Output with Feedback – Schematic

3.5.1 Valve Setup (Feedback Types)



Level 5 – Valve Setup

Note. To select this frame from anywhere in this page, press and hold the ⮌ key for a few seconds.

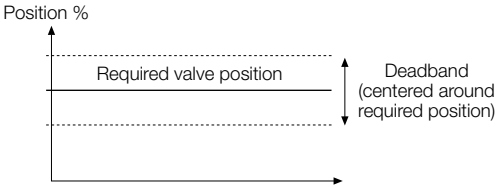
Motorized Valve Ratio and Bias
Desired valve position = (Ratio x PID output) + Bias

Motorized Valve Ratio
[0.01 to 10.00]

Motorized Valve Bias
[–100.0 to 100.0%]

Motorized Valve Deadband

[0.0 to 100% of the position feedback span]



Example. If the valve is set to be driven to the 50% open position and the deadband is set to 4%, the motor stops driving when the position feedback is 48%. The deadband is between 48% and 52%.

Regulator Travel Time
The time entered is compared with the actual travel time. If the valve is sticking an error message is generated.

[0 to 5000 seconds, 0 = no check]

Return to top of page.

3.5.2 Valve Setup (Boundless Types) – Fig. 3.4

A 'boundless' process controller provides an output that is effectively the time derivative of the required regulator position, i.e. the COMMANDER 350 signals the regulator, not where to go to (position derivative), but in which direction to travel and how far to move, by a series of integral action pulses. Thus, the COMMANDER 350 does not need to know the absolute regulator position and is unaffected when regulator reaches the upper or lower limit, as determined by the regulator's limit switches (giving rise to the term 'boundless').

When a deviation from set point is introduced the regulator is driven, for a length of time equivalent to the proportional step. The regulator is then driven by integral action pulses until the deviation is within the deadband setting.

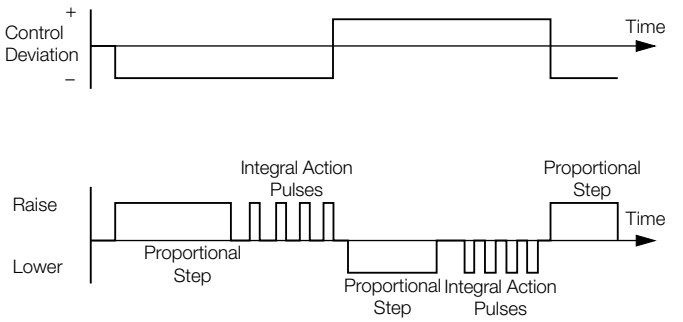


Fig. 3.4 Boundless Control Action

Calculation for Control Pulses (Boundless Control)

The following calculations are shown for guidance when setting deadband, proportional and integral values. They can be used to check the suitability of boundless control for a particular actuator/ application.

Minimum 'ON' time of integral action pulses (for a fixed control deviation).

$$= \frac{\text{Travel Time x Deadband \%}}{\text{\% Proportional Band}} \text{ (in seconds)}$$

Minimum (approximate) time between integral action pulses (for a fixed control deviation)

$$= \frac{\text{Integral Action Time x Deadband \%}}{\text{2 x \% Control Deviation}} \text{ (in seconds)}$$

Duration of the proportional step

$$= 2 \times \left[\frac{\text{\% Control Deviation}}{\text{\% Proportional Band}}\right] \times \text{Travel Time in Seconds}$$

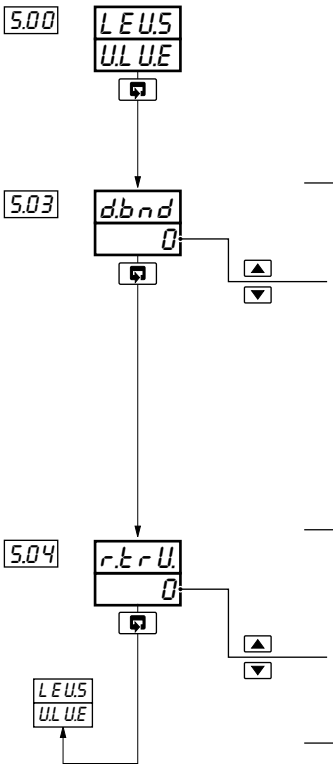
% Control Deviation

$$= \frac{\text{Set Point – Process Variable}}{\text{Eng Hi – Eng Lo}} \times 100\%$$

% Deadband

$$= \frac{\text{Deadband (eng units)}}{\text{Eng Hi – Eng Lo}} \times 100\%$$

…3.5.2 Valve Setup – Boundless

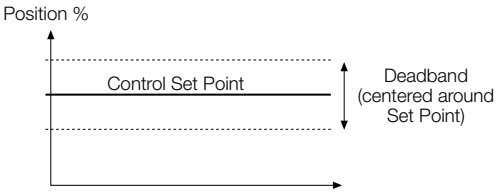


Level 5 – Valve Setup

✳ Note. To select this frame from anywhere in this page, press and hold the ↵ key for a few seconds.

Boundless Deadband

[In engineering units]



Regulator Travel Time

The time taken for the regulator to travel from the fully open to the fully closed position.

[1 to 5000 seconds]

Return to top of page.

4.1 Introduction

To access the Configuration mode (Levels 6 to E) the correct password must be entered in the security code frame.

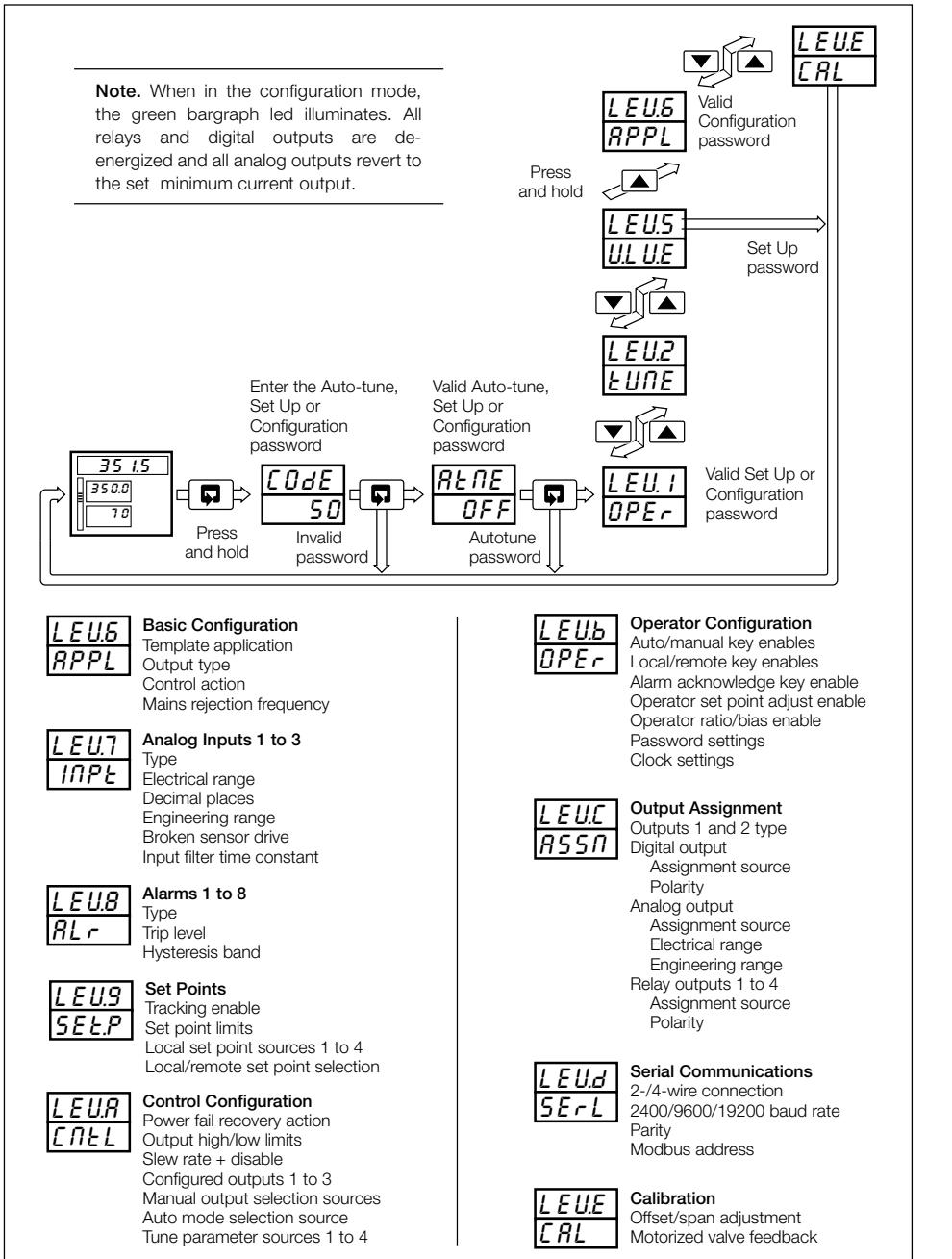
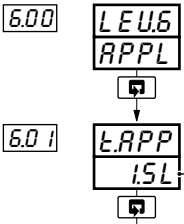


Fig. 4.1 Configuration Mode – Summary

4.2 Level 6 – Basic Configuration

6.00...6.01



Level 6 – Basic Configuration

Template Application

Templates are provided to make the basic configuration for a particular application as simple as possible. The appropriate template should be selected before any other parameters are configured. When a template is selected, the COMMANDER 350 assumes the preset form for that template (see Appendix A). The inputs and software blocks are automatically soft-wired to perform the selected function.

Select the Template required

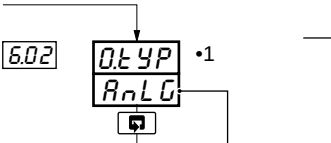
Display	Template Description
0 1.5L	Single loop with local set point only
02.5L	Single loop with remote set point
03.A_	Auto/Manual station with low signal selection
04.A_	Auto/Manual station with digital selection
05.Ab	Analog backup with low signal selection
06.Ab	Analog backup with digital selection
07. In	Single indicator/manual loader
08. In	Double indicator/manual loader

Note 1. When a template is selected, the following default values apply: The 'Analog Input Type' of all inputs used by the template defaults to '2', i.e. 4 to 20mA; The engineering ranges of all inputs used default to '0.0 to 100.0'. All other inputs are set to '*OFF*'.

Note 2. Templates customized using the PC Configurator are identified by the letter '*U*' in the template code – i.e. template '*0 1.5L* ' becomes '*0 1.U*'.

Continued…

...4.2 Level 6 – Basic Configuration 6.02



Control Output Type

The appropriate relays, digital outputs and analog outputs are assigned to the control output variables. The other hardware outputs are provisionally assigned to alarm and retransmission functions but these may be changed in the output assignment level – see Section 4.8.

Select the Output Type required – see also Fig. 4.2 overleaf and Rear Fold-out/ Table B.

Display	Output Type
nOnE	None
AnLG	Analog output (Control output = ao1)
rLY	Relay output (Control output = RLY1)
d IG	Digital output (Control output = do1)
PFb	Motorized valve with feedback (Open = RLY1, Close = RLY2) •-2
bNd	Motorized valve without feedback (Open = RLY1, Close = RLY2)
HC.rr	Heat/cool with OP1 = relay, OP2 = relay
HC.rd	Heat/cool with OP1 = relay, OP2 = digital output
HC.dr	Heat/cool with OP1 = digital output, OP2 = relay
HC.Ar	Heat/cool with OP1 = analog, OP2 = relay
HC.AA	Heat/cool with OP1 = analog, OP2 = analog

Continued…

•1 Only output types 'nOnE' and 'AnLG' are applicable to indicator templates. Only output type 'AnLG' is applicable to auto/manual station and analog backup templates.

•2 Analog Input 3 Type defaults to '11' – Resistance Feedback.

...4.2 Level 6 – Basic Configuration

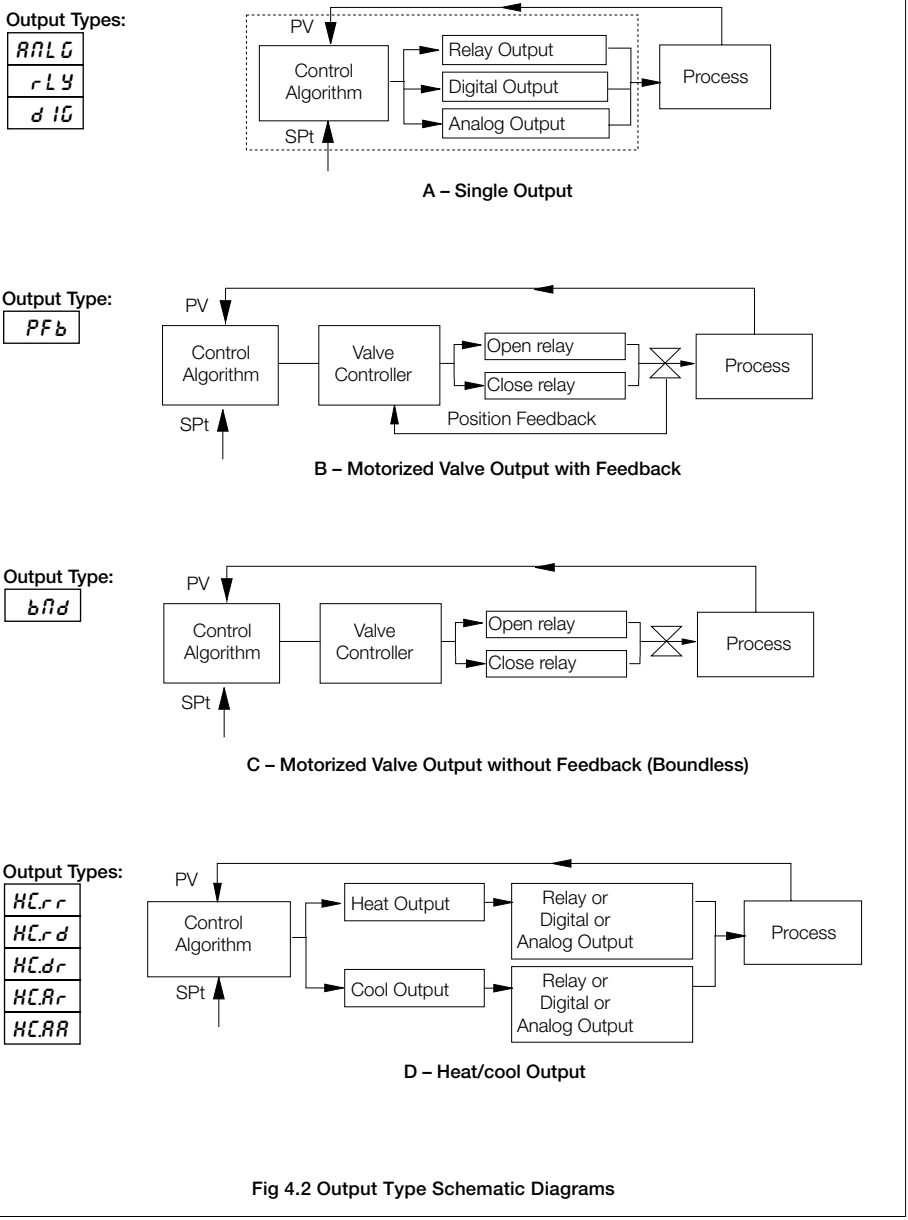
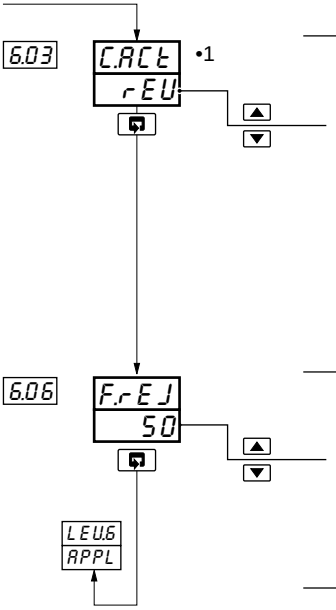


Fig 4.2 Output Type Schematic Diagrams

...4.2 Level 6 – Basic Configuration

6.03...6.06



Control Action

	Single Loop	Output 1	
•2	rEU.	Reverse	
•2	dir	Direct	
	Heat/Cool	**Output 1 (Heat)**	**Output 2 (Cool)**
•3	r-d	Reverse	Direct
•3	r-r	Reverse	Reverse
•3	d-r	Direct	Reverse
•3	d-d	Direct	Direct

Mains Rejection Frequency

Used to filter mains frequency pick-up on external analog input wiring.

[50 or 60Hz]

Return to top of page.

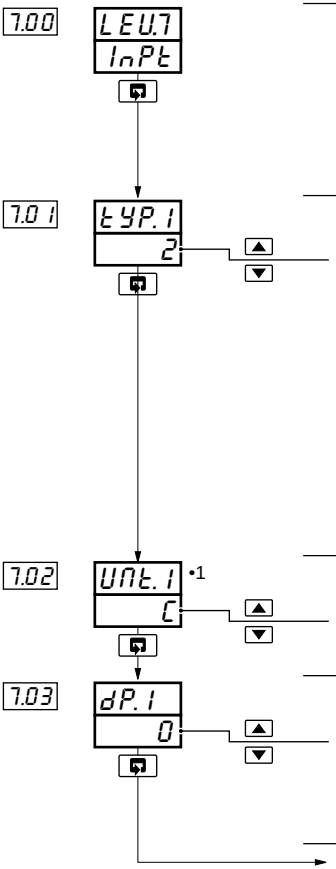
•1 Not displayed for auto/manual or indicatortemplates.

•2 Not displayed if Heat/Cool output types selected – see parameter 6.02.

•3 Displayed only if Heat/Cool output types selected – see parameter 6.02.

4.3 Level 7 – Analog Inputs

7.00...7.03



Level 7 – Analog Inputs

Note 1. Refer also to Rear Foldout/Table A, Template Applications.

Note 2. To select this frame from anywhere in this page, press the ↵ key for a few seconds.

Analog Input 1 (I/P1) Type & Electrical Range

Display	Description	Display	Description
OFF	Not Used	P	PT100 RTD
b	THC Type B	1	0 to 20mA
E	THC Type E	2	4 to 20mA
J	THC Type J	3	0 to 5V
K	THC Type K	4	1 to 5V
L	THC Type L	6	0 to 50mV
n	THC Type N	7	4 to 20mA square root linearizer
r	THC Type R	8	4 to 20mA power 3/2
S	THC Type S	9	4 to 20mA power 5/2
t	THC Type T	U	Custom

Temperature Units (I/P1)

C – THC/PT100 readings displayed in °C
F – THC/PT100 readings displayed in °F

Decimal Places (Engineering Range, I/P1)

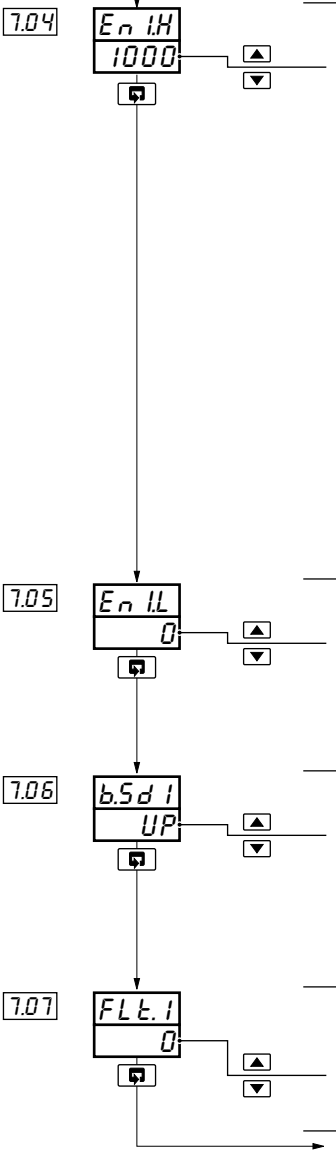
0 – XXXX
1 – XXX.X
2 – XX.XX
3 – X.XXX

Continued…

•1 Displayed only if THC or RTD input types are selected

... 4.3 Level 7 – Analog Inputs

7.04...7.07



Engineering High (I/P1)

[–999 to 9999]

Note. This parameter defaults to the maximum allowed value when THC or RTD inputs are selected – see Table 4.1.

THC/RTD Type	°C			°F		
	Min.	Max.	Min. Span	Min.	Max.	Min. Span
Type B	–18	1800	710	0	3272	1278
Type E	–100	900	45	–148	1652	81
Type J	–100	900	50	–148	1652	90
Type K	–100	1300	65	–148	2372	117
Type L	–100	900	50	–148	1652	90
Type N	–200	1300	90	–328	2372	162
Type R & S	–18	1700	320	0	3092	576
Type T	–250	300	60	–418	572	108
Pt100	–250	600	25	–328	1112	45

Table 4.1 Engineering Limits, THC & RTD Inputs

Engineering Low (I/P1)

[–999 to 9999]

Note. This parameter defaults to the minimum allowed value when THC or RTD inputs are selected – see Table 4.1.

Broken Sensor Drive (I/P1)

- `nONE` – No action. Actual input values remain valid.
- `UP` – Input driven to the maximum upscale value (999)
- `dn` – Input driven to the minimum downscale value (–999)

In the event of a fault being detected on the input, the input is driven in the direction selected.

Input Filter Time Constant (I/P1)

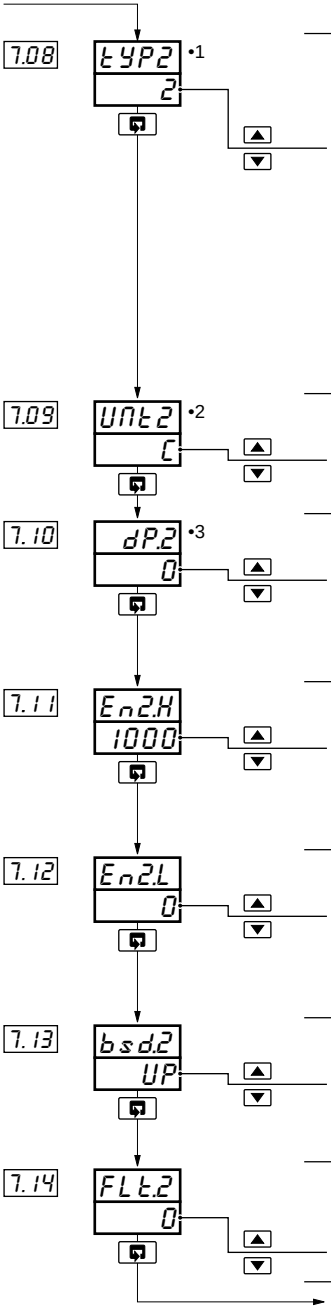
The input values are averaged over the time set.

[0 to 60 seconds]

Continued…

... 4.3 Level 7 – Analog Inputs

7.08...7.14



Analog Input Type & Electrical Range (I/P2)

Note. THC inputs can only be used on I/P2 if I/P1 is also set to THC.

Display	Description	Display	Description
OFF	Not Used	t	THC Type 1
b	THC Type B	1	0 to 20mA
E	THC Type E	2	4 to 20mA
J	THC Type J	6	0 to 50mV
K.	THC Type K	7	4 to 20mA square root linearizer
L	THC Type L	8	4 to 20mA power 3/2
n	THC Type N	9	4 to 20mA power 5/2
r	THC Type R	U	Custom
S	THC Type S		

Temperature Units (I/P2)

C – THC readings displayed in °C
F – THC readings displayed in °F

Decimal Places (Engineering Range, I/P2)

0 – XXXX
1 – XXX.X
2 – XX.XX
3 – X.XXX

Engineering High (I/P2)

[–999 to 9999]

Note. This parameter defaults to the maximum allowed value when THC input type is selected – see Table 4.1.

Engineering Low (I/P2)

[–999 to 9999]

Note. This parameter defaults to the minimum allowed value when THC input is selected – see Table 4.1.

Broken Sensor Drive (I/P2)

nonE – No action. Actual input values remain valid.
UP – Input driven to the maximum upscale value (999)
dn – Input driven to the minimum downscale value (–999)

Filter Time Constant (I/P2)
The input values are averaged over the time set.

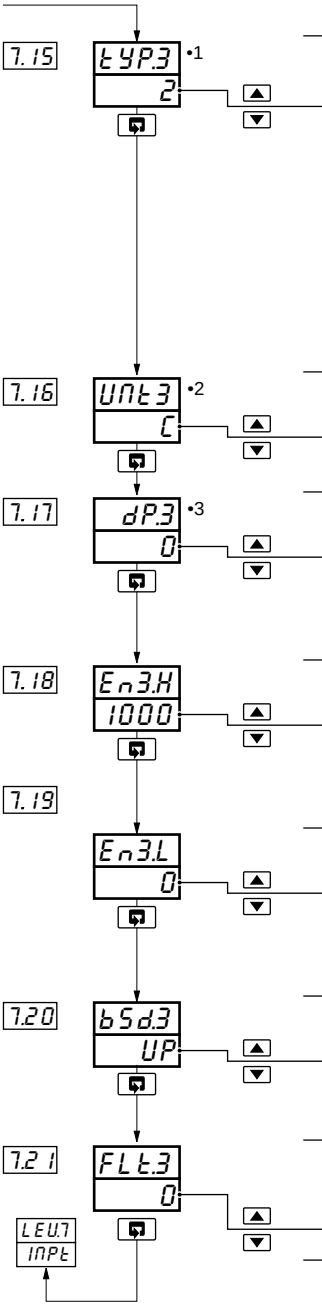
[0 to 60 seconds]

Continued…

•1 Frames 7.09 to 7.14 are not displayed if Analog Input Type 2 is set to 'OFF'.
•2 Displayed only if THC input type is selected.
•3 When i/p 2 is assigned to a remote set point input, it is displayed with the same number of decimal places as the associated process variable.

... 4.3 Level 7 – Analog Inputs

7.15...7.21



Analog Input Type & Electrical Range (I/P3)

Display	Description	Display	Description
OFF	Not Used	1	0 to 20mA
b	THC Type B	2	4 to 20mA
E	THC Type E	3	0 to 5V
J	THC Type J	4	1 to 5V
K	THC Type K	6	0 to 50mV
L	THC Type L	7	4 to 20mA square root linearizer
n	THC Type N	8	4 to 20mA power 3/2
r	THC Type R	9	4 to 20mA power 5/2
S	THC Type S	11	Resistance feedback for
t	THC Type T		motorized valve
P	PT100 RTD	U	Custom

Temperature Units

C – THC readings displayed in °C
F – THC readings displayed in °F

Decimal Places

0 – XXXX
1 – XXX.X
2 – XX.XX
3 – X.XXX

Engineering High

[–999 to 9999]

Note. This parameter defaults to the maximum allowed value when THC or RTD inputs are selected – see Table 4.1.

Engineering Low

[–999 to 9999]

Note. This parameter defaults to the minimum allowed value when THC or RTD inputs are selected – see Table 4.1.

Broken Sensor Drive (I/P3)

NONE	–	No action. Actual input values remain valid.
UP	–	Input driven to the maximum upscale value (999)
dn	–	Input driven to the minimum downscale value (–999)

Filter Time Constant (I/P3)
The input values are averaged over the time set.

[0 to 60 seconds]

Return to top of page.

•1 Frames 7.16 to 7.21 are not displayed if Analog Input Type 3 is set to 'OFF'.
•2 Displayed only if THC or RTD input types are selected.
•3 When i/p 2 is assigned to a remote set point input, it is displayed with the same number of decimal places as the associated process variable.

4.4 Level 8 – Alarms

Note. Any type of alarm can be used to sound an annunciator (klaxon/horn) which is disabled when the alarm is acknowledged. This is achieved by assigning the relay to the acknowledge state of the alarm instead of the actual alarm state.

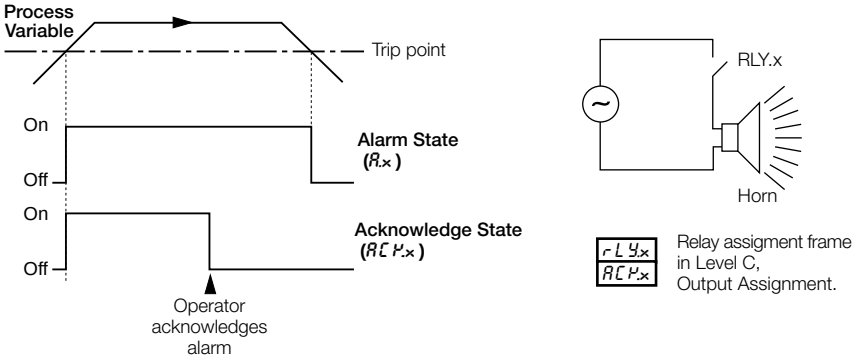


Fig 4.3 Using an Alarm to Sound a Horn

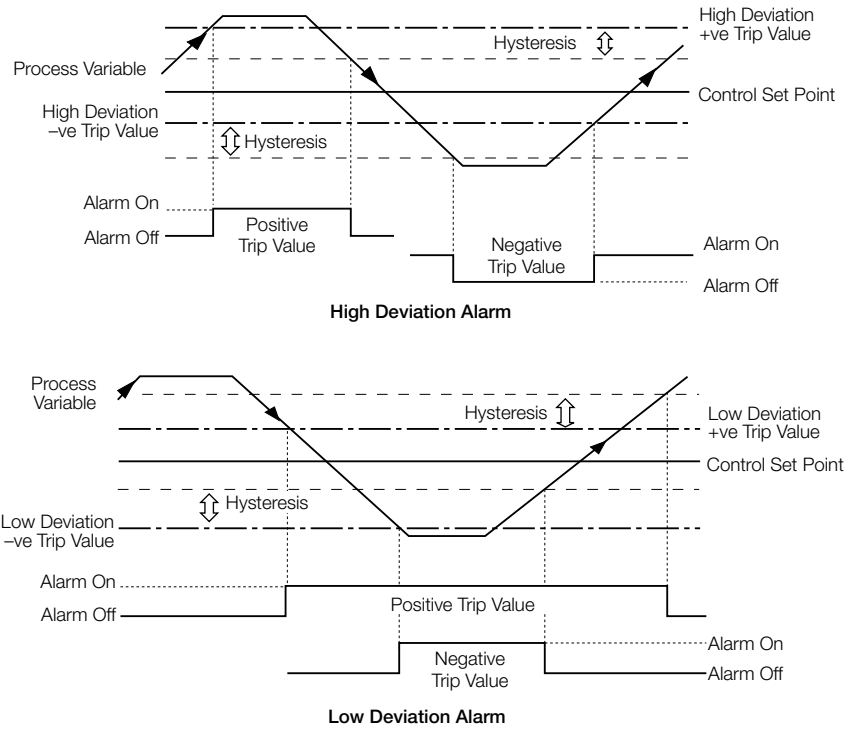


Fig 4.4 High and Low Deviation Alarm Action

...4.4 Level 8 – Alarms

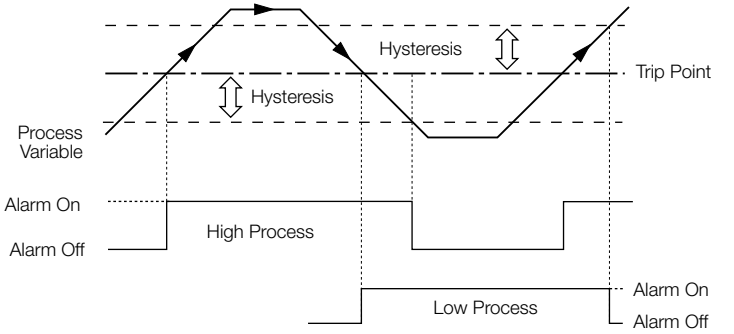
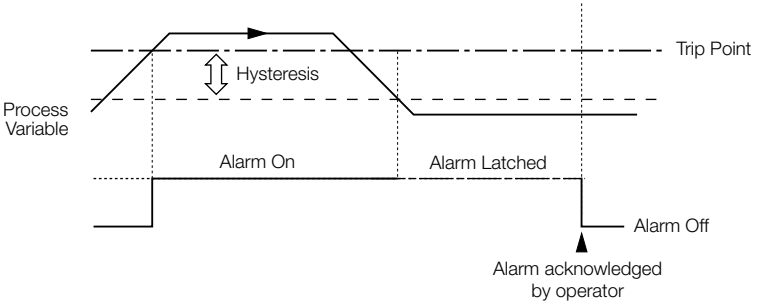
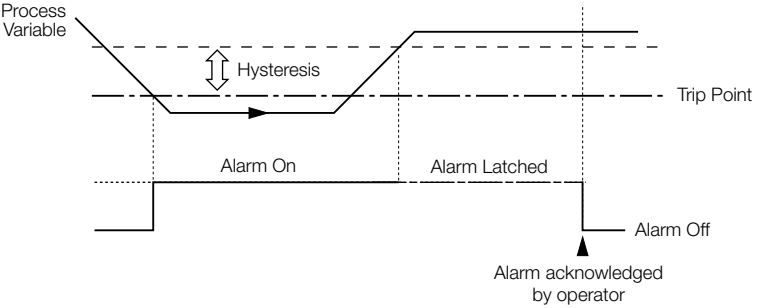


Fig 4.5 High and Low Process Alarm Action



High Latch Alarm Action

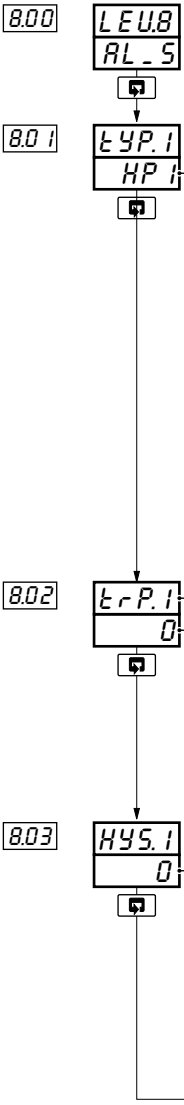


Low Latch Alarm Action

Fig 4.6 High and Low Latch Alarm Action

...4.4 Level 8 – Alarms

8.00...8.03



Level 8 – Alarms

Note. To select this frame from anywhere in this page, press the [⮌] key for a few seconds.

Alarm 1 Type

See Figs 4.3 to 4.6

Display	Description	Display	Description	
nONE	None	LP3	Low Process I/P3	
HPU.	High Process, PV	HO	High Output	•1
LPU.	Low Process, PV	LO	Low Output	•1
HLP	High Latch, PV	Hb1	Math Block 1 High	
LLP	Low Latch, PV	Lb1	Math Block 1 Low	
Hd	High Deviation	Hb2	Math Block 2 High	
Ld	Low Deviation	Lb2	Math Block 2 Low	
HP1	High Process I/P1	Hb3	Math Block 3 High	
LP1	Low Process I/P1	Lb3	Math Block 3 Low	
HP2	High Process I/P2	Hb4	Math Block 4 High	
LP2	Low Process I/P2	Lb4	Math Block 4 Low	
HP3	High Process I/P3			

Note. Alarm 1 is set automatically as a Low Process alarm on I/P2 when template 3 or 5 is selected.

Alarm 1 Trip

Alarm Number

Trip Value

[In engineering units]

Alarm 1 Hysteresis

Set the hysteresis value (in engineering units) for Alarm 1.

The alarm is activated at the trip level but is only deactivated when the process variable has moved into the safe region by an amount equal to the hysteresis value – see Figs. 4.4 to 4.6.

[In engineering units]

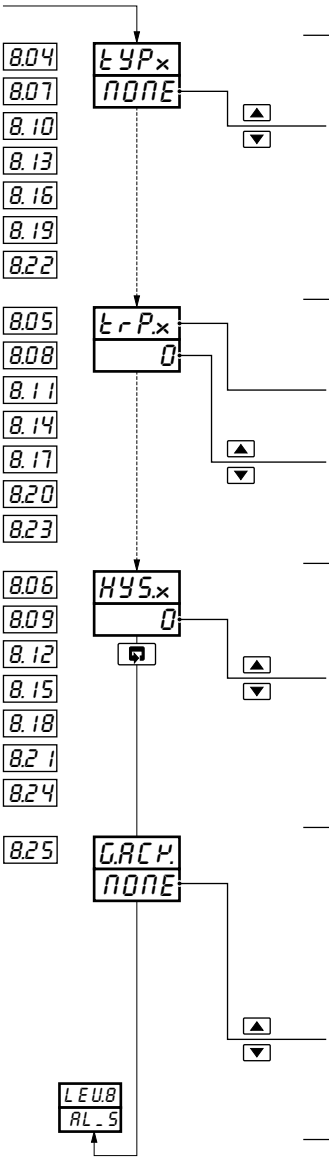
Note. Time hysteresis is set using the PC Configurator.

Continued…

•1 Applies to the PID output with single or heat/cool output types selected – see Section 3.4.

... 4.4 Level 8 – Alarms

8.04...8.25



Alarm Type 2 (Alarms 2 to 8)

[see Alarm 1 Type]

Alarm 2 to Alarm 8 Trip

Alarm Number and Type
[see Alarm 1 Trip]

Trip Value
[In engineering units]

Alarm 2 to Alarm 8 Hysteresis
Set the hysteresis value (in engineering units) – see Alarm 1 Hysteresis.

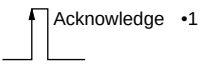
[In engineering units]

Global Alarm Acknowledge Source

Note. This frame is applicable only to issue 4 and later software.

All active and unacknowledged alarms can be acknowledged by a single digital input.
Set the source required to acknowledge all alarms

See Rear Fold-out/ Table C – Digital Sources.



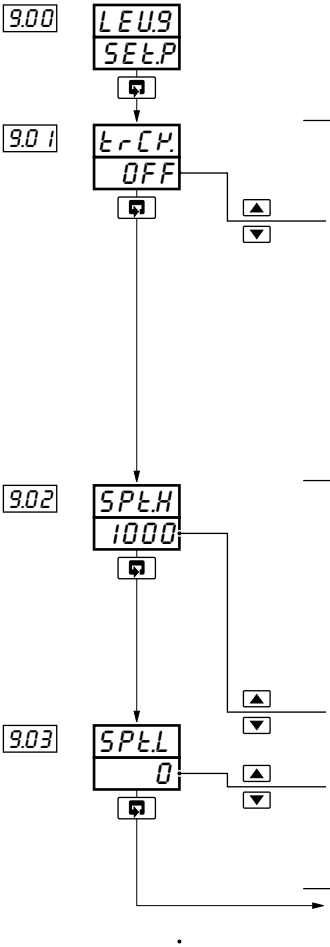
Return to top of page.

•1 A digital input becomes active when a volt-free contact is closed or a low TTL signal is applied.

4.5 Level 9 – Set Point Configuration

9.00...9.03

Note. Level 9 is not applicable when an Indicator template (templates 7 and 8) or an Auto/Manual station template (templates 3 and 4) is selected.



Level 9 – Set Point Configuration

Note. To select this frame from anywhere in this page, press and hold the ⟲ key for a few seconds.

Set Point Tracking Enable

Display	Local Set Point Tracking	Remote Set Point Tracking	
OFF	OFF	OFF	
LOC	ON	OFF	
rEM	OFF	ON	•1
L-r	ON	ON	•1

Local Set Point Tracking – the local set point tracks the process variable when manual mode is selected.
Remote Set Point Tracking – local set point tracks the remote set point when in remote set point mode. If the controller is put into manual mode the set point reverts from remote to local.

Set Point Limits
The set point limits define the maximum and minimum values to which the local and/or remote set points can be adjusted.The set point limits do not apply when in Manual mode with local set point tracking enabled. If the set point is outside its limits when Automatic mode is selected, the set point value can only be adjusted towards its limits. Once within the limits they apply as normal.

Control Set Point (CSPT) High Limit
[–999 to 9999 in engineering units]

Control Set Point (CSPT) Low Limit
[–999 to 9999 in engineering units]

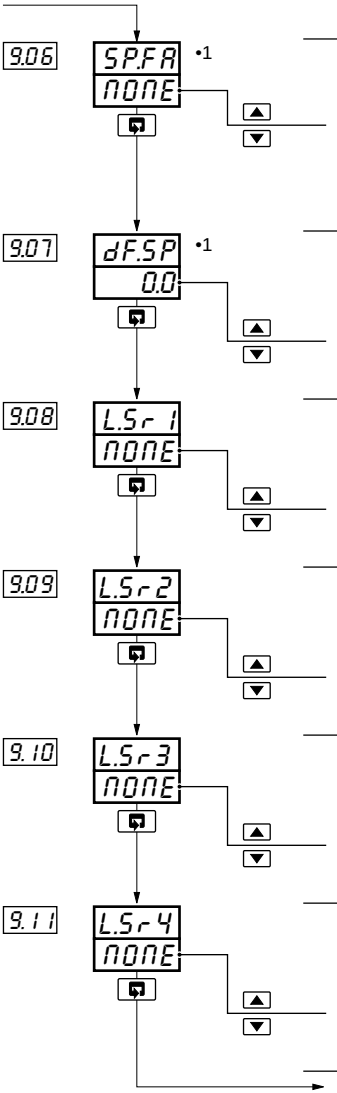
Note. Operator level adjustment of the set point can be disabled – see Section 4.7, Operator Configuration/ Set Point Adjustment Enable.

Continued…

•1 Only available if a remote set point template is selected.

...4.5 Level 9 – Set Point Configuration

9.06...9.11



Remote Set Point Fault Action
The action required when a fault occurs with the remote set point.

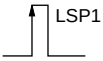
NONE – No action
LOC – Select local set point mode
dFLt – Select local set point mode and set to the default value

Local Set Point Default Value
Set the value required for the local set point under remote set point fault conditions.

[In engineering units]

Local Set Point Source 1
The source required to select local set point 1 (LSP1) as the current local set point.

See Rear Fold-out/ Table C – Digital Sources.



•2

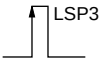
Local Set Point Source 2
The source required to select local set point 2 (LSP2) as the current local set point.

See Rear Fold-out/ Table C – Digital Sources.

•2

Local Set Point Source 3
The source required to select local set point 3 (LSP3) as the current local set point.

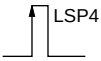
See Rear Fold-out/ Table C – Digital Sources.



•2

Local Set Point Source 4
The source required to select local set point 4 (LSP4) as the current local set point.

See Rear Fold-out/ Table C – Digital Sources.



•2

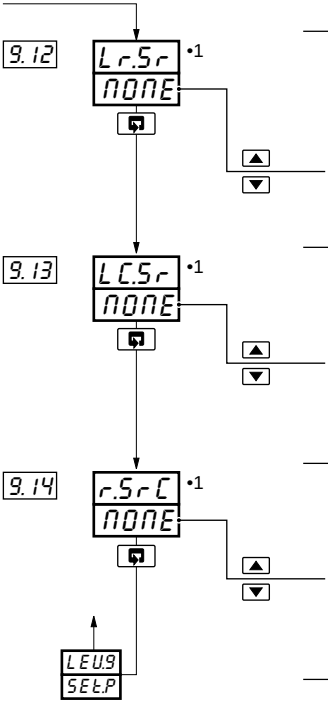
Continued…

•1 Displayed only if a remote set point template is selected.

•2 A digital input becomes active when a volt-free contact is closed or a low TTL signal is applied.

...4.5 Level 9 – Set Point Configuration

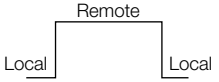
9.12...9.14



Local/Remote Set Point Selection Source
The source required to lock into remote set point mode.

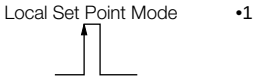
When the source is active the key does not operate.

See Rear Fold-out/ Table C – Digital Sources.



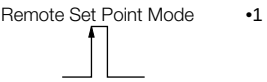
Local Set Point Selection Source
The source required to select local set point mode.

See Rear Fold-out/ Table C – Digital Sources.



Remote Set Point Selection Source
The source required to select remote set point mode.

See Rear Fold-out/ Table C – Digital Sources.



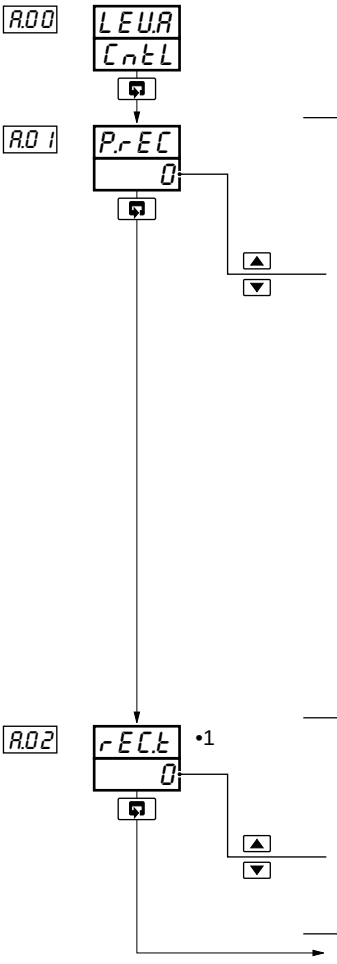
Return to top of page.

•1 Digital inputs are active when a volt-free contact is closed or a low TTL signal is applied

4.6 Level A – Control Configuration

A.00...A.02

Note. Level A is not displayed if an indicator template is selected.



Level A – Control Configuration

Note. To select this frame from anywhere in this page, press and hold the key for a few seconds.

Power Fail Recovery Mode

Select the default power failure mode required following a power interruption or failure.

Display	Setting	Display	Setting
0	Last mode	5	Auto mode, integral term reset
1	Manual mode, using last output	6	Auto mode, using last integral term
2	Manual mode with 0.0% output	7	Power outage ≤ Recovery time: Auto mode. Power outage > Recovery time: Manual mode, last output
3	Manual mode with 100.0% output	8	Power outage ≤ Recovery time: Auto mode. Power outage > Recovery time: Manual mode, configured output
4	Manual mode with configured output		

Recovery Time

If power is restored within the recovery time, the controller continues in the last mode when power fail recovery modes 7 or 8 are selected.

[0 to 9999 seconds]

Continued…

•1 Not displayed if power fail modes 0 to 6 are selected.

...4.6 Level A – Control Configuration

A.03...A.08

A.03 PU.FA / NONE

Process Variable Fail Action
Determines controller output when the process variable input fails.

NONE – No action
HOLd – Put into Manual mode
dFLt – Put into Manual mode and select default output

A.04 dF.OP / 0

Default Output
This output is used in conjunction with Power Recovery mode 8 and Process Variable Fail action.

[0 to 100%] (–100% to +100% for heat/cool)

A.05 OP.H 1 •1 / 100

Output High Limit – Single Output Control
Limits the high level of the control output in automatic mode. If the control output is above this limit when automatic mode is selected, the current output value becomes the high limit until the value falls below the limit set.

[0.0 to 100.0%]

A.06 OP.LO •1 / 0

Output Low Limit – Single Output Control
Limits the low level of the control output in automatic mode. If the control output is below this limit when automatic mode is selected, the current output value becomes the low limit until the value rises above the limit set.

[0.0 to 100.0%]

A.07 OP 1H •2 / 100.0

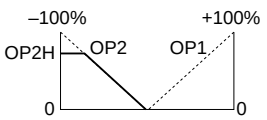
Output 1 (Heat) High Limit – Heat/Cool Control
Limits the high level of control output 1 in automatic mode. If the control output is above this limit when automatic mode is selected, the current output value becomes the high limit until the value falls below the limit set.

[0.0 to 100.0%]

A.08 OP2H •2 / 100

Output 2 (Cool) High Limit – Heat/Cool Control
Limits the high level of control output 2 in automatic mode, when 'reverse-direct' or 'direct-reverse' control action selected in the Basic Configuration level. If the control output is above this limit when automatic mode is selected, the current output value becomes the high limit until the value falls below the limit set.

[0.0 to –100.0%]



Continued…

•1 Displayed only if a single output type is selected.

•2 Displayed only if a heat/cool output type is selected.

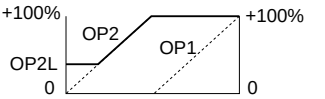
...4.6 Level A – Control Configuration

A.09...A.12

A.09 OP2L •1
0

[0 to 100%]

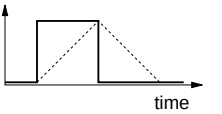
Output 2 (Cool) Low Limit – Heat/Cool Control
Limits the low level of control output 2 in automatic mode, when 'reverse-reverse' or 'direct-direct' control action is selected in the Basic Configuration level. If the control output is below this limit when automatic mode is selected, the current output value becomes the low limit until the value rises above the limit set.



A.10 OP.Sr
OFF

[0.01 to 99.99% change per second or 'OFF']

Output Slew Rate
The maximum rate of change of the control output (or both control outputs for heat/cool).

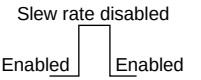


Note. The default slew rate setting is applied to both increasing and decreasing output values. The slew rate setting can be applied to either increasing values only or decreasing values only using the PC Configurator.

A.11 SrdS
OFF

See Rear Fold-out/ Table C – Digital Sources.

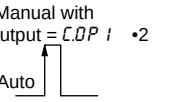
Slew Rate Disable Source
The digital source required to disable slew rate control of the output.



A.12 _Sr1
OFF

See Rear Fold-out/ Table C – Digital Sources.

Manual 1 Mode Selection Source
The digital source required to select manual mode and Configured Output 1.



Continued...

•1 Displayed only if reverse-reverse or direct-direct control actions are selected.

•2 Digital inputs are active when a volt free contact is closed or a low TTL signal is applied.

...4.6 Level A – Control Configuration

A.13...A.17

A.13 C.OP1 0.0

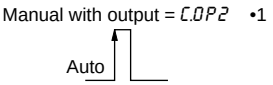
Configured Output 1
The control output value required when manual is selected by manual mode source 1.

[0 to 100% or LAST (non-heat/cool)]
[–100 to 100% (heat/cool only)]

A.14 _Sr2 OFF

Manual Mode Selection Source 2
The digital source required to select manual mode and Configured Output 2.

See Rear Fold-out/ Table C – Digital Sources.



A.15 C.OP2 0.0

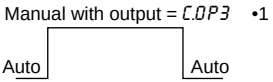
Configured Output 2
The control output value required when manual is selected by manual mode source 2.

[0 to 100% or LAST (non-heat/cool)]
[–100 to 100% (heat/cool only)]

A.16 A_Sr OFF

Auto/Manual Selection Source
Used with auto/manual station.
The source required to lock into manual mode with Configured Output 3.
Switching from manual to auto is not possible via the front panel.

See Rear Fold-out/ Table C – Digital Sources.



Note. If template 3 is selected, the source is assigned to alarm 1. If template 4 is selected, the source is assigned to digital input 1.

A.17 C.OP3 0.0

Configured Output 3
The control output value required when manual mode is selected by the auto/manual selection source.

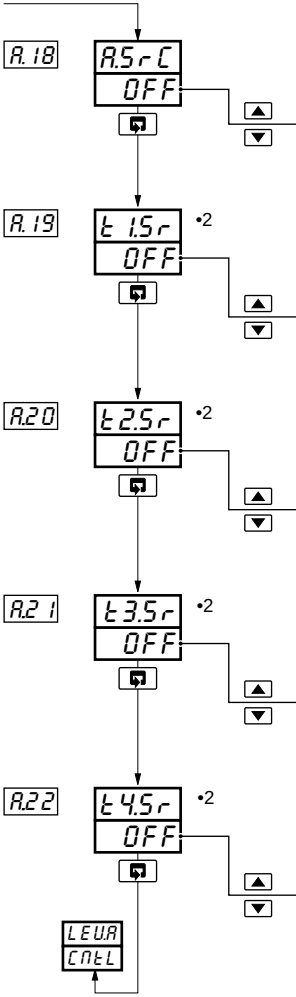
[0 to 100% or LAST (non-heat/cool)]
[–100 to 100% (heat/cool only)]

Continued...

•1 Digital inputs are active when a volt free contact is closed or a low TTL signal is applied

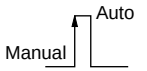
...4.6 Level A – Control Configuration

A.18...A.22



Auto Mode Selection Source
Select the digital source used to activate auto mode.

See Rear Fold-out/ Table C – Digital Sources.

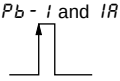


•1

Tune Parameter Source 1 (Gain Scheduling)
Determine the digital source used to select the proportional 1 and integral 1 terms as the tuning parameters.

See Rear Fold-out/ Table C – Digital Sources.

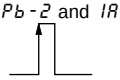
Select Pb - 1 and IAt.1 •1



Tune Parameter Source 2 (Gain Scheduling)
Determine the digital source used to select the proportional 2 and integral 2 terms as the tuning parameters.

See Rear Fold-out/ Table C – Digital Sources.

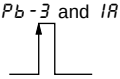
Select Pb - 2 and IAt.2 •1



Tune Parameter Source 3 (Gain Scheduling)
Determine the digital source used to select the proportional 3 and integral 3 terms as the tuning parameters..

See Rear Fold-out/ Table C – Digital Sources.

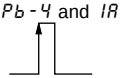
Select Pb - 3 and IAt.3 •1



Tune Parameter Source 4 (Gain Scheduling)
Determine the digital source used to select the proportional 4 and integral 4 terms as the tuning parameters.

See Rear Fold-out/ Table C – Digital Sources.

Select Pb - 4 and IAt 4 •1



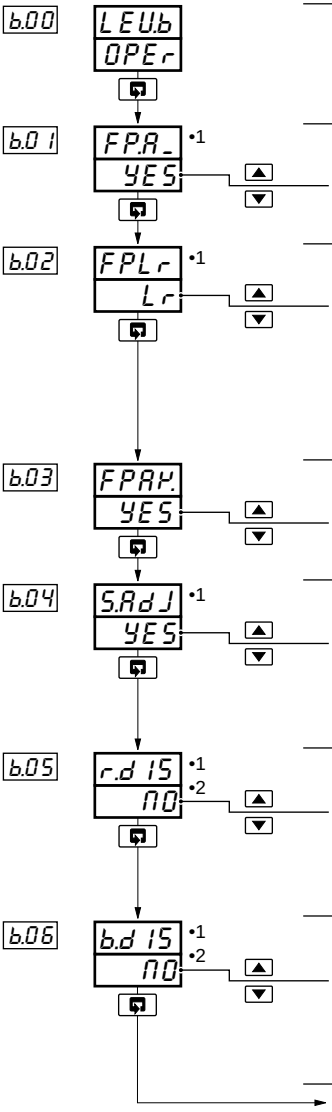
Return to top of page.

•1 Digital inputs are active when a volt free contact is closed or a low TTL signal is applied.

•2 PB-x and Int.x values are set in Level 2 – see Section 3.2, Tune/Proportional Band x and Integral Action Time x. This function is not applicable to Auto/Manual Station or Indicator templates.

4.7 Level B – Operator Configuration

b.00...b.06



Level B – Operator Configuration

Note. To select this frame from anywhere in this page, press and hold the key for a few seconds.

Front Panel Auto/Manual Key Enable

YES – Enabled
NO – Disabled

Front Panel Local/Remote Key Enable

Display	Local/Remote Key Action
NO	Local/Remote key disable.
Lr	Switches between local and remote set point modes.
2L	Selects local set point 1 or 2.
3L	Selects local set point 1, 2 or 3.
4L	Selects local set point 1, 2, 3 or 4.

Front Panel Alarm Acknowledge Key Enable

YES – Enabled
NO – Disabled

Operator Level Set Point Adjustment Enable

YES – Enabled
NO – Disabled

Operator Ratio Display

YES – Ratio setting for Remote set point displayed in operator level.
NO – Ratio setting for Remote set point not displayed in operator level.

Operator Bias Display

YES – Bias setting for Remote set point displayed in operator level.
NO – Bias setting for Remote set point not displayed in operator level.

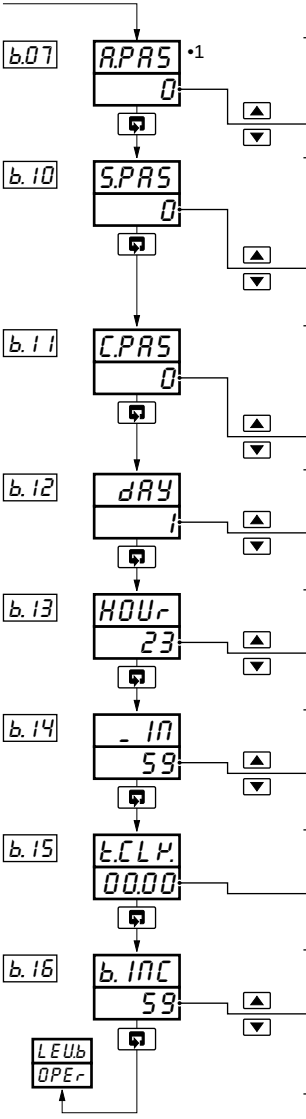
Continued…

•1 Not displayed if the Indicator template is in use.

•2 Displayed only if a template with remote set point is selected.

...4.7 Level B – Operator Configuration

b.07...b.16



Auto-tune Password
Enables access to the auto-tune facility in the operator level.

[0 to 9999 (default 0)]

Set Up Password
Enables access to the set up levels (levels 2, 3, 4 and 5) and the autotune facility.

[0 to 9999 (default 0)]

Configuration Password
Enables access to the configuration levels, set up levels and the autotune facility.

[0 to 9999 (default 0)]

Day Setting
Use to set the weekday of the on-board clock.
[1 to 7. 1 = Sunday, 7= Saturday]

Hour Setting
Use to set the hour of the on-board clock.
[0 to 23]

Minute Setting
Use to set the minute of the on-board clock.
[0 to 59]

Current Time
Actual on-board clock time.
[Hours : Mins]

Bargraph Increment
Deviation represented by each bargraph element.
[1 to 10% of engineering range]

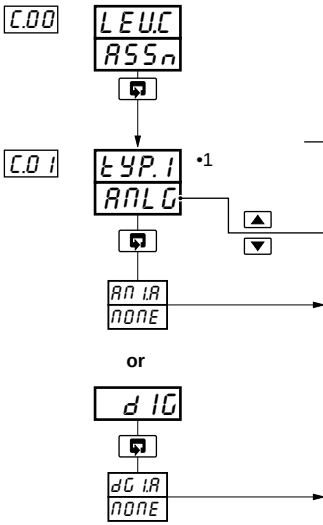
Return to top of page.

•1 Not displayed on Indicator or Auto/manual station templates.

4.8 Level C – Output Assignment Configuration

C.00, C01

Note. The Output Assignment default settings are preconfigured to each template – see Table B, Output Sources on the rear fold-out.



Level C – Output Assignment

Note. To select this frame from anywhere in this page, press and hold the [↵] key for a few seconds.

Analog/Digital Output 1 (ao1/do1) Type
Select the output type for Output 1.

ANLG – Analog
d IG – Digital

Press [↵] to advance to Analog Output 1 Assignment Source.

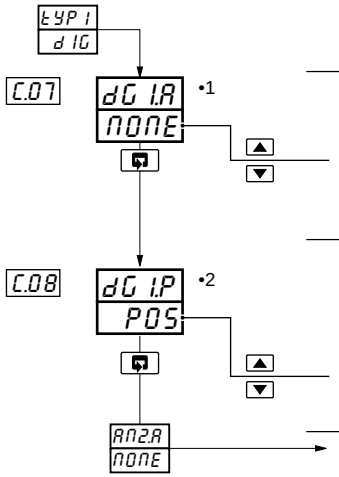
Press [↵] to advance to Digital Output 1 Assignment Source.

Continued…

•1 If the output is assigned to a control output by the control type, the setting displayed cannot be changed – see Section 4.2, Basic Configuration/Control Output Type.

4.8.1 Digital Output 1

C07, C08



Digital Output 1 (do1) Assignment Source
Select the source required to activate Digital Output 1.

See Rear Fold-out/ Table C – Digital Sources.

Digital Output 1 (do1) Polarity
The output can be set to energize for either an active or inactive digital signal.

POS – Output energized when source is active.
nEG – Output energized when source is inactive.

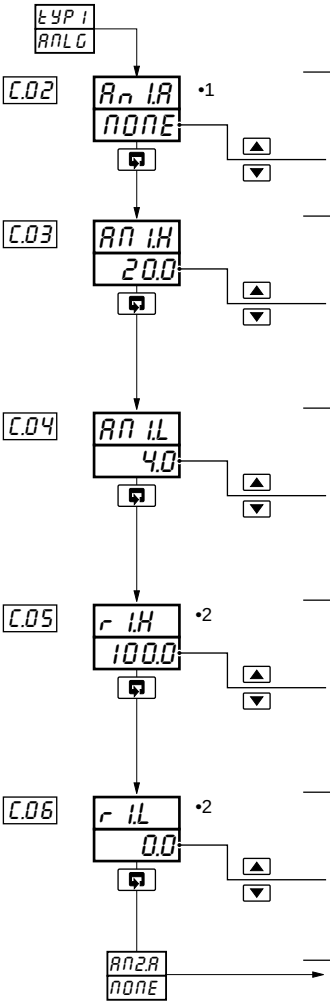
Continued…

•1 If the output is assigned to a control output by the control type, the setting displayed cannot be changed – see Section 4.2, Basic Configuration/Control Output Type.

•2 Not applicable if digital output 1 is assigned to a control output.

4.8.2 Analog Output 1

C02...C06



Analog Output 1 (ao1) Assignment Source
Select the source required to activate Analog Output 1.

See Rear Fold-out/ Table D – Analog Sources.

Analog Output 1 (ao1) Electrical High
The maximum current output required for the analog output.

[0.0 to 22.0mA]

Analog Output 1 (ao1) Electrical Low
The minimum current output required for the analog output.

[0.0 to 22.0mA]

Retransmission 1 Engineering High
The engineering range value at which maximum output is required.

[In engineering units]

Retransmission 1 Engineering Low
The engineering range value at which minimum output is required.

[In engineering units]

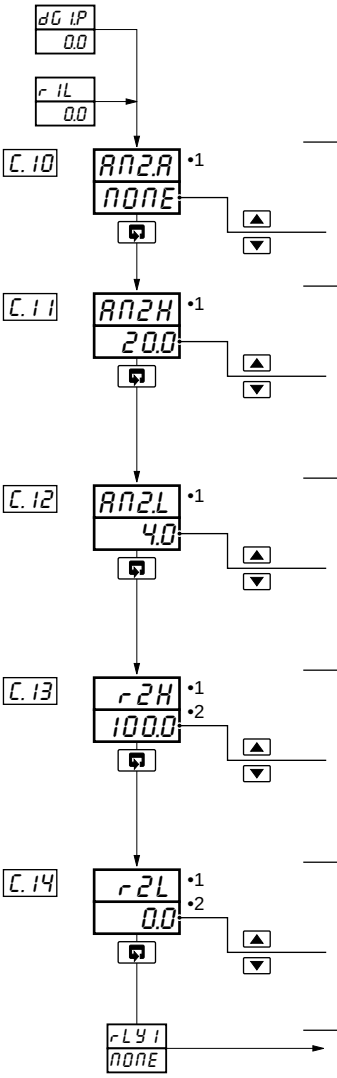
Continued...

•1 If the output is assigned to a control output by the control type, the setting displayed cannot be changed – see Section 4.2, Basic Configuration/ Control Output Type.

•2 Not applicable if analog output 1 is assigned to a control output.

4.8.3 Analog Output 2

C1 0...C1 4



Analog Output 2 (ao2) Assignment Source
Select the source required to activate Analog Output 2.

See Rear Fold-out/ Table D – Analog Sources.

Analog Output 2 (ao2) Electrical High
The maximum current output required for the retransmission range.

[0.0 to 20.0mA]

Analog Output 2 (ao2) Electrical Low
The minimum current output required for the retransmission range.

[0.0 to 20.0mA]

Retransmission 2 Engineering High
The engineering range value at which maximum output is required.

[In engineering units]

Retransmission 2 Engineering Low
The engineering range value at which minimum output is required.

[In engineering units]

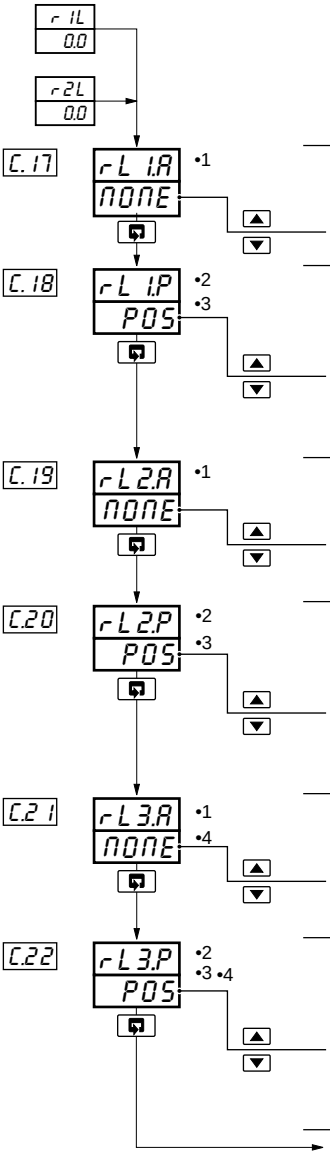
Continued…

•1 If the output is assigned to a control output by the control type, the setting displayed cannot be changed – see Section 4.2, Basic Configuration/ Control Output Type.

•2 Not applicable if analog output 2 is assigned to a control output.

4.8.4 Relay Outputs 1 to 4

C17...C22



Relay 1 Assignment Source
Select the source required to activate relay output 1.

See Rear Fold-out/ Table C – Digital Sources.

Relay 1 Polarity
The relay can be set to energize for either an active or inactive digital signal.

POS – Relay energized when source is active.
NEG – Relay energized when source is inactive.

Relay 2 Assignment Source
Select the source required to activate relay output 2.

See Rear Fold-out/ Table C – Digital Sources.

Relay 2 Polarity
The relay can be set to energize for either an active or inactive digital signal.

POS – Relay energized when source is active.
NEG – Relay energized when source is inactive.

Relay 3 Assignment Source
Select the source required to activate relay output 3.

See Rear Fold-out/ Table C – Digital Sources.

Relay 3 Polarity
The relay can be set to energize for either an active or inactive digital signal.

POS – Relay energized when source is active.
NEG – Relay energized when source is inactive.

Continued...

•1 If the output is assigned to a control output by the control type, the setting displayed cannot be changed – see Section 4.2, Basic Configuration/ Control Output Type.

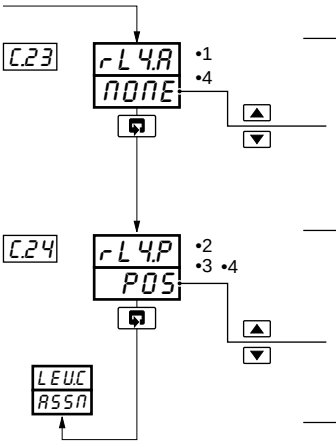
•2 Not displayed if relay is assigned to a control output signal.

•3 Not applicable if relay is assigned to a control output.

•4 Displayed only if optional relay ouput is fitted.

...4.8.4 Relay Outputs 1 to 4

C23...C24



Relay 4 Assignment Source
Select the source required to activate relay output 4.

See Rear Fold-out/ Table C – Digital Sources.

Relay 4 Polarity
The relay can be set to energize for either an active or inactive digital signal.

POS – Relay energized when source is active.
NEG – Relay energized when source is inactive.

Return to top of page.

•1 If the output is assigned to a control output by the control type, the setting displayed cannot be changed – see Section 4.2, Basic Configuration/ Control Output Type.

•2 Not displayed if relay is assigned to a control output signal.

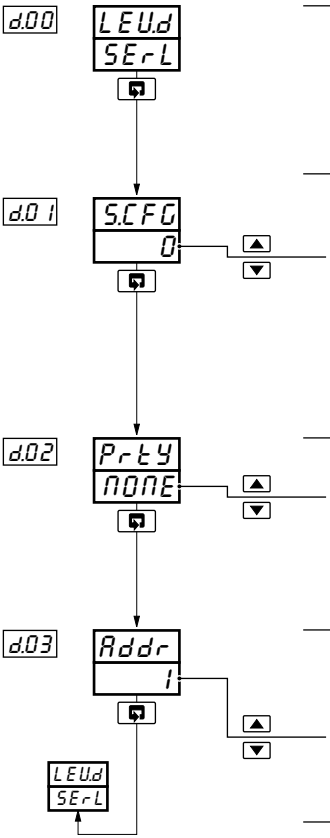
•3 Not applicable if relay is assigned to a control output.

•4 Displayed only if relay ouput is fitted.

4.9 Level D – Serial Communications Configuration

d.00...d.03

Note. Level D is only applicable if the serial communications option is fitted.



Level D – Serial Communications Configuration

Note. To select this frame from anywhere in this page, press and hold the ↺ key for a few seconds.

Serial Configuration

0 – Off
1 – 2-wire connection, 2400 baud rate
2 – 4-wire connection, 2400 baud rate
3 – 2-wire connection, 9600 baud rate
4 – 4-wire connection, 9600 baud rate
5 – 2-wire connection, 19200 baud rate
6 – 4-wire connection, 19200 baud rate

Parity

NONE – None
Odd – Odd
EVEN – Even

Modbus™ Address

Each slave on a Modbus link must be assigned a unique address – see *IM/C350–MOD.*

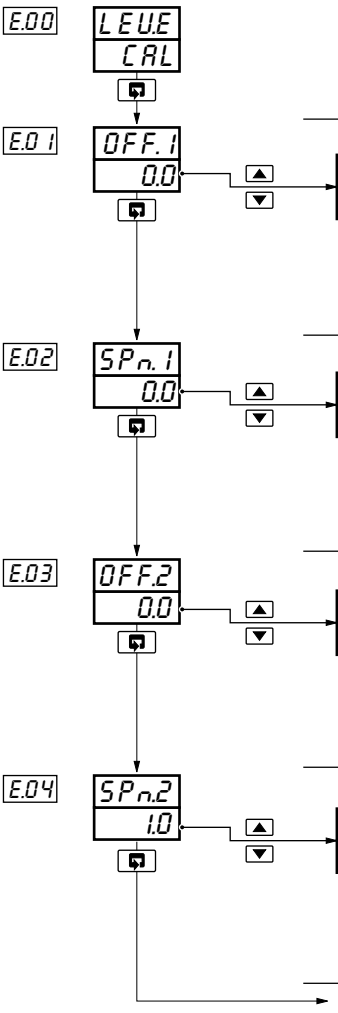
[1 to 99]

Return to top of page.

4.10 Level E – Calibration

E.00...E.04

Note. This page enables fine tuning of the inputs to eliminate system errors.



Level E – Calibration

Note. To select this frame from anywhere in this page, press the ↺ key for a few seconds.

Analog Input 1 Offset Calibration

Analog Input 1 Value in Engineering Units

Offset [in engineering Units]

If the ▲ and ▼ keys are not operated for three seconds the display reverts to the offset value only.

Analog Input 1 Span Calibration

Analog Input 1 Value in Engineering Units

Span Adjustment
[0.750 to 1.250]

If the ▲ and ▼ keys are not operated for three seconds the display reverts to the span value only.

Analog Input 2 Offset Calibration

Analog Input 2 Value in Engineering Units

Offset [In engineering Units]

If the ▲ and ▼ keys are not operated for three seconds the display reverts to the offset value only.

Analog Input 2 Span Calibration

Analog Input 2 Value in Engineering Units

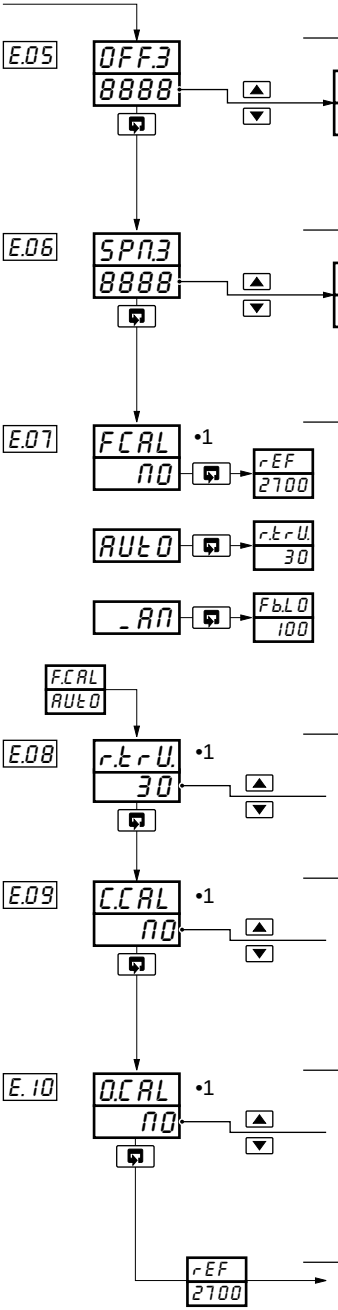
Span Adjustment
[0.750 to 1.250]

If the ▲ and ▼ keys are not operated for three seconds the display reverts to the offset value only.

Continued…

...4.10 Level E – Calibration

E.05...E.10



Analog Input 3 Offset Calibration

Analog Input 3 Value in Engineering Units

Offset [In engineering Units]

If the ▲ and ▼ keys are not operated for three seconds the display reverts to the offset value only.

Analog Input 3 Span Calibration

Analog Input 3 Value in Engineering Units

Span Adjustment
[0.750 to 1.250]

If the ▲ and ▼ keys are not operated for three seconds the display reverts to the offset value only.

Position Feedback Calibration

Select the calibration required.

- no – No Calibration
- AUtO – Auto Calibration
- _AN – Manual Calibration

Regulator Travel Time

[0 to 5000 seconds]
Ensure that the value entered is compatible with the regulator motor, as this is used to determine the length of travel of the feedback mechanism.

Motorized Valve Feedback – Fully-closed Position

- no – No action
- YES – Fully closes the valve automatically and sets the electrical input to low range value.

Note. Input value flashes when calibration is in progress.

Motorized Valve Feedback – Fully-open Position

- no – No action
- YES – Fully opens the valve automatically and sets the electrical input to high range value.

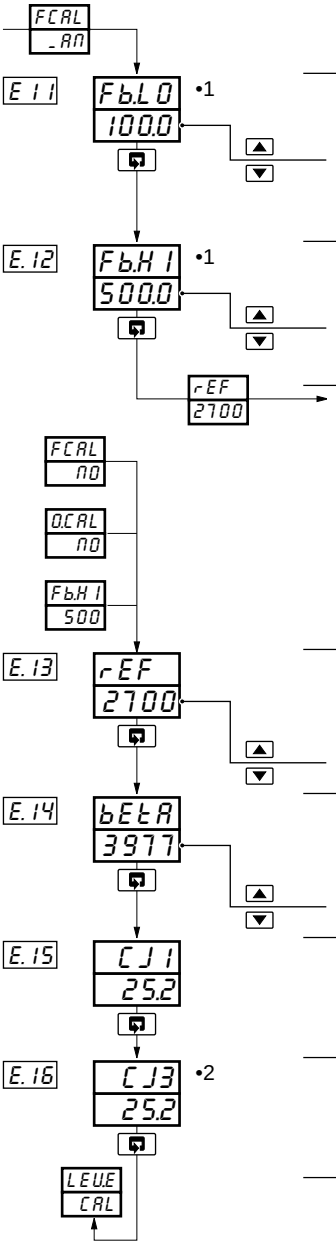
Note. Input value flashes when calibration is in progress.

Continued in Cold Junction Reference Value frame.

•1 Displayed only if Motorized Valve with feedback output type is selected – see Section 4.2, Basic Configuration.

...4.10 Level E – Calibration

E.11 ...E.16



Position Feedback Electrical Range Low
Set the minimum electrical input value.

[0.0 to 999.9]
For resistance input types, no decimal places are displayed. For all other input types, 1 decimal place is displayed.

Position Feedback Electrical Range High
Set the maximum electrical input value.

[0.0 to 999.9]

Continued in Cold Junction **Reference Value** frame.

Cold Junction Reference Value
This value should only be changed if a new CJ sensor is supplied with a CJ reference value different to 2700.

The resistance (in Ohms) of the CJ sensor at 25°C.

Cold Junction Beta Value
This value should only be changed if a new CJ sensor is supplied with a CJ Beta value different to 3977.

The beta value of the CJ sensor.

Cold Junction Reading – I/P1 and I/P2
The temperature measured by the cold junction sensor is displayed in °C.

Cold Junction Reading – I/P3
The temperature measured by the cold junction sensor is displayed in °C.

Return to top of Calibration Level.

•1 Displayed only if Motorized Valve with feedback output type is selected – see Section 4.2, Basic Configuration.

•2 Displayed only if corresponding input type is set to 'THC'.

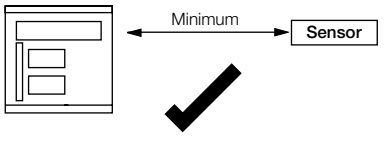
EC Directive 89/336/EEC
In order to meet the requirements of EC Directive 89/336/EEC for EMC regulations, this product must not be used in a non-industrial environment.

Cleaning
Clean only the front panel, using warm water and a mild detergent.

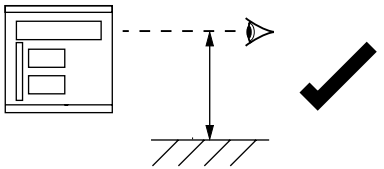
End of Life Disposal
- The instrument contains a small lithium battery which should be removed and disposed of responsibly in accordance with local environmental regulations.
- The remainder of the instrument does not contain any substance that will cause undue harm to the environment and may therefore be considered as normal waste and disposed of accordingly.

5.1 Mechanical Installation

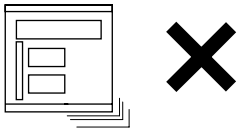
5.1.1 Siting – Figs. 5.1 and 5.2



A – Close to Sensor

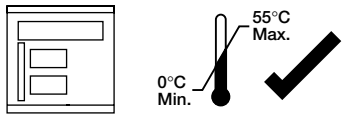


B – At Eye-level Location

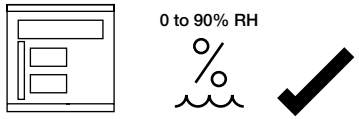


C – Avoid Vibration

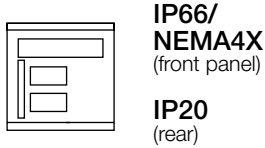
Fig. 5.1 General Requirements



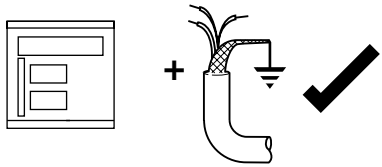
A – Within Temperature Limits



B – Within Humidity Limits



C – Within Protection Rating Limits



Warning. Select a location away from strong electrical and magnetic fields. If these cannot be avoided, particularly in applications where 'walkie talkies' are used, connect using screened cables within grounded metal conduit.

D – Use Screened Cables

Fig. 5.2 Environmental Requirements

5.1.2 Mounting – Figs. 5.3 to 5.5

The instrument is designed for panel mounting (Fig. 5.4). Overall dimensions are shown in Fig. 5.3.

Note. For NEMA4X protection, a minimum panel thickness of 2.5mm is recommended.

Dimensions in mm (in.)

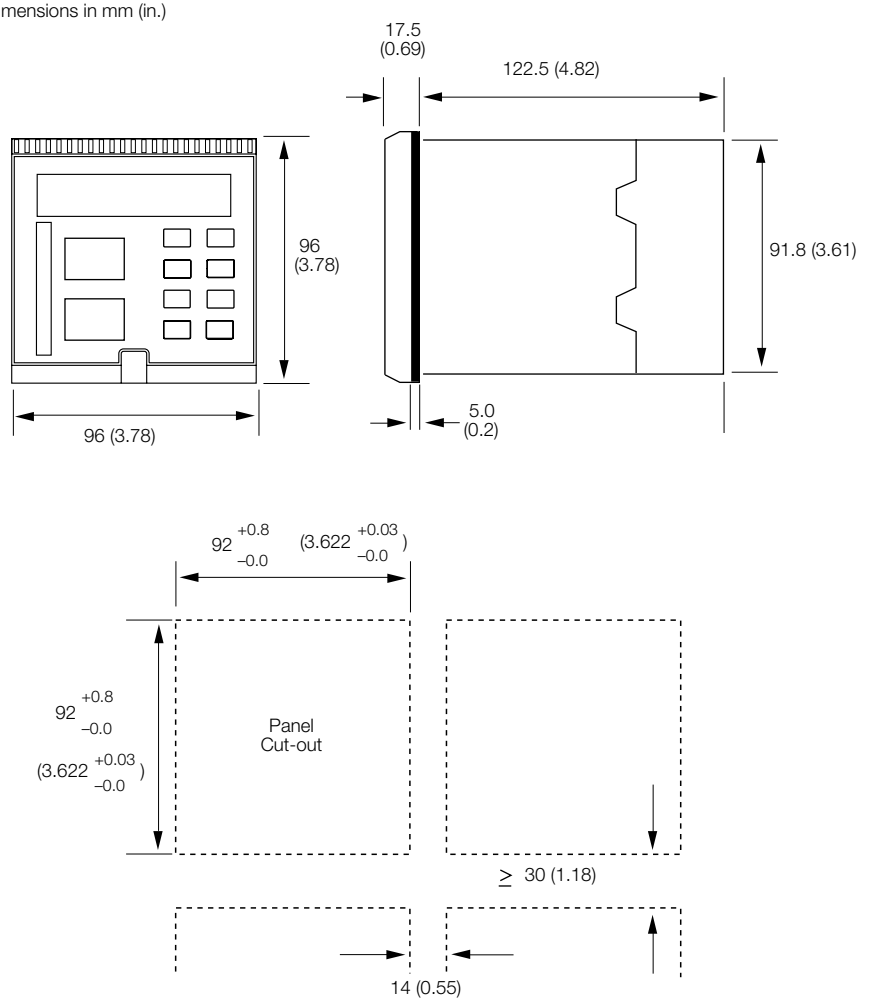


Fig. 5.3 Overall Dimensions

...5.1.2 Mounting – Figs. 5.3 to 5.5

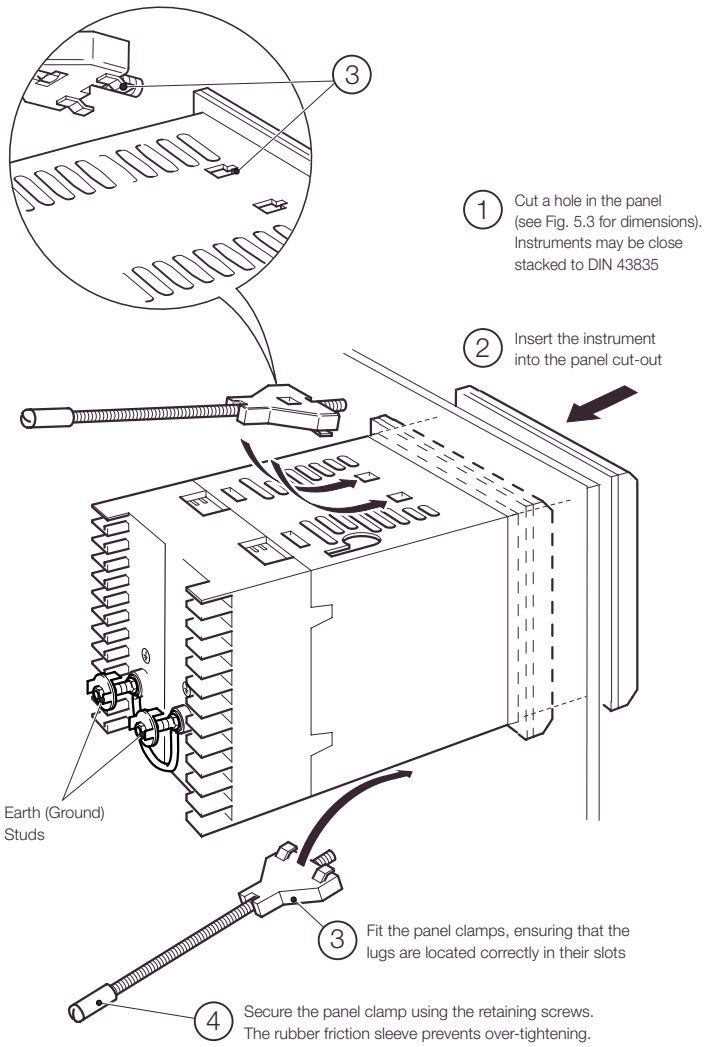
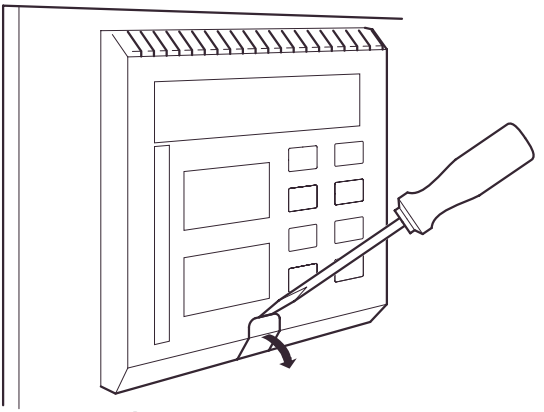
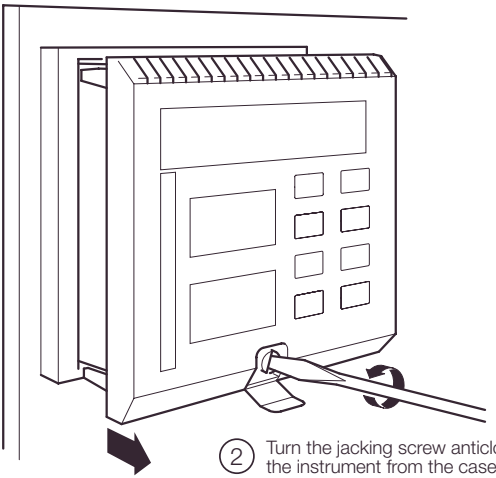


Fig. 5.4 Mounting

...5.1.2 Mounting – Figs. 5.3 to 5.5



1 Release the jacking screw cover



2 Turn the jacking screw anticlockwise to pull the instrument from the case

Note. Refitting is the reversal of removal.

Fig. 5.5 Inserting/Removing the Instrument from the Case

5.2 Electrical Installation

Refer to the Template Applications table and Output Sources table on the rear fold-out to determine the input and output connections to be made.

Warnings.

- The instrument is not fitted with a switch therefore a disconnecting device such as a switch or circuit breaker conforming to local safety standards must be fitted to the final installation. It must be fitted in close proximity to the instrument within easy reach of the operator and must be marked clearly as the disconnection device for the instrument.
- Remove all power from supply, relay and any powered control circuits and high common mode voltages before accessing or making any connections.
- Use cable appropriate for the load currents. The terminals accept cables up to 14AWG (2.5mm^2).
- The instrument conforms to Mains Power Input Insulation Category II. All other inputs and outputs conform to Category II.
- All connections to secondary circuits must have basic insulation.
- After installation, there must be no access to live parts e.g. terminals.
- Terminals for external circuits are for use only with equipment with no accessible live parts.
- If the instrument is used in a manner not specified by the Company, the protection provided by the equipment may be impaired.
- All equipment connected to the instrument's terminals must comply with local safety standards (CEI/IEC 61010-1:2001-2).

Notes.

- Always route signal leads and power cables separately, preferably in earthed (grounded) metal conduit.
- It is strongly recommended that screened cable is used for signal inputs and relay connections. Connect the screen to the earth (ground stud) – see Fig. 5.4.
- The battery is a 3V non-replaceable lithium cell.

5.2.1 Electrical Connections – Figs 5.6 to 5.8

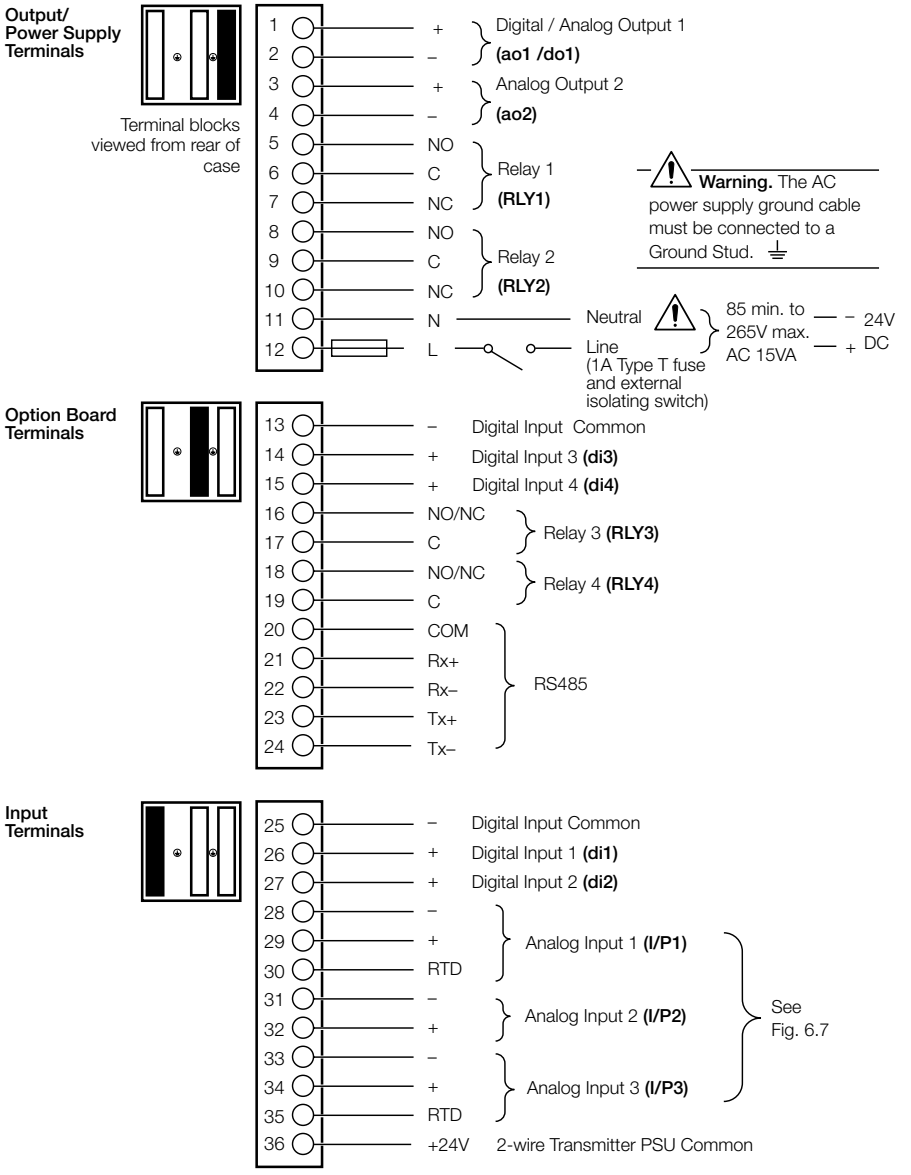
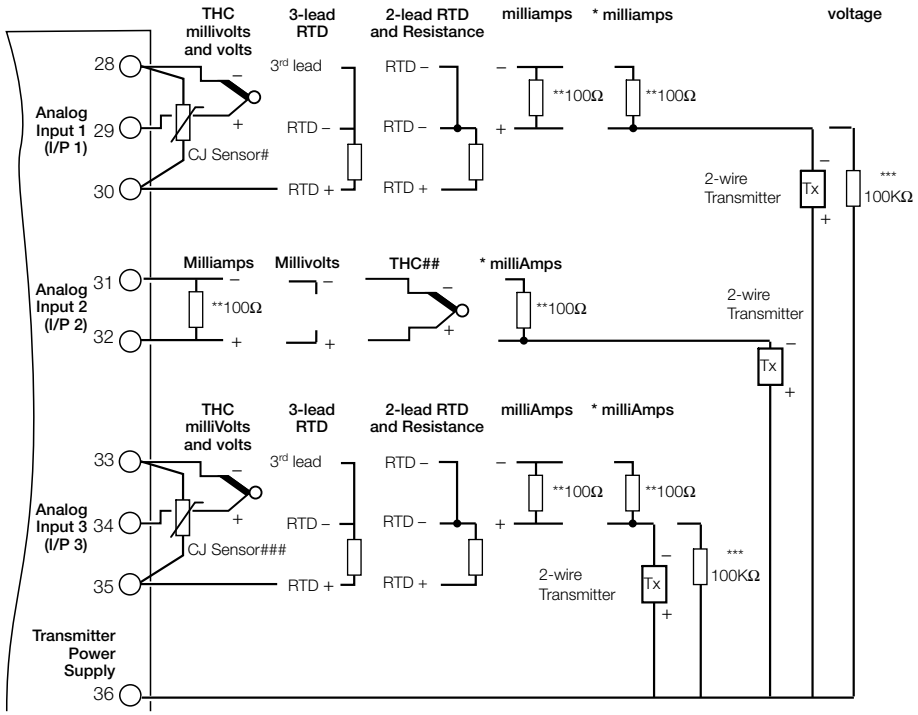


Fig. 5.6 Electrical Connections – General

...5.2.1 Electrical Connections – Figs 5.6 to 5.8



* Using internal transmitter power supply

** Use 100Ω shunt resistor provided with instrument

*** For correct broken sensor operation with voltage inputs, fit a 100KΩ pull-up resistor

\# Fit the CJ sensor supplied if I/P1 or I/P2 are THC inputs

\## I/P2 can only be used with THC inputs if I/P1 is also used as a THC input

\### Fit the CJ sensor supplied if I/P3 is a THC input

Fig. 5.7 Electrical Connections – Analog Inputs

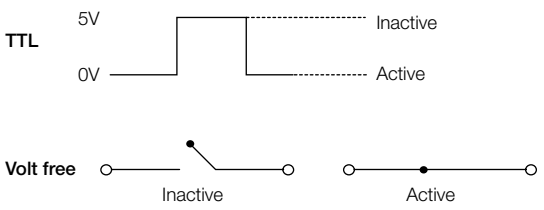


Fig. 5.8 Electrical Connections – Digital Inputs

5.3 Relays

Note. Refer to the Rear Fold-out/ Table B for default relay assignments.

Relay contacts are rated at:
115/230 V AC at 5 A (non-inductive)
250 V DC 25 W max.

A suitable fuse must be fitted.

5.4 Digital Output

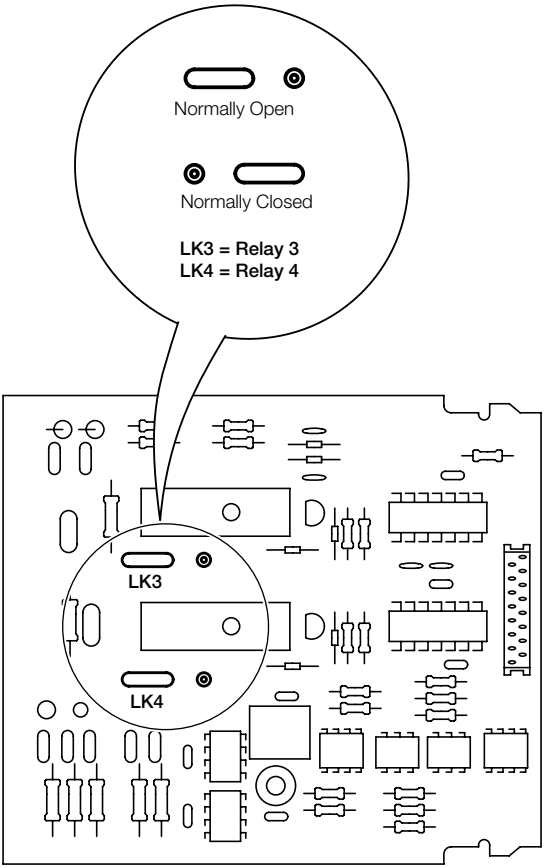
15 V DC min. at 20 mA
Min. load 750 Ω

5.5 Control or Retransmission Analog Output

Max. load 15 V (750 Ω at 20 mA).
Isolated from analog input, dielectric strength 500 V for 1 minute.

5.3.1 Setting the Relay Links – Fig. 5.9

Set the links on the option board (if fitted).

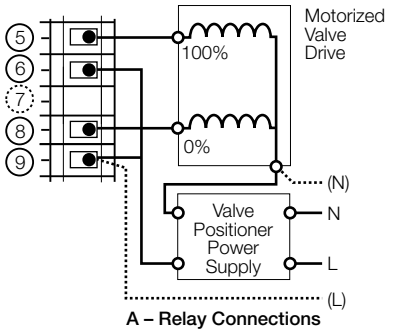


Note. The default setting for the relay links is 'Normally Open' (N/O).

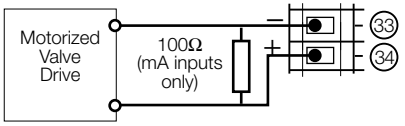
Fig. 5.9 Relay Links

5.6 Motorized Valve Connections – Fig. 5.10

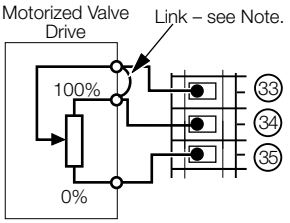
Note. Relays used to drive the motorized valve must be set for 'Normally Open' operation – see Section 5.3.1.



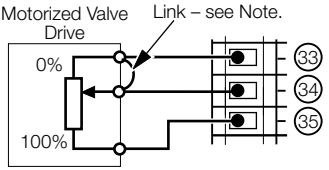
A – Relay Connections



B – Feedback Connections (V, mA or mV Input Types)



C – Feedback Slidewire Connection



D – Alternative Feedback Slidewire Connection

Note. The wire link must be connected at the motorized valve end, NOT to the instrument terminals.

Fig. 5.10 Motorized Valve Connections

5.7 Input Connections

Make connections to each input – see Fig 5.7.

Refer to Table A on the rear fold-out for the default input assignment settings.

5.7.1 Thermocouple (THC) Inputs

Note. Use the correct compensating cable between the THC and the terminals – see Table 5.1.

Automatic Cold Junction Compensation (ACJC) is incorporated by use of CJ sensors wired across the input terminals of I/P1 and I/P3 – see Fig. 5.11.

Alternatively, the CJ sensor can be mounted remotely at the point where the thermocouple cable terminates into copper cable, e.g. where cables enter an instrument panel – see Fig. 5.12.

It is possible to use an external fixed cold (reference) junction, if the instrument is programmed for use with millivolt inputs and the appropriate thermocouple linearizer is selected. This is only possible via the PC Configurator.

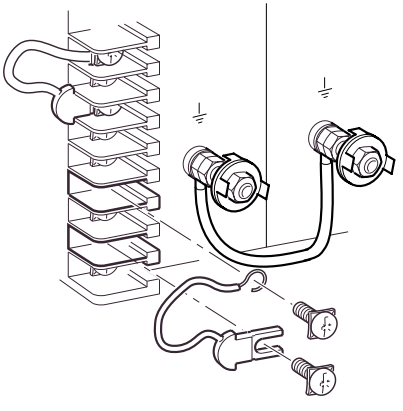


Fig. 5.11 CJ Sensor – Connections

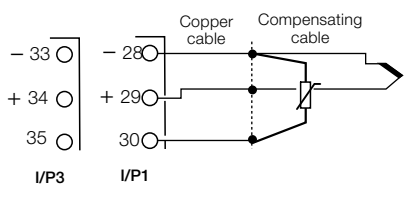


Fig. 5.12 Remote-mounted CJ Sensor – Connections

5.7.2 3-lead Resistance Thermometer (RTD) Inputs

The three leads must have equal resistance, not exceeding 50Ω each.

5.7.3 2-lead Resistance Thermometer (RTD) Inputs

If long leads are necessary it is preferable to use a 3-lead RTD. If the RTD is to be used in a hazardous area, a 3-lead RTD connected via a suitable Zener barrier, must be used.

5.8 Output Connections

Make connections as shown in Fig 5.6.

Refer to Table B on the rear fold-out for the default output assignment settings.

5.9 Power Supply Connections

Warning.

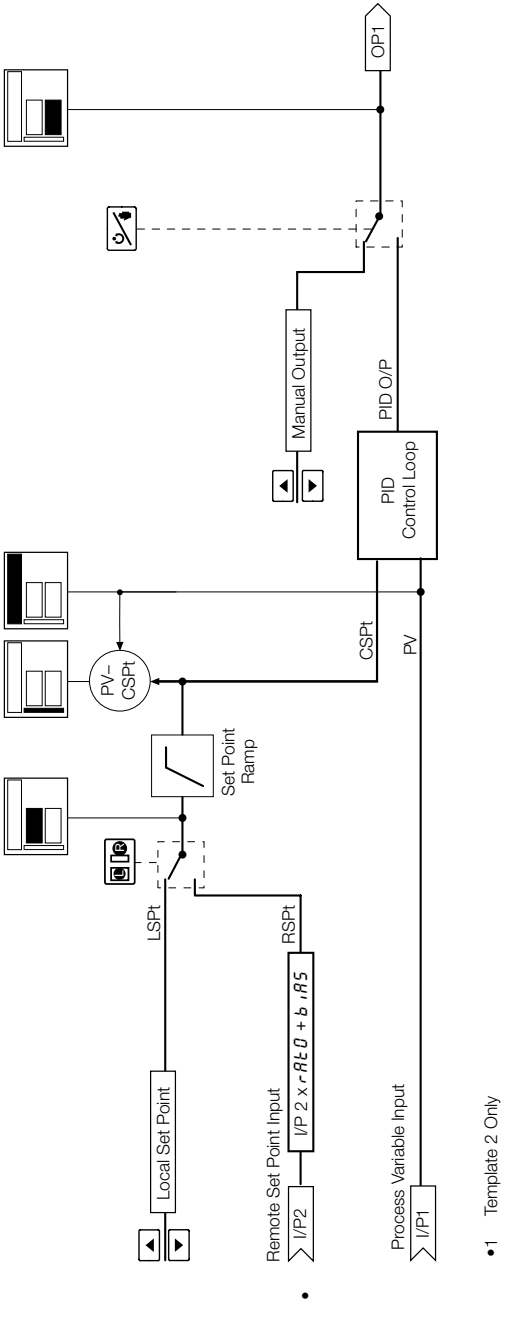
- A 1A Type T fuse must be fitted in the live (+ve) supply line.
- The ground lead must be connected to one of the earth (ground) studs in the terminal block compartment – see Fig. 5.6.
- Do not disturb the link between the two ground studs.
- The type of power supply required (AC or DC) is stated at the time of order and can be identified from the instrument code number:
  C35X/XX0X/STD = 100 to 240 V AC
  C35X/XX1X/STD = 24 V DC

Type of Thermo-couple	Compensating Cable											
	BS1843			ANSI MC 96.1			DIN 43714			BS4937 Part No.30		
	+	–	Case	+	–	Case	+	–	Case	+	–	Case
Ni-Cr/Ni-Al (K)	Brown	Blue	Red	Yellow	Red	Yellow	Red	Green	Green	Green	White	Green *
Nicrisil/Nisil (N)	Orange	Blue	Orange	Orange	Red	Orange	—			Pink	White	Pink *
Pt/Pt-Rh (R and S)	White	Blue	Green	Black	Red	Green	Red	White	White	Orange	White	Orange *
Pt-Rh/Pt-Rh (B)	–			–			–			Grey	White	Grey *
Cu/Cu-Ni (T)	White	Blue	Blue	Blue	Red	Blue	Red	Brown	Brown	Brown	White	Brown *
Fe/Con (J)	Yellow	Blue	Black	White	Red	Black	Red	Blue	Blue	Black	White	Black *
* Case Blue for intrinsically safe circuits												
Fe/Con (L) (DIN 43710)	–			—			DIN 43710			—		
							Blue/ red	Blue	Blue			

Table 5.1 Thermocouple Compensating Cable

A1 Single Loop Controller (Templates 1 and 2)

Single Loop Control provides basic feedback control using three term PID or On/off control. The controller output is calculated from the difference between the process variable and the control set point. The control set point can be a fixed value entered by the user or from a remote source.



A2 Auto/Manual Station and Analog Backup Station

A2.1 Series and Parallel Operation

Note. See Sections A2.2 and A2.3 for detailed templates.

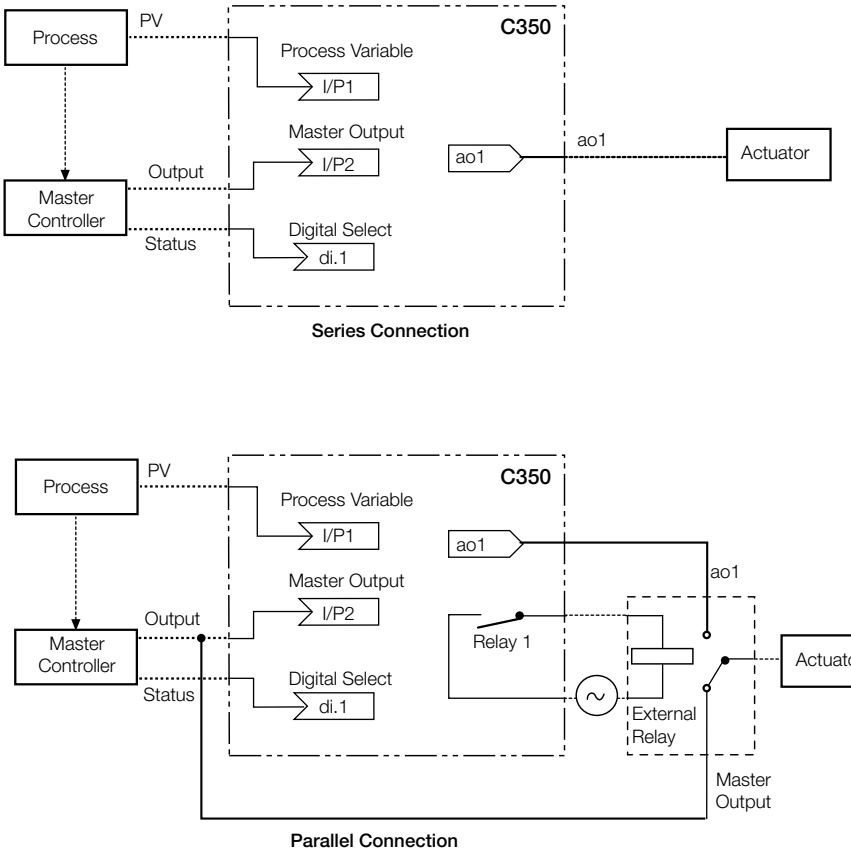
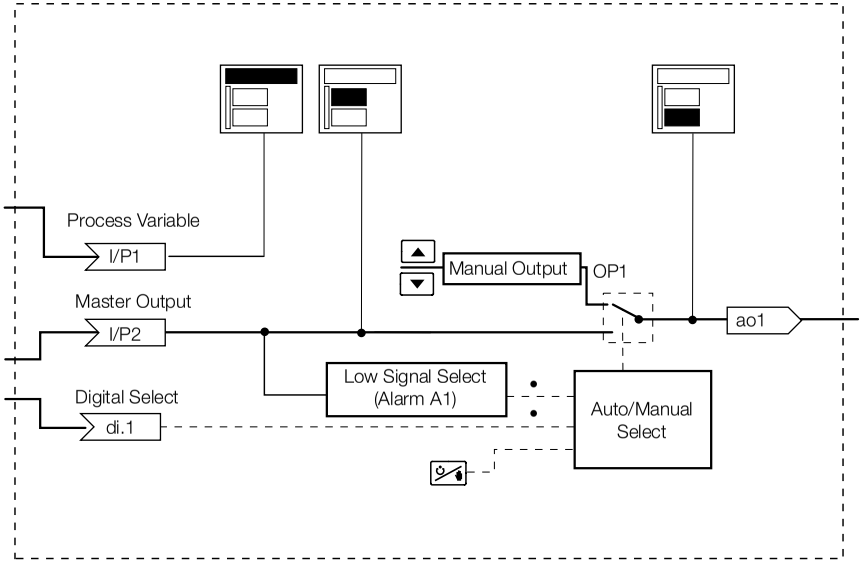


Fig. A1 Series and Parallel Operation

...A2.2 Auto/Manual Station (Templates 3 and 4)

The **Auto/manual Station** provides a backup for a Master controller. In normal operation the COMMANDER 350's current output follows the master controller's output value. A fault in the master system can be identified either by detecting a low signal on the master output (template 3) or via a digital signal (template 4). When a fault is detected the COMMANDER 350 selects manual mode with its output either set to the last valid master output value or to a configured output value – see Section 4.6/ Control Configuration/ Configured Output 1. When the master signal is restored or the digital input returns to its normal state the COMMANDER 350 switches back to auto mode (i.e. COMMANDER 350 output = master output).

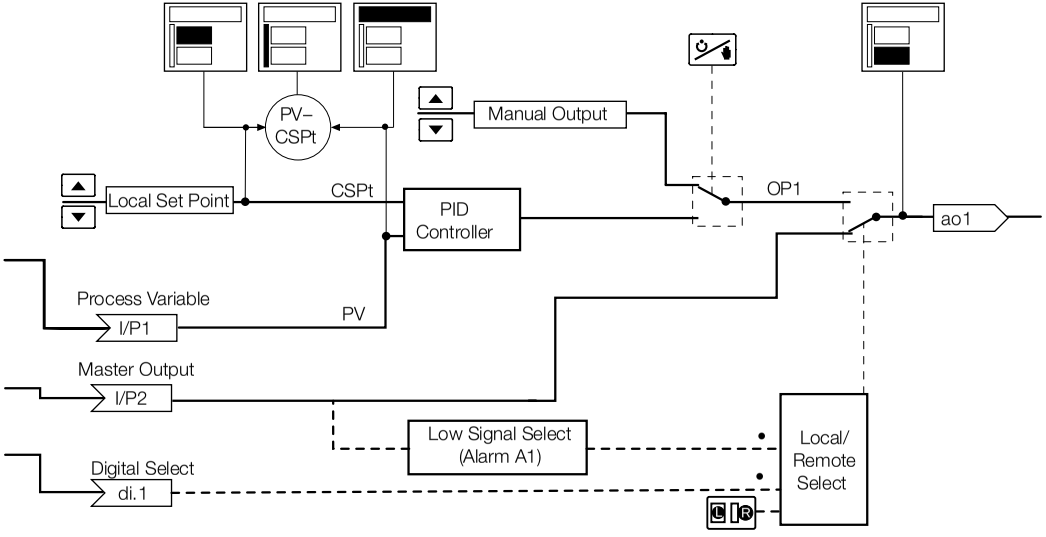
The auto/manual station can be used in series or in parallel with the master output signal – see Fig. A1. Parallel operation is achieved by using relay 1 in the COMMANDER 350 to energize an external relay (with suitable changeover contacts for switching low level signals) which selects the output to be routed to the actuator.



•1 Template 3 only. Alarm A1 trip value can be set to give the desired low signal detection
•2 Template 4 only

The **Analog Backup** provides a backup for a master controller. In normal operation (remote control mode selected) the COMMANDER 350's current output follows the master controller's output value. A fault in the master system can be identified either by detecting a low signal on the master output (template 5) or via a digital signal (template 6). When a fault is detected the COMMANDER 350 switches into local control mode and the process is controlled by the PID output of the COMMANDER 350. The COMMANDER 350 PID algorithm continually tracks the master output value to ensure bumpless transfer from remote to local mode operation. When the master signal is restored or the digital input returns to its normal state the COMMANDER 350 switches back to remote control mode (i.e. COMMANDER 350 output = master output).

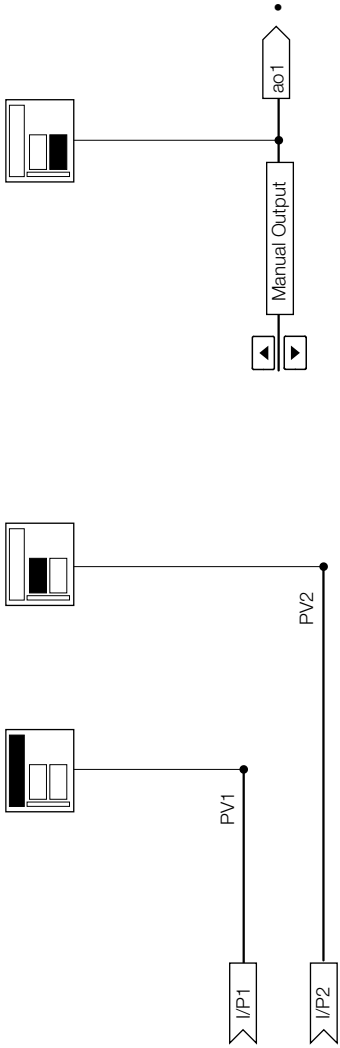
The analog backup station can be used in series or in parallel with the master output signal. (See Fig. A1). Parallel operation is achieved by using relay 1 in the COMMANDER 350 to energize an external relay (with suitable changeover contacts for switching low level signals) which selects the output to be routed to the actuator.



•1 Template 5 only. Alarm A1 trip value can be set to give the desired low signal detection
•2 Template 6 only.

A3 Indicator/Manual Loader Station (Templates 7 and 8)

The **Indicator/manual Loader Station** is used to display one or two process variables on the digital and bargraph displays. If the control output is assigned to an analog output, the lower display indicates its value which can be adjusted by the user. This output can be used to manually control a process or to provide a set point value for another controller.



•1 Template 8 Only

•2 Not applicable if Control Output Type is set to 'None' – see Section 4.2/Basic Configuration.

B1 Introduction

Using the COMMANDER Configurator the COMMANDER 350 can be programmed without using any of the front panel keys.

In addition to the standard settings, the Configurator also gives access to more advanced features not accessible via the front panel keys. These are summarized below.

For information on using individual features, refer to the on-line help facility.

Note. The instrument must be in Configuration Mode (Level 6 or above) and Modbus serial communications must be disabled when uploading or downloading from the PC Configurator.

B2 Analog Input Customization

- Custom mA, mV, Voltage and Resistance ranges
- Standard Linearizers can be assigned to electrical inputs (eg. allowing transmitter inputs to have thermocouple or resistance linearizers to be applied)
- Programmable fault detection levels (default = 10%)

B3 Four Programmable Math Blocks

One of seven types can be assigned to each math block:

Standard Arithmetic	Up to 4 operands and 3 operators can be combined in each block, with the operands being calculated sequentially. Operators: add, subtract, divide, multiply, high select, low select, median select Operands: any analog or digital signals (digital signals have the value '1' or '0')
Average	The average value of an analog signal over a selectable time period, reset by digital signal
Maximum detection	The maximum value of an analog signal, reset by digital signal
Minimum detection	The minimum value of an analog signal, reset by digital signal
Relative humidity	Calculated from wet and dry bulb temperature sensors
Square root	The square root value of any analog signal
Input multiplexer	Selection of one or two analog variables using a digital signal

B4 Six Logic Equations

Elements	Up to 15 per equation
Operators	Up to 7 per equation: OR, AND, NOR, NAND, NOT, EXOR
Operands	Up to 8 per equation: any digital signal. The NOT operator can be used to invert digital signals.

B5 Process Alarm Customization

- Time Hysteresis, 0 to 9999 seconds
- Alarm Disable Source

B6 Two Real Time Alarms

- Programmable ON days, hours, minutes and duration (00:00 to 23:59)
- Wildcard (*) to allow operation every *x* minutes past the hour

B7 Two Delay Timers

- Programmable delay and duration (0 to 9999 seconds)

B8 Two Custom Linearizers

- 15 breakpoints per linearizer
- The source can be any analog signal

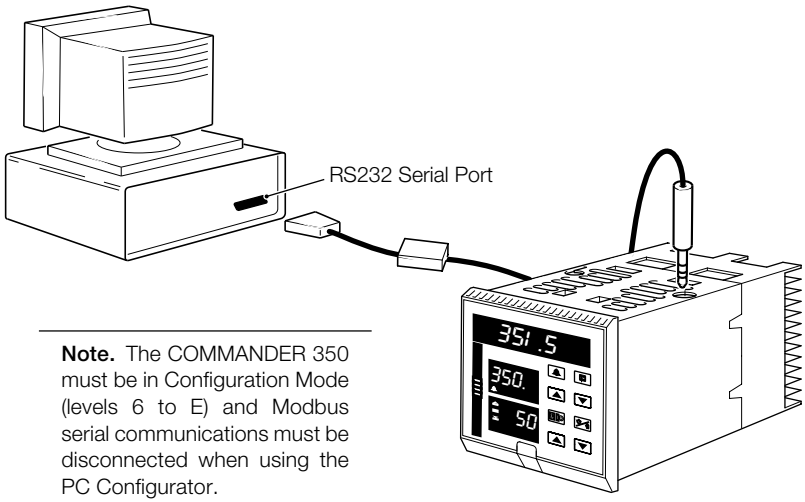
B9 Template Customization

Each template can be customized by changing the sources for various functions in the COMMANDER 350. This allows maths blocks and custom linearizers to be added into the standard template format.

The following sources can be programmed:

- process variable inputs
- set point inputs
- position feedback input
- input to ratio/bias block
- ratio inputs
- bias inputs

B10 Connecting the COMMANDER PC Configurator



Note. The COMMANDER 350 must be in Configuration Mode (levels 6 to E) and Modbus serial communications must be disconnected when using the PC Configurator.

Fig. B1 Connecting the COMMANDER PC Configurator

Summary

- 8 application templates: Single loop, Auto/Manual, Analog backup, Indicator
- Two Autotune options
- Control Efficiency Monitor (CEM)
- PC configuration
- IP66/NEMA4X front face

Operation

Display

1 x 4-digit, 14 mm (Red) LED – process variable

1 x 4-digit 8 mm (Green) LED – set point

1 x 3-digit, 8 mm (Yellow) LED – output

1 x 21-segment deviation bargraph

Configuration

Basic configuration via front panel keys or PC

Advanced feature configuration by PC

Security

Password-protected menus

Standard Functions

Control Strategies

Single-loop, Auto/manual Station, Analog Backup, Indicator/Manual Loader

Output Types

Current proportioning, Time proportioning, On/off, Motorized valve (with and without feedback), Heat/cool.

Control Parameters

Four sets of PI settings, selectable via digital signals

Set Points

Local, remote and four local fixed set points, selectable via digital signals

Configured Outputs

Three preset output values, selectable via digital signals

Autotune

On demand for 1/4 wave or minimal overshoot

Process Alarms

Number	8
Types	High/low process, High/low output, High/low deviation
Hysteresis	Level and time *
Alarm enable/disable	Enable/disable of alarms via digital signal

Real Time Alarms *

Number	2
Programmable	On time/day and duration

* Accessed via PC Configurator

Analog Inputs

Universal Process Inputs

Number

2 standard

Type

Universally configurable to provide:

- Thermocouple (THC)
- Resistance thermometer (RTD)
- mV
- Volts
- mA
- Resistance

Non-universal Process Input

Number

1 standard

Types

mV only (THC only if I/P1 is also THC)

mA

Analog Inputs – Common

Linearizer Functions

THC types B, E, J, K, L, N, R, S, T, PT100, √, $^{3}/_{2}$, $^{5}/_{2}$

Input Impedance

mA	100Ω
mV, V	10MΩ

Broken Sensor Protection

Programmable for upscale or downscale drive

Sample Interval

125ms (1 input)

Digital filter

Programmable

Cold Junction Compensation

Automatic CJC incorporated as standard

Stability 0.05°C/°C (0.05°F/°F) change in ambient temperature

Input Protection

Common mode rejection 300Ω imbalance resistance	>120dB at 50/60Hz with
Series mode rejection	> 60dB at 50/60Hz

Transmitter Power Supply

Voltage:	24V DC nominal
Drive:	Up to 60mA, (3 loops)

Standard Analog Input Ranges

Thermocouple	Maximum Range °C	Maximum Range °F	Accuracy (% of reading)
B	–18 to 1800	0 to 3270	0.1% or ±1°C (1.8°F) [above 200°C (392°F)] *
E	–100 to 900	–140 to 1650	0.1% or ±0.5°C (0.9°F)
J	–100 to 900	–140 to 1650	0.1% or ±0.5°C (0.9°F)
K	–100 to 1300	–140 to 2350	0.1% or ±0.5°C (0.9°F)
L	–100 to 900	–140 to 1650	0.1% or ±1.5°C (2.7°F)
N	–200 to 1300	–325 to 2350	0.1% or ±0.5°C (0.9°F)
R	–18 to 1700	0 to 3000	0.1% or ±0.5°C (0.9°F) [above 300°C (540°F)] *
S	–18 to 1700	0 to 3000	0.1% or ±0.5°C (0.9°F) [above 200°C(392°F)] *
T	–250 to 300	–400 to 550	0.1% or ±0.5°C (0.9°F)

* Performance accuracy is not guaranteed below 300ºC (572ºF) for B, R and S thermocouples

Min. span below zero Type T 70ºC (126ºF) Type N 105ºC (189ºF)

THC standards DIN 43710 IEC 584

RTD	Maximum Range °C	Maximum Range °F	Accuracy (% of reading)**
PT100	–200 to 600	–325 to 1100	0.1% or ±0.5°C (0.9°F)

** RTD, 3-wire platinum, 100Ω per DIN43760 standard (IEC751), with range of 0 to 400Ωs

Linear Inputs	Range	Accuracy (% of reading)
Millivolts	0 to 500 mV	0.1% or ±10µA
Milliamps	0 to 50 mA	0.2% or ±2µA
Volts	0 to 5V	0.2% or ±2mV
Resistance	0 to 5000Ω	0.2% or ±0.08Ω

Outputs

Control/Retransmission Outputs

Number	2 standard
Type	1 x programmable as analog or logic (digital) output
	1 x analog only
Isolation	Galvanically isolated from the rest of the circuitry
Analog range	0 and 20mA (programmable), max. 750Ω
	accuracy: 0.25%
Digital voltage	17V @ 20mA

Relay Outputs

Number	2 standard,
Type	SPCO, rated 5A at 115/230V AC

Digital Inputs

Number	2 standard,
Type	Volt-free
Minimum pulse	200ms

Advanced Features

Maths Blocks *

Number	4
Operators	+, –, x, ÷, Average, Maximum, Minimum, High select, Low select, √, Median select, Relative Humidity
	Input multiplexer (digitally selected)

Delay Timers *

Number	2
Programmable	Delay and Duration in seconds

Logic Equations *

Number	6
Elements	15 per equation
Operators	OR, AND, NOR, NAND, NOT, EXOR

Custom Linearizers *

Number	2
Breakpoints	15 per linearizer

* Accessed via PC Configurator

Options

Relay Outputs

Number	2
Type	SPST, rated 5A at 115/230V AC

Digital Inputs

Number	2
Type	Volt-free
Minimum pulse	200ms

Serial Communications

Connections	RS485, 2- or 4-wire
Protocol	Modbus RTU
Isolation	Galvanically isolated from the rest of the circuitry

EMC

Emissions

Meets requirements of EN50081-2

Immunity

Meets requirements of EN50082-2

Design & manufacturing standards

CSA/UL General Safety (cCSAus mark)

Satisfies the requirements of –
CAN/CSA C22.2 No. 1010.1-1-92 Standard
CAN/CSA C22.2 No. 1010.1-B97
UL Standard 3121-1

FM General Safety Pending

Physical

Size

96 x 96 x 122.5mm (3.78 in. x 3.78 in. x 4.82 in.)

Weight

680g (1.5lb)

Electrical

Voltage

85 min. to 265 V max. AC 50/60Hz

24V DC

Power consumption

15VA max.

Power interruption protection

Up to 60ms

Safety

General safety EN 61010-1

Isolation

All inputs/outputs to earth:	500V DC
Analog/digital output 1 to rest of the circuitry:	500V DC for 1 minute
Analog output 2 to rest of the circuitry:	500V DC for 1 minute
Serial communications to rest of the circuitry:	500V DC for 1 minute

Environmental

Operating Limits

0°C to 55°C (32°F to 130°F)

5 to 95%RH (non-condensing)

Temperature stability

<0.02%/°C or 2µV/°C (<0.011%/°F or 1.11µV/°F)

Long term drift <0.02% of reading or 20µV annually

Front face

NEMA4X (IP66)

SS/C351_6

Set Up Frames

Frame Title	*Mnemonic*	*Number*
A		
Alarm 1 Trip	1.xxx	4.01
Alarm 2 Trip	2.xxx	4.02
Alarm 3 Trip	3.xxx	4.03
Alarm 4 Trip	4.xxx	4.04
Alarm 5 Trip	5.xxx	4.05
Alarm 6 Trip	6.xxx	4.06
Alarm 7 Trip	7.xxx	4.07
Alarm 8 Trip	8.xxx	4.08
Approach Band 1	Ab 1	2.15
C		
Control Zone Deadband	dbnd	2.21
Cycle Time 1	CYC 1	2.01
Cycle Time 2	CYC2	2.02
D		
Deadband (Feedback only)	dbnd	5.03
Derivative Action Time 1	drU.1	2.13
H		
Heat/Cool Output 1 Start	Y1St	2.22
Heat/Cool Output 2 Start	Y2St	2.23
I		
Integral Action Time 1	IAt.1	2.09
Integral Action Time 2	IAt.2	2.10
Integral Action Time 3	IAt.3	2.11
Integral Action Time 4	IAt.4	2.12
L		
Local Set Point 1	LSP.1	3.01
Local Set Point 2	LSP.2	3.02
Local Set Point 3	LSP.3	3.03
Local Set Point 4	LSP.4	3.04
M		
Manual Reset	rSt.1	2.17
Motorised Valve Bias	U.b IA	5.02
Motorised Valve Ratio	U.rAt	5.01
O		
Output 1 On/off Hysteresis Value	HYS.1	2.03
Output 2 On/off Hysteresis Value	HYS.2	2.04

Frame Title	*Mnemonic*	*Number*
P		
Proportional Band 1	Pb-1	2.05
Proportional Band 2	Pb-2	2.06
Proportional Band 3	Pb-3	2.07
Proportional Band 4	Pb-4	2.08
R		
Ramp Rate	r.rtE	3.10
Regulator Travel Time	r.trU.	5.04
Remote Set Point Bias	b IAS	3.07
Remote Set Point Ratio	rAtO	3.06
S		
Set Points	LEU3	3.00
T		
Tune	LEU2	2.00
V		
Valve Set Up	LEU5	5.00

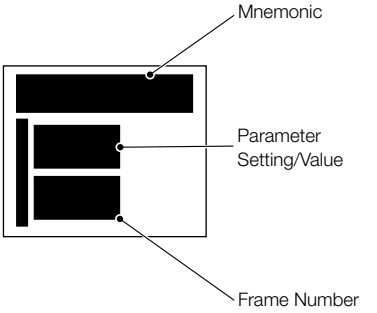


Fig. I.1 Parameter Identification

Configuration Frames

Frame Title	*Mnemonic*	*Number*
A		
Alarm 1 Hysteresis	HYS.1	8.03
Alarm 1 Trip	trP.1	8.02
Alarm 1 Type	tYP.1	8.01
Alarm 2 Hysteresis	HYS.2	8.06
Alarm 2 Trip	trP.2	8.05
Alarm 2 Type	tYP.2	8.04
Alarm 3 Hysteresis	HYS.3	8.09
Alarm 3 Trip	trP.3	8.08
Alarm 3 Type	tYP.3	8.07
Alarm 4 Hysteresis	HYS.4	8.12
Alarm 4 Trip	trP.4	8.11
Alarm 4 Type	tYP.4	8.10
Alarm 5 Hysteresis	HYS.5	8.15
Alarm 5 Trip	trP.5	8.14
Alarm 5 Type	tYP.5	8.13
Alarm 6 Hysteresis	HYS.6	8.18
Alarm 6 Trip	trP.6	8.17
Alarm 6 Type	tYP.6	8.16
Alarm 7 Hysteresis	HYS.7	8.21
Alarm 7 Trip	trP.7	8.20
Alarm 7 Type	tYP.7	8.19
Alarm 8 Hysteresis	HYS.8	8.24
Alarm 8 Trip	trP.8	8.23
Alarm 8 Type	tYP.8	8.22
Alarm Acknowledge Enable	FPAK.	b.03
Alarm Configuration	LEU.8, AL_S	8.00
Analog I/P 1 Offset Cal	OFF.1	E.01
Analog I/P 1 Span Cal	SPN.1	E.02
Analog I/P 2 Offset Cal	OFF.2	E.03
Analog I/P 2 Span Cal	SPN.2	E.04
Analog I/P 3 Offset Cal	OFF.3	E.05
Analog I/P 3 Span Cal	SPN.3	E.06
Analog O/P 1 Electrical High	AN1H	C.03
Analog O/P 1 Electrical Low	AN1L	C.04
Analog O/P 1 Engineering High	r1H	C.05
Analog O/P 1 Engineering Low	r1L	C.06
Analog O/P 2 Electrical High	AN2H	C.11
Analog O/P 2 Electrical Low	AN2L	C.12
Analog O/P 2 Engineering High	r2H	C.13
Analog O/P 2 Engineering Low	r2L	C.14
Analog Output 1 Source	AN1A	C.02
Analog Output 2 Source	AN2A	C.10
Analog/Dig Output 1 Type	tYP.1	C.01
Auto Selection Source	ASrC	A.18
Auto/Manual Switch Enable	FPA_	b.01
Autotune Password	A.PAS	b.07

Frame Title	*Mnemonic*	*Number*
B		
Basic Configuration	LEU.6, APPL	6.00
Bias Display Enable	b.d15	b.06
Bargraph Increment	b INC	b.16
C		
Calibration	LEU.E, CAL	E.00
CJ Beta Value	bEtA	E.14
CJ Reading - I/P1 & I/P2	CJ 1	E.15
CJ Reading - I/P3	CJ 3	E.16
CJ Reference Value	rEF	E.13
Configuration Password	C.PAS	b.09
Configured Output 1	C.OP.1	A.13
Configured Output 2	C.OP.2	A.15
Configured Output 3	C.OP.3	A.17
Control Action	C.ACt	6.03
Control Configuration	LEU.A	A.00
Current Time	t.CLK.	b.15
D		
Day Setting	dAY	b.10
Digital Output 1 Polarity	dG1P	C.08
Digital Output 1 Source	dG1A	C.07
F		
Feedback Range High	Fb.H1	E.12
Feedback Range Low	Fb.L0	E.11
G		
Global Alarm Acknowledge	G.ACK.	8.25
H		
Hour Setting	HOUr	b.13

...Configuration Frames

Frame Title	Mnemonic	Number
I		
Input 1 Broken Sensor	bSd.1	7.06
Input 1 Decimal Point	dP.1	7.03
Input 1 Engineering High	EN1H	7.04
Input 1 Engineering Low	EN1L	7.05
Input 1 Filter Time Constant	FLt.1	7.07
Input 1 Temp Units	UNt.1	7.02
Input 1 Type	tYP.1	7.01
Input 2 Broken Sensor	bSd.2	7.13
Input 2 Decimal Point	dP.2	7.10
Input 2 Engineering High	EN2H	7.11
Input 2 Engineering Low	EN2L	7.12
Input 2 Filter Time Constant	FLt.2	7.14
Input 2 Temp Units	UNt.2	7.09
Input 2 Type	tYP.2	7.08
Input 3 Broken Sensor	bSd.3	7.20
Input 3 Decimal Point	dP.3	7.17
Input 3 Engineering High	EN3H	7.18
Input 3 Engineering Low	EN3L	7.19
Input 3 Filter Time Constant	FLt.3	7.21
Input 3 Temp Units	UNt.3	7.16
Input 3 Type	tYP.3	7.15
L		
Level Heading	LEU.7	7.00
Local Set Point Source	LCSr	9.13
Local/Remote Enable	FPLr	b.02
Local/Remote Set Point Source	Lr.Sr	9.12
M		
MV Calibration selection	FCAL	E.07
MV Feedback – closed	C.CAL	E.09
MV Feedback – open	O.CAL	E.10
Mains Rejection	F.rEJ	6.06
Man/Auto Selection Source	A_.Sr	A.16
Manual 1 Selection Source	_.Sr1	A.12
Manual 2 Selection Source	_.Sr2	A.14
Minute Setting	_1N	b.14
Modbus Address	Addr	d.03
Modbus Parity	PrtY	d.02
O		
O/P Low Limit	OP.LO	A.06
O/P High Limit	OP.H1	A.05
OP 1 High Limit	OP1H	A.07
OP 2 High Limit	OP2H	A.08
OP 2 Low Limit	OP2L	A.09
Operator Configuration	LEU.b, OPEr	b.00
Output Assignment	LEU.C, ASSn	C.00
Output Slew Rate	OP.Sr	A.10
Output Slew Rate Disable	SrdS	A.11
Output Type	O.tYP	6.02

Frame Title	Mnemonic	Number
P		
Power Fail Recovery Mode	P.rEC	A.01
Power Fail Recovery Time	rEC.t	A.02
Process Variable Fail Action	PU.FA	A.03
PV Fail Default Output	dF.OP	A.04
R		
Ratio Display Enable	r.d1S	b.05
Regulator Travel Time	r.trU.	E.08
Relay 1 Polarity	rL1P	C.18
Relay 1 Source	rL1A	C.17
Relay 2 Polarity	rL2P	C.20
Relay 2 Source	rL2A	C.19
Relay 3 Polarity	rL3P	C.22
Relay 3 Source	rL3A	C.21
Relay 4 Polarity	rL4P	C.24
Relay 4 Source	rL4A	C.23
Remote Set Point Source	r.SrC	9.14
RSPT Fault Action	SP.FA	9.06
S		
Serial Communications	LEU.d	d.00
Serial Configuration	S.CFG	d.01
Set Point Configuration	LEU.9, SEt.P	9.00
Set Point 1 Source	L.Sr.1	9.08
Set Point 2 Source	L.Sr.2	9.09
Set Point 3 Source	L.Sr.3	9.10
Set Point 4 Source	L.Sr.4	9.11
Set Point Default Value	dF.SP	9.07
Set Point High Limit	SPt.H	9.02
Set Point Low Limit	SPt.L	9.03
Set Point Tracking	trCP.	9.01
Set up Password	S.PAS	b.10
Slave Set Point High Limit	SSP.H	9.04
Slave Set Point Low Limit	SSPL	9.05
Set Point Adjust Disable	S.AdJ	b.04
T		
Template Applications	t.APP	6.01
Time Display	t.CLK.	b.13
Tune Select Source 1	t1Sr	A.19
Tune Select Source 2	t2Sr	A.20
Tune Select Source 3	t3Sr	A.21
Tune Select Source 4	t4Sr	A.22

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PRODUCTS & CUSTOMER SUPPORT

Products

Automation Systems
- ***for the following industries:***
  - Chemical & Pharmaceutical
  - Food & Beverage
  - Manufacturing
  - Metals and Minerals
  - Oil, Gas & Petrochemical
  - Pulp and Paper

Drives and Motors
- ***AC and DC Drives, AC and DC Machines, AC motors to 1kV***
- ***Drive systems***
- ***Force Measurement***
- ***Servo Drives***

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- ***Circular Chart , Strip Chart and Paperless Recorders***
- ***Paperless Recorders***
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- ***Industrial Robots and Robot Systems***

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- ***Mass Flow Meters***
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- ***Electrical Systems***
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- ***Process Gas Analysis***
- ***Systems Integration***

Transmitters
- ***Pressure***
- ***Temperature***
- ***Level***
- ***Interface Modules***

Valves, Actuators and Positioners
- ***Control Valves***
- ***Actuators***
- ***Positioners***

Water, Gas & Industrial Analytics Instrumentation
- ***pH, conductivity, and dissolved oxygen transmitters and sensors***
- ***ammonia, nitrate, phosphate, silica, sodium, chloride, fluoride, dissolved oxygen and hydrazine analyzers.***
- ***Zirconia oxygen analyzers, katharometers, hydrogen purity and purge-gas monitors, thermal conductivity.***

Customer Support

We provide a comprehensive after sales service via our Worldwide Service Organization. Contact one of the following offices for details on your nearest Service and Repair Centre.

United Kingdom
ABB Limited
Tel: +44 (0)1480 475321
Fax: +44 (0)1480 217948

United States of America
ABB Inc.
Tel: +1 215 674 6000
Fax: +1 215 674 7183

Client Warranty
Prior to installation, the equipment referred to in this manual must be stored in a clean, dry environment, in accordance with the Company's published specification.
Periodic checks must be made on the equipment's condition. In the event of a failure under warranty, the following documentation must be provided as substantiation:

1. A listing evidencing process operation and alarm logs at time of failure.
2. Copies of all storage, installation, operating and maintenance records relating to the alleged faulty unit.

Table A – Template Applications

Config. Display		Template Title	Analog Input 1 (I/P1)	Analog Input 2 (I/P2)	Analog Input 3 (I/P3)
1.	SL	Single loop	Process Variable		Feedback †
2.	SL	Single loop + Remote set point	Process Variable	Remote Set Point	Feedback †
3.	A_	Auto/Manual station (low signal select)	Process Variable	Master Output	–
4.	A_	Auto/Manual station (digital select)	Process Variable	Master Output	–
5.	Ab	Analog backup (low signal select)	Process Variable	Master Output	–
6.	Ab	Analog backup (digital select)	Process Variable	Master Output	–
7.	IN	Single indicator/manual loader	Process Variable	–	–
8.	IN	Double indicator/manual loader	Process Variable 1	Process Variable 2	–

† Motorized Valve output types only

Table B – Output Sources

Note. Settings shown in bold are fixed and cannot be adjusted. Other settings are changed in Level C/ Output Assignment.

Setting	Output Type	Relays				Analog Outputs		Digital Output
		Rly 1	Rly 2	Rly 3	Rly 4	ao1	ao2	do1
NONE	None	–	–	–	–	–	–	–
ANLG	Analog Output	Alm1#	Alm 2	Alm 3	Alm 4	**OP1**	PV	–
rLY	Relay Output	**OP1**	Alm 1#	Alm 2	Alm 3	PV	CSPT	–
d IO	Digital Output	Alm 1	Alm 2	Alm 3	Alm 4	OP1	PV	**OP1**
PFb	Motorized valve with FB	**OPEN**	**CLOSE**	Alm 1	Alm 2	PV	CSPT	–
bnd	Motorized valve without FB	**OPEN**	**CLOSE**	Alm 1	Alm 2	PV	CSPT	–
HC.rr	Heat/Cool	**OP1** (Heat)	**OP2** (Cool)	Alm 1	Alm 2	PV	CSPT	–
HC.rd	Heat/Cool	**OP1**	Alm 1	Alm 2	Alm 3	–	PV	**OP2**
HC.dr	Heat/Cool	**OP2**	Alm 1	Alm 2	Alm 3	–	PV	**OP1**
HC.Ar	Heat/Cool	**OP2**	Alm 1	Alm 2	Alm 3	**OP1**	PV	–
HC.AA	Heat/Cool	Alm 1	Alm 2	Alm 3	Alm 4	**OP1**	**OP2**	–

Relay 1 is assigned to energize when in manual mode and templates 3, 4, 5 or 6 are selected

Alm = Alarm
Rly = Relay
ao1 = Analog Output1
ao2 = Analog Output2

do1 = Digital Output 1
OP1, 2 =Output 1, 2
PV = Process Variable RTX
CSPT = Set Point RTX

Table C – Digital Sources

Source	Display	Description
Control Outputs	OP 1	Control output 1 (heat)
	OP2	Control output 2 (cool)
	OPEN	Motorized valve Open Relay
	CLSE	Motorized valve Close Relay
Process Alarms	A 1	Alarm 1 active
	A2	Alarm 2 active
		:
	A8	Alarm 8 active
Alarm Acknowled-ge	ACK.1	Alarm 1 acknowledge
	ACK.2	Alarm 2 acknowledge
		:
	ACK.8	Alarm 8 acknowledge
Digital inputs	D.G1	Digital input 1 active
	D.G2	Digital input 2 active
	D.G3	Digital input 3 active
	D.G4	Digital input 4 active
Control Modes	_AN	Manual mode selected
	AUt	Auto mode selected
	LOC	Local set point/ Local control selected
	rE_	Remote set point/ Remote control selected

Source	Display	Description
Failure States	F. IN. 1	Input 1 failed
	F. IN.2	Input 2 failed
	F. IN.3	Input 3 failed
	LbK.1	Loop break - analog output 1
	dOG	Watchdog active
	PF	Power fail
Logic equations*	LG 1	Logic equation 1 true
	LG 2	Logic equation 2 true
		:
	LG 6	Logic equation 6 true
Timers	rt1	Real time alarm 1
	rt2	Real time alarm 2
	dt1	Delay timer 1
	dt2	Delay timer 2
Modbus Signals	_b.1	Modbus Signal 1
	_b.2	Modbus Signal 2
	_b.3	Modbus Signal 3
	_b.4	Modbus Signal 4
Other	ON	Always enabled

* The default factory settings for each logic equation is:

LG1 – The OR of all alarm states; LG2 – The AND of all alarm states

LG3 – The OR of the alarm acknowledge states

LG4 – The OR of the first four alarm state; LG5 – The OR of the second four alarm states

LG6 – The OR of the input fail states

Table D – Analog Sources

Display	Description
OP 1	Control output 1 (heat)
OP2	Control output 2 (cool)
PV.	Process variable 1
PV.2	Process variable 2
I/P 1	Analog input 1
I/P2	Analog input 2
I/P3	Analog input 3
CSPt	Control setpoint
rSPt	Remote setpoint
LSP 1	Local setpoint 1
LSP2	Local setpoint 2
LSP3	Local setpoint 3
LSP4	Local setpoint 4

Display	Description
SSPt	Slave setpoint
dEV.1	PID deviation (PV – setpoint)
AV.P	Actual valve position
bLK.1	Math block 1 output
bLK.2	Math block 2 output
bLK.3	Math block 3 output
bLK.4	Math block 4 output
CUS.1	Custom linearizer 1 output
CUS.2	Custom linearizer 2 output
PID.1	PID block output
rb.	Remote set point ratio/bias

IM/C351 Issue 9

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