GETTING STARTED

The COMMANDER 360 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 360 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 fold-out.

**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 6.2 of this manual (Electrical Installation) for more information.
GETTING STARTED

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

A. Power-up the instrument. Press the \( \text{and } \) keys simultaneously and hold for 3 seconds to advance directly to Level 6 – Basic Configuration.

B. Set the appropriate application template, output type and control action. Use the \( \text{and } \) keys to advance between frames and \( \text{and } \) keys to adjust the default values – see Section 5.2 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.

C. If you are not using 4 to 20mA inputs, then select Level 7 using the \( \text{and } \) keys and set up Analog Inputs I/P1 to I/P3 to suit your process – see Section 5.3.

D. Controller templates only:
   - Select Level 2 using the \( \text{and } \) 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.

E. Press \( \text{to return to the Operating displays.}

F. Adjust the set point to the required value.

Your COMMANDER 360 is now in operation.

---

**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.

---

**Electrical Safety**

This equipment complies with the requirements of CEI/IEC 61010-1:2001-2 "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](image)
- ![Alternating current supply only](image)
- ![Both direct and alternating current supply](image)
- ![The equipment is protected through double insulation](image)

Information in this manual is intended only to assist our customers in the efficient operation of our equipment. Use of this manual for any other purpose is specifically prohibited and its contents are not to be reproduced in full or part without prior approval of the Technical Publications Department.

---

**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.
This manual is divided into 6 sections which contain all the information needed to install, configure, commission and operate the COMMANDER 360. 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
- Cascade Controllers

### Profile Mode (Levels P, r and t)
- Level P – Profile States
- Level r – Profile Control
- Level t – Profile Program

### 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

### Fig. 3 Accessories
- Pull-up Resistors 2 x 100kΩ
- Shunt Resistors 3 x 100Ω
- Panel Clamps x2
- CJ Sensor x2
CONTENTS

OVERVIEW .................................................... 1

1 DISPLAYS AND FUNCTION KEYS .......... 3
  1.1 Introduction ...................................... 3
  1.2 Use of Function Keys ....................... 4
  1.3 Secret-till-Lit Indicators ................. 7
  1.4 Character Set ................................... 7
  1.5 Error Messages ................................ 8
  1.6 Processor Watchdog ........................ 9
  1.7 Loop Break Monitor .......................... 9
  1.8 Glossary of Abbreviations ................ 9

2 OPERATOR LEVEL ............................... 10
  2.1 Introduction .................................... 10
  2.2 Single Loop Controller (Template 1) 11
  2.3 Cascade Control (Template 11) .... 13
  2.4 Heat/Cool Output Types ................. 16
  2.5 Motorized Valve Output Types ....... 17
  2.6 AlarmAcknowledgement .................... 18
  2.7 Auto-tune ....................................... 19
  2.8 Control Efficiency Monitor .............. 22

3 PROFILES .............................................. 25
  3.1 Introduction .................................... 25
  3.2 Introduction to Ramp/Soak Profile Control ..................................... 26
    3.2.1 Ramp Types ................................ 26
    3.2.2 Guaranteed Ramp/Soak ............... 27
    3.2.3 Power Recovery Function ........ 27
    3.2.4 Self-seeking Set Point .............. 28
    3.2.5 Retort Function ....................... 28
    3.2.6 Time Events ............................. 29
    3.2.7 End of Profile State .................. 29
    3.2.8 Current Segment Time Adjustment ................. 30
  3.3 Profile States.................................. 31
  3.4 Ramp/Soak Profile Control ............... 32
  3.5 Ramp/Soak Profile Program ............... 36

4 SET UP MODE ....................................... 39
  4.1 Introduction .................................... 39
  4.2 Level 2 – Tune ................................ 40
  4.3 Level 3 – Set Points ....................... 44
  4.4 Level 4 – Alarm Trip Points ............. 46
  4.5 Level 5 – Valve Setup ....................... 47

5 CONFIGURATION MODE ...................... 50
  5.1 Introduction .................................... 50
  5.2 Level 6 – Basic Configuration ........ 51
  5.3 Level 7 – Analog Inputs ................. 55
  5.4 Level 8 – Alarms ............................. 59
  5.5 Level 9 – Set Point Configuration ... 63
  5.6 Level A – Control Configuration ....... 65
  5.7 Level B – Operator Configuration .... 70
  5.8 Level C – Output Assignment
    Configuration .................................. 72
    5.8.1 Digital Output 1 ....................... 73
    5.8.2 Analog Output 1 ....................... 74
    5.8.3 Analog Output 2 ....................... 75
    5.8.4 Relay Outputs 1 to 4 ............... 76
  5.9 Level D – Serial Communications
    Configuration .................................. 78
    5.10 Level E – Calibration ................. 79

6 INSTALLATION ................................. 82
  6.1 Mechanical Installation ................. 82
  6.2 Electrical Installation ................... 86
  6.3 Relays ............................................ 89
  6.4 Digital Output ............................. 89
  6.5 Control or Retransmission
    Analog Output .................................. 89
  6.6 Motorized Valve Connections .......... 90
  6.7 Input Connections ........................... 90
  6.8 Output Connections ....................... 91
  6.9 Power Supply Connections ............. 91

SPECIFICATION .......................................... 92

APPENDIX A – CONTROL TEMPLATES ... 96
  A1 Single Loop Controller (Template 1) 96
  A2 Cascade Controller (Template 11) .... 97

APPENDIX B – COMMANDER CONFIGURA-
   TION EDITOR .............................................. 98
  B1 Introduction .................................... 98
  B2 Analog Input Customization .......... 98
  B3 Four Programmable Math Blocks ..... 98
  B4 Six Logic Equations ...................... 98
  B5 Process Alarm Customization ......... 98
  B6 Two Real Time Alarms ................... 98
  B7 Two Delay Timers ......................... 99
  B8 Two Custom Linearizers ............... 99
  B9 Template Customization ............... 99
  B10 Connecting the COMMANDER PC
      Configurator .................................. 99

FRAMES INDEX ........................................ 100

INDEX .................................................................. 104
1.1 Introduction
The COMMANDER 360 front panel displays, function keys and LED indicators are shown in Fig. 1.1.

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 profile parameters, the output value and move between frames within a Setup or Configuration level. Any changes made on 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... ...select the top (LEV.x) frame from within a level

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

Fig. 1.2a Use of Function Keys
...1.2 Use of Function Keys

**D – Auto/Manual Key**

![Diagram of Auto and Manual modes]

Use to select Auto or Manual control mode.

**E – Run / Hold Key**

![Diagram of Run / Hold states]

Use to start a profile program. Pressing the key when a profile is active toggles the profile between the run and hold states.

**F – Stop Key**

![Diagram of Stop key action]

Use to stop a profile program that is running.

(This is equivalent to putting a program in Hold mode and then resetting the program)

The local set point will revert to the starting value for the program.

---

**Fig. 1.2b Use of Function Keys**
### 1.2 Use of Function Keys

**G – Short-cuts Keys**

Press simultaneously and hold for 3 seconds

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

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

**Note.** This Short-cut 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 2.7.3
- Profiles Level – See Fig. 3.1
- Set Up Level – See Fig. 4.1
- Configuration Level – See Fig. 5.1

**Fig. 1.2c Use of Function Keys**
1.3 Secret-til-Lit Indicators

<table>
<thead>
<tr>
<th>Flashing</th>
<th>ON</th>
<th>OFF</th>
</tr>
</thead>
<tbody>
<tr>
<td>▲</td>
<td>One or more alarms active and unacknowledged</td>
<td>All active alarms acknowledged</td>
</tr>
<tr>
<td>~</td>
<td>Profile is ramping down</td>
<td>Profile is ramping up</td>
</tr>
<tr>
<td>~</td>
<td>Profile performing a soak</td>
<td></td>
</tr>
</tbody>
</table>

A – Upper Display

<table>
<thead>
<tr>
<th>Flashing</th>
<th>ON</th>
<th>OFF</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>OP1</td>
<td>Output 1 (heat) value displayed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OP2</td>
<td>Output 2 (cool) value displayed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>Autotune in progress</td>
<td>Manual control selected</td>
<td>Auto control selected</td>
</tr>
<tr>
<td>II</td>
<td>Program on Hold</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PRG</td>
<td>Current program number displayed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SEG</td>
<td>Current program segment displayed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>✂️</td>
<td>Time remaining in current segment displayed</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

B – Lower Display

Fig. 1.3 Secret-til-lit Indicators

1.4 Character Set – Fig. 1.4

| A | R | ą | I | ļ | R | r |
| B | b | j | J | ķ | S | ą |
| C | Ć | K | ć | T | ĝ | ą |
| D | ő | L | Ł | U | ń | ą |
| E | Ė | M | Ė | V | ę | ę |
| F | F | N | ń | Y | ę | ą |
| G | G | O | ő | Y | ę | ą |
| H | H | P | P |                |

Fig. 1.4 Character Set
## 1.5 Error Messages

<table>
<thead>
<tr>
<th>Display</th>
<th>Error/Action</th>
<th>To clear the display:</th>
</tr>
</thead>
</table>
| ![Error Icon](image1.png) | **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 and hold the \( \text{B} \) key |
| ![Error Icon](image2.png) | **A to D Converter Fault**  
  The analog to digital converter is not communicating correctly. | Contact the Customer Support Organization |
| ![Error Icon](image3.png) | **Input Value Over/Under Range** | Restore valid input |
| ![Error Icon](image4.png) | **Auto-tune Error**  
  The number displayed indicates the type of error present – see Table 2.1 on page 19. | Press and hold the \( \text{B} \) key |
| ![Error Icon](image5.png) | **Cold Junction Failed**  
  Cold junction sensor is faulty or has not been fitted correctly. | Check connections or replace if faulty. |
| ![Error Icon](image6.png) | **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 4.5. Check the valve. |
| ![Error Icon](image7.png) | **Position Feedback Fail**  
  Input value is over- or under-range. Only appears if output type set to 'PFb' – motorized valve with feedback. | Restore valid input |
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

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PV</td>
<td>Process Variable</td>
<td>di1</td>
<td>Digital Input 1</td>
</tr>
<tr>
<td>LSPt</td>
<td>Local Set Point Value</td>
<td>di2</td>
<td>Digital Input 2</td>
</tr>
<tr>
<td>LSP1</td>
<td>Local Set Point 1 Value</td>
<td>di3</td>
<td>Digital Input 3</td>
</tr>
<tr>
<td>LSP2</td>
<td>Local Set Point 2 Value</td>
<td>di4</td>
<td>Digital Input 4</td>
</tr>
<tr>
<td>LSP3</td>
<td>Local Set Point 3 Value</td>
<td>ao1</td>
<td>Analog Output 1</td>
</tr>
<tr>
<td>LSP4</td>
<td>Local Set Point 4 Value</td>
<td>ao2</td>
<td>Analog Output 2</td>
</tr>
<tr>
<td>P.SPt</td>
<td>Profile Set Point Value</td>
<td>do1</td>
<td>Digital Output 1</td>
</tr>
<tr>
<td>PID O/P</td>
<td>Output of the PID Algorithm</td>
<td>M.PV</td>
<td>Master Process Variable</td>
</tr>
<tr>
<td>OP1</td>
<td>Controller Output 1 (heat)</td>
<td>M.SPt</td>
<td>Master Control Set Point</td>
</tr>
<tr>
<td>OP2</td>
<td>Controller Output 2 (cool)</td>
<td>M.OP</td>
<td>Master PID Output</td>
</tr>
<tr>
<td>I/P1</td>
<td>Analog Input 1</td>
<td>S.SPt</td>
<td>Slave Set Point</td>
</tr>
<tr>
<td>I/P2</td>
<td>Analog Input 2</td>
<td>S.PV</td>
<td>Slave Process Variable</td>
</tr>
<tr>
<td>I/P3</td>
<td>Analog Input 3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2.1 Introduction
The Operator level (Level 1) is the normal day-to-day mode of the COMMANDER 360. This section describes the operator facilities available on each frame depending on the control template and output type selected.

The template types available on COMMANDER 360 instruments, and detailed in this section, are:
- Single loop controller
- Cascade control

Note. Only the frames relevant to the selected template are displayed – see Section 5.

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

Profile operation and setting up is detailed in Section 3.

Fig. 2.1 Power-up Displays
2.2 Single Loop Controller (Template 1)
The single loop controller is a basic feedback control system using three-term PID or on/off control.

Fig. 2.2 Single Loop Controller

Process Variable

Control Set Point
["SP Lt" to "SP Ht" – see Section 5.5]
Adjustable only when profile is not running. Local Set Point 1 is used for the profile set point and is selected automatically when a profile is run.

Current Program/Segment
[1.01 to L.99]

When the profile is in Run or Hold mode:
Press ▲ to skip forward to the start of the next segment.
Press ▼ to skip back to the start of the current segment.

When the profile is Stopped:
Press ▲ or ▼ to select the profile program to be run.

Note. Only valid programs (i.e. those not switched off) can be selected.

Continued on next page

• 1 With the Ramping Set Point function enabled (see Section 4.3, Set Points/ Ramp Rate), the deviation bargraph shows the difference between the process variable and the actual (ramping) set point value. The digital display shows the target set point value.

• 2 Program selection can only be adjusted when the current program is stopped and program selection is enabled – see Section 3.4/Profile Control/ Front Panel Program Select.

• 3 Segments can only be skipped if a program is in Run or Hold mode and Segment Skip is enabled – see Section 3.4/Profile Control/ Front Panel Skip Enable.
### Time Remaining in Current Segment

[0.0 to 99.9 hours or minutes]

Allows the total segment time to be increased or decreased by the Time Adjust value set in the Profile Control Level. If the current segment is a ramp, it will change the ramp rate.

Time units are set in the Profile Control Level – see Section 3.4/Profile Control/ Program Time Units. 99.9 is displayed if the time remaining is greater than 99.9 hours or minutes.

### 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.

**Note.** This frame is displayed automatically when manual mode is selected from the front panel.
2.3 Cascade Control (Template 11)

For cascade control, two internally-linked PID controllers are used, with the first (master) PID controller providing the set point for the second (slave) controller. The master output is weighted using the cascade ratio (C.rtO) and bias (C.blA) values to create the slave set point value.

![Fig. 2.3 Cascade Controller](image)

- **Master Process Variable (M.PV)**
- **Master Control Set Point (M.SPt)**
  
  - \[\text{SPt.L} \text{ to } \text{SPt.H} \text{ – see Section 5.5}\]
  
  Adjustable in local control only. Local Set Point 1 is used for the profile set point and is selected automatically when a profile is run.

- **Current Program/Segment**
  
  [1.01 to L.99]

  When the profile is in Run or Hold mode:
  
  - Press ▲ to skip forward to the start of the next segment.
  - Press ▼ to skip back to the start of the current segment.

  When the profile is Stopped:
  
  - Press ▲ or ▼ to select the profile program to be run.

  **Note.** Only valid programs (i.e. those not switched off) can be selected.

- **With the Ramping Set Point function enabled (see Section 4.3, Set Points/ Ramp Rate), the deviation bargraph shows the difference between the process variable and the actual (ramping) set point value. The digital display shows the target set point value.**

- **Program selection can only be adjusted when the current program is stopped and program selection is enabled – see Section 3.4/Profile Control/ Front Panel Program Select.**

- **Segments can only be skipped if a program is in Run or Hold mode and Segment Skip is enabled – see Section 3.4/Profile Control/ Front Panel Skip Enable.**
...2 OPERATOR LEVEL

2.3 Cascade Control (Template 11)

**Time Remaining in Current Segment**

[0.0 to 99.9 hours or minutes]

Allows the total segment time to be increased or decreased by the Time Adjust value set in the Profile Control Level. If the current segment is a ramp, it will change the ramp rate.

Time units are set in the Profile Control Level – see Section 3.4/Profile Control/ Program Time Units. 99.9 is displayed if the time remaining is greater than 99.9 hours or minutes.

**Slave 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.

**Note.** This frame is displayed automatically when manual mode is selected from the front panel.

**Slave Process Variable**

Slave Control Set Point (S.SPt)

['SSP.L' to 'SSP.H' – see Section 5.5]

Adjustable in local control only.

---

*1 Adjustment can be disabled in the Profile Control Level*
2 OPERATOR LEVEL...

...2.3 Cascade Control (Template 11)

**Slave Set Point Select**
Use this frame to select between local and cascade slave set points.

[CASC or LOCL]

- **CASC** = Slave set point derived from Master Output
- **LOCL** = Slave set point independent of Master Output

**Cascade Slave Set Point Ratio**

[0.001 to 9.999]
Slave set point (S.SPt) value = (ratio x master output) + bias [in engineering units]

**Cascade Slave Set Point Bias**

[In engineering units]

Return to Master Process Variable (M.PV) display

• Only displayed if ratio/bias display enabled – see Section 5.7, Operator Configuration.
2.4 Heat/Cool Output Types

2.4.1 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. 2.4 Typical Response – Reverse/Direct or Direct/Reverse Control Action

- Output Positive (Heat Output Active)
  - Heat output
  - [0 to 100% (0 to 110% for analog output)]
  - Adjustable in manual mode only.

- Output Negative (Cool Output Active)
  - Cool output
  - [−100 to 0% (−110 to 0% for analog output)]
  - Adjustable in manual mode only.

1. 0 to 100% for heat/cool analog output
2. −100 to 0% for heat/cool analog output
2.4.2 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. 2.5 Typical Response – Reverse/Reverse or Direct/Direct Control Action

2.5 Motorized Valve Output Types
2.5.1 Motorized Valve with Feedback

Valve Position Display

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

2.5.2 Motorized Valve without Feedback (Boundless)

Valve State Display

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

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

   - NONE None
   - HPU High Process, PV
   - LP1 Low Process, PV
   - HLP High Latch, PV
   - LLP Low Latch, PV
   - HD High Deviation
   - LD Low Deviation
   - HP1 High Process I/P1
   - LP1 Low Process I/P1
   - HP2 High Process I/P2
   - LP2 Low Process I/P2
   - HP3 High Process I/P3
   - LP3 Low Process I/P3

   - HO High Output
   - LO Low Output
   - PFT Power Failure Time – See Note
   - Hb1 Math Block 1 High
   - Lb1 Math Block 1 Low
   - Hb2 Math Block 2 High
   - Lb2 Math Block 2 Low
   - Hb3 Math Block 3 High
   - Lb3 Math Block 3 Low
   - Hb4 Math Block 4 High
   - Lb4 Math Block 4 Low

2. The lower display shows alarm status:
   - ACL Alarm active and unacknowledged
   - ACY Alarm active and acknowledged
   - CLR Cleared or Inactive alarm
   - LAL 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.

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

**Fig. 2.6 Alarm Acknowledgement**
2.7 Auto-tune

Note. Auto-tune is not available while a profile is running or when boundless or heat/cool control types are selected.

Information.
- Auto-tune optimizes process control by manipulating the COMMANDER 360 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 360 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 360 selects either 'start-up' or 'at set point' tuning automatically, depending upon the level of the process variable relative to the control set point.

2.7.1 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 5.
- If no errors exist, the COMMANDER 360 enters auto mode and begins to control the process using the new PID parameters.
- If an error occurs during the auto-tune, the COMMANDER 360 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 2.7a Typical Start-up Auto-tune Cycles](image)

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

Table 2.1 Auto-tune Error Codes
2.7.2 '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.** The time taken to complete auto-tune depends upon the system response time.

**Notes For Special Cases.**

**Cascade Control** – the slave loop must be tuned before the master loop. The slave must be placed into local set point mode (cascade disabled) and the slave set point adjusted to the required value prior to tuning.

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

Accessing the Auto-tune Facility
From any operating frame, press and hold the COdE 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
- Type A
- Type B

Cascade Templates
- Slave type A
- Slave type B
- Master type A
- Master type B

Auto-tune is started automatically when the COdE key is pressed. Auto-tune can be stopped at any time by pressing the COdE key.

Note. Profile program – If a profile is running, the auto-tune feature cannot be started. When the COdE key is pressed, the display reverts to 'OFF'.

Note. Slave control loops only – place the slave into local set point mode and adjust the set point to the required value prior to autotuning.

Note. P + I control only – set the derivative term to 'OFF' in the Tuning Level – see Section 4.2.

Return to the Operating Level.

Fig. 2.8 Autotune Types
2.8 Control Efficiency Monitor

**Note.** With cascade control, the Control Efficiency Monitor is applicable only to the master controller.

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.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Ideal Setting</th>
<th>Actual Setting</th>
<th>Effect on Response</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rate of Approach</td>
<td>Fast</td>
<td>Too slow</td>
<td>![Graph]</td>
<td>• Decrease proportional band</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Decrease integral time</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Increase derivative time</td>
</tr>
<tr>
<td>Overshoot</td>
<td>Small</td>
<td>Too large</td>
<td>![Graph]</td>
<td>• Increase proportional band</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Increase derivative time</td>
</tr>
<tr>
<td>Decay Ratio</td>
<td>Small</td>
<td>Too large (Oscillatory)</td>
<td>![Graph]</td>
<td>• Increase proportional band</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Increase integral time</td>
</tr>
<tr>
<td>Settling Time</td>
<td>Short</td>
<td>Too long</td>
<td>![Graph]</td>
<td>• Increase proportional band</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Decrease integral time</td>
</tr>
<tr>
<td>Error Integral</td>
<td>Small</td>
<td>Too large</td>
<td>![Graph]</td>
<td>If large overshoot and oscillatory then:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Increase proportional band</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Increase integral time</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Increase derivative time</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>If slow approach and overdamped then:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Decrease proportional band</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Decrease integral time</td>
</tr>
</tbody>
</table>

Table 2.2 Control Efficiency Monitor Settings
2.8 Control Efficiency Monitor

2.8.1 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 \( \frac{1}{4} \) 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:

\[
\begin{align*}
\text{Integral action time} &= \text{Period}/1.5 \\
\text{Derivative action time} &= \text{Period}/6
\end{align*}
\]

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

\[
\text{Rate of approach} = \frac{Y_1}{t_{\text{approach}}}
\]

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

\[
\text{Overshoot} = \left(\frac{X_1}{\text{Set Point}}\right) \times 100
\]

**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 \((t_{\text{period}})\).

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

**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'.

\[
\text{Error integral} = \int_{0}^{t_{\text{settle}}} (\text{PV} - \text{SP}) \, dt
\]

Return to the first operating frame.
3.1 Introduction
To access the Profile operating and configuration modes (Levels P, r and t) the correct password must be entered in the security code frame.

**Profile States**
- Program Select
- Run/Hold
- Reset Profile
- Skip Segment

**Profile Control Level**
- Time Units
- Program select source
- Run/hold sources
- Skip forwards/backwards source
- Reset source
- End of profile reset source
- Soak time increment/decrement source

**Profile Program Level**
- Program Begin/End
- Segment Start/End Value
- Soak time
- Ramp Rate
- Guaranteed Ramp/Soak
- Time Events
- Program Repeats
- Program Source

---

**Fig. 3.1 Set Up Mode – Overview**

**Fig. 3.2 – Scroll Display Overview**
3.2 Introduction to Ramp/Soak Profile Control

<table>
<thead>
<tr>
<th>Information.</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 20 programs.</td>
</tr>
<tr>
<td>• Digital State program selection – allows digital inputs to select program</td>
</tr>
<tr>
<td>to be run.</td>
</tr>
<tr>
<td>• 99 programmable segments – can be shared between programs</td>
</tr>
<tr>
<td>• Programmable time units – can be programmed in hours or minutes.</td>
</tr>
<tr>
<td>• Programmable Ramps – can be programmed as rates or in time units.</td>
</tr>
<tr>
<td>• Program repeat – 0 to 99 times or continuously.</td>
</tr>
<tr>
<td>• Program holdback hysteresis – separate settings for ramping segments and</td>
</tr>
<tr>
<td>soak segments.</td>
</tr>
<tr>
<td>– can be applied above, below or above and below the set point.</td>
</tr>
<tr>
<td>• 6 types of ramp/soak generated events – segment active event, program</td>
</tr>
<tr>
<td>active event, end of program event, holdback event, hold active event</td>
</tr>
<tr>
<td>and time events.</td>
</tr>
<tr>
<td>• 6 ramp/soak commands – can be selected from the front panel or via</td>
</tr>
<tr>
<td>digital signals to run/hold programs, reset programs, skip forward to</td>
</tr>
<tr>
<td>next segment, skip backwards to beginning of segment, increase soak</td>
</tr>
<tr>
<td>time or decrease soak time (refer to Fig. 3.8 for ramp/soak adjust</td>
</tr>
<tr>
<td>example).</td>
</tr>
<tr>
<td>• 4 time event states – common to each segment</td>
</tr>
<tr>
<td>• Self-seeking set point function – avoids unnecessary delays when a</td>
</tr>
<tr>
<td>program is started – see Fig. 3.5.</td>
</tr>
<tr>
<td>• Retort function – ensures safe operation under fault conditions – see</td>
</tr>
<tr>
<td>Fig. 3.6.</td>
</tr>
<tr>
<td>• Power recovery function – determines ramp/soak profile restart position.</td>
</tr>
<tr>
<td>• End of Profile State – latched ‘ON’ until reset</td>
</tr>
</tbody>
</table>

The Ramp/Soak facility is a set point profile generator which can be used with any type of control process for more complex control. A Profile Program is made up of Ramps (the set point is increased or decreased at a linear rate until it reaches the desired value) and Soaks (the set point is maintained at a fixed value for a set time duration).

3.2.1 Ramp Types – Fig. 3.3

The profile set point can be configured to increment in one of two way: for a fixed period of time or for a number of engineering units per hour.
3.2.2 Guaranteed Ramp/Soak

If the process variable deviates from the set point by more than the hysteresis value, the program status is set to ‘HOLD’ and Guaranteed ramp/soak is applied automatically. Each program has two associated hysteresis values:

- \( HYS_r \) — applied to ramping segments, and
- \( HYS_S \) — applied to soak segments.

The hysteresis value can be set within the limits ‘0’ to ‘9999’ where a setting of ‘0’ implies that no deviation from the set point value can be tolerated.

Hysteresis can be applied in one of four ways, with individual settings for each segment:

- **OFF** — hysteresis not applied, ramp/soak not guaranteed.
- **HI** — hysteresis applied above set point (‘HOLD’ set if \( PV > [SP + \text{Hysteresis}] \)).
- **LO** — hysteresis applied below set point (‘HOLD’ set if \( PV < [SP - \text{Hysteresis}] \)).
- **HI.LO** — hysteresis applied above and below set point (‘HOLD’ set if \( PV > [SP + \text{Hysteresis}] \) or \( PV < [SP - \text{Hysteresis}] \)).

![Fig 3.4 Typical 6-segment Ramp/Soak Profile](image)

**Note.** Ramping segments can have a different hysteresis to soak segments.

3.2.3 Power Recovery Function

The Power Recovery function allows pre-selection of the restart position within a ramp/soak profile when power is restored after a failure.

With options \( R, b \) or \( C \), if power is restored before the **Power Down Time** expires, the ramp/soak profile continues from the point at which power failed. If power is restored after the **Power Down Time** has expired, the profile resumes from one of the following user-selected points: start of the current program; start of the current segment or from the profile position at the time of failure. In all three cases the controller restarts in **HOLD** mode.

With option \( d \), the profile continues in run mode from the position on the profile that would have been reached had the power failure not occurred.
3.2.4 Self-seeking Set Point – Fig. 3.5
The Self-seeking Set Point function reduces the delay between the end of a program and the beginning of the next program. The process variable value is used as the program start point and the set point steps up to the process variable value. This has the effect of changing the overall segment time and maintains a constant ramp rate.

![Fig 3.5 Self-seeking Set Point](image)

3.2.5 Retort Function – Fig. 3.6
The Retort function ensures safe operation of retort vessels under fault conditions. If the heat source fails during a soak segment, the process variable will inevitably fall. When the process variable falls below the holdback hysteresis value the program is put on HOLD (as for normal operation). The set point then follows the process variable as it continues to fall (Retort Hold).

Set Point = Process Variable + Hysteresis value

Upon recovery of the heat source, the process is controlled at the new set point value. When the process variable reaches the set point it is then ramped back to the initial soak value at the rate of the previous ramp (Retort Ramp). When the soak level is reached the program is released from its hold state and the segment is either completed or repeated from the beginning, depending on the retort mode selected.

The retort mode is selected in the Ramp/Soak Profile Page.

**Note.** For the retort function to operate, either LOW or HI-LOW hysteresis must be applied to the soak segments.

![Fig 3.6 Retort Function](image)
3.2.6 Time Events – Fig. 3.7
Each state generates a source (‘$t_{EV.1}$’ to ‘$t_{EV.4}$’) which can be assigned to relays, digital outputs, logic equations etc. in the same way as any other digital signal.

Time event states are provided in addition to program and segment events states and do not affect their operation. Each segment has an associated ‘$EV.N_t$’ setting which is used to control the Time-event states.

![Fig 3.7 Time Events](image)

3.2.7 End of Profile State
The end of profile state is a digital source which can be assigned in the same manner as any other digital signal. The state is set automatically when the program is complete and remains set until a reset signal is received. The state can be configured to reset via a digital source or to reset automatically after two seconds – see Section 3.4/Profile Control/End of Profile Reset Source.
3.2.8 Current Segment Time Adjustment – Fig. 3.8 & 3.9

The Time Adjust function allows the time of a segment to be extended or reduced by a value preset in the ‘t.Adj’ frame – see Ramp/Soak Profile Control Page. The segment time can be adjusted repeatedly (in preset increments) while the segment is running, either from the controller faceplate or by a digital signal (assigned in the ‘Inc.S’ or ‘dEc.S’ frames).

**Note.** Any changes made to the segment time using this function are not saved in the program memory. At the end of the program, all segment times are reset to their original values.

Fig. 3.8a Time Adjustment on a Soak Segment

Fig. 3.8b Time Adjustment on a Ramp Segment
3.3 Profile States

**Level P – Profile States**

**Program Select**
Select the program to be run

*Note.* This frame is displayed only if no other program is running.

[1 to 9, A to L excluding I]

**Run/Hold Action**

[r UN or HOL d — Starts the selected program.
HOL d — Activates the selected Operator Hold.

*Note.* If a digital input assigned to the run/hold function has been used to run a program, the user is prevented from activating the operator hold.

**Profile Reset**
Select *YES* to restart the profile at the beginning of the program.

*YES* — restart the profile
*NO* — do not restart the profile

*Note.* To end a program, select *HOL d* at the Profile Status frame (see above) and then select *YES* at this frame. The local set point value takes the value of the first level of the selected program and the profile status reverts to ‘STOP’.

**Skip Segment**
The current segment number (or NN) is shown in the upper display.

SKP.F or SKP.b

*Skip Forward* — abandon current segment and start the next segment.
*Do Not Skip* — maintain control using current segment.

*Skip Back* — return to beginning of current segment.

---

•1  Displayed only if the current profile status is Stopped.

•2  Not displayed if the current profile state is Stopped or End.
3.4 Ramp/Soak Profile Control

**Level r – Profile Control**

**Program Time Units**
Select the time units required
- **h** – Hours
- **m** – Minutes

The time base selected applies to all segments.

**Select Ramp Type**
Select the ramp type required
- **k i. E** – Ramp time
- **r A t E** – Ramp rate

The ramp type selected applies to all segments.

**Next Program Select Source**
See Rear Fold-out/Table D – Digital Sources
Only programs which have been set up in the profile program level, level t, can be selected.

**Program Run/Hold Source**
The run/hold source is level triggered i.e. the active logic state must be maintained to select the alternative function.

See Rear Fold-out/Table D – Digital Sources

**Note.** If a program is run using **Program Run/Hold Source**, ‘Operator Hold’ is disabled until the **Program Run/Hold Source** has been de-activated. The **Program Hold Source** and front panel switches have no effect.

**Program Run Source**
The run source is leading edge triggered i.e. the active logic state can be removed after the function is selected.

See Rear Fold-out/Table D, Digital Sources

---

1 A digital input becomes active when a volt-free contact is closed or a low TTL signal is applied.
...3.4 Ramp/Soak Profile Control

Program Hold Source
The hold source is leading edge triggered.

See Rear Fold-out/Table D, Digital Sources.

The program is restarted using the Program Run Source or the front panel keys.

Segment Skip Forward Source
Select the source required to skip to the next segment.

See Rear Fold-out/Table D, Digital Sources.

Note. If the segment running is the last segment of the program, the program is stopped. The skip source is leading edge triggered.

Segment Skip Backward Source
Select the source required to skip back to the beginning of the ramp/soak segment running. The skip source is leading edge triggered.

See Rear Fold-out/Table D, Digital Sources.

Program Reset Source
Select the source required to reset a running program. The reset source is leading edge triggered.

See Rear Fold-out/Table D, Digital Sources.

Note. If the program is running normally and is reset, the program returns to the beginning of the first segment and continues to run. If the program is on hold and is reset, the program returns to the beginning of the first segment and stops. No action is taken if a program has already finished.

End of Profile Event Reset Source
The end of profile event state is set automatically when the program is complete. A digital source can be activated to cause the end of profile event state to be reset.

Select the source required to reset the end of profile event state.

See Rear Fold-out/Table D, Digital Sources.

Note. If ‘NONE’ is selected, the end of profile event state is reset automatically after 2 seconds.

•1 A digital input becomes active when a volt-free contact is closed or a low TTL signal is applied.
...3.4 Ramp/Soak Profile Control

Segment Time Increment Source (Current Segment)
The time of the current segment can be increased (by an amount set in the Segment Time Adjust frame) each time the source is activated. (ie. the source is leading edge triggered).
 Increment Segment Time

See Rear Fold-out/Table D, Digital Sources.

Segment Time Decrement Source (Current Segment)
The time of the current segment can be decreased (by an amount set in the Segment Time Adjust frame) each time the source is activated. (ie. the source is leading edge triggered).
  Decrement Segment Time

See Rear Fold-out/Table D, Digital Sources.

Segment Time Adjust Value (Current Segment)
The value set is added to or subtracted from the remaining time of a running segment via a digital signal or from front panel keys, when in the Time Remaining in Current Segment frame of the Operating Page.
[0.1 to 100.0 or OFF]
The time units are set in the Time Units frame. If OFF is selected, this function is disabled.

Front Panel Run/Hold Enable
YES – Enabled
NO – Disabled

Front Panel Stop Key Enable
YES – Enabled
NO – Disabled

Front Panel Program Select Enable
YES – Operator level program select enabled
NO – Operator level program select disabled

Continued...

• 1 A digital input becomes active when a volt-free contact is closed or a low TTL signal is applied.
### Front Panel Segment Skip Enable
- **Fd bK** – Operator level segment skip forwards & backwards enabled
- **bK** – Operator level segment skip backwards enabled
- **Fd** – Operator level segment skip forwards enabled
- **NO** – Operator level segment skip disabled

### Front Panel Segment Time Adjustment Enable
- **UP dN** – Operator level time increment and decrement enabled
- **dN** – Operator level time decrement enabled
- **UP** – Operator level time increment enabled
- **NO** – Operator level time adjust disabled

### Power-down Recovery Option
Select the profile restart position when power is restored after a failure and the Power Down Time Period (see below) has expired. See Section 3.2.3.
- **R** – Start of the current program, profile set to operator hold mode
- **b** – Start of the current segment, profile set to operator hold mode
- **C** – Profile position unchanged, profile set to operator hold mode
- **d** – Calculated position in profile had the power not failed

**Note.** Option d does not work with segments of more than 24 hours duration or if the power down time is greater than 24 hours. When power is restored, the profile is set to operator hold mode and the profile position is unchanged.

### Power-down Time Period (Power-down recovery options R, b & C)
Set the time period during which, if power is restored, the profile continues from the point at which power failed. If the Power-down Time is exceeded the Power-down Recovery Option, selected above, is invoked.
- [0.0 to 99.9 minutes]

### Self-Seeking Set Point
- **YES** – Enable self-seeking set point
- **NO** – Disable self-seeking set point

When enabled, the controller uses the current process variable value as the starting point of the first profile segment – see Section 3.2.4.

### Retort Function
See Section 3.2.5
- **OFF** – Disable retort function
- **R** – Complete soak segment
- **b** – Repeat soak segment

Return to the top of the Profile Control Page.

---

*1 Not displayed if power down recovery option d is selected.*
3.5 Ramp/Soak Profile Program

**Level t – Profile Program.**

**Select Program**
Select the program to be configured

[1 to 9, A to L excluding I]

**Program Begin**
Select the program start segment

[1 to 99 or OFF]
Setting this parameter to OFF prevents the program being selected.

**Note.** Program 1 cannot be switched off.

**Program End**
Select the program end segment

[1 to 99]

**Note.** If the program end segment is less than the program start segment, the display reverts to the Program Begin frame.

**Select Segment**
Select the segment to be programmed

[Valid segments of selected program or NONE]

When all segments have been programmed, select NONE to advance to Repeat Program frame.

Continued…
### 3.5 Ramp/Soak Profile Program

**Segment Start Value**
The segment start value can only be set if it is the first segment of a program.

[-999 to 9999 in engineering units]

**Note.** A Ramp has different start and end set point values. A Soak has the same start and end set point values. Adjacent segments of different Ramp or Soak programs MUST have the same start and end values, unless an intermediate ‘spacer’ segment is used. The start value of a segment can only be adjusted if the segment is the first of the selected program.

**Segment End Value**

[-999 to 9999 in engineering units]

If segment start/end values are the same or the ramp type is set to ‘\( \text{r \& E} \)’, advance to the Segment Time frame. If segment start/end values are different and the ramp type is set to ‘\( \text{r \& E} \)’, advance to the Ramp Rate frame.

**Segment Time**

[0 to 999.9]

The time units (hours or minutes) are configured in Ramp/Soak Time Units frame, Profile Control Page.

**Ramp Rate**

[0.001 to 9999 engineering units per time period]

The time period (hours or minutes) is set in the Ramp/Soak Time Units frame, Profile Control Page.

**Example**—If a ramp of 10°F at 2°F every minute is required, the ramp rate value entered is 2.0 (in the minutes time base).

**Note.** If the Program Time Units parameter is set to minutes, the engineering units value is displayed to an extra decimal place.

**Guaranteed Ramp/Soak Hysteresis**

- **HI.LD** — hysteresis applied above and below set point
  - (HI.LD set if PV > [SP + Hysteresis] or PV < [SP + Hysteresis])
- **LO** — hysteresis applied below set point
  - (HI.LD set if PV < [SP – Hysteresis])
- **HI** — hysteresis applied above set point
  - (HI.LD set if PV > [SP + Hysteresis])
- **OFF** — hysteresis not applied, ramp/soak not guaranteed.

•1 Displayed only if segment start and end values are the same, or the Ramp Type is set to ‘\( \text{r \& E} \)’.

•2 Displayed only if segment start and end values are different and the Ramp Type is set to ‘\( \text{r \& E} \)’.

Continued...
### ...3.5 Ramp/Soak Profile Program

**Time Events**
Up to four time-events can be assigned to the segment currently being programmed – see Fig. 3.7 on page 29.

- Press the key to turn event 1 ON.
- Press the key to turn event 1 OFF.
- Press the key to advance to the next event.

**Example.** '12-4' indicates time events 1, 2, and 4 are active during this segment and time event 3 is inactive

---

**Repeat Program Profile**

[0 to 99 or INFN]

**Note.** If 1 is selected, the program runs twice; if 99 is selected, the program runs 100 times in total.

If 'INFN' (infinity) is selected, the program is repeated until stopped by the operator.

---

**Guaranteed Ramp Hysteresis**

[0.001 and 9999 in engineering units or '0' if no deviation from the profile is allowed]

---

**Guaranteed Soak Hysteresis**

[0.001 and 9999 in engineering units or '0' if no deviation from the profile is allowed]

---

**Program Source**
The program source is leading edge triggered i.e. the active logic state can be removed after the function is selected.

See Rear Fold-out/Table D, Digital Sources.

---

Return to **Select Program** frame.

---

* A digital input becomes active when a volt-free contact is closed or a low TTL signal is applied.
4 SET UP MODE

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

---

**Valid Configuration Password**
**Valid Set Up Password**
---

**Valid Profile Configuration Password**
---

**Alarm Acknowledgement**
see Section 2.7
---

** alarm trip points**
Alarm 1 to 8 trip points
---

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

Fig. 4.1 Set Up Mode – Overview
---

Fig. 4.2 – Scroll Display Overview
4.2 Level 2 – Tune

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

Cycle Time Output 1

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

Note. On/off Control is not available on output 1 with heat/cool control or with cascade templates.

Cycle Time Output 2 (Cool)

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

Note. On/off Control is not available on output 2 with cascade templates.

Output 1 On/Off Hysteresis Value

[In engineering units]

Output 2 On/Off Hysteresis Value

[0% to (Y1.St – Y2.St)%] – see parameters 2.22 and 2.23 on page 43

Continued on next page

1. Displayed only if Relay or Digital output type is selected – see section 5.2, Basic Configuration/Output Type.

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

3. Only if On/Off control is selected – see Section 5, Configuration.

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

Proportional Band 1

Enter the value for Proportional Band 1.

\[0.1\% \text{ to } 999.9\%\]

‘Pb - 1’ is the default proportional band and is the proportional band for the master controller if a cascade template is selected – see Section 5.2, Basic Configuration/ Template Application.

Proportional Band 2, 3 and 4

Enter the value for Proportional Band 2, 3 and/or 4.

\[0.1\% \text{ to } 999.9\%\]

‘Pb - 2’ is the proportional band for the slave controller if a cascade template is selected – see Section 5.2, Basic Configuration/ Template Application.

Integral Action Time 1

[1 to 7200 seconds or ‘OFF’]

‘IAt.1’ is the default integral action time and is the integral action time for the master controller if a cascade template is selected – see Section 5.2, Basic Configuration/ Template Application.

Integral Action Time 2, 3 and 4

[1 to 7200 seconds or ‘OFF’]

‘IAt.2’ is the integral action time for the slave controller if a cascade template is selected – see Section 5.2, Basic Configuration/ Template Application.

Derivative Action Time 1

[0.1 to 999.9 seconds or ‘OFF’]

‘drV.1’ is the derivative action time for the master controller if a cascade template is selected – see Section 5.2, Basic Configuration/ Template Application.

Continued on next page.

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

•2 Displayed only if the cascade template or a tune parameter source is selected – see Section 5.2, Basic Configuration/ Template Application and Section 5.6, Control Configuration/ Tune Parameter Source.

•3 Displayed only if a tune parameter source is selected – see Section 5.6, Control Configuration/ Tune Parameter Source.
...4 SET UP MODE

...4.2 Level 2 – Tune

2.14 Derivative Action Time 2

[0.1 to 999.9 seconds or 'OFF']

The derivative action time for the slave controller if a cascade template is selected – see Section 5.2, Basic Configuration/Template Application.

2.15 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.

2.16 Approach Band 2

[0.1 to 3.0 proportional bands]

This parameter limits when derivative action time 2 is applied to the slave control loop when a cascade template is selected.

2.17 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 integral action is selected ON or OFF.

2.18 Manual Reset Value 2

As Manual Reset Value 1, but applied to the slave output.

[0.0 to 100%]

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

Continued on next page.

•1 Displayed only if a cascade template is selected – see Section 5.2, Basic Configuration/Template Application.

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

•3 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.
...4.2 Level 2 – Tune

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’]

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 \( Y \leq \%\)] – see Heat/Cool Output 1

\*1 Displayed only if a Heat/Cool output type is selected – see Section 5.2, Basic Configuration/ Output Type.

Return to top of page
4.3 Level 3 – Set Points

Level 3 – Set Points

**Note.** To select this frame from anywhere in this page, press and hold the [ ] 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]

**Note.** This set point is modified by the profile and is selected automatically when a profile program is run.

**Local Set Point Values 2 to 4**
[Within set point high and low limits, in engineering units – see Level 9]

**Cascade Slave Set Point Value**
Set the slave set point value.
[Within slave set point high and low limits, in engineering units]
Only adjustable in Manual mode.

...Continued...

---

1. Displayed only if a local set point source is selected – see Section 5.5/ Set Point Configuration/ Local/Remote Set Point Source.
2. Displayed only if the cascade template is selected
4.3 Level 3 – Set Points

3.08 Cascade Set Point Ratio
In automatic mode, the slave set point value is:
\[(\text{ratio} \times \text{master output}) + \text{bias}\].

[0.001 to 9.999]

3.09 Cascade Set Point Bias
[In engineering units]

3.10 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.

• Displayed only if the Cascade template is selected – see Section 5.2, Basic Configuration/ Template Application.
4.4 Level 4 – Alarm Trip Points

Note. Level 4 is not applicable if all alarm types are set to ‘None’ – see Section 5.4, 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

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

Trip Value
[In engineering units]

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 5.4, Alarms/Alarm Type.

• 2 Applies to PID output with single or heat/cool outputs.
4.5 Level 5 – Valve Setup

**Note.** Level 5 is applicable only for a motorized valve output type – see Section 5.2, Basic Configuration/Output Type.

---

![Diagram of Motorized Valve Output with Feedback](image)

**Fig. 4.3 Motorized Valve Output with Feedback – Schematic**

### 4.5.1 Valve Setup (Feedback Types)

#### 5.00 U.LU.E

**Level 5 – Valve Setup**

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

#### 5.01 d.bNd

**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%]

#### 5.02 VbIA

**Motorized Valve DEADBAND**

[0.0 to 100% of the position feedback span]

- **Position %**
  - Desired valve position
  - Deadband (centered around required position)

**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%.

#### 5.03 d.bNd

**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.
4.5.2 Valve Setup (Boundless Types) – Fig. 4.4

A ‘boundless’ process controller provides an output that is effectively the time derivative of the required regulator position, i.e. the COMMANDER 360 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 360 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. 4.4 Boundless Control Action](image)

**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).

\[
\text{Minimum 'ON' time} = \frac{\text{Travel Time} \times \text{Deadband} \%}{\% \text{Proportional Band}} \quad \text{(in seconds)}
\]

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

\[
\text{Minimum} \approx \frac{\text{Integral Action Time} \times \text{Deadband} \%}{2 \times \% \text{Control Deviation}} \quad \text{(in seconds)}
\]

Duration of the proportional step

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

% Control Deviation

\[
\% \text{Control Deviation} = \frac{\text{Set Point} - \text{Process Variable}}{\text{Eng Hi} - \text{Eng Lo}} \times 100\%
\]

% Deadband

\[
\% \text{Deadband} = \frac{\text{Deadband (eng units)}}{\text{Eng Hi} - \text{Eng Lo}} \times 100\%
\]
...4.5.2 Valve Setup (Boundless Types)

5.00

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]

Position %

Control Set Point

Deadband (centered around Set Point)

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

---

Press and hold CODE 50. 
Alarm Acknowledgement – see Section 2.6

---

<table>
<thead>
<tr>
<th>Valid Configuration Password</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid Set Up Password</td>
</tr>
<tr>
<td>Valid Profile Configuration Password</td>
</tr>
</tbody>
</table>

---

Note. When in the configuration mode, all relays and digital outputs are de-energized and all analog outputs revert to the set minimum current output.

---

**Basic Configuration**
- Template application
- Output type
- Control action
- Mains rejection frequency

**Analog Inputs 1 to 3**
- Type
- Electrical range
- Decimal places
- Engineering range
- Broken sensor drive
- Input filter time constant

**Alarms 1 to 8**
- Type
- Trip level
- Hysteresis band

**Set Points**
- Tracking enable
- Set point limits
- Local set point sources 1 to 4

**Control Configuration**
- Power fail recovery action
- Output high/low limits
- Slew rate + disable
- Configured outputs 1 to 3
- Manual output selection sources
- Auto mode selection source
- Tune parameter sources 1 to 4

**Operator Configuration**
- Auto/manual key enables
- Alarm acknowledge key enable
- Operator set point adjust enable
- Operator ratio/bias enable
- Password settings
- Clock settings

**Output Assignment**
- Outputs 1 and 2 type
- Digital output
  - Assignment source
  - Polarity
- Analog output
  - Assignment source
  - Electrical range
  - Engineering range
- Relay outputs 1 to 4
  - Assignment source
  - Polarity

**Serial Communications**
- 2-/4-wire connection
- 2400/9600/19200 baud rate
- Parity
- Modbus address

**Calibration**
- Offset/span adjustment
- Motorized valve feedback

---

Fig. 5.1 Configuration Mode – Summary
5.2 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 360 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

<table>
<thead>
<tr>
<th>Display</th>
<th>Template Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 iSL</td>
<td>Single loop with local set point only</td>
</tr>
<tr>
<td>1 iCC</td>
<td>Cascade with local set point only</td>
</tr>
</tbody>
</table>

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 iSL’ becomes ‘0 iLU’.

Continued…
5.2 Level 6 – Basic Configuration

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 5.8, Output Assignment Configuration.

Select the Output Type required – see also Fig. 5.2 overleaf and Rear Fold-out/ Table B.

<table>
<thead>
<tr>
<th>Display</th>
<th>Output Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>none</td>
<td>None</td>
</tr>
<tr>
<td>analog</td>
<td>Analog output (Control output = ao1)</td>
</tr>
<tr>
<td>relay</td>
<td>Relay output (Control output = RLY1)</td>
</tr>
<tr>
<td>digital</td>
<td>Digital output (Control output = do1)</td>
</tr>
<tr>
<td>motorized valve with feedback (Open = RLY1, Close = RLY2)</td>
<td></td>
</tr>
<tr>
<td>motorized valve without feedback (Open = RLY1, Close = RLY2)</td>
<td></td>
</tr>
<tr>
<td>heat/cool with OP1 = relay, OP2 = relay</td>
<td></td>
</tr>
<tr>
<td>heat/cool with OP1 = relay, OP2 = digital output</td>
<td></td>
</tr>
<tr>
<td>heat/cool with OP1 = digital output, OP2 = relay</td>
<td></td>
</tr>
<tr>
<td>heat/cool with OP1 = analog, OP2 = relay</td>
<td></td>
</tr>
<tr>
<td>heat/cool with OP1 = analog, OP2 = analog</td>
<td></td>
</tr>
</tbody>
</table>

• Analog Input 3 Type defaults to ‘11’ – Resistance Feedback.
...5.2 Level 6 – Basic Configuration

![Diagram of Output Types]

Output Types:
- **ANLG**: Analog Output
- **rLY**: Relay Output
- **dIG**: Digital Output

A – Single Output

Output Type: **PV**

B – Motorized Valve Output with Feedback

Output Type: **bNd**

C – Motorized Valve Output without Feedback (Boundless)

Output Types:
- **HC.rr**: Heat Output
- **HC.rd**: Relay or Digital Output
- **HC.dr**: Direct Relay Output
- **HC.Ar**: Heat Output with Relay
- **HC.AA**: Analog Output

D – Heat/cool Output

Fig 5.2 Output Type Schematic Diagrams
### 5.2 Level 6 – Basic Configuration

#### 6.03 Control Action

<table>
<thead>
<tr>
<th>Single Loop</th>
<th>Output 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>-2</td>
<td>r EU</td>
</tr>
<tr>
<td>-3</td>
<td>d Ir</td>
</tr>
</tbody>
</table>

-2 Displayed only if a Cascade template is selected.

#### 6.04 Control Action (Master Loop)

- r EU – Reverse
- d Ir – Direct

#### 6.05 Control Action (Slave Loop)

[Options as frame 6.03 above]

#### 6.06 Mains Rejection Frequency

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

- [50 or 60Hz]

---

1. Displayed only if a Cascade template is selected.
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.
5.3 Level 7 – Analog Inputs

Level 7 – Analog Inputs

Note. Refer also to Table A, Input Assignments on the rear fold-out.

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

<table>
<thead>
<tr>
<th>Display</th>
<th>Description</th>
<th>Display</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>OFF (Not Used)</td>
<td>P</td>
<td>PT100 RTD</td>
</tr>
<tr>
<td>b</td>
<td>THC Type B</td>
<td>l</td>
<td>0 to 20mA</td>
</tr>
<tr>
<td>E</td>
<td>THC Type E</td>
<td>2</td>
<td>4 to 20mA</td>
</tr>
<tr>
<td>J</td>
<td>THC Type J</td>
<td>3</td>
<td>0 to 5V</td>
</tr>
<tr>
<td>K</td>
<td>THC Type K</td>
<td>4</td>
<td>1 to 5V</td>
</tr>
<tr>
<td>L</td>
<td>THC Type L</td>
<td>6</td>
<td>0 to 50mV</td>
</tr>
<tr>
<td>N</td>
<td>THC Type N</td>
<td>7</td>
<td>4 to 20mA square root linearizer</td>
</tr>
<tr>
<td>r</td>
<td>THC Type R</td>
<td>8</td>
<td>4 to 20mA power 3/2</td>
</tr>
<tr>
<td>S</td>
<td>THC Type S</td>
<td>9</td>
<td>4 to 20mA power 5/2</td>
</tr>
<tr>
<td>t</td>
<td>THC Type T</td>
<td>U</td>
<td>Custom</td>
</tr>
</tbody>
</table>

Temperature Units (I/P1)

- C – THC/PT100 readings displayed in degrees Centigrade
- F – THC/PT100 readings displayed in degrees Farenheit

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
...5 CONFIGURATION MODE

... 5.3 Level 7 – Analog Inputs

7.04

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 5.1.

<table>
<thead>
<tr>
<th>THC /RTD Type</th>
<th>°C</th>
<th>°F</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Min.</td>
<td>Max.</td>
</tr>
<tr>
<td>Type B</td>
<td>-18</td>
<td>1800</td>
</tr>
<tr>
<td>Type E</td>
<td>-100</td>
<td>900</td>
</tr>
<tr>
<td>Type J</td>
<td>-100</td>
<td>900</td>
</tr>
<tr>
<td>Type K</td>
<td>-100</td>
<td>1300</td>
</tr>
<tr>
<td>Type L</td>
<td>-100</td>
<td>900</td>
</tr>
<tr>
<td>Type N</td>
<td>-200</td>
<td>1300</td>
</tr>
<tr>
<td>Type R &amp; S</td>
<td>-18</td>
<td>1700</td>
</tr>
<tr>
<td>Type T</td>
<td>-250</td>
<td>300</td>
</tr>
<tr>
<td>Pt100</td>
<td>-200</td>
<td>600</td>
</tr>
</tbody>
</table>

Table 5.1 Engineering Limits, THC & RTD Inputs

7.05

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 5.1.

7.06

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.

7.07

Input Filter Time Constant (I/P1)

The input values are averaged over the time set.

[0 to 60 seconds]

Continued...
5.3 Level 7 – Analog Inputs

### 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.

<table>
<thead>
<tr>
<th>Display</th>
<th>Description</th>
<th>Display</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 OFF</td>
<td>Not Used</td>
<td>ζ</td>
<td>THC Type 1</td>
</tr>
<tr>
<td>b</td>
<td>THC Type B</td>
<td>1</td>
<td>0 to 20mA</td>
</tr>
<tr>
<td>£</td>
<td>THC Type E</td>
<td>2</td>
<td>4 to 20mA</td>
</tr>
<tr>
<td>Ј</td>
<td>THC Type J</td>
<td>6</td>
<td>0 to 50mV</td>
</tr>
<tr>
<td>Ρ</td>
<td>THC Type K</td>
<td>7</td>
<td>4 to 20mA square root linearizer</td>
</tr>
<tr>
<td>Λ</td>
<td>THC Type L</td>
<td>θ</td>
<td>4 to 20mA power $\frac{3}{2}$</td>
</tr>
<tr>
<td>Ν</td>
<td>THC Type N</td>
<td>9</td>
<td>4 to 20mA power $\frac{5}{2}$</td>
</tr>
<tr>
<td>ρ</td>
<td>THC Type R</td>
<td>U</td>
<td>Custom</td>
</tr>
<tr>
<td>S</td>
<td>THC Type S</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Temperature Units (I/P2)

- Ζ – THC readings displayed in °C
- Φ – THC readings displayed in °F

### Decimal Places (Engineering Range, I/P2)

1. 0 – XXXX
2. 1 – XXX.X
3. 2 – XX.XX
4. 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 5.1.

### Engineering Low (I/P2)

[–999 to 9999]

**Note.** This parameter defaults to the minimum allowed value when THC input is selected – see Table 5.1.

### 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]

---

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.
5.3 Level 7 – Analog Inputs

### Analog Input Type & Electrical Range (I/P3)

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

#### 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 5.1.

#### Engineering Low

[-999 to 9999]

**Note.** This parameter defaults to the minimum allowed value when THC or RTD inputs are selected – see Table 5.1.

#### 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. If I/P3 is used as a remote set point input, then the number of decimal places is the same as the number of decimal places on the process variable input.
5.4 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 5.3 Using an Alarm to Sound a Horn**

**Fig 5.4 High and Low Deviation Alarm Action**
...5 CONFIGURATION MODE

...5.4 Level 8 – Alarms

Fig 5.5 High and Low Process Alarm Action

Fig 5.6 High and Low Latch Alarm Action
...5.4 Level 8 – Alarms

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. 5.3 to 5.6

<table>
<thead>
<tr>
<th>Display</th>
<th>Description</th>
<th>Display</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NONE</td>
<td>None</td>
<td>LP3</td>
<td>Low Process I/P3</td>
</tr>
<tr>
<td>HPU</td>
<td>High Process, PV</td>
<td>HP0</td>
<td>High Output</td>
</tr>
<tr>
<td>LPU</td>
<td>Low Process, PV</td>
<td>L0</td>
<td>Low Output</td>
</tr>
<tr>
<td>HLP</td>
<td>High Latch, PV</td>
<td>Lb1</td>
<td>Math Block 1 Low</td>
</tr>
<tr>
<td>LLP</td>
<td>Low Latch, PV</td>
<td>Lb1</td>
<td>Math Block 1 Low</td>
</tr>
<tr>
<td>Hd</td>
<td>High Deviation</td>
<td>Hb2</td>
<td>Math Block 2 High</td>
</tr>
<tr>
<td>Ld</td>
<td>Low Deviation</td>
<td>Lb2</td>
<td>Math Block 2 Low</td>
</tr>
<tr>
<td>HP1</td>
<td>High Process I/P1</td>
<td>Hb3</td>
<td>Math Block 3 High</td>
</tr>
<tr>
<td>LP1</td>
<td>Low Process I/P1</td>
<td>Lb3</td>
<td>Math Block 3 Low</td>
</tr>
<tr>
<td>HP2</td>
<td>High Process I/P2</td>
<td>Hb4</td>
<td>Math Block 4 High</td>
</tr>
<tr>
<td>LP2</td>
<td>Low Process I/P2</td>
<td>Lb4</td>
<td>Math Block 4 Low</td>
</tr>
<tr>
<td>HP3</td>
<td>High Process I/P3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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. 5.4 to 5.6.

[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.
5.4 Level 8 – Alarms

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 D – Digital Sources.
5.5 Level 9 – Set Point Configuration

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

<table>
<thead>
<tr>
<th>Display</th>
<th>Local Set Point Tracking</th>
</tr>
</thead>
<tbody>
<tr>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>LOC</td>
<td>ON</td>
</tr>
</tbody>
</table>

Local Set Point Tracking – the local set point tracks the process variable when manual mode is selected. Applies to master and slave set points with cascade templates.

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 (C.SPT) or Master Set Point (M.SPT) High Limit

[–999 to 9999 in engineering units]

Control Set Point (C.SPT) or Master Set Point (M.SPT) Low Limit

[–999 to 9999 in engineering units]

Note. Operator level adjustment of the set point can be disabled – see Section 5.7, Operator Configuration/ Set Point Adjustment Enable.

High Limit for Slave Set Point

[In engineering units]

Low Limit for Slave Set Point

[In engineering units]

Continued…

•1 Displayed only if the Cascade template is selected.
5.5 Level 9 – Set Point Configuration

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 D – Digital Sources.

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 D – Digital Sources.

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 D – Digital Sources.

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 D – Digital Sources.

Return to top of Set Point Configuration page.

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

• 2 Local Set Point 1 is selected automatically when a profile program is running. No other local set point can be selected until the profile program is stopped.
5.6 Level A – Control Configuration

**Power Fail Recovery Mode**
Select the default power failure mode required following a power interruption or failure.

<table>
<thead>
<tr>
<th>Display</th>
<th>Setting</th>
<th>Display</th>
<th>Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Last mode</td>
<td>5</td>
<td>Auto mode, integral term reset</td>
</tr>
<tr>
<td>1</td>
<td>Manual mode, using last output</td>
<td>6</td>
<td>Auto mode, using last integral term</td>
</tr>
<tr>
<td>2</td>
<td>Manual mode with 0.0% output</td>
<td>7</td>
<td>Power outage ≤ Recovery time: Auto mode. Power outage &gt; Recovery time: Manual mode, last output</td>
</tr>
<tr>
<td>3</td>
<td>Manual mode with 100.0% output</td>
<td>8</td>
<td>Power outage ≤ Recovery time: Auto mode. Power outage &gt; Recovery time: Manual mode, configured output</td>
</tr>
<tr>
<td>4</td>
<td>Manual mode with configured output</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note.** For profile power recovery options, refer to Section 3.4/ Profile Control/ Power Down Recovery Option.

**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…
...5.6 Level A – Control Configuration

**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

**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)

**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%]

**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%]

**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%]

**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%]

---

1 Displayed only if a single output type is selected.
2 Displayed only if a heat/cool output type is selected.
5 CONFIGURATION MODE...

...5.6 Level A – Control Configuration

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.

[0 to 100%]

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

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

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.

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

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

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

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

•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.
5.6 Level A – Control Configuration

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

- [0 to 100% or 'L R5E' (non-heat/cool)]
- [-100 to 100% (heat/cool only)]

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

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

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

- [0 to 100% or 'L R5E' (non-heat/cool)]
- [-100 to 100% (heat/cool only)]

**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 D – Digital Sources.

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

- [0 to 100% or 'L R5E' (non-heat/cool)]
- [-100 to 100% (heat/cool only)]

---

*1 Digital inputs are active when a volt free contact is closed or a low TTL signal is applied*
### 5.6 Level A – Control Configuration

<table>
<thead>
<tr>
<th></th>
<th>Auto Mode Selection Source</th>
<th>Tune Parameter Source 1 (Gain Scheduling)</th>
<th>Tune Parameter Source 2 (Gain Scheduling)</th>
<th>Tune Parameter Source 3 (Gain Scheduling)</th>
<th>Tune Parameter Source 4 (Gain Scheduling)</th>
</tr>
</thead>
<tbody>
<tr>
<td>R.18</td>
<td>Select the digital source used to activate auto mode.</td>
<td>Determine the digital source used to select the proportional 1 and integral 1 terms as the tuning parameters.</td>
<td>Determine the digital source used to select the proportional 2 and integral 2 terms as the tuning parameters.</td>
<td>Determine the digital source used to select the proportional 3 and integral 3 terms as the tuning parameters.</td>
<td>Determine the digital source used to select the proportional 4 and integral 4 terms as the tuning parameters.</td>
</tr>
<tr>
<td>R.19</td>
<td>See Rear Fold-out/ Table D – Digital Sources.</td>
<td>See Rear Fold-out/ Table D – Digital Sources.</td>
<td>See Rear Fold-out/ Table D – Digital Sources.</td>
<td>See Rear Fold-out/ Table D – Digital Sources.</td>
<td>See Rear Fold-out/ Table D – Digital Sources.</td>
</tr>
<tr>
<td>R.20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R.21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R.22</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **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 4.2, Tune/Proportional Band \( x \) and Integral Action Time \( x \). This function is not available with Cascade control.
5.7 Level B – Operator Configuration

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

**Local / Cascade Display**

- **YES** – Slave set point displayed in operator level
- **NO** – Slave set point not displayed in operator level

**Front Panel Alarm Acknowledge Enable**

- **YES** – Enabled
- **NO** – Disabled

**Operator Level Set Point Adjustment Enable**

- **YES** – Enabled
- **NO** – Disabled

**Note.** Applies to master and slave set points in cascade mode.

**Operator Ratio Display**

- **YES** – Ratio setting for Cascade set point displayed in operator level.
- **NO** – Ratio setting for Cascade set point not displayed in operator level.

**Operator Bias Display**

- **YES** – Bias setting for Cascade set point displayed in operator level.
- **NO** – Bias setting for Cascade set point not displayed in operator level.

**Auto-tune Password**

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

[0 to 9999 (default 0)]

Continued...

- **1** Displayed only if the cascade template is selected.
...5.7 Level B – Operator Configuration

- **Profile Operator Password**
  Enables access to the profile states level (level P) and the autotune facility.
  
  [0 to 9999 (default 0)]

- **Profile Configuration Password**
  Enables access to the profile states, profile control and profile program levels (levels P, r and t) and the autotune facility.
  
  [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.
5.8 Level C – Output Assignment Configuration

**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**

**Analog/Digital Output 1 (ao1/do1) Type**

Select the output type for Output 1.

- **ANLG** - Analog
- **DIG** - Digital

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

or

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

---

- **1** If the output is assigned to a control output by the control type, the setting displayed cannot be changed – see Section 5.2, Basic Configuration/Control Output Type.
5.8.1 Digital Output 1

Digital Output 1 (do1) Assignment Source
Select the source required to activate Digital Output 1
See Rear Fold-out/ Table D – 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.

•1 If the output is assigned to a control output by the control type, the setting displayed cannot be changed – see Section 5.2, Basic Configuration/Control Output Type.

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

Analog Output 1 (ao1) Assignment Source
Select the source required to activate Analog Output 1
See Rear Fold-out/ Table C – 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]

• 1 If the output is assigned to a control output by the control type, the setting displayed cannot be changed – see Section 5.2, Basic Configuration/Control Output Type.

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

Analog Output 2 (ao2) Assignment Source
Select the source required to activate Analog Output 2
See Rear Fold-out/ Table C – 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]

• 1 If the output is assigned to a control output by the control type, the setting displayed cannot be changed – see Section 5.2, Basic Configuration/Control Output Type.
• 2 Not applicable if analog output 2 is assigned to a control output.
5.8.4 Relay Outputs 1 to 4

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

See Rear Fold-out/ Table D – 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 D – 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 D – 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...
5  CONFIGURATION MODE...

...5.8.4 Relay Outputs 1 to 4

<table>
<thead>
<tr>
<th>C23</th>
<th>rLYA</th>
<th>NONE</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>C24</th>
<th>rLYP</th>
<th>POS</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4</td>
</tr>
</tbody>
</table>

Return to top of page.

**Relay 4 Assignment Source**
Select the source required to activate relay output 4
See Rear Fold-out/ Table D – 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.

•1 If the output is assigned to a control output by the control type, the setting displayed cannot be changed – see Section 5.2, 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 output is fitted.
5.9 Level D – Serial Communications Configuration  

**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 – 4-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/C360–MOD.*

[1 to 99]

---

Return to top of page.
5.10 Level E – Calibration

**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...**
...5 CONFIGURATION MODE

...5.10 Level E – Calibration

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 [0.75 to 1.25]
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 5.2, Basic Configuration.
5 CONFIGURATION MODE

...5.10 Level E – Calibration

---

**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.

---

*1 Displayed only if Motorized Valve with feedback output type is selected – see Section 5.2, Basic Configuration.

*2 Displayed only if corresponding input is a Thermocouple input.
EC Directive 89/336/EEC

In order to meet the requirements of the 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.

6.1 Mechanical Installation

6.1.1 Siting – Figs. 6.1 and 6.2

A – Close to Sensor

B – At Eye-level Location

C – Avoid Vibration

Fig. 6.1 General Requirements

A – Within Temperature Limits

B – Within Humidity Limits

C – Within Protection Rating Limits

D – Use Screened Cables

Fig. 6.2 Environmental Requirements

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.

Fig. 6.1 General Requirements

Fig. 6.2 Environmental Requirements
6.1.2 Mounting – Figs. 6.3 to 6.5
The instrument is designed for panel mounting (Fig. 6.4). Overall dimensions are shown in Fig. 6.3.

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

Fig. 6.3 Overall Dimensions
6.1.2 Mounting – Figs. 6.3 to 6.5

1. Cut a hole in the panel (see Fig. 6.3 for dimensions). Instruments may be close stacked to DIN 43835.

2. Insert the instrument into the panel cut-out.

3. Fit the panel clamps, ensuring that the lugs are located correctly in their slots.

4. Secure the panel clamp using the retaining screws. The rubber friction sleeve prevents over-tightening.

Fig. 6.4 Mounting
6.1.2 Mounting – Figs. 6.3 to 6.5

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. 6.5 Inserting/Removing the Instrument from the Case
6.2 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 (2.5mm²).
• 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.

☐ This equipment is protected through double insulation (Class II).
### 6.2.1 Electrical Connections – Figs 6.6 to 6.8

**Output/ Power Supply Board Terminals**

<table>
<thead>
<tr>
<th>Terminal Block Viewed from Rear of Case</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>6</td>
</tr>
<tr>
<td>7</td>
</tr>
<tr>
<td>8</td>
</tr>
<tr>
<td>9</td>
</tr>
<tr>
<td>10</td>
</tr>
<tr>
<td>11</td>
</tr>
<tr>
<td>12</td>
</tr>
<tr>
<td>13</td>
</tr>
<tr>
<td>14</td>
</tr>
<tr>
<td>15</td>
</tr>
</tbody>
</table>

**Warning.** The AC power supply ground cable must be connected to a Ground Stud.

- 85 min. to 265V max. AC 15VA
- 24V DC

**Option Board Terminals**

<table>
<thead>
<tr>
<th>Terminal Block Viewed from Rear of Case</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
</tr>
<tr>
<td>14</td>
</tr>
<tr>
<td>15</td>
</tr>
<tr>
<td>16</td>
</tr>
<tr>
<td>17</td>
</tr>
<tr>
<td>18</td>
</tr>
<tr>
<td>19</td>
</tr>
<tr>
<td>20</td>
</tr>
<tr>
<td>21</td>
</tr>
<tr>
<td>22</td>
</tr>
</tbody>
</table>

**Input Board Terminals**

<table>
<thead>
<tr>
<th>Terminal Block Viewed from Rear of Case</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
</tr>
<tr>
<td>26</td>
</tr>
<tr>
<td>27</td>
</tr>
<tr>
<td>28</td>
</tr>
<tr>
<td>29</td>
</tr>
<tr>
<td>30</td>
</tr>
<tr>
<td>31</td>
</tr>
</tbody>
</table>

---

**See Fig. 6.7**
6.2.1 Electrical Connections – Figs. 6.6 to 6.8

- 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. 6.7 Electrical Connections – Analog Inputs

Fig. 6.8 Electrical Connections – Digital Inputs
6.3 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)
- 250V DC 25 W max.
A suitable fuse must be fitted.

6.3.1 Setting the Relay Links – Fig. 6.9

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

6.4 Digital Output

15 V DC min. at 20 mA
Min. load 750 Ω

6.5 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.

---

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

**Fig. 6.9 Relay Links**
6.6 Motorized Valve Connections – Fig. 6.10

Note. Relays used to drive the motorized valve must be set for 'Normally Open' operation – see Section 6.3.1.

6.7 Input Connections

Make connections to each input – see Fig 6.7.

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

6.7.1 Thermocouple (THC) Inputs

Note. Use the correct compensating cable between the THC and the terminals – see Table 6.1.

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. 6.11.

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. 6.12.

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. 6.10 Motorized Valve Connections

Fig. 6.11 CJ Sensor – Connections

Fig. 6.12 Remote-mounted CJ Sensor – Connections
6.7.2 3-lead Resistance Thermometer (RTD) Inputs
The three leads must have equal resistance, not exceeding 50Ω each.

6.7.3 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.

6.8 Output Connections
Make connections as shown in Fig. 6.6.

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

6.9 Power Supply Connections

Warning.
- A 315mA Type T fuse must be fitted in the live (+ve) supply line.
- The ground line must be connected to the ground studs on the terminal block – see Fig. 6.6.
- 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:
  - C36X/XX0X/STD = 100 to 240 V AC
  - C36X/XX1X/STD = 24 V DC

<table>
<thead>
<tr>
<th>Type of Thermocouple</th>
<th>Compensating Cable</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BS1843</td>
</tr>
<tr>
<td>Ni-Cr/Ni-Al (K)</td>
<td>Brown</td>
</tr>
<tr>
<td>Nicrisil/Nisil (N)</td>
<td>Orange</td>
</tr>
<tr>
<td>Pt/Pt-Rh (R and S)</td>
<td>White</td>
</tr>
<tr>
<td>Pt-Rh/Pt-Rh (B)</td>
<td></td>
</tr>
<tr>
<td>Fe/Con (J)</td>
<td>Yellow</td>
</tr>
<tr>
<td>Fe/Con (L)</td>
<td></td>
</tr>
<tr>
<td>(DIN 43710)</td>
<td></td>
</tr>
</tbody>
</table>

Table 6.1 Thermocouple Compensating Cable
### SPECIFICATION

#### Summary
- Single-loop or Cascade
- Two Autotune options
- 20 profiles, 99 segments
- PC configuration
- IP66/NEMA4X front face

#### Operation

**Display**
- 1 x 4-digit, 14mm (Red) LED, process variable
- 1 x 4-digit, 8mm (Green) LED, set point
- 1 x 3-digit, 8mm (Yellow) LED, output, program/segment, profile time remaining

**Configuration**
- Basic configuration via front panel keys or PC
- Advanced feature configuration by PC

**Security**
- Password-protected menus

#### Standard Functions

**Control strategies**
- Single-loop or Cascade

**Output types**
- Current Proportioning, Time Proportioning, On/off, Motorized Valve (with or without feedback), Heat/Cool

**Control parameters**
- Four sets of PI settings, selectable via digital signals

**Set points**
- 99 segments, 20 profiles

**Configured outputs**
- Three preset control output values, selectable via digital signals

**Autotune**
- On demand for ¼ wave or minimal overshoot

**Process alarms**
- Number: 8
- Types: High/Low process, High/Low output, High/Low deviation, High/Low inputs
- Hysteresis: Level and time *
- Alarm enable/disable: Level and time *

**Real time alarms** *
- Number: 2
- Programmable: On time/day and duration

* Access 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
Type
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, √, √/2, √/4
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 (0.09°F/°F) change in ambient temperature
Input Protection
Common mode rejection >120dB at 50/60Hz with
300Ω imbalance resistance
Series mode rejection >60dB at 50/60Hz
2-Wire Transmitter Power Supply
Voltage 24V DC nominal
Drive Up to 60mA as standard, (3 loops)
Isolation Share common analog 0V
**SPECIFICATION**

### Standard Analog Input Ranges

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

* Performance accuracy is not guaranteed below 300°C (572°F) for B, R and S thermocouples.

Min. span below zero Type T 76°C (169°F) THD standards DIN 43710
Type N 159°C (318°F) IEC 584

<table>
<thead>
<tr>
<th>RTD</th>
<th>Maximum Range °C</th>
<th>Maximum Range °F</th>
<th>Accuracy (% of reading) **</th>
</tr>
</thead>
<tbody>
<tr>
<td>PT100</td>
<td>–200 to 600</td>
<td>–325 to 1100</td>
<td>0.1% or ±0.5°C (0.9°F)</td>
</tr>
</tbody>
</table>

** RTD, 3-wire platinum, 1050Ω per DIN43760 standard (IEC751), with range of 0 to 400Ωs

<table>
<thead>
<tr>
<th>Linear Inputs</th>
<th>Range</th>
<th>Accuracy (% of reading)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Millivolts</td>
<td>0 to 500 mV</td>
<td>0.1% or ±10µA</td>
</tr>
<tr>
<td>Millamps</td>
<td>0 to 50 mA</td>
<td>0.2% or ±20µA</td>
</tr>
<tr>
<td>Volts</td>
<td>0 to 5V</td>
<td>0.2% or ±2mV</td>
</tr>
<tr>
<td>Resistance</td>
<td>0 to 5000Ω</td>
<td>0.2% or ±0.08Ω</td>
</tr>
</tbody>
</table>

### EMC

**Emissions**
Meets requirements of EN50081-2

**Immunity**
Meets requirements of EN50082-2

**Design & manufacturing standards**
CSA/UL General Safety
Satisfies the requirements of –
CAN/CSA C22.2 No. 1010.1-1-92 Standard
CAN/CSA C22.2 No. 1010.1-997
UL Standard 3121-1
FM General Safety Pending

### Outputs

**Control/Retransmission Outputs**

<table>
<thead>
<tr>
<th>Number</th>
<th>2 standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>1 x Programmable as analog or logic (digital) output</td>
</tr>
<tr>
<td>Isolation</td>
<td>Galvanically isolated from each other and the rest of the circuitry</td>
</tr>
<tr>
<td>Analog range</td>
<td>0 and 20mA (programmable), accuracy 0.25%</td>
</tr>
<tr>
<td>Digital voltage</td>
<td>17V @ 20mA</td>
</tr>
</tbody>
</table>

**Relay outputs**

<table>
<thead>
<tr>
<th>Number</th>
<th>2 standard, 2 optional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>SPCO, rated 5A at 115/230V AC (non-inductive)</td>
</tr>
</tbody>
</table>
### Digital Inputs
- **Number**: 2 standard, 2 optional
- **Type**: Volt-free
- **Minimum pulse**: 200ms
- **Isolation**: Share common digital 0V

### Advanced Features
#### Maths Blocks *
- **Number**: 4
- **Operators**: +, −, ×, ÷, Average, Maximum, Minimum, High select, Low select, √, Median select

#### 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 normally open or normally closed

#### 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

### Physical
#### Size
- 96 x 96 x 122.5mm (3.78 x 3.78 x 4.82 in.)
- **Weight**: 680g (1.5 lb)

### Electrical
#### Voltage
- 85V min. to 165V max. AC 50/60Hz
- 24V DC

#### Power consumption
- 15VA max.

#### Power interruption protection
- Up to 60ms

#### Dielectric Strength
- 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 to 55°C (32 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)
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 a value derived by the profile control algorithm.
**Cascade Controller.** Two PID controllers are used with the first (master) controller providing the set point for the second (slave) controller. The two controllers are linked internally. The master output can be weighted using the cascade ratio (C.rto) and bias (C.bia) values to create the slave set point value. When the auto/manual mode is changed (from the front panel or by a digital signal) both the master and slave controllers change mode. In manual the slave set point can be adjusted by the user and the value is tracked by the master controller to ensure bumpless transfer back into auto. The slave can also be taken out of cascade mode by selecting local mode using the front panel keys.
**APPENDIX B – COMMANDER CONFIGURATION EDITOR**

**B1 Introduction**
Using the COMMANDER Configurator the COMMANDER 360 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:

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

**B4 Six Logic Equations**

<table>
<thead>
<tr>
<th>Elements</th>
<th>Up to 15 per equation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operators</td>
<td>Up to 7 per equation: OR, AND, NOR, NAND, NOT, EXOR</td>
</tr>
<tr>
<td>Operands</td>
<td>Up to 8 per equation: any digital signal. The NOT operator can be used to invert digital signals.</td>
</tr>
</tbody>
</table>

**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 360. This allows math 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
- profiles

B10 Connecting the COMMANDER PC Configurator

Note. The COMMANDER 360 must be in Configuration Mode (levels 6 to E) and Modbus serial communications must be disabled when using the PC Configurator.

Fig. B1 Connecting the COMMANDER PC Configurator
### Profile Frames

**E**
- End of Profile Reset Source: `End` (r.10)

**F**
- Front Panel:
  - Program Select Enable: `PGSL` (r.16)
  - Run/Hold Enable: `rHE` (r.14)
  - Segment Skip Enable: `SKPE` (r.17)
  - Segment Time Adjustment Enable: `TRdE` (r.18)
  - Stop Key Enable: `SbPE` (r.15)

**G**
- Guaranteed:
  - Ramp Hysteresis: `HYSr` (r.11)
  - Ramp/Soak Hysteresis: `GUr` (r.08)
  - Soak Hysteresis: `HYSS` (r.12)

**L**
- Level P – Profile States: `PSb` (P.00)
- Level r – Profile Control: `PCE` (r.00)
- Level t – Profile Program: `PPG` (t.00)

**N**
- Next Program Select Source: `PSEL` (r.03)

**P**
- Power-down:
  - Recovery Option: `rREC` (r.19)
  - Time Period: `PPer` (r.20)
  - Profile Reset: `rSEb` (P.03)

**S**
- Segment:
  - End Value: `End` (r.06)
  - Skip Backward Source: `SKPb` (r.08)
  - Skip Forward Source: `SKPF` (r.07)
  - Start Value: `Str` (r.05)
  - Adjust Value: `tADJ` (r.13)
  - Decrement Source: `dECs` (r.12)
  - Increment Source: `INCs` (r.11)

**T**
- Time Events: `Time` (t.09)

**R**
- Ramp Rate: `rmE` (r.07)
- Repeat Program Profile: `rPE` (r.10)
- Retort Function: `rEL` (r.22)
- Run/Hold Action: `ACtx` (P.02)
### Set Up Frames

<table>
<thead>
<tr>
<th>Frame Title</th>
<th>Mnemonic</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alarm 1 Trip</td>
<td>$i_{xxx}$</td>
<td>4.01</td>
</tr>
<tr>
<td>Alarm 2 Trip</td>
<td>$i_{xxx}$</td>
<td>4.02</td>
</tr>
<tr>
<td>Alarm 3 Trip</td>
<td>$i_{xxx}$</td>
<td>4.03</td>
</tr>
<tr>
<td>Alarm 4 Trip</td>
<td>$i_{xxx}$</td>
<td>4.04</td>
</tr>
<tr>
<td>Alarm 5 Trip</td>
<td>$i_{xxx}$</td>
<td>4.05</td>
</tr>
<tr>
<td>Alarm 6 Trip</td>
<td>$i_{xxx}$</td>
<td>4.06</td>
</tr>
<tr>
<td>Alarm 7 Trip</td>
<td>$i_{xxx}$</td>
<td>4.07</td>
</tr>
<tr>
<td>Alarm 8 Trip</td>
<td>$i_{xxx}$</td>
<td>4.08</td>
</tr>
<tr>
<td>Alarm Trip Points</td>
<td>$LEVY$</td>
<td>4.00</td>
</tr>
<tr>
<td>Approach Band 1</td>
<td>$Rb_{1}$</td>
<td>2.15</td>
</tr>
<tr>
<td>Approach Band 2</td>
<td>$Rb_{2}$</td>
<td>2.16</td>
</tr>
<tr>
<td>Cascade (Slave) Set Point</td>
<td>$SSEPt$</td>
<td>3.05</td>
</tr>
<tr>
<td>Cascade Set Point Bias</td>
<td>$Cb_{IR}$</td>
<td>3.09</td>
</tr>
<tr>
<td>Cascade Set Point Ratio</td>
<td>$C_r_0$</td>
<td>3.08</td>
</tr>
<tr>
<td>Control Deadband</td>
<td>$CbNd$</td>
<td>2.21</td>
</tr>
<tr>
<td>Cycle Time 1</td>
<td>$CYC1$</td>
<td>2.01</td>
</tr>
<tr>
<td>Cycle Time 2</td>
<td>$CYC2$</td>
<td>2.02</td>
</tr>
<tr>
<td>Deadband (Feedback only)</td>
<td>$d_B_Nd$</td>
<td>5.03</td>
</tr>
<tr>
<td>Derivative Action Time 1</td>
<td>$d_U_{1}$</td>
<td>2.13</td>
</tr>
<tr>
<td>Derivative Action Time 2</td>
<td>$d_U_{2}$</td>
<td>2.14</td>
</tr>
<tr>
<td>Heat/Cool Output 1 Start</td>
<td>$YiS_{1}$</td>
<td>2.24</td>
</tr>
<tr>
<td>Heat/Cool Output 2 Start</td>
<td>$YiS_{2}$</td>
<td>2.25</td>
</tr>
<tr>
<td>Integral Action Time 1</td>
<td>$IA_{1}$</td>
<td>2.09</td>
</tr>
<tr>
<td>Integral Action Time 2</td>
<td>$IA_{2}$</td>
<td>2.10</td>
</tr>
<tr>
<td>Integral Action Time 3</td>
<td>$IA_{3}$</td>
<td>2.11</td>
</tr>
<tr>
<td>Integral Action Time 4</td>
<td>$IA_{4}$</td>
<td>2.12</td>
</tr>
<tr>
<td>Local Set Point 1</td>
<td>$LSP_{1}$</td>
<td>3.01</td>
</tr>
<tr>
<td>Local Set Point 2</td>
<td>$LSP_{2}$</td>
<td>3.02</td>
</tr>
<tr>
<td>Local Set Point 3</td>
<td>$LSP_{3}$</td>
<td>3.03</td>
</tr>
<tr>
<td>Local Set Point 4</td>
<td>$LSP_{4}$</td>
<td>3.04</td>
</tr>
<tr>
<td>Manual Reset</td>
<td>$rS_{1}$</td>
<td>2.17</td>
</tr>
<tr>
<td>Manual Reset 2</td>
<td>$rS_{2}$</td>
<td>2.18</td>
</tr>
<tr>
<td>Motorized Valve Bias</td>
<td>$Ub_{IR}$</td>
<td>5.02</td>
</tr>
<tr>
<td>Motorized Valve Ratio</td>
<td>$Ur_R_{1}$</td>
<td>5.01</td>
</tr>
<tr>
<td>Output 1 On/off Hysteresis Value</td>
<td>$HY_{1}$</td>
<td>2.03</td>
</tr>
<tr>
<td>Output 2 On/off Hysteresis Value</td>
<td>$HY_{2}$</td>
<td>2.04</td>
</tr>
</tbody>
</table>

### Mnemonic Number

<table>
<thead>
<tr>
<th>Mnemonic</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pb-1</td>
<td>2.05</td>
</tr>
<tr>
<td>Pb-2</td>
<td>2.06</td>
</tr>
<tr>
<td>Pb-3</td>
<td>2.07</td>
</tr>
<tr>
<td>Pb-4</td>
<td>2.08</td>
</tr>
<tr>
<td>r_r_E</td>
<td>3.10</td>
</tr>
<tr>
<td>r_r_U</td>
<td>5.04</td>
</tr>
<tr>
<td>SE_LP</td>
<td>3.00</td>
</tr>
<tr>
<td>t_UNE</td>
<td>2.00</td>
</tr>
<tr>
<td>UL_UE</td>
<td>5.00</td>
</tr>
</tbody>
</table>

### Diagram

![Parameter Identification Diagram](image-url)
## Configuration Frames

<table>
<thead>
<tr>
<th>Frame Title</th>
<th>Mnemonic</th>
<th>Number</th>
<th>Frame Title</th>
<th>Mnemonic</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A</strong> Alarm 1 Hysteresis</td>
<td>HY5.1</td>
<td>8.03</td>
<td>Basic Configuration</td>
<td>LEU.6</td>
<td>8.00</td>
</tr>
<tr>
<td>Alarm 1 Trip</td>
<td>trP.1</td>
<td>8.02</td>
<td>Bias Display Enable</td>
<td>b.d</td>
<td>15.06</td>
</tr>
<tr>
<td>Alarm 1 Type</td>
<td>YP.1</td>
<td>8.01</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alarm 2 Hysteresis</td>
<td>HY5.2</td>
<td>8.06</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alarm 2 Trip</td>
<td>trP.2</td>
<td>8.05</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alarm 2 Type</td>
<td>YP.2</td>
<td>8.04</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alarm 3 Hysteresis</td>
<td>HY5.3</td>
<td>8.09</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alarm 3 Trip</td>
<td>trP.3</td>
<td>8.08</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alarm 3 Type</td>
<td>YP.3</td>
<td>8.07</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alarm 4 Hysteresis</td>
<td>HY5.4</td>
<td>8.12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alarm 4 Trip</td>
<td>trP.4</td>
<td>8.11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alarm 4 Type</td>
<td>YP.4</td>
<td>8.10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alarm 5 Hysteresis</td>
<td>HY5.5</td>
<td>8.15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alarm 5 Trip</td>
<td>trP.5</td>
<td>8.14</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alarm 5 Type</td>
<td>YP.5</td>
<td>8.13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alarm 6 Hysteresis</td>
<td>HY5.6</td>
<td>8.18</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alarm 6 Trip</td>
<td>trP.6</td>
<td>8.17</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alarm 6 Type</td>
<td>YP.6</td>
<td>8.16</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>B</strong> Alarm Acknowledge Enable</td>
<td>FPRK</td>
<td>b.03</td>
<td>Control Configuration</td>
<td>CNL</td>
<td>8.00</td>
</tr>
<tr>
<td>Alarm Configuration</td>
<td>RL.5</td>
<td>8.00</td>
<td>Control Output Type</td>
<td>0YP.</td>
<td>8.02</td>
</tr>
<tr>
<td>Analog Inputs</td>
<td>INPE</td>
<td>7.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analog I/P 1 Offset Cal</td>
<td>OFF.1</td>
<td>8.01</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analog I/P 1 Span Cal</td>
<td>SPN.1</td>
<td>8.02</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analog I/P 2 Offset Cal</td>
<td>OFF.2</td>
<td>8.03</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analog I/P 2 Span Cal</td>
<td>SPN.2</td>
<td>8.04</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analog I/P 3 Offset Cal</td>
<td>OFF.3</td>
<td>8.05</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analog I/P 3 Span Cal</td>
<td>SPN.3</td>
<td>8.06</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>C</strong> Analog O/P 1 Electrical High</td>
<td>RN.1H</td>
<td>C.03</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analog O/P 1 Electrical Low</td>
<td>RN.1L</td>
<td>C.04</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analog O/P 1 Engineering High</td>
<td>rIH</td>
<td>C.05</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analog O/P 1 Engineering Low</td>
<td>rIL</td>
<td>C.06</td>
<td>Input 2 Broken Sensor</td>
<td>b5d.2</td>
<td>7.13</td>
</tr>
<tr>
<td><strong>D</strong> Analog O/P 2 Electrical High</td>
<td>RN2H</td>
<td>C.11</td>
<td>Input 2 Decimal Point</td>
<td>dP.2</td>
<td>7.10</td>
</tr>
<tr>
<td>Analog O/P 2 Electrical Low</td>
<td>RN2L</td>
<td>C.12</td>
<td>Input 2 Engineering High</td>
<td>EN2H</td>
<td>7.11</td>
</tr>
<tr>
<td><strong>E</strong> Analog O/P 2 Engineering High</td>
<td>r2H</td>
<td>C.13</td>
<td>Input 2 Engineering Low</td>
<td>EN2L</td>
<td>7.12</td>
</tr>
<tr>
<td>Analog O/P 2 Engineering Low</td>
<td>r2L</td>
<td>C.14</td>
<td>Input 2 Filter Time Constant</td>
<td>FLt.2</td>
<td>7.14</td>
</tr>
<tr>
<td><strong>F</strong> Analog Output 1 Source</td>
<td>RA.1R</td>
<td>C.02</td>
<td>Input 2 Temp Units</td>
<td>UNL.2</td>
<td>7.09</td>
</tr>
<tr>
<td>Analog Output 2 Source</td>
<td>RA2R</td>
<td>C.10</td>
<td>Input 2 Type</td>
<td>YP.2</td>
<td>7.08</td>
</tr>
<tr>
<td>Analog/Dig Output 1 Type</td>
<td>YP.1</td>
<td>C.01</td>
<td>Input 3 Broken Sensor</td>
<td>b5d3</td>
<td>7.20</td>
</tr>
<tr>
<td>Auto Mode Selection Source</td>
<td>RS-L</td>
<td>R.18</td>
<td>Input 3 Decimal Point</td>
<td>dP3</td>
<td>7.11</td>
</tr>
<tr>
<td>Auto/Manual Switch Enable</td>
<td>FPR</td>
<td>b.01</td>
<td>Input 3 Engineering High</td>
<td>EN3H</td>
<td>7.18</td>
</tr>
<tr>
<td>Autotune Password</td>
<td>RPS</td>
<td>b.07</td>
<td>Input 3 Engineering Low</td>
<td>EN3L</td>
<td>7.19</td>
</tr>
<tr>
<td>Global alarm Acknowledge</td>
<td>GRCY.</td>
<td>8.25</td>
<td>Input 3 Filter Time Constant</td>
<td>FLt3</td>
<td>7.21</td>
</tr>
<tr>
<td>Feedback Range High</td>
<td>FBH.</td>
<td>E.12</td>
<td>Input 3 Temp Units</td>
<td>UNL3</td>
<td>7.16</td>
</tr>
<tr>
<td>Feedback Range Low</td>
<td>FBL.0</td>
<td>E.11</td>
<td>Input 3 Type</td>
<td>YP3</td>
<td>7.15</td>
</tr>
</tbody>
</table>
### Configuration Frames

#### Frame Title | Mnemonic | Number
--- | --- | ---
Local/Cascade Display | LC.dS | b.02

#### Serial Communications

| Frame Title | Mnemonic | Number |
--- | --- | ---
Serial Communications | LE Ud, Se rL | d.00
Serial Configuration | SCFG | d.01
Set Point Configuration | L.Eu B, SE LP | 9.00

| Frame Title | Mnemonic | Number |
--- | --- | ---
Set Point 1 Source | LS.r 1 | 9.08
Set Point 2 Source | LS.r 2 | 9.09
Set Point 3 Source | LS.r 3 | 9.10
Set Point 4 Source | LS.r 4 | 9.11

#### Set Point Configuration

| Frame Title | Mnemonic | Number |
--- | --- | ---
Set Point Default Value | dSP | 9.01
Set Point High Limit | SP.H | 9.02
Set Point Low Limit | SP.L | 9.03
Set Point Tracking | ts Cr.k | 9.04

#### Template Applications

| Frame Title | Mnemonic | Number |
--- | --- | ---
Template Applications | tAPP | 6.01
Time Display | tCLk | b.15
Tune Select Source 1 | ts 1Sr A | R.19
Tune Select Source 2 | ts 2Sr A | R.20
Tune Select Source 3 | ts 3Sr A | R.21
Tune Select Source 4 | ts 4Sr A | R.22

#### Power Fail Recovery Mode

| Frame Title | Mnemonic | Number |
--- | --- | ---
Power Fail Recovery Mode | Pr.EC | R.01
Power Fail Recovery Time | rEC.b | R.02
Process Variable Fail Action | PuFR | R.03
Profile Operator Password | OP.RS | b.08
Profile Configuration Password | OP.RS | b.09
PV Fail Default Output | dF.OP | R.04

#### Ratio Display Enable

| Frame Title | Mnemonic | Number |
--- | --- | ---
Ratio Display Enable | rd IS | b.05
Regulator Travel Time | r.dtr.U | E.08
Relay 1 Polarity | rL 1P | C.18
Relay 1 Source | rL 1R | C.17
Relay 2 Polarity | rL 2P | C.20
Relay 2 Source | rL 2R | C.19
Relay 3 Polarity | rL 3P | C.22
Relay 3 Source | rL 3R | C.21
Relay 4 Polarity | rL 4P | C.24
Relay 4 Source | rL 4R | C.23
INDEX

A
Accessories ................................................................. 1
Alarms ........................................................................... 46, 59
  Acknowledge ........................................................... 18
  Acknowledge enable ............................................... 70
  Configuration .......................................................... 59
  Global ....................................................................... 62
  Hysteresis ................................................................ 61, 62
  Set Up ....................................................................... 46
  Trip Settings ................................................................ 46, 59
  Type ................................................................. 46, 59, 61
Analog Inputs – Level 7 ................................................. 55
  Broken Sensor .......................................................... 56, 57, 58
  Calibration ............................................................... 79
  Decimal Point ........................................................... 55, 57, 58
  Engineering Range ..................................................... 56, 57, 58
  Failure Action ............................................................ 66
Analog Outputs 1 and 2 .................................................. 72
  Electrical Ranges ....................................................... 74, 75
  Engineering Ranges .................................................... 74, 75
  See Also: Digital Output 1 Sources .................................. 72, 73
  See Also: Rear Fold-out/ Table C
Analog Sources .......................................................... Rear Fold-out/ Table C
Auto/Manual
  Mode Selection Source ................................................ 67 to 70
  Starting .................................................................. 21

B
Bargraphs .................................................................... 3
  See Also: Relevant Operator
  Template in Section 2 .................................................. 10
Boundless Control – see Motorized Valve
Broken Sensor Drive ....................................................... 56, 57, 58
  Mode Selection Source ................................................ 67 to 70
  Starting .................................................................. 21

C
Calibration
  Calibration Error .......................................................... 8
  Calibration – see Analog Inputs
Cascade Controller .......................................................... 13, 93
  Control Action ........................................................... 54
  Control Parameters ..................................................... 41, 42
  Set Point Limits .......................................................... 63
  Set Point Scaling .......................................................... 45
  Tuning ..................................................................... 20, 21
Character Set ................................................................... 7
Clock Setting .................................................................. 71
Cold Junction
  Compensation ................................................................ 81, 88, 91
  Failed ....................................................................... 8
  See Also: Analog Inputs (Process Variable)

D
Date and Time Setting ..................................................... 71
Deadband
  Control Output ........................................................... 43
  MV Feedback ............................................................. 47
  Default Outputs ........................................................ 66
  Delay Timer ................................................................ 94
  Derivative Action Time ............................................... 42
  Deviation Alarms ......................................................... 59
  Digital Inputs 1 to 4 ..................................................... 87, 88
  See Also: Rear Fold-out/ Table D
  Digital Output 1 ........................................................... 73
  Polarity ................................................................... 73
  Source .................................................................... 73
  Digital Sources .......................................................... Rear Fold-out/ Table D
  Direct Control Action ................................................... 54
  Displays LCD Alphabet ............................................... 7
  Displays ................................................................. 7, 8, 10

E
Electrical Connections ...................................................... 87
Error Codes .................................................................... 8

F
Failure Modes
  Analog Input ............................................................... 66
  Power Failure ............................................................ 65
  Process Variable ........................................................ 66
  Fault Detection Level .................................................... 94
  Fault-finding – see Error Messages
  Feedback (Motorized Valves) ......................................... 47
  See Also: Analog Inputs (Process Variable)
  Filter Time Constant .................................................... 57, 58
  Fine Tuning ............................................................... 23, 79
  Front Panel Key Enable .............................................. 34, 35
INDEX...

G
Gain Scheduling
  Proportional and Integral Terms ............. 41, 42
  Selection ............................................. 69
  Sources ............................................. 69
Global Alarm Acknowledge Source ............... 62
Glossary of Abbreviations ......................... 9
Guaranteed Ramp/Soak ......................... 27, 37, 38

H
Heat/Cool ................................................ 16
  Control Action ..................................... 52, 54
  Output limits ...................................... 66
  Start positions .................................... 43
Holdback Hysteresis ............................. 26
Hysteresis
  Alarms ........................................... 59 to 62
  On/off Control .................................... 40

I
Inputs – see Analog Inputs
Installation ........................................... 82
Integral Action Time ................................ 41

K
Klaxon Alarms ........................................ 59

L
Latch Alarms .......................................... 60
LEDs ..................................................... 7
Line Filter Frequency ............................ 54
Linearizers ......................................... 55, 57, 58, 94
Local Set Point – see Set Points
Locking Front Panel Keys ....................... 70
Logic Equations ..................................... 94
Loop Break Monitor .............................. 9

M
Mains Rejection Frequency ....................... 54
Manual Mode Selection ......................... 67, 68, 70
  Pre-set manual output ......................... 68
Manual Reset ...................................... 42
Master – see Cascade Controller
Maths Blocks ......................................... 94
Mechanical Installation .......................... 82
MODBUS ............................................. 78, 87
Motorized Valve
  Boundless ......................................... 48
  Calibration ........................................ 80
  Connections ..................................... 90
  Control Type Selection ....................... 52
  Feedback ......................................... 47
  Regulator Travel Time ......................... 47, 49, 80
  Set Up ............................................ 47
  Mounting ......................................... 83

O
On/off Control ....................................... 40
  See Also: Control Types
Operating Displays .............................. 3
Operator Configuration – Level B ............. 70
Operator Level ..................................... 10
Operator Ratio/Bias Display Enable .......... 70
Output Assignment – Level C ................... 72
  Connections .................................... 87, 89, 90
  Heat/Cool ......................................... 16
  Limits .............................................. 66
  Output Sources .......................... Rear Fold-out/ Table B
  Slew Rate ....................................... 67
  Types ............................................ 52

P
Panel Clamps .......................................... 2, 84
Passwords ............................................. 70, 71
PC Configurator ..................................... 94
PID Parameters .................................... 41, 42
  See Also: Gain Scheduling
Power Fail Recovery ............................. 65
Power Supplies ..................................... 87, 91
  Power Up Displays ............................ 10
PowerRecovery Option ......................... 27, 35
  Process Alarms ................................. 60
  Optimization – see Control Efficiency Monitor
  Variable – see Analog Inputs
Profile Control Level ......................... 32
Profile Program
  Begin .............................................. 36
  End .............................................. 36
  End of Program Reset Source ............... 33
  Hold ............................................. 31, 32
  Power-down option ......................... 35
  Ramp Rate ....................................... 37
  Ramp Type ....................................... 32
  Repeats ......................................... 38
  Reset ............................................ 31, 33
  Run ............................................. 31, 32
  Select .......................................... 31, 32
  Self-seeking Set Point ...................... 35
  Skip ............................................. 33
  Sources ......................................... 32, 33
  Time Increment/Decrement ............... 34
  Time Units .................................... 32
Profile Program Level ......................... 36
Profile States Level ............................ 31
Program See Profile Program
Proportional Band Settings .................... 41, 42
INDEX

R
Ramp ........................................................... 29, 37
Ramp Rate (Set Point) ................................. 45
   See Also: Output Slew Rate
Ratio – Cascade Set Point .......................... 45
   Ratio Display Enable ................................. 70
Real-time Alarm ........................................... 94
Reference Tables .................................... Rear Fold-out
Regulator Travel Time – see Motorized Valves
Relative Humidity ...................................... 94
Relay Connections ..................................... 87
   Links ....................................................... 89
   See Also: Output Assignment, Output Types
Resistance Thermometer ............................ 55, 57, 58, 87, 88
Retort Function ........................................ 28, 35
Retransmission – See Analog Outputs,
Reverse Control Action ............................ 54
Run/Hold Action ......................................... 31
Segment
   End Value ............................................... 37
   Select ...................................................... 36
   Skip Backwards/Forwards ...................... 31, 35
   Start Value ............................................ 37
   Time ....................................................... 37
   Time Adjustment ................................. 34
Self-Seeking Set Point ............................... 35
Serial Communications – Level d ............. 78
Set Points
   Configuration – Level 9 ......................... 63
   Default Value ........................................ 64
   Limits ...................................................... 63
   Operator Adjust enable ....................... 70
   Ramp Rate .............................................. 45
   Scaling .................................................. 44
   Selecting ................................................. 64
   Setting – see Relevant Operator Template
   Sources .................................................. 64
   Tracking ................................................ 63
Short-cut keys .......................................... 6
Siting .................................................... 82
Slave Controller – see Cascade Controllers
Slave Set Point – see Cascade Controllers
Slew Rate ................................................ 67
Soak ....................................................... 26
Soft-start –
   see Set Point Ramp Rate, Output Slew Rate
Span Adjustment – see Calibration

T
Temperature Units ..................................... 55, 57, 58
Template Applications ............................ 10, 51, 92, 93
Terminals and Connections .................. 87
Thermocouple ......................................... 55, 57, 58, 87, 88
Time
   Delay Timers .......................................... 94
   Real-time alarms ......................................... 94
   Setting .................................................... 71
Time Events .............................................. 29, 38
Tuning – Automatic .................................... 19
   Manual ................................................... 23
   Tune Parameter Source ....................... 69

U
Units – see Temperature Units

V
Valve Sticking ........................................... 8
Valve – see Motorized Valve

W
Warning Messages ..................................... 8
Watchdog ................................................... 9
## 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

**Controllers & Recorders**
- Single and Multi-loop Controllers
- Circular Chart , Strip Chart and Paperless Recorders
- Paperless Recorders
- Process Indicators

**Flexible Automation**
- Industrial Robots and Robot Systems

**Flow Measurement**
- Electromagnetic Flowmeters
- Mass Flow Meters
- Turbine Flowmeters
- Flow Elements

**Marine Systems & Turbochargers**
- Electrical Systems
- Marine Equipment
- Offshore Retrofit and Refurbishment

**Process Analytics**
- Process Gas Analysis
- Systems Integration

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

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

**Water, Gas & Industrial Analytics**
- 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 7163

### Table D – Digital Sources

<table>
<thead>
<tr>
<th>Source Type</th>
<th>Display</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Outputs</td>
<td>DP 1</td>
<td>Control output 1 (heat)</td>
</tr>
<tr>
<td></td>
<td>DP 2</td>
<td>Control output 2 (cool)</td>
</tr>
<tr>
<td></td>
<td>DPEN</td>
<td>Motorized valve Open Relay</td>
</tr>
<tr>
<td></td>
<td>CLSE</td>
<td>Motorized valve Close Relay</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source Type</th>
<th>Display</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logic Equations*</td>
<td>LG 1</td>
<td>Logic equation 1 true</td>
</tr>
<tr>
<td></td>
<td>LG 2</td>
<td>Logic equation 2 true</td>
</tr>
<tr>
<td></td>
<td>LG 6</td>
<td>Logic equation 6 true</td>
</tr>
</tbody>
</table>

| Process Alarms | RL 1 | Alarm 1 active |
| | RL 2 | Alarm 2 active |
| | RL 8 | Alarm 8 active |

| Modbus Signals | _b 1 | Modbus Signal 1 |
| | _b 2 | Modbus Signal 2 |
| | _b 3 | Modbus Signal 3 |
| | _b 4 | Modbus Signal 4 |
| Time | r:1 | Real time alarm 1 |
| | r:2 | Real time alarm 2 |
| | _d:1 | Delay timer 1 |
| | _d:2 | Delay timer 2 |

| Other | _d:1 | Always enabled |
| Profile States | _d:U1 | Time Event 1 Active |
| | _d:U4 | Time Event 4 Active |

| Control Modes | _R:0 | Manual mode selected |
| | L:G | Local set point |
| | _R:1 | Local control selected |
| | _E:1 | Remote set point |
| | _E:2 | Remote control selected |

| Failure States | _F:1R | Input 1 failed |
| | _F:1R2 | Input 2 failed |
| | _F:1R3 | Input 3 failed |
| | _H:1 | Loop break - analog output 1 |
| | _D:0 | Watchdog active |
| | _F:0 | Power fail |

* 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 states; LG5 - The OR of the second four alarm states
LG6 - The OR of the input fail states

---

**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 warrantly, 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.
## REFERENCE TABLES

### Table A – Template Applications

<table>
<thead>
<tr>
<th>Config. Display</th>
<th>Template Title</th>
<th>Analog Input 1 (I/P1)</th>
<th>Analog Input 2 (I/P2)</th>
<th>Analog Input 3 (I/P3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SL</td>
<td>Single loop</td>
<td>Process Variable</td>
<td></td>
<td>Feedback †</td>
</tr>
<tr>
<td>L L</td>
<td>Cascade</td>
<td>Master PV</td>
<td>Slave PV</td>
<td>Feedback †</td>
</tr>
</tbody>
</table>

† Motorized Valve output types only

### Note

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

### Table B – Output Sources

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

<table>
<thead>
<tr>
<th>Setting</th>
<th>Output Type</th>
<th>Relays</th>
<th>Analog Outputs</th>
<th>Digital Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>Analog Output</td>
<td>Rly 1</td>
<td>Rly 2</td>
<td>Rly 3</td>
</tr>
<tr>
<td>OP1</td>
<td>Heat/Cool</td>
<td>OP1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OP2</td>
<td>Heat/Cool</td>
<td>OP2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OP3</td>
<td>Heat/Cool</td>
<td>OP3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Aim = Alarm  
Rly = Relay  
ao1 = Analog Output1  
ao2 = Analog Output2  
PV = Process Variable RTX  
CSPT = Set Point RTX

### Table C – Analog Sources

<table>
<thead>
<tr>
<th>Display</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>OP1</td>
<td>Control output 1 (heat)</td>
</tr>
<tr>
<td>OP2</td>
<td>Control output 2 (cool)</td>
</tr>
<tr>
<td>PI1</td>
<td>Process variable 1</td>
</tr>
<tr>
<td>PI2</td>
<td>Process variable 2</td>
</tr>
<tr>
<td>PI3</td>
<td>Master process variable</td>
</tr>
<tr>
<td>PI4</td>
<td>Slave process variable</td>
</tr>
<tr>
<td>I/P1</td>
<td>Analog input 1</td>
</tr>
<tr>
<td>I/P2</td>
<td>Analog input 2</td>
</tr>
<tr>
<td>I/P3</td>
<td>Analog input 3</td>
</tr>
<tr>
<td>LSPI</td>
<td>Control setpoint</td>
</tr>
<tr>
<td>LSPI1</td>
<td>Local set point 1</td>
</tr>
<tr>
<td>LSPI2</td>
<td>Local set point 2</td>
</tr>
<tr>
<td>LSPI3</td>
<td>Local set point 3</td>
</tr>
<tr>
<td>LSPI4</td>
<td>Local set point 4</td>
</tr>
<tr>
<td>SPF1</td>
<td>Slave setpoint</td>
</tr>
</tbody>
</table>

---

ABB Inc  
125 E. County Line Road  
Warminster  
PA 18974  
USA  
Tel: +1 215 674 6000  
Fax: +1 215 674 7183

**ABB has Sales & Customer Support expertise in over 100 countries worldwide.**

The Company’s policy is one of continuous product improvement and the right is reserved to modify the information contained herein without notice.

Printed in UK (07.05)  
© ABB 2005