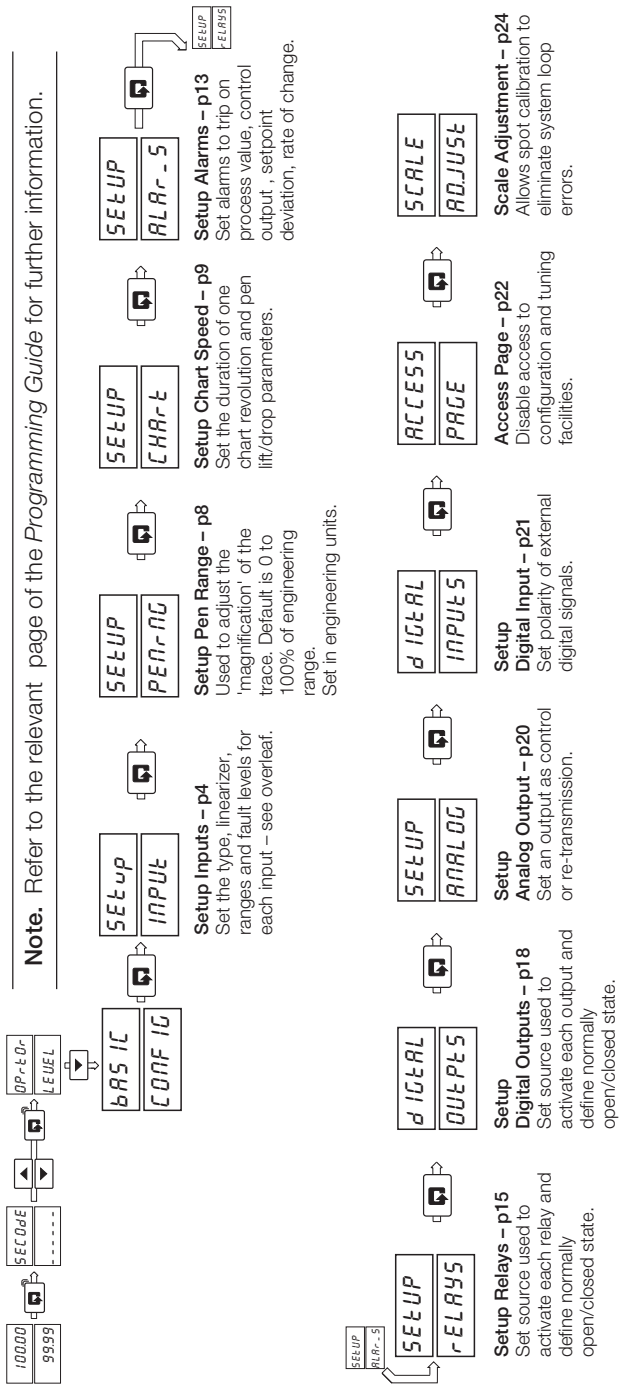
## Basic configuration overview




**Note.** Refer to the relevant page of the *Programming Guide* for further information.

**Setup Inputs – p4**
Set the type, linearizer, ranges and fault levels for each input – see overleaf.

**Setup Pen Range – p8**
Used to adjust the 'magnification' of the trace. Default is 0 to 100% of engineering range.
Set in engineering units.

**Setup Chart Speed – p9**
Set the duration of one chart revolution and pen lift/drop parameters.

**Setup Alarms – p13**
Set alarms to trip on process value, control output , setpoint deviation, rate of change.

**Setup Relays – p15**
Set source used to activate each relay and define normally open/closed state.

**Setup Digital Outputs – p18**
Set source used to activate each output and define normally open/closed state.

**Setup Analog Output – p20**
Set an output as control or re-transmission.

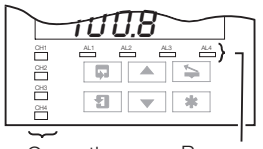
**Setup Digital Input – p21**
Set polarity of external digital signals.

**Access Page – p22**
Disable access to configuration and tuning facilities.

**Scale Adjustment – p24**
Allows spot calibration to eliminate system loop errors.

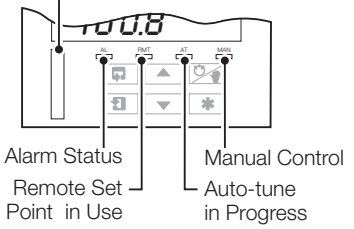
## Displays and controls

### Recorder Faceplate




### Controller Faceplate

Bar Graph (Indicates deviation of measured value from set point)

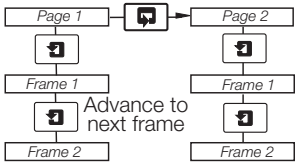


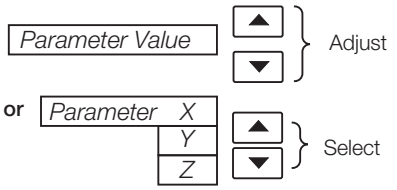

**Sideways Scroll**

**Down Scroll**

**Raise and Lower**

Advance to next page




**Function Key**

Alarm acknowledge; Auto-tune; Pen lift/ lower; Profile Control; Local/Remote or 'Home' – See *Programming Guide, 'Advanced Configuration'*

**Pen Lift**

(Recorder Only) Raises and lowers the chart pen.

**Auto/Manual**

(Controller Only) Switches between automatic and manual control modes.

**Note.** All programming is carried out using the faceplate keys and displays.

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**www.abb.com/measurement**



IM/C1900-QC Rev. E 03.2019



# C1900 recorder and recorder/controller
## Quick reference guide

### Operating Guide

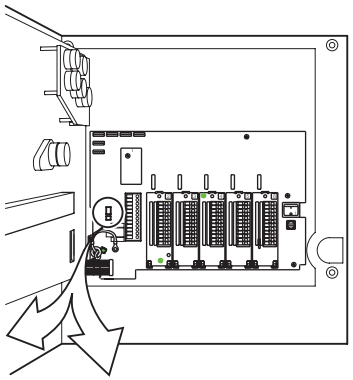


### Programming Guide



### Installation Guide

## Setting analog input links



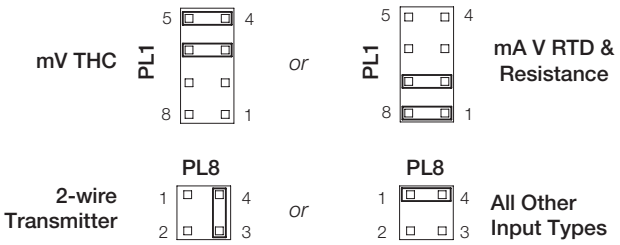
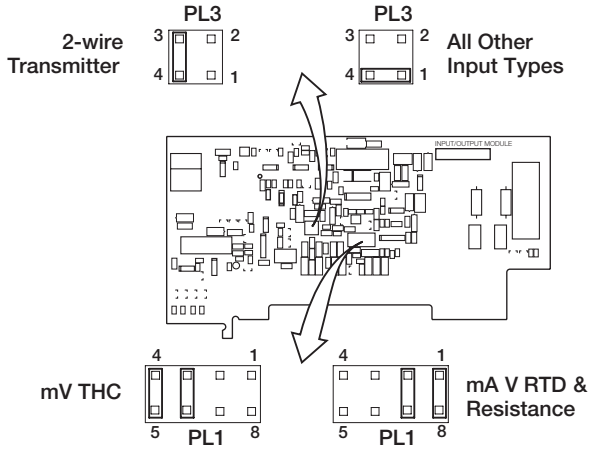


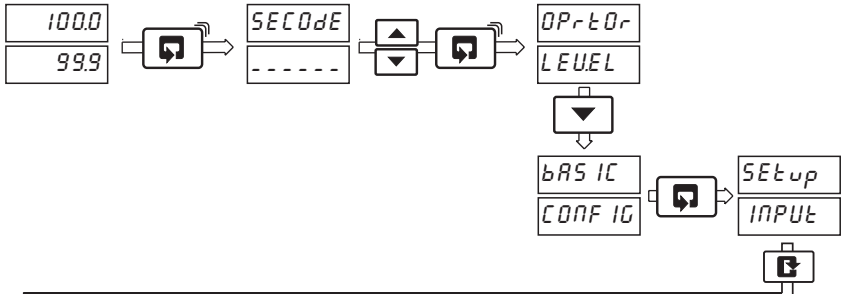

Fig. 1 Input Links – Channel 1




**Warning.** Ensure that the unit is isolated from all power supplies before removing I/O boards.

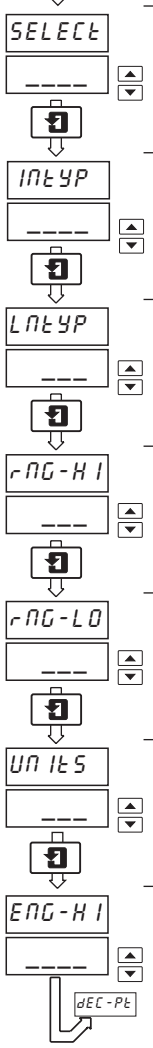
Fig. 2 Input Links – Channels 2 to 4 (If fitted)

## Configuring analog inputs




**Information.** The alphabet used to display page and parameter titles is as follows:

| | |
|---|---|
| A – A | M – _ |
| B – b | N – n or r |
| C – C or c | O – O or o |
| D – d | P – P |
| E – E | Q – Q |
| F – F | R – r |
| G – G | S – S |
| H – H or h | T – t |
| I – I | U – U |
| J – J | V – U |
| K – K | Y – y |
| L – L | |




**Select Channel –** Choose the input channel to be configured

**Input type** – _A_P (mA), U.OLt (V), _U.Lt (mV), tCPL (Thermocouple), rtd (RTD) and LO OH (< 750 Ohms) HI OH (> 750 Ohms).

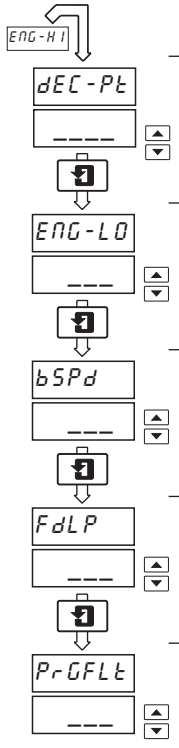
**Linearizer:** If using a thermocouple set to J, K, B, N, E, r, S, A. Other options are 5/2, 3/2, SQ.rt, rtd or NONE.

**Range High:** For a 4 to 20mA current input, set this to 20.00, or for 0 to 5V, set to 5.0. The frame does not appear if tCPL or rtd are used.

**Range Low:** Set the low end of the electrical input range, e.g. 4.00, for 4 to 20mA, or 0.0 for 0 to 5V.

**Units:** Select NONE if the input is not temperature, otherwise select dEG F or dEG C.

**Engineering Range High:** Select the highest engineering value that will be displayed when the input is at its maximum value – e.g. for an engineering range of 0 to 300.0 °F set to 3000.




**Decimal Point:** Select the decimal point position for the process variable, e.g. 300.0.

**Engineering Range Low:** Select the lowest engineering value that will be displayed when the input is at its minimum value – e.g. for an engineering range of 0 to 300.0 °F set to 0.0.

**Broken Sensor Drive:** Determine pen action when the input signal fails: NONE – pen follows failed input; UP – pen driven to full scale; dn – pen driven to zero scale.

**Fault Detection Drive:** Determine maximum input travel outside engineering range before an error is detected. E.g. for a 0 to 300°F range, a 10% fault level will trigger at 330°F.

**Input Filter:** Adjust the instrument response time from 0 to 60 seconds in one second increments to reduce pen jump & dampen out noisy signals.

ABB MEASUREMENT & ANALYTICS | INSTALLATION GUIDE | IM/C1900-INS REV. P

# C1900

## Circular chart recorder and recorder/controller


## Measurement made easy

C1900
circular chart recorder
and recorder/controller

## For more information

Further publications are available for free download from:

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or by scanning this code:

| | Search for or click on |
|---|---|
| Data Sheet<br>C1900<br>Circular chart recorder | DS/C1900R-EN |
| Data Sheet<br>C1900<br>Circular chart recorder/controller | DS/C1900RC-EN |
| Quick Reference Guide<br>C1900 recorders | IM/C1900-QR |
| Quick Reference Guide<br>C1900 recorder and recorder/controller | IM/C1900-QC |

| | Search for or click on |
|---|---|
| Operating Guide<br>C1900<br>Circular chart recorders | IM/C1900-OGR |
| Programming Guide<br>C1900<br>Circular chart recorders | IM/C1900-PGR |
| Operating Guide<br>C1900<br>Circular chart recorder/controllers | IM/C1900-OGC |
| Programming Guide<br>C1900<br>Circular chart recorder/controllers | IM/C1900-PGC |

## 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 |
|  | Alternating current supply only |
|  | Both direct and alternating current supply |
|  | The equipment is protected through double insulation |

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:

- The relevant sections of these instructions must be read carefully before proceeding.
- Warning labels on containers and packages must be observed.
- Installation, operation, maintenance and servicing must only be carried out by suitably trained personnel and in accordance with the information given.
- Normal safety precautions must be taken to avoid the possibility of an accident occurring when operating in conditions of high pressure and/or temperature.
- Chemicals must be stored away from heat, protected from temperature extremes and powders kept dry. Normal safe handling procedures must be used.
- 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.

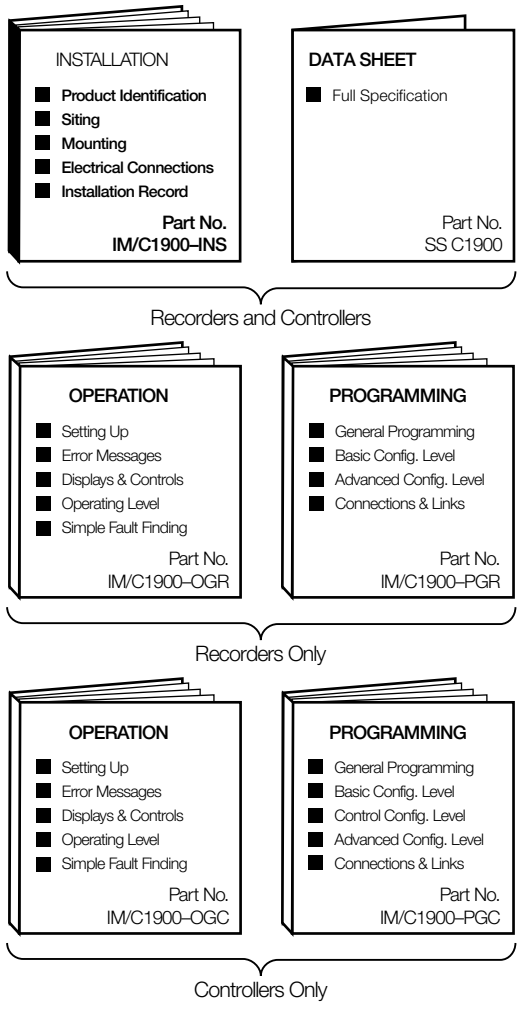
# CONTENTS



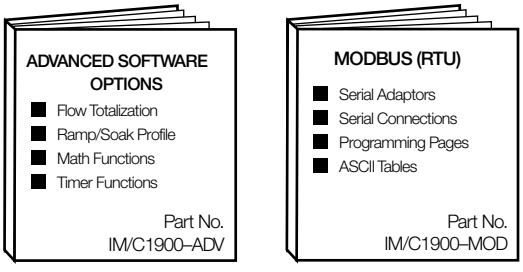
# 1 INTRODUCTION

The documentation for the C1900 series of circular chart recorders is shown in Fig. 1.1. The **Standard Manuals**, including the data sheet, are supplied with all instruments. The **Supplementary Manuals** supplied depend on the specification of the instrument.

This manual includes an **Installation Record** which should be completed as a log of the electrical installation. The record is useful when carrying out initial instrument programming and can be retained for future reference.




**A – Standard Manuals**

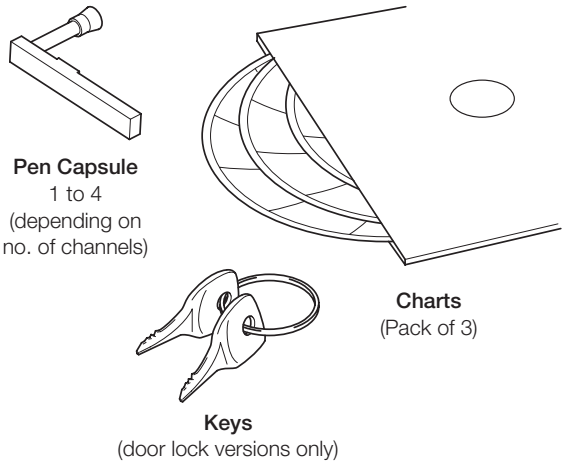



**B – Supplementary Manuals**

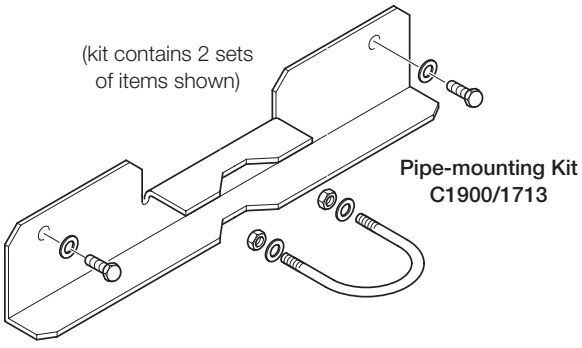
**Fig. 1.1 C1900 Documentation**

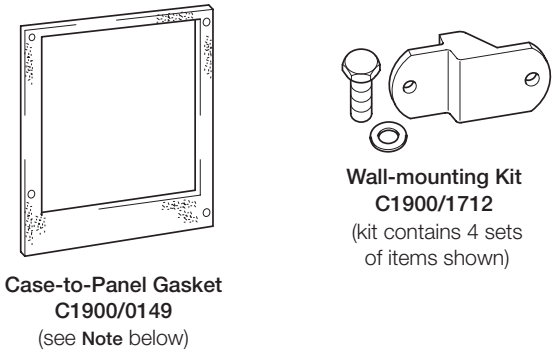
# 2 PREPARATION

## 2.1 Accessories – Fig. 2.1




**A – Standard Accessories**




**B – Optional Accessories**

**Note.** If panel-mounting to NEMA 4X standard is required, a continuous bead of suitable silicon sealant ***must*** be applied between the case flange and the panel. ***Do not*** use the optional gasket.

**Fig. 2.1 Accessories**

## 2.2 Checking the Code Number – Fig. 2.2

### 2.2.1 Non-upgradeable Version

**Note.** The 1901J is a basic, non-upgradeable single pen recorder. This version is not fitted with an analog output, relay, transmitter power supply unit or digital inputs and no additional modules can be fitted. The full identification code is shown below.

**1901J A 0 0 1 1 00000 STD**

**C1900**
**single pen recorder**
Electrical code – **standard**
Option module – **none**
Options – **none**
Door lock – **not fitted**
Power supply – **115V AC**
Modules fitted in module positions 2 to 6 – **none**
Special Settings – **company standard**

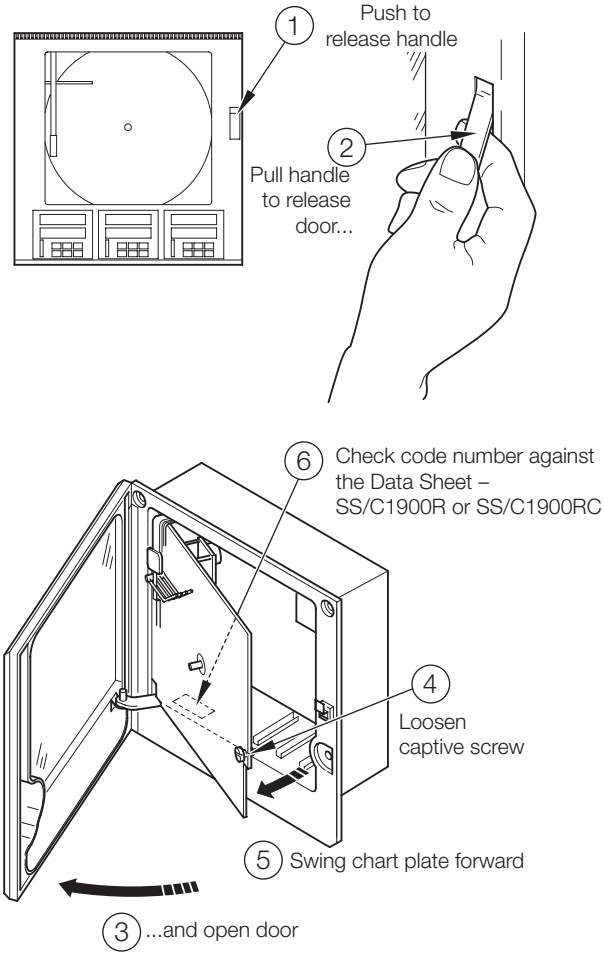
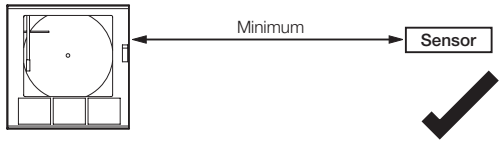


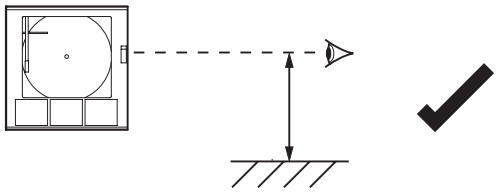

**Fig. 2.2 Checking the Code Number**

# 3 MECHANICAL INSTALLATION

## 3.1 Siting – Figs 3.1 and 3.2



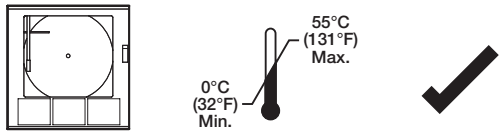

A – Close to Sensor



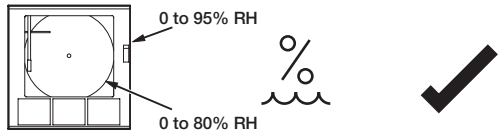
B – At Eye-level Location

C – Avoid Vibration

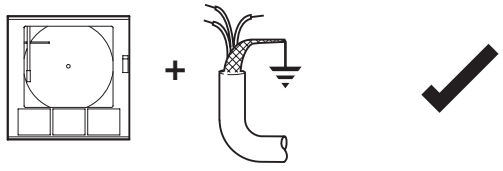
Fig. 3.1 General Requirements




A – Within Temperature Limits




B – Within Humidity Limits



**Caution.** Select a location away from strong electrical and magnetic fields. If this is not possible, particularly in applications where mobile communications equipment is expected to be used, screened cables within earthed (grounded) metal conduit must be used.

C – Use Screened Cables

Fig. 3.2 Environmental Requirements

## 3.2 Mounting – Figs. 3.3 to 3.5

Dimensions in inches (mm)

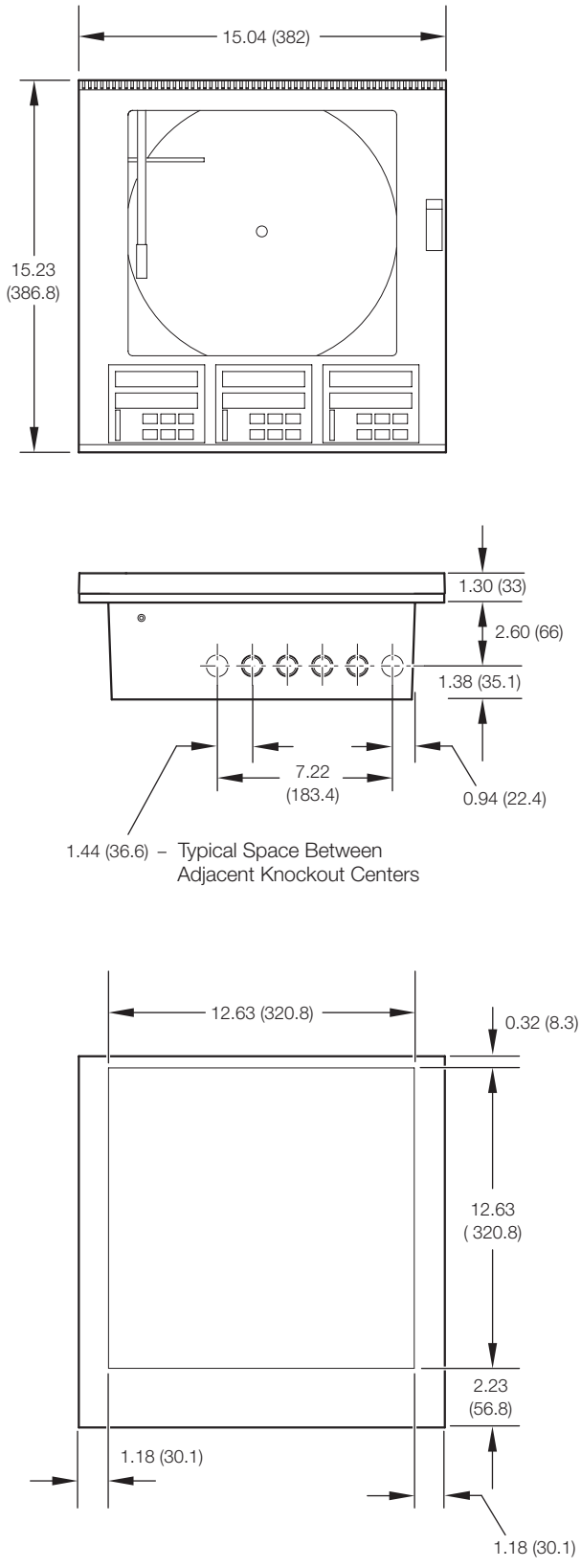
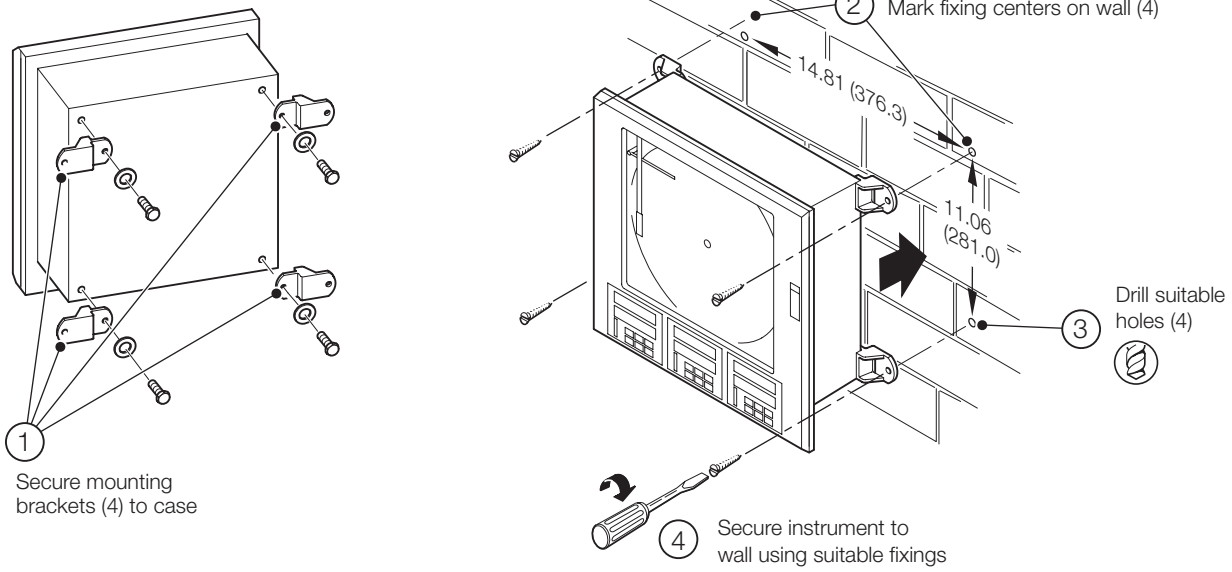
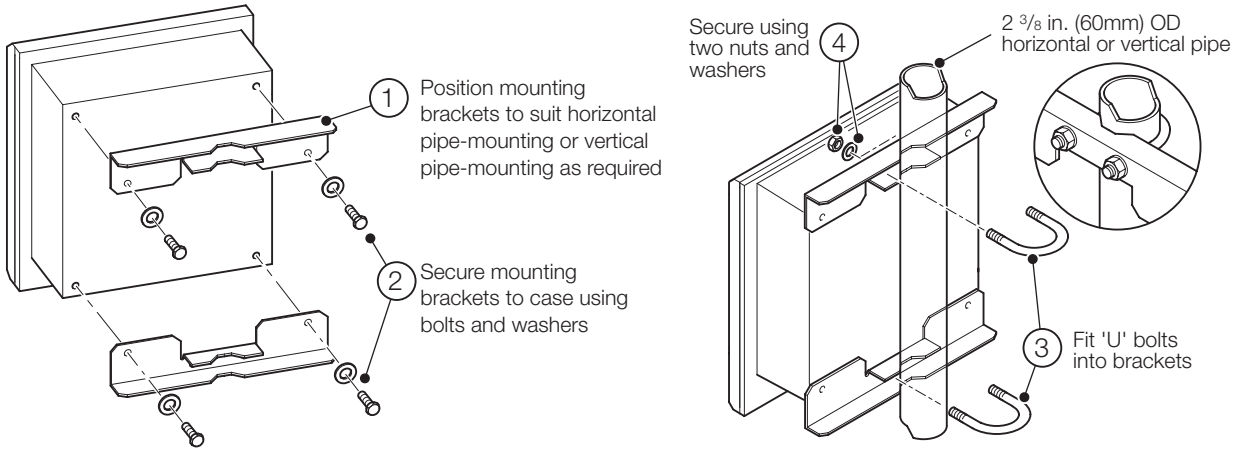



Fig. 3.3 Overall Dimensions

### 3.2.1 Wall-/Pipe-Mounting – Fig. 3.4




**A – Wall-mounting (Optional)**

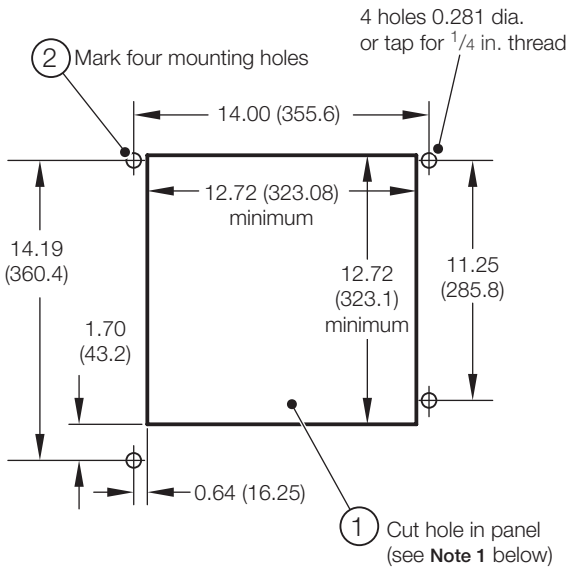



**B – Pipe-Mounting (Optional)**

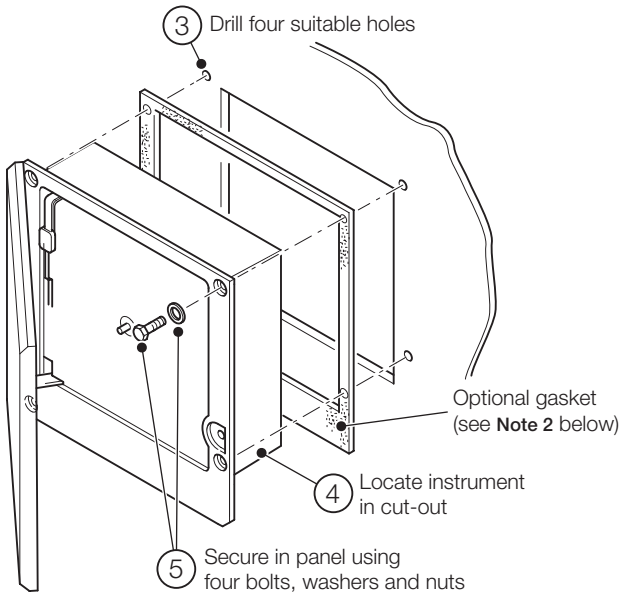
**Fig. 3.4 Wall-/Pipe Mounting**

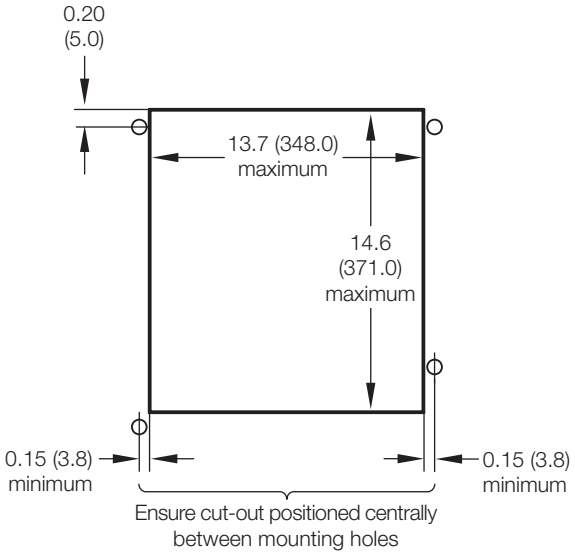
### 3.2.2 Panel Mounting – Fig. 3.5

Dimensions in inches (mm)




Minimum Cut-out Dimensions




Maximum Cut-out Dimensions

**Notes.**

1. The instrument can be inserted into a panel cut-out of any size between the minimum and maximum dimensions illustrated, provided the cut-out is positioned centrally relative to the fixing holes. If the panel cut-out is larger than the maximum, a locally manufactured adaptor plate will be required.
2. If panel-mounting to NEMA 4X hosedown standard is required, a continuous bead of suitable silicon sealant ***must*** be applied beween the case flange and the panel. ***Do not*** use the optional gasket.

**Fig. 3.5 Panel Mounting**

# 4 ELECTRICAL INSTALLATION

**Warnings.**

- To comply with Underwriter Laboratories (UL) and Canadian Standards Association (CSA) certification, route signal leads and power cables in earthed (grounded), flexible metal conduit. Use the Position 1 protective ground stud ⏚ (NOT the terminal module ground stud) to ground the flexible metal conduit.
- Instruments not fitted with the optional internal on/off switch and fuse must have a disconnecting device such as a switch or circuit breaker conforming to local safety standards fitted to the final installation. It must be fitted in close proximity to the instrument within easy reach of the operator and must be marked clearly as the disconnection device for the instrument.
- Remove all power from supply, relay and any powered control circuits and high common mode voltages before accessing or making any connections.
- Use cable appropriate for the load currents. The terminals accept cables up to 14AWG (2.5mm$^2$).
- The instrument and all inputs and outputs conform to Mains Power Input Insulation 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 (IEC 60950, EN601010-1).

**Notes.**

- Always route signal leads and power cables separately.
- Use screened cable for signal inputs and relay connections. Connect the screen to the earth (ground) stud – see Fig. 4.10.
- The terminal blocks can be removed from the main PCB when making connections – see Fig. 4.1. Before removing a module, note its position.
- If wall- or pipe-mounting to NEMA 4X hosedown standard is required, suitable cable glands must be used to prevent water ingress.

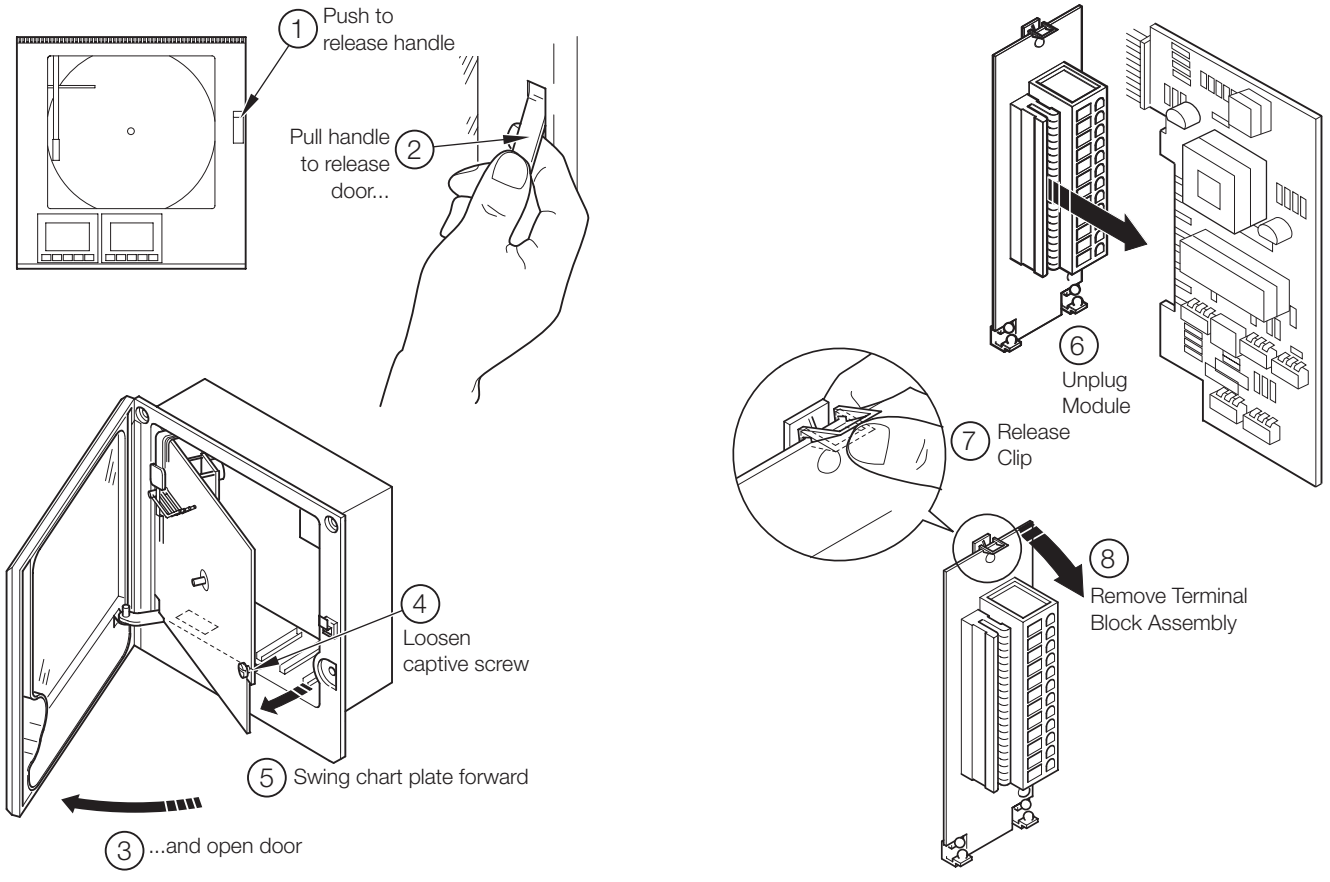



**Fig. 4.1 Removing Terminal Block Assembly**

### 4.1 Identifying the Input/Output Modules – Fig. 4.2

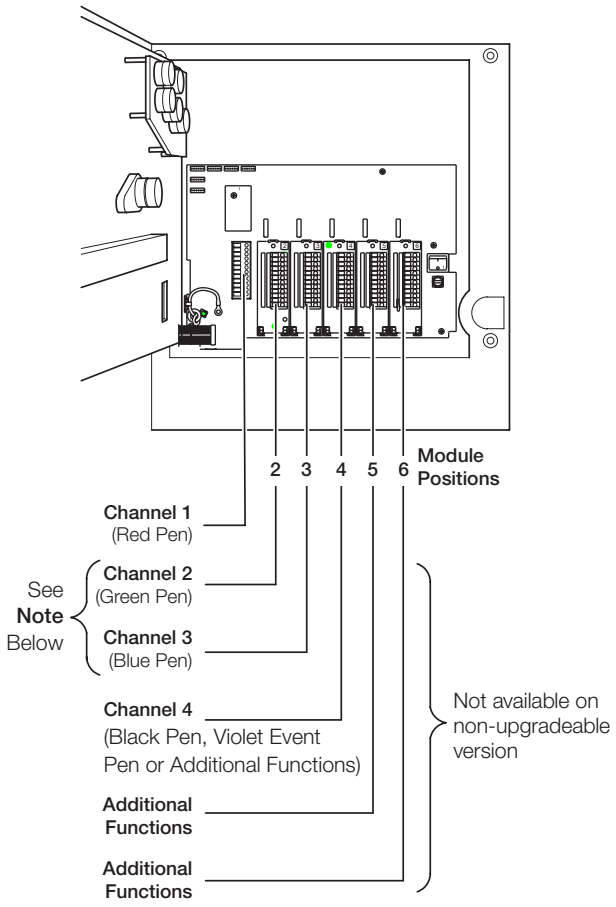
To gain access to the modules, open the door and chassis – see Fig. 2.2. There are six module positions as shown in Fig. 4.2.

### 4.2 Channel Connections

**Channel 1 connections** are made directly to the terminal block mounted on the motherboard.

**Other Channel connections** are made to standard I/O modules, fitted in positions 2, 3 or 4 – see Fig. 4.2.

⚠ **Warning.** The maximum channel to channel voltage (between any 2 channels) must not exceed 500V DC.




**Notes.**

- Module positions can also be used for additional I/O modules (module types 1 and 2) for use with math functions.
- The module type is marked on the component side of the PCB.

**Fig. 4.2 Module Positions and Functions**

### 4.2.1 Selecting the Analog Input Type(s) – Figs. 4.3 and 4.4

Plug-in links are used to select the input type:

**Channel 1** PL1 & PL8 on the main p.c.b. (Fig. 4.3)

**Channels 2 to 4** PL1 & PL3 on the module (Fig. 4.4)

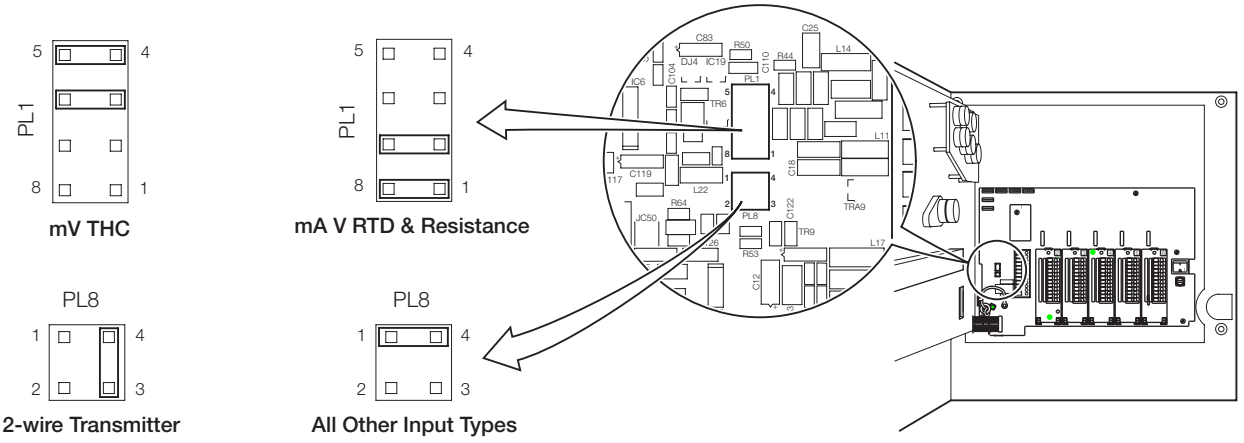



Fig. 4.3 Selecting the Input Type (Main Board)

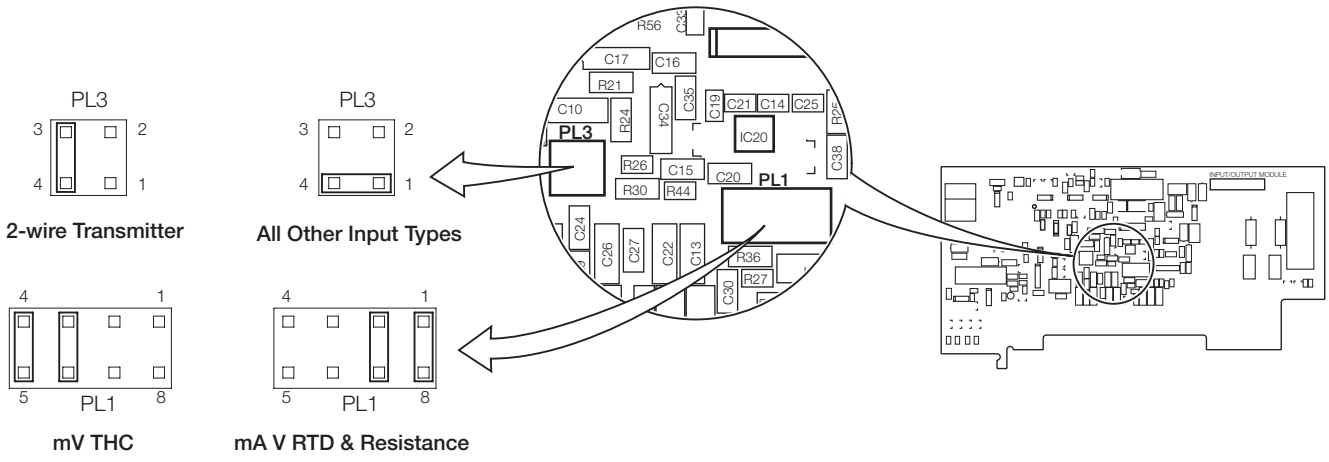



Fig. 4.4 Selecting the Input Type (I/O Modules)

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

Table 4.1 Thermocouple Compensating Cable

### 4.2.2 Voltage and Current – Fig. 4.5

**Input impedances:**

| | |
|---|---|
| Low voltage (mV) | >10MΩ |
| Voltage | >10MΩ |
| Current (mA) | 100Ω |

### 4.2.3 2-wire Transmitter Input – Fig. 4.5

Power for the transmitter is supplied by terminal 6.

**Note.** The voltage across terminals 4 and 6 is 20V (nominal). This is due to internal voltage drops across a shunt resistor and measurement circuitry.

### 4.2.4 Thermocouple – Fig. 4.5

Use correct compensating cable between the thermocouple and the terminals – see Table 4.1 (previous page).

Automatic cold junction (ACJC) is incorporated but an independent cold (reference) junction may be used.

### 4.2.5 Resistance Thermometer (RTD) – Fig. 4.5

If long leads are necessary it is preferable to use a 3-lead resistance thermometer.

If 2-lead resistance thermometers are used each input must be calibrated to take account of the lead resistance.

### 4.2.6 Logic Inputs – Fig. 4.5

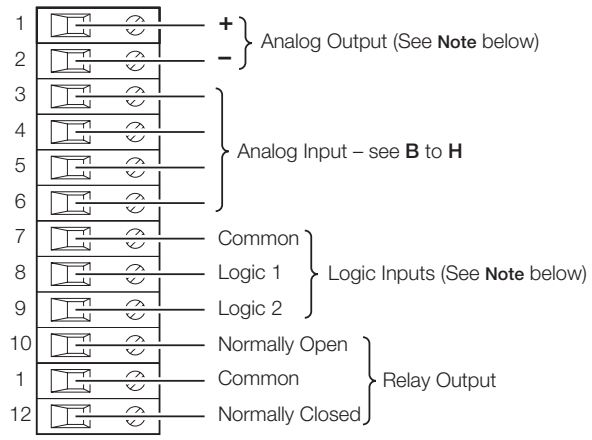
The two logic inputs accept either volt-free (switch) or TTL (5V) input types and can be used for remote switching of many recorder functions, e.g. chart stop/go, alarm acknowledgment, totalizer reset etc. Refer to the **Programming Guide**, IM/C1900–PGR or IM/C1900–PGC.

### 4.2.7 Analog Output – Fig. 4.5

### 4.2.8 Relay Output – Fig. 4.5

**Relay specification:**

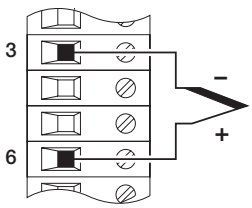
| | | |
|---|---|---|
| Type | single pole changeover | |
| Voltage | 250V AC | 250V DC |
| Current | 5A AC | 5A DC |
| Loading (non inductive) | 1250VA | 50W |
| Isolation, contacts to earth | 2kV RMS | |



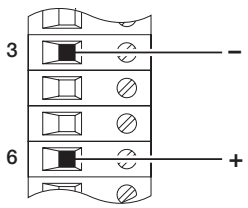

**Note.** Not applicable on Type 2 Modules.

**A – Summary of Connections**

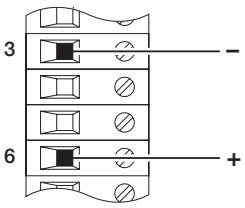

**D – 2-wire Transmitter**
(not available on non-upgradeable version)



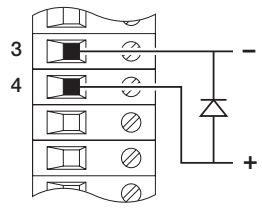

**E – Thermocouple**



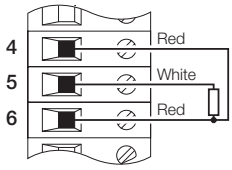

**F – Low Voltage (mV)**



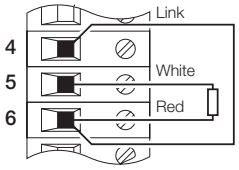

**B – Voltage**




**C – Current**
**(non 2-wire transmitters) ***




**G – 3-wire RTD**




**H – 2-wire RTD & Resistance**

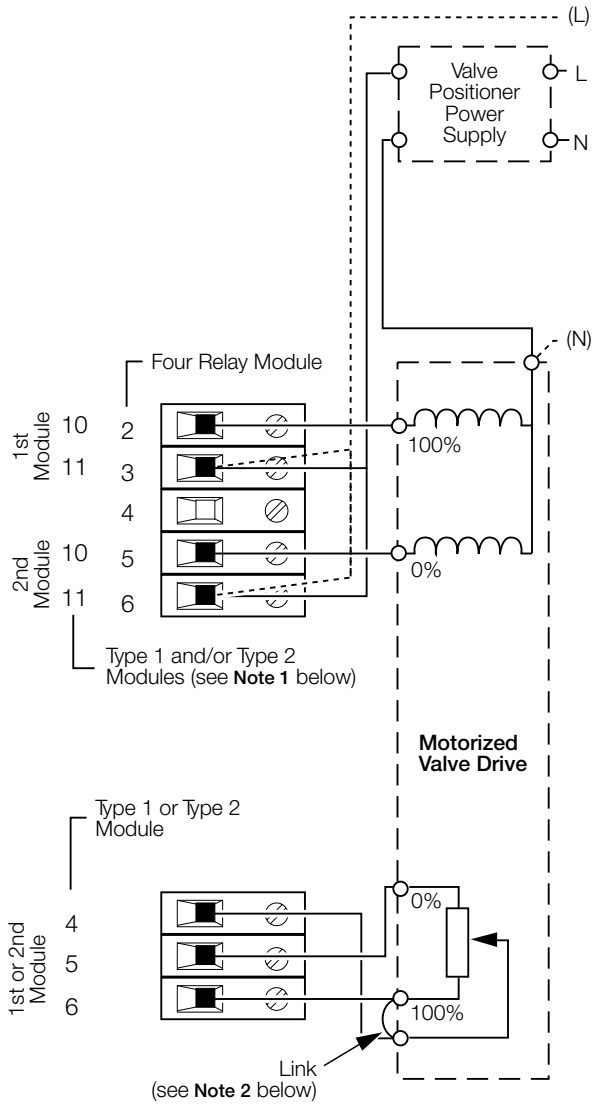
* Recommended diode:
Diode forward voltage > 0.8 V @ 20 mA or use 2 x 1N4001 general purpose diodes in series

**Fig. 4.5 Channel Connections**

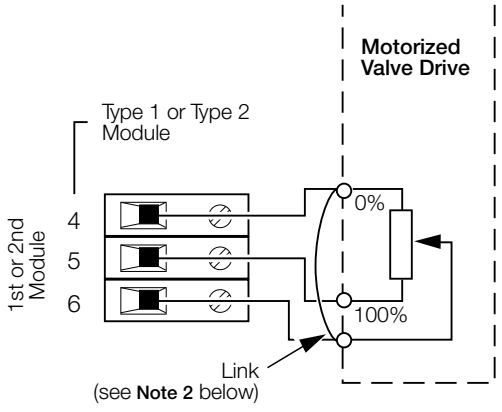
### 4.2.9 Motorized Valve – Fig. 4.6

A motorized valve with or without feedback requires 2 relays (common and normally open terminals) to drive the valve in either direction. Any two relays can be allocated for this function. Fig. 4.6 A shows two possible combinations.

**Note.** For valves with position feedback using low voltage (mV), voltage (V) or current (C), refer to Fig. 4.5 B, C and F for connections.




**A – Standard Feedback Slidewire Configuration**




**B – Alternative Feedback Slidewire Configuration**

**Notes.**

**1** Type 1 and type 2 modules have one relay output, therefore two modules are required.

**2** Link must be connected at valve drive end, not at the controller terminals.

**Fig 4.6 Motorized Valve Connections (using feedback slidewire)**

## 4.3 Module Connections

### 4.3.1 Standard I/O or Analog + Relay (Module Types 1, 2 and 7) – Fig. 4.5

The connections are the same as Channel connections to the main board. Refer to Section 4.2.

### 4.3.2 Four Relay Module (Module Type 3) – Fig. 4.7

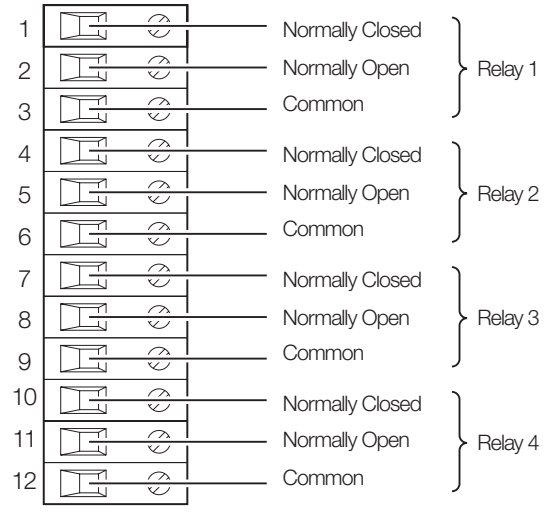



**Fig. 4.7 Four Relay Module Connections (Module Type 3)**

### 4.3.3 Eight Digital Inputs or Outputs (Module Types 4 and 5 respectively) – Figs. 4.8 and 4.9

A plug-in link is used to select the board's function; digital inputs or digital outputs – see Fig. 4.8. The maximum current drain from each TTL output must not exceed 5mA.

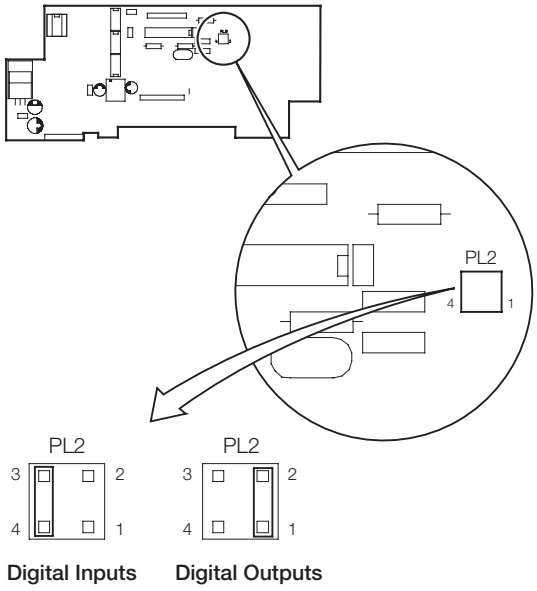



**Fig. 4.8 Selecting the Digital Module Function (Module Types 4 and 5)**

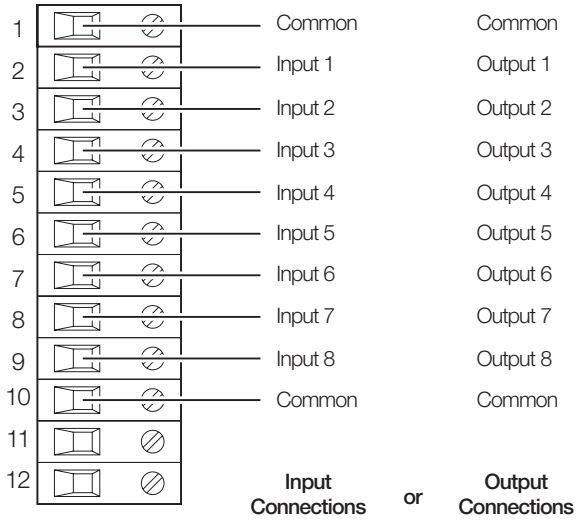
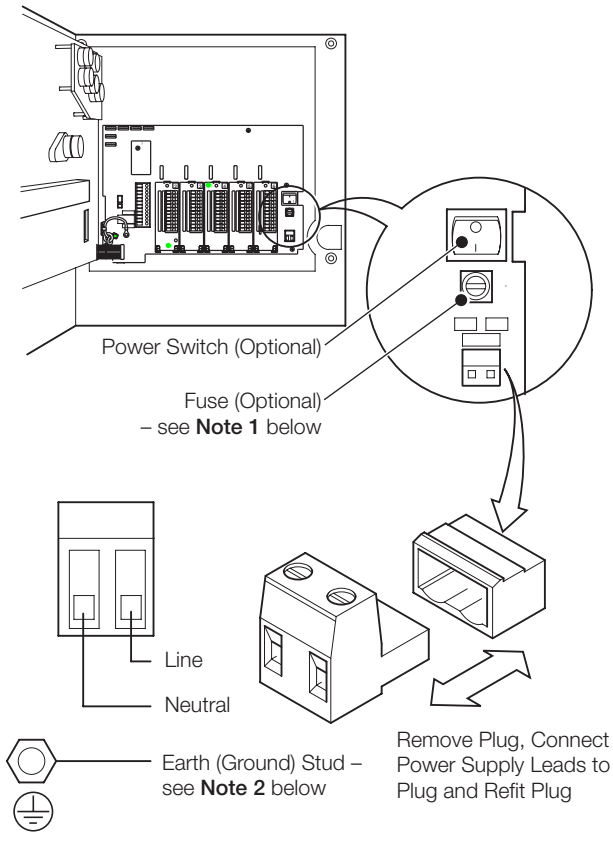
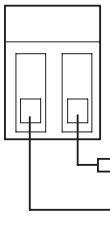



**Fig. 4.9 Eight Digital Inputs or Outputs Connections (Module Types 4 and 5)**

## 4.4 Power Supply Connections – Fig. 4.10




**Warning.** If the optional internal power switch and fuse are not fitted, an external disconnection device and fuse must be fitted – see also **Warnings** on page 6.

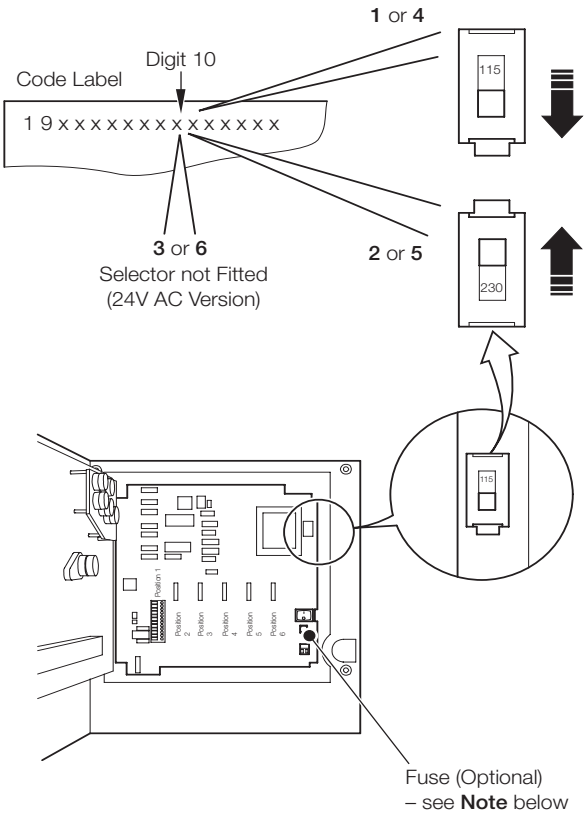
**Before making any electrical connections, see Warnings on page 6**

**Notes.**

1. Fuse rating:
   500mA (20 X 5mm) Type T
2. Ensure that the Earth (Ground) lead is longer than the Line and Neutral leads.

**Fig. 4.10 Power Supply Connections**

**Note.** Recorders manufactured before June 2005 are fitted with a Mainboard that is not equipped with a universal power supply. Ensure the supply voltage selector switch is set correctly and the appropriate fuse is fitted – see Fig 4.11.



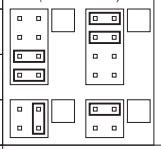

**Note.** Fuse ratings:

| | |
|---|---|
| 115V Supply | 1A (20 x 5mm) Type T |
| 230V Supply | ½A (20 x 5mm) Type T |
| 24V Supply | 4A (20 x 5mm) Type T |

**Fig. 4.11 Power Supply Selection**
(Recorders Manufactured Before June 2005 Only)

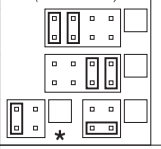
## Position 1

**Module Type** 1 ☑

| | | | |
|---|---|---|---|
| Analog Output | 1 | + | |
| | 2 | – | |
| Analog Input | 3 | | Link Positions *(Tick Boxes)*  |
| | 4 | | |
| | 5 | | |
| | 6 | | |
| Logic Inputs | 7 | C | |
| | 8 | L1 | |
| | 9 | L2 | |
| Relay Output | 10 | NO | |
| | 1 | C | |
| | 12 | NC | |

## Position 2

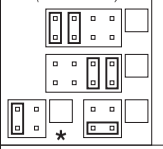
**Module Type** *(Tick Box)* 1 ☐ 2 ☐

| | | | |
|---|---|---|---|
| * Analog Output | 1 | + | |
| | 2 | – | |
| Analog Input | 3 | | Link Positions *(Tick Boxes)*  |
| | 4 | | |
| | 5 | | |
| | 6 | | |
| * Logic Inputs | 7 | C | |
| | 8 | L1 | |
| | 9 | L2 | |
| Relay Output | 10 | NO | |
| | 1 | C | |
| | 12 | NC | |

* Not applicable on Module Type 2

## Position 3

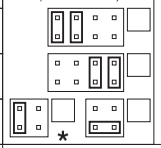
**Module Type** *(Tick Box)* 1 ☐ 2 ☐

| | | | |
|---|---|---|---|
| * Analog Output | 1 | + | |
| | 2 | – | |
| Analog Input | 3 | | Link Positions *(Tick Boxes)*  |
| | 4 | | |
| | 5 | | |
| | 6 | | |
| * Logic Inputs | 7 | C | |
| | 8 | L1 | |
| | 9 | L2 | |
| Relay Output | 10 | NO | |
| | 1 | C | |
| | 12 | NC | |

* Not applicable on Module Type 2

## Position 4

**Module Type** *(Tick Box)* 1 ☐ 2 ☐ 6 ☐ 7 ☐

| | | | |
|---|---|---|---|
| * Analog Output | 1 | + | |
| | 2 | – | |
| Analog Input | 3 | | Link Positions *(Tick Boxes)*  |
| | 4 | | |
| | 5 | | |
| | 6 | | |
| * Logic Inputs | 7 | C | |
| | 8 | L1 | |
| | 9 | L2 | |
| Relay Output | 10 | NO | |
| | 1 | C | |
| | 12 | NC | |

* Not available on Module Type 2

3 ☐

| | | | |
|---|---|---|---|
| Relay Output 1 | 1 | NC | |
| | 2 | NO | |
| | 3 | C | |
| Relay Output 2 | 4 | NC | |
| | 5 | NO | |
| | 6 | C | |
| Relay Output 3 | 7 | NC | |
| | 8 | NO | |
| | 9 | C | |
| Relay Output 4 | 10 | NC | |
| | 1 | NO | |
| | 12 | C | |

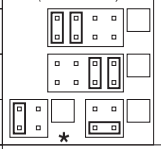
4 ☐ 5 ☐

| | | | |
|---|---|---|---|
| Logic I/Ps (Type 4) or Logic O/Ps (Type 5) | 1 | C | |
| | 2 | 1 | |
| | 3 | 2 | |
| | 4 | 3 | |
| | 5 | 4 | |
| | 6 | 5 | |
| | 7 | 6 | |
| | 8 | 7 | |
| | 9 | 8 | |
| | 10 | C | |

**Link Positions** *(Tick Box)*  Type 4  Type 5

## Position 5

**Module Type** *(Tick Box)* 2☐ 3☐ 4☐ 5☐

| | | | |
|---|---|---|---|
| * Analog Output | 1 | + | |
| | 2 | – | |
| Analog Input | 3 | | Link Positions *(Tick Boxes)*  |
| | 4 | | |
| | 5 | | |
| | 6 | | |
| * Logic Inputs | 7 | C | |
| | 8 | L1 | |
| | 9 | L2 | |
| Relay Output | 10 | NO | |
| | 1 | C | |
| | 12 | NC | |

* Not available on Module Type 2

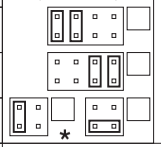
| | | | |
|---|---|---|---|
| Relay Output 1 | 1 | NC | |
| | 2 | NO | |
| | 3 | C | |
| Relay Output 2 | 4 | NC | |
| | 5 | NO | |
| | 6 | C | |
| Relay Output 3 | 7 | NC | |
| | 8 | NO | |
| | 9 | C | |
| Relay Output 4 | 10 | NC | |
| | 1 | NO | |
| | 12 | C | |

| | | | |
|---|---|---|---|
| Logic I/Ps (Type 4) or Logic O?ps (Type 5) | 1 | C | |
| | 2 | 1 | |
| | 3 | 2 | |
| | 4 | 3 | |
| | 5 | 4 | |
| | 6 | 5 | |
| | 7 | 6 | |
| | 8 | 7 | |
| | 9 | 8 | |
| | 10 | C | |

**Link Positions** *(Tick Box)*  Type 4  Type 5

## Position 6

**Module Type** *(Tick Box)* 2☐ 4☐ 5☐

| | | | |
|---|---|---|---|
| * Analog Output | 1 | + | |
| | 2 | – | |
| Analog Input | 3 | | Link Positions *(Tick Boxes)*  |
| | 4 | | |
| | 5 | | |
| | 6 | | |
| * Logic Inputs | 7 | C | |
| | 8 | L1 | |
| | 9 | L2 | |
| Relay Output | 10 | NO | |
| | 1 | C | |
| | 12 | NC | |

* Not available on Module Type 2

| | | | |
|---|---|---|---|
| Logic I/Ps (Type 4) or Logic O/Ps (Type 5) | 1 | C | |
| | 2 | 1 | |
| | 3 | 2 | |
| | 4 | 3 | |
| | 5 | 4 | |
| | 6 | 5 | |
| | 7 | 6 | |
| | 8 | 7 | |
| | 9 | 8 | |
| | 10 | C | |

**Link Positions** *(Tick Box)*  Type 4  Type 5

# NOTES

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Service

Software

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Fax: +44 (0)1480 217 948
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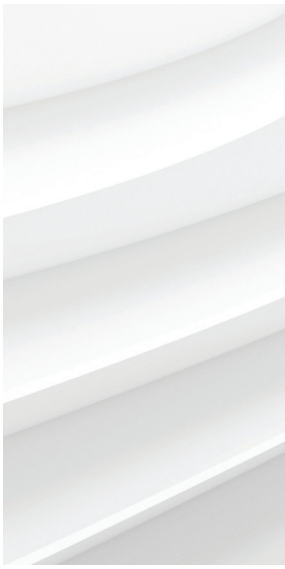
Fax: +1 215 674 7183

**abb.com/measurement**

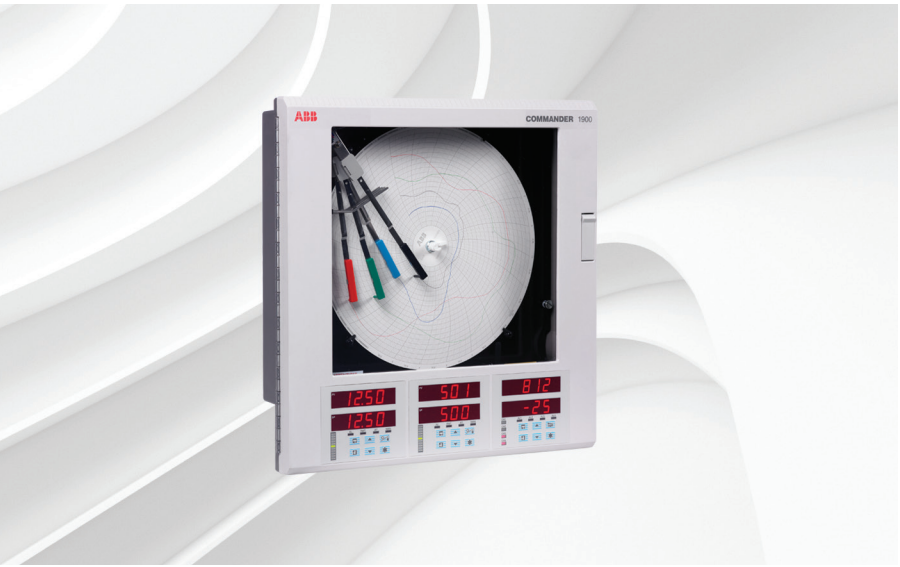




IM/C1900-INS Rev. P 09.2018

# C1900

## Circular chart recorder/controller




## Measurement made easy

C1900
circular chart
recorder/controller

## For more information

Further publications are available for free download from:

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or by scanning this code:

| | Search for or click on |
|---|---|
| Data Sheet<br>C1900<br>Circular chart recorder/controller | DS/C1900RC-EN |
| Quick Reference Guide<br>Circular chart recorder/controller | IM/C1900-QC |
| Installation Guide<br>C1900<br>Circular chart recorder and recorder/controller | IM/C1900-INS |
| Programming Guide<br>C1900<br>Circular chart recorder/controller | IM/C1900-PGC |
| Operating Instructions<br>C1900<br>Circular chart recorder and recorder/controller | IM/C1900-MOD |
| User Guide<br>C1900<br>Circular chart recorder and recorder/controller | IM/C1900-ADV |

## 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 |
|  | Alternating current supply only |
|  | Both direct and alternating current supply |
|  | The equipment is protected through double insulation |

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:

- The relevant sections of these instructions must be read carefully before proceeding.
- Warning labels on containers and packages must be observed.
- Installation, operation, maintenance and servicing must only be carried out by suitably trained personnel and in accordance with the information given.
- Normal safety precautions must be taken to avoid the possibility of an accident occurring when operating in conditions of high pressure and/or temperature.
- Chemicals must be stored away from heat, protected from temperature extremes and powders kept dry. Normal safe handling procedures must be used.
- 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.

# CONTENTS



# 1 INTRODUCTION

The documentation for the C1900 series of circular chart recorders is shown in Fig. 1.1. The **Standard Manuals**, including the specification sheet, are supplied with all instruments. The **Supplementary Manuals** supplied depend on the specification of the instrument.

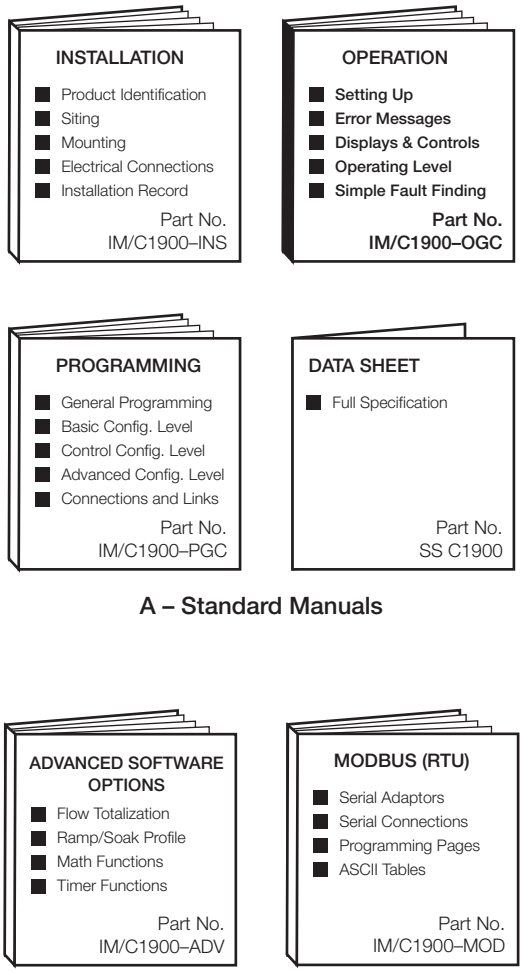



**Fig. 1.1 C1900 Documentation**

# 2 SETTING UP

## 2.1 Instrument Power-up – Fig. 2.1 and 2.2

**Caution.** Ensure that all connections, especially to the earth stud, are made correctly.

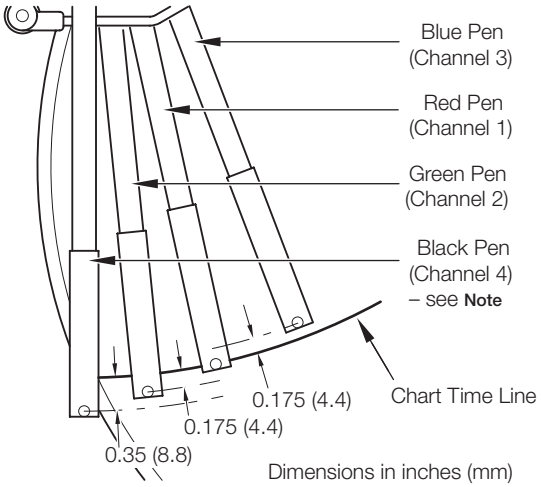
a) Check that the input sensors are installed correctly.

b) Check that the pen(s) are installed correctly – see Fig. 2.1.

c) Switch on the supply to the instrument, any power-operated control circuits and the input signals. Wait for the pens to settle.

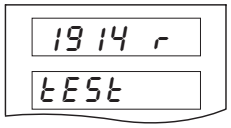
**Note.** On power-up, the pens are moved to an off-chart position for automatic referencing. Pen chatter may occur on those pens nearest the reference position. **This is a normal function of the instrument.**

d) The start-up sequence shown in Fig. 2.2 is displayed on faceplate 1 when the supply is first switched on.

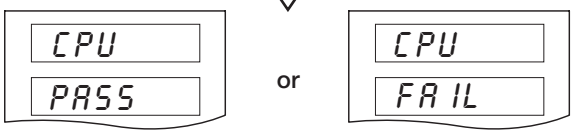



**Note.** If the true time line event option is fitted, the violet event pen records on the same time line as the red pen, but on the outer edge of the chart.

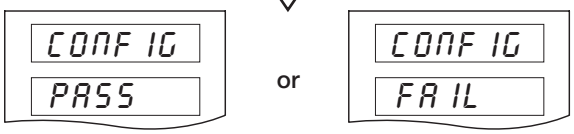
**Fig. 2.1 Checking the Pen(s) Installation**



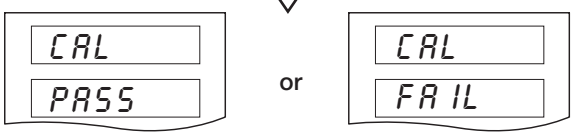

**Instrument Test** identifies the instrument type, e.g. 1914r – see Table 2.1 in the **Installation Manual**.



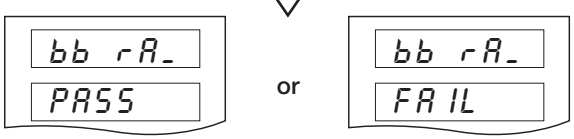

**CPU Test** carries out check of processor circuitry – see **Error Codes** below.



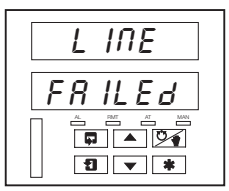

**Configuration Test** carries out check of non-volatile memories containing the instrument configuration, then indicates pass or fail – see **Error Codes** below.



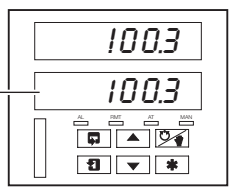

**Calibration Test** carries out check of non-volatile memories containing the calibration data for each analog input and output, then indicates pass or fail – see **Error Codes** below.



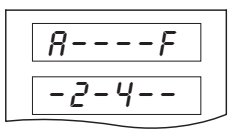

**Battery Back RAM Test** carries out check of battery-backed RAM, then indicates pass or fail – see **Error Codes** below.




Flashing between




or




**Lined Failed** indicates power failure and is cleared when advancing to the next frame or page.

**Normal Display**

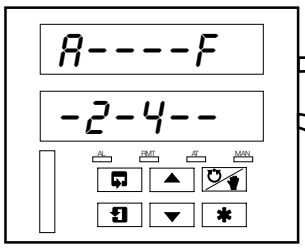
Not applicable on single channel instruments

**Error Codes** are displayed in the event of a fault – see Section 2.1.1.

**Fig. 2.2 Instrument Displays at Start-up**

### 2.1.1 Power-up Error Codes

If any of the power-up tests fail (see Fig. 2.2), error codes are displayed to identify the fault. Refer to Fig. 2.3 for error code interpretations.




**Configuration and battery-backed RAM errors**

| Code | Error | Action |
|---|---|---|
| _ | No error | None |
| A | Main program data stored in non-volatile memory on main board is corrupt | Check and correct program data |
| b | Control Date stored in non-volatile memory on main board is corrupt | Check and correct control program data |
| C | Timer set up stored in battery-backed RAM is corrupt | Check and correct data in **Set Up Timer Page*** |
| d | Maths set up stored in battery-backed RAM is corrupt | Check and correct data in **Set Up Maths Page*** |
| E | Ramp/soak profile set up stored in battery-backed RAM is corrupt | Check and correct data in **Profile Control** and **Profile Program Pages** |
| F | Totalizer set up in battery-backed RAM has been corrupt | Check and correct data in **Set Up Totals Page*** |

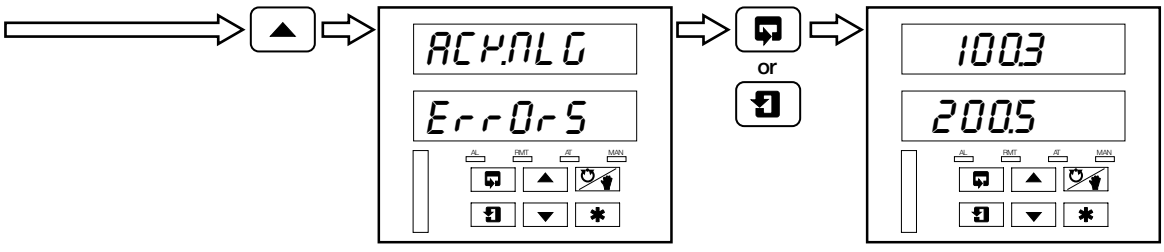
* Refer to the **Advanced Software Options Manual**

Calibration errors

| Code | Error | Action |
|---|---|---|
| _ | No error | None |
| 1 | Main board | Power down and then up again.<br>If fault remains, contact the local Service Organisation. |
| 2 | Module in position 2 | |
| 3 | Module in position 3 | |
| 4 | Module in position 4 | |
| 5 | Module in position 5 | |
| 6 | Module in position 6 | |

Analog input and/or analog output calibration is corrupt

**Acknowledging Error Codes**




**Note.** Acknowledging the Error Code clears the error state but does not rectify the fault. After acknowledging the error, carry out the relevant action detailed in the above tables.

**Fig. 2.3 Power-up Error Codes**

## 2.2 Fitting the Chart – Fig. 2.4

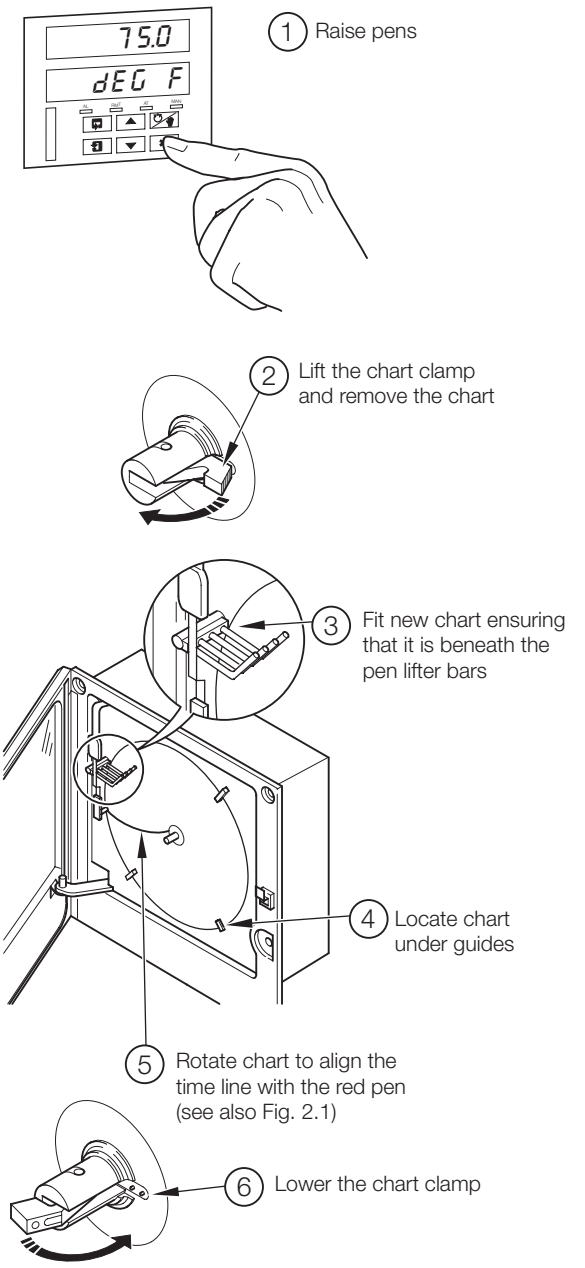
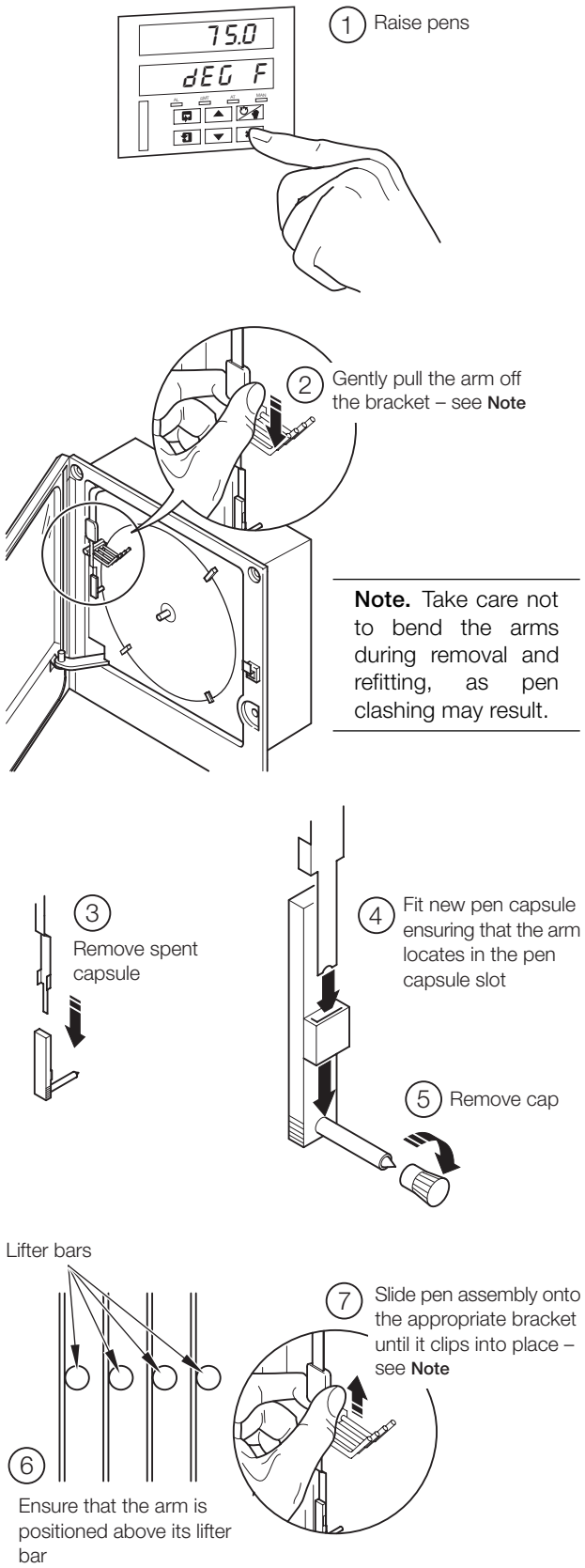



**Fig. 2.4 Fitting the Chart**

## 2.3 Fitting the Pen Capsule(s) – Fig. 2.5




**Note.** Take care not to bend the arms during removal and refitting, as pen clashing may result.

**Fig. 2.5 Fitting the Pen Capsules**

# 3 DISPLAYS & CONTROLS

The displays, LED indicators and operation/programming controls are located on the faceplates on the front panel of the instrument – see Fig 3.1.

### 3.1 Displays and LED Indicators – Fig. 3.1

The displays comprise 2 rows of 6 characters.

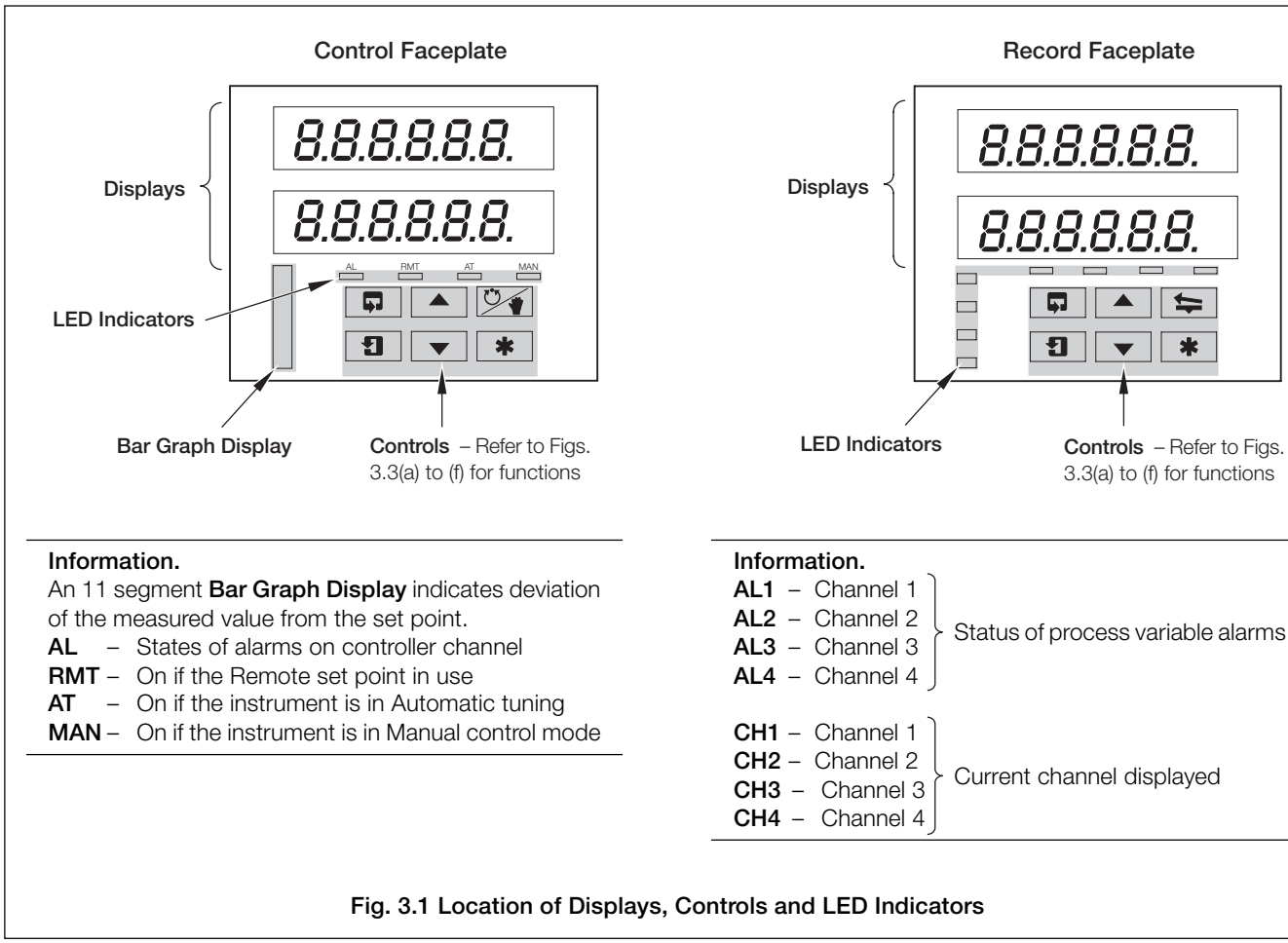
At the top of each programming page (the page header) both displays are used to describe the particular page selected.

When parameters within the selected page are viewed, the upper display shows the parameter and the lower display shows the value or setting for that parameter.

Alarm and Channel states are indicated by separate LEDs on the front panel faceplate(s) – see Fig. 3.1.

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

**Table 3.1 Character Set**




**Information.**
An 11 segment **Bar Graph Display** indicates deviation of the measured value from the set point.
**AL** – States of alarms on controller channel
**RMT** – On if the Remote set point in use
**AT** – On if the instrument is in Automatic tuning
**MAN** – On if the instrument is in Manual control mode

**Information.**
**AL1** – Channel 1
**AL2** – Channel 2
**AL3** – Channel 3
**AL4** – Channel 4
} Status of process variable alarms

**CH1** – Channel 1
**CH2** – Channel 2
**CH3** – Channel 3
**CH4** – Channel 4
} Current channel displayed

**Fig. 3.1 Location of Displays, Controls and LED Indicators**

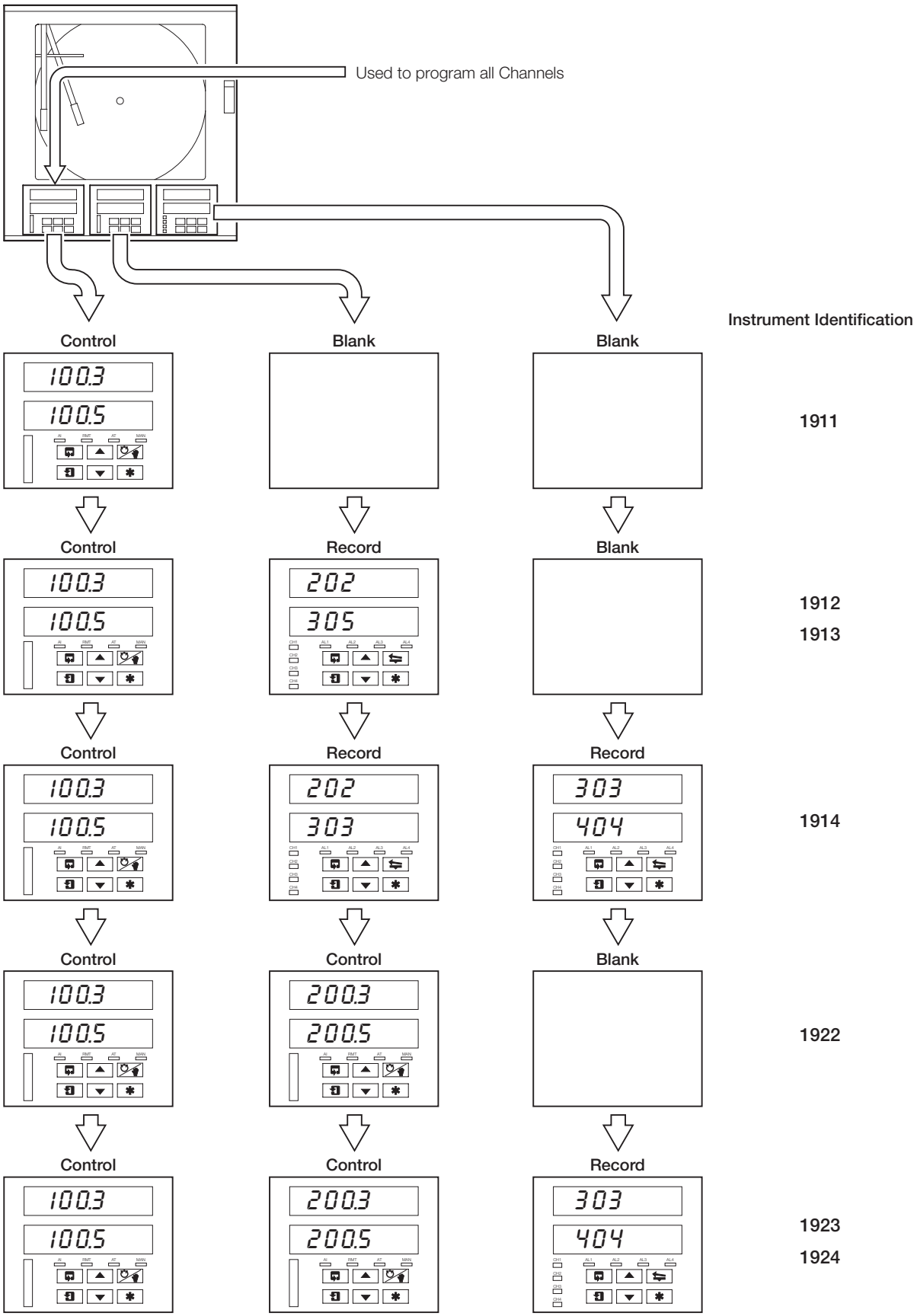



Fig. 3.2 Faceplate Combinations and Product Codes

## 3.2 Use of Controls – Fig. 3.3(a) to (g)

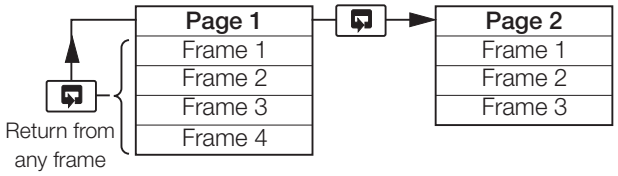



**Fig. 3.3(a) Advancing to Next Page**

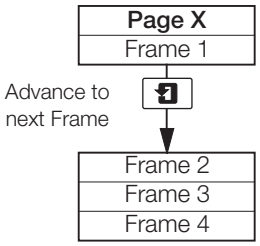
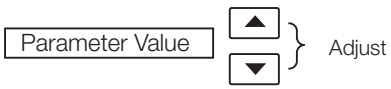
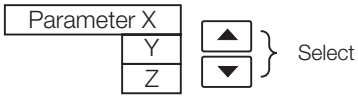



**Fig. 3.3(b) Moving Between Parameters**




**Note.** Continued pressure on the ▲ and ▼ keys causes the rate of change of the displayed value to increase. To make small adjustments operate the keys momentarily.

**Fig. 3.3(c) Adjusting a Parameter Value**




**Note.** Continued pressure on the ▲ and ▼ keys causes the rate of change of the displayed value to increase. To make small adjustments operate the keys momentarily

**Fig. 3.3(d) Selecting a Parameter Choice**

Lift/Lower pen on alternate operations

**Note.** If **'Auto Pen Drop'** is selected in the **Set Up Chart Page, BASIC CONFIGURATION LEVEL**, the pens return automatically to their operating positions after a five minute delay.

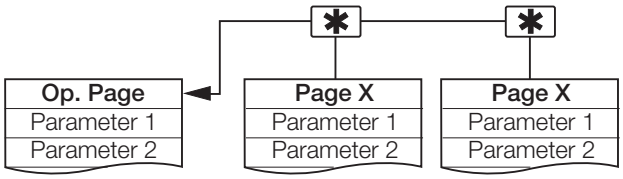
**Fig. 3.3(e) Lifting/Lowering the Pens**

**Information.** The ✱ key is programmed in the **Set Up Function Keys Page, ADVANCED CONFIGURATION LEVEL**.

✱ Acknowledge any alarm
Auto-tune
Pen lift/lower
Profile ramp soak
Local /Remote

**or**

Return operator to top of **Operating Page**.

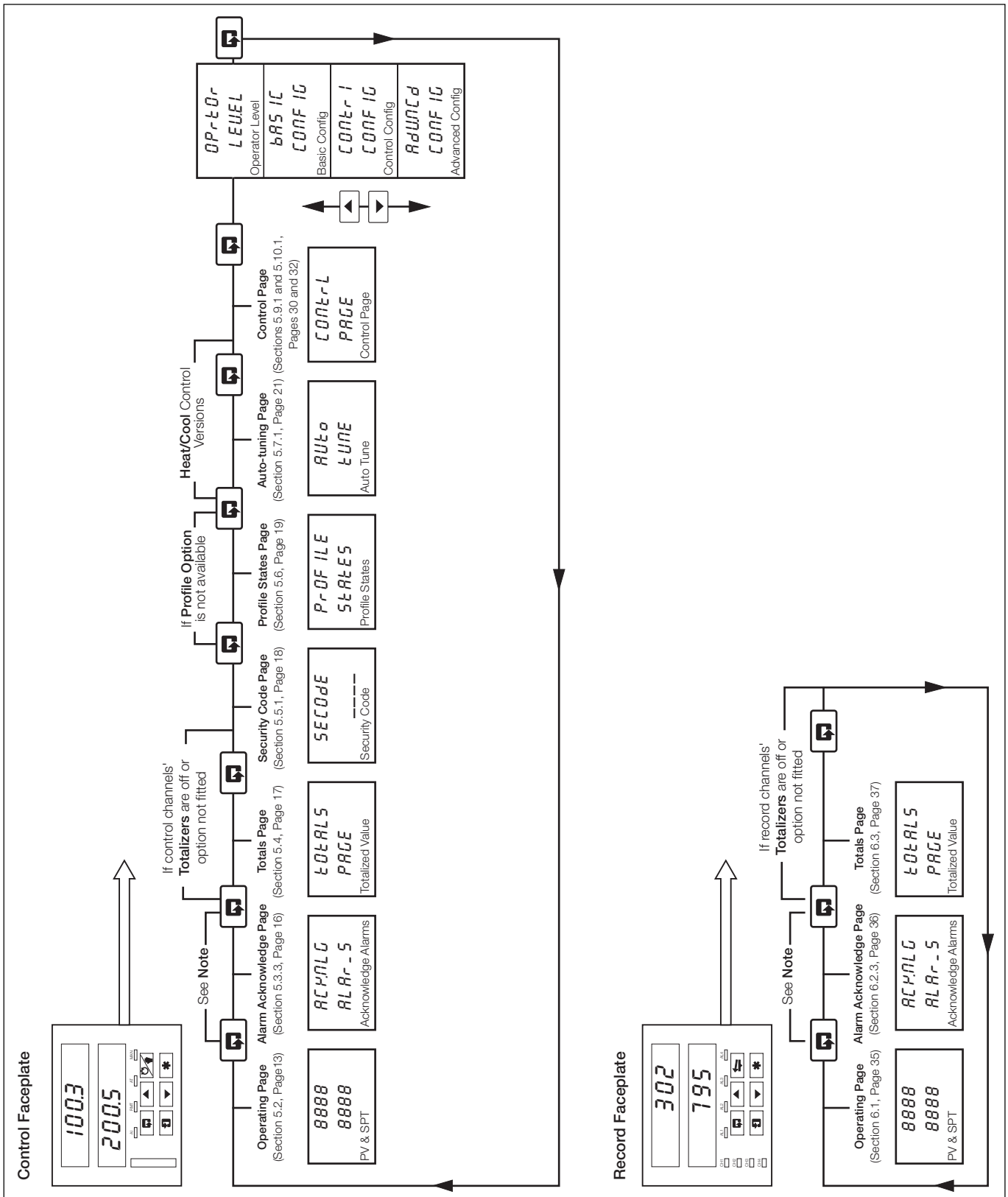



**Note.** The ✱ key returns the instrument display to the start of the operating page only when the display is at the top of any page.

**Fig. 3.3(f) Selecting Programmable Functions**

Auto/Manual key – used for selecting Automatic or Manual mode on alternate operations.
When manual mode is selected the displays revert automatically to the process variable values and control output or valve position (if position-proportioning or boundless motorized valve control is selected at **Control Type** in the **Set Up Control Page**).

**Fig. 3.3(g) Auto/Manual Key Functions**



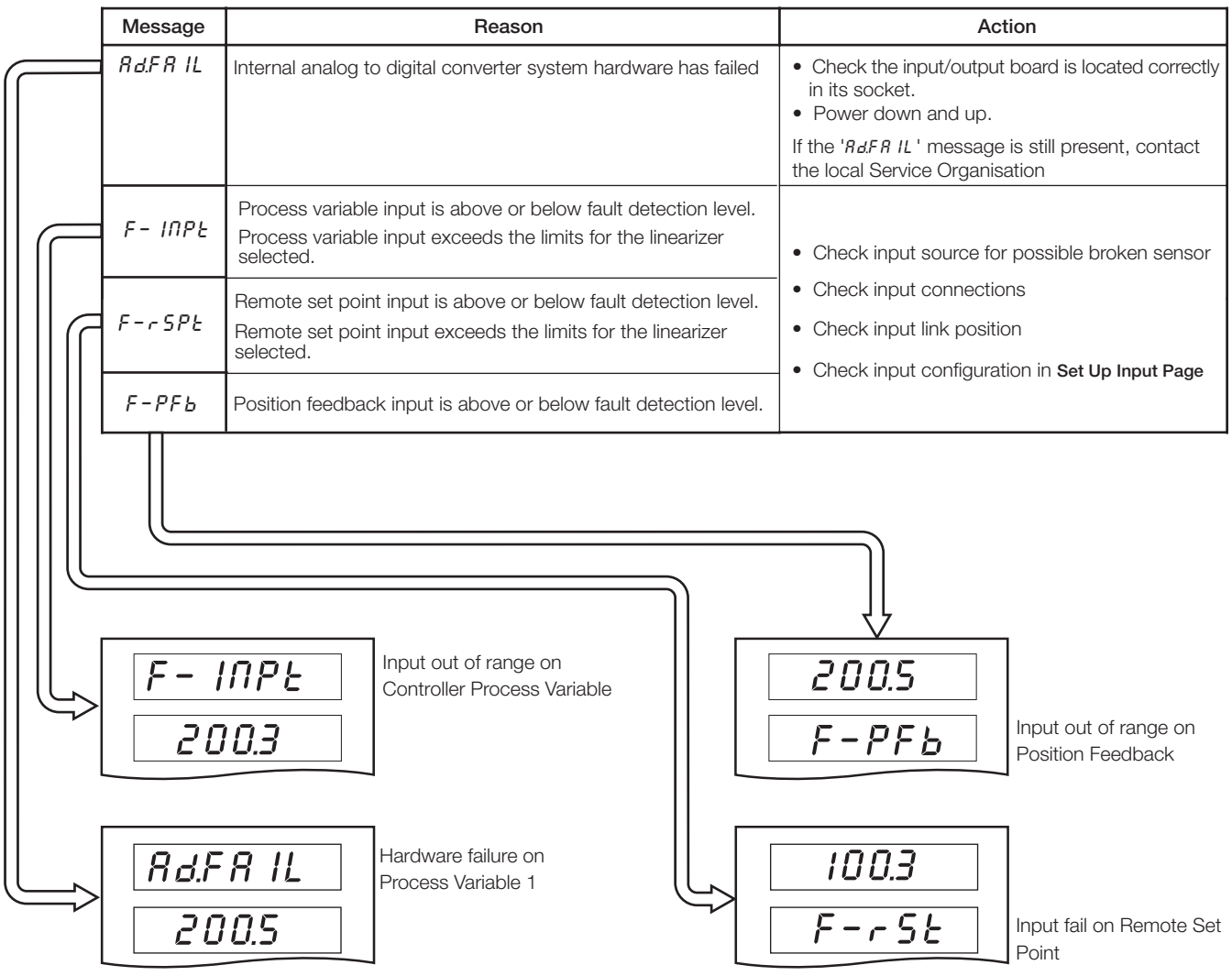

**Note.** The **Alarm Acknowledge** pages are displayed only if an alarm is active.

**Fig. 4.1 Summary of Operating Levels for Different Faceplate Types**

The instrument has dedicated Operating Pages – see Fig. 4.1. These pages are used for general monitoring of the process measurements and are not affected by the security system which inhibits access to the programming and control pages only – see Section 5.5 on page 18.

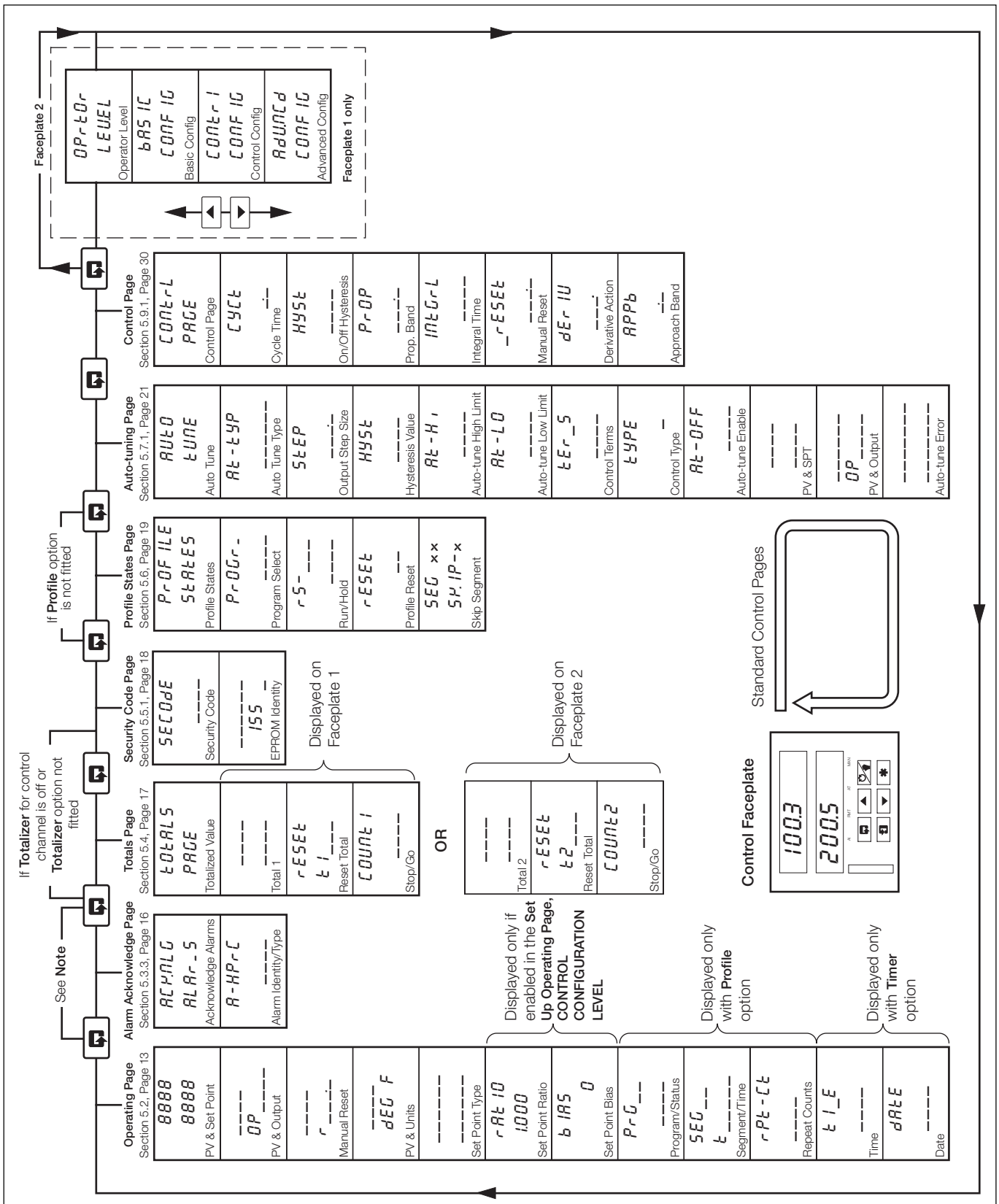
## 4.1 Input Error Messages – Fig. 4.2

| Message | Reason | Action |
|---|---|---|
| AdFAIL | Internal analog to digital converter system hardware has failed | • Check the input/output board is located correctly in its socket.<br>• Power down and up.<br>If the 'AdFAIL' message is still present, contact the local Service Organisation |
| F-INPt | Process variable input is above or below fault detection level.<br>Process variable input exceeds the limits for the linearizer selected. | • Check input source for possible broken sensor<br>• Check input connections<br>• Check input link position<br>• Check input configuration in **Set Up Input Page** |
| F-rSPt | Remote set point input is above or below fault detection level.<br>Remote set point input exceeds the limits for the linearizer selected. | |
| F-PFb | Position feedback input is above or below fault detection level. | |



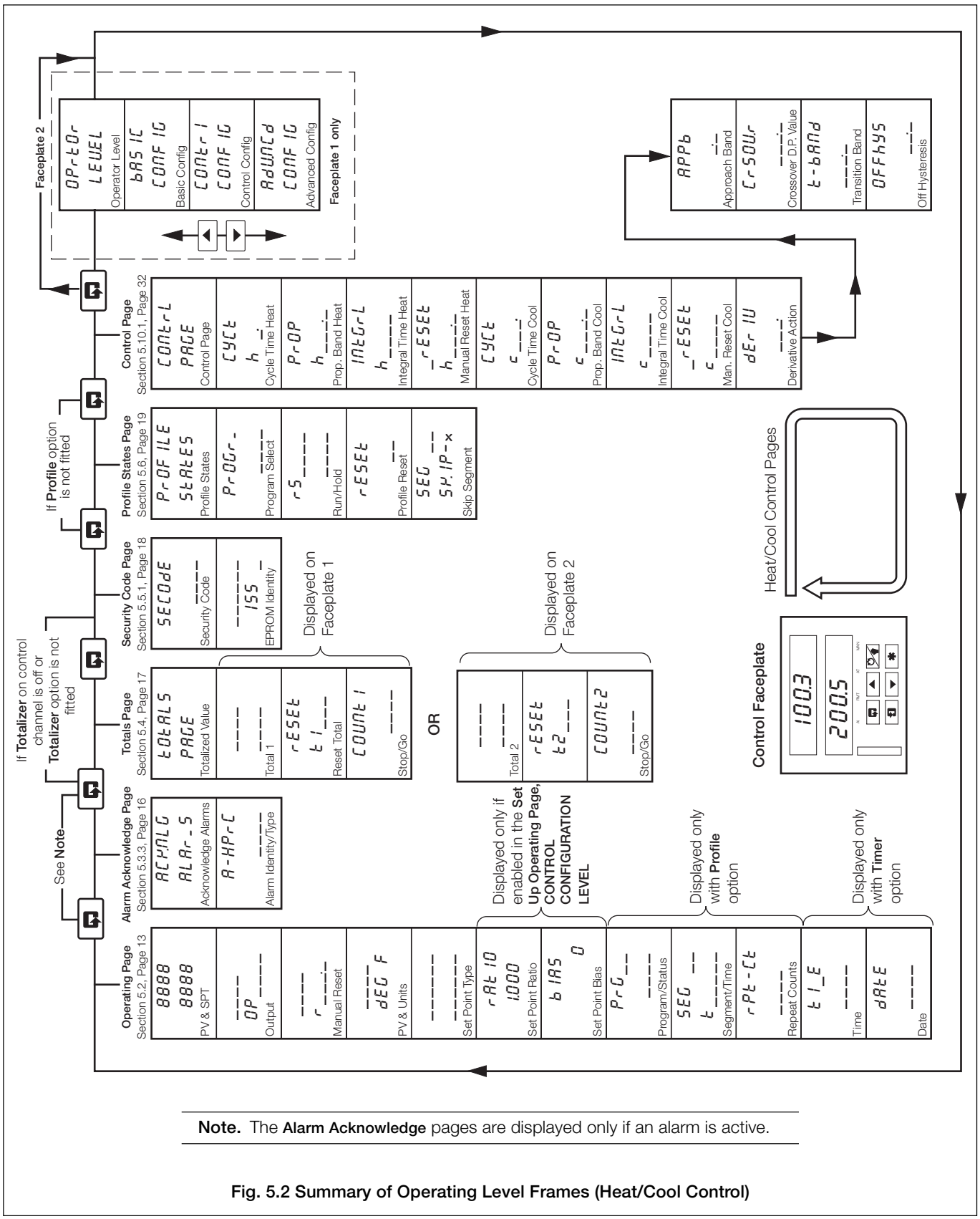

**Note.** Error messages are cleared automatically when the fault condition no longer exists.

**Fig. 4.2 Input Error Messages Displayed in the Operating Page**




**Note.** The **Alarm Acknowledge** pages are displayed only if an alarm is active.

**Fig. 5.1 Summary of Operating Level Frames (Standard Control)**




**Note.** The **Alarm Acknowledge** pages are displayed only if an alarm is active.

**Fig. 5.2 Summary of Operating Level Frames (Heat/Cool Control)**

## 5.1 Operating Page Introduction

### 5.1.1 Set Point Tracking

With set point tracking enabled (**Set Points Page, CONTROL CONFIGURATION LEVEL**) the local set point value tracks the process variable when the controller is in Manual control mode. In this mode of operation the set point limits do not apply. If the set point value is outside its limits when Automatic control mode is selected, the local set point remains outside its limits and can only be adjusted in one direction, towards its limits. Once inside the limits they apply as normal.

With remote set point tracking enabled, the local set point tracks the remote set point value when in the remote set point mode. In this mode of operation the local set point limits do not apply. If the set point value is outside its limits when the local set point value is selected, the local set point remains outside its limits and can only be adjusted in one direction, towards its limits. Once inside the limits they apply as normal.

### 5.1.2 Auto/Manual Transfer

All auto-to-manual transfers are bumpless. If the local set point is used and set point tracking is enabled, all manual-to-auto transfers are bumpless, since the set point is always at the same value as the process variable. Without set point tracking enabled, the response following a manual-to-auto transfer depends on the control settings. With an integral action setting the output is ramped up or down to remove any process variable offset from the set point (providing the process variable is within the proportional band). If the integral action is off, the output may step to a new value when the controller is transferred back to automatic control mode.

With remote set point tracking enabled, the control set point switches automatically from remote to local when manual mode is selected.

### 5.1.3 Profile Control – Fig. 5.3

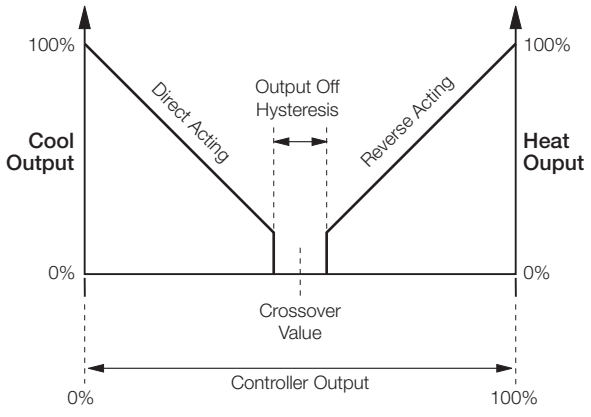



**Fig. 5.3 Overall Profile Example**

### 5.1.4 Cascade Control

The master in a cascade set-up is always channel 1 and the slave is always channel 2. If the slave is switched to manual control with cascade set point selected, the slave's set point reverts automatically to local set point.

Ratio and bias are applied to the master output value so that the slave's cascade set point value = Ratio x Master Output + Bias.

With **Output Tracking enabled** – if the slave is switched to manual mode or local set point, the master is switched automatically to manual. The manual output of the master tracks the local set point value of the slave. The value fed back to the master takes into account any ratio and bias settings.

With **Output Tracking disabled** – switching the slave to manual mode or local set point does not affect the operation of the master.

To return to full cascade control carry out the following procedure:

a) Switch the Slave controller into automatic control mode.

b) Switch the Slave Controller set point to 'Cascade'.

c) Switch the Master controller to automatic control mode (if currently in Manual)

### 5.1.5 Heat/Cool Control – Fig. 5.4

When in automatic control mode both the heat and cool outputs are turned off when in the Output Off Hysteresis Band. In manual control mode the Output Off Hysteresis Band has no effect. If the PID output is within the Off Hysteresis Band when the controller is returned to auto control mode, the Off Hysteresis Band has no effect until either the PID output goes outside the band or becomes equal to the Crossover Value.

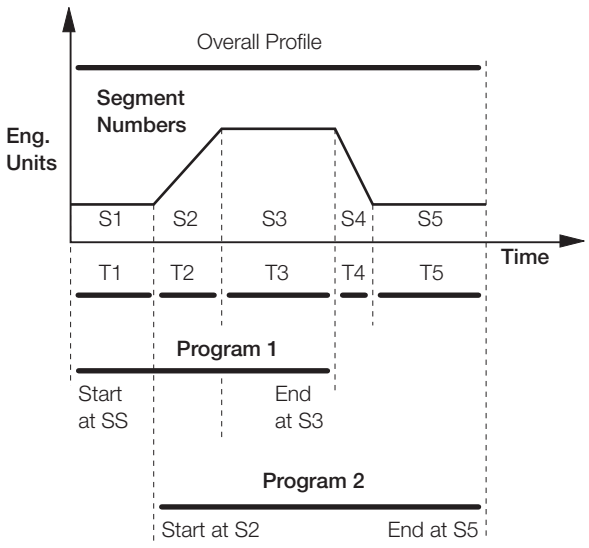
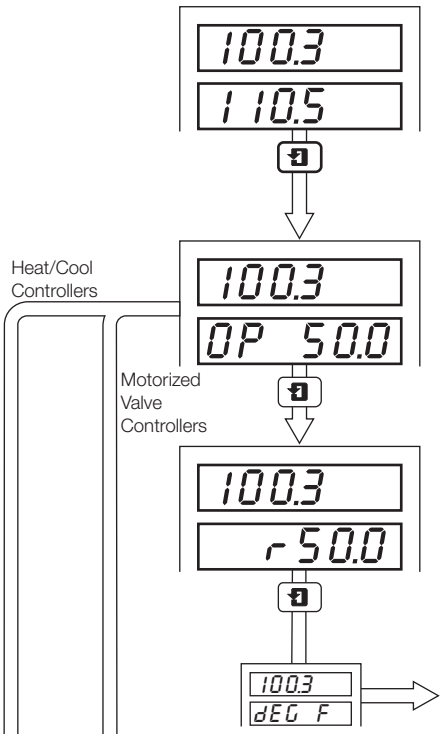



**Fig. 5.4 Heat/Cool Control – Principle of Operation**

## 5.2 Operating Page Displays




**Process Variable**

**Control Set Point**
The set point in use is displayed (Local, Remote, Dual or Cascade). If the Local or Dual set point is displayed it can be adjusted using the ▲ and ▼ keys, providing adjustment is enabled in the **Set Up Operating Page**, **CONTROL CONFIGURATION LEVEL** – refer to the **Programming Guide**.

**Process Variable**

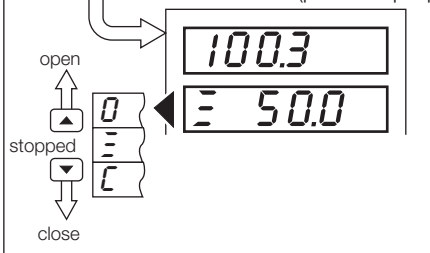
**Control Output Value (%)**
To adjust the output value manually: select Manual control mode using the ⚙ key ('MAN' LED is illuminated) and then use the ▲ and ▼ keys to set the required value (between 0 and 100%).

**Process Variable**

**Manual Reset**
Use the ▲ and ▼ keys to set a value which eliminates any offset from the set point (between 0 and 100%). Manual reset only appears if enabled in the **Set Up Operating Page, CONTROL CONFIGURATION LEVEL** and the **Integral Action Time** in the **OPERATOR LEVEL** is 'OFF'.

Continued on next page.

**Motorized Valve** (position-proportioning and boundless)

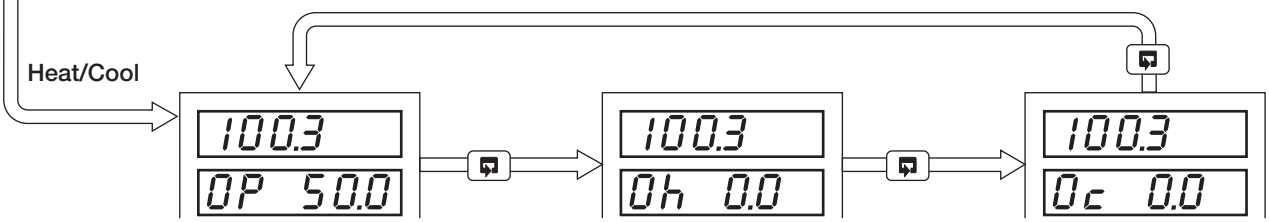



**Process Variable**

**Valve Status and Valve Position (%)**

| | | |
|---|---|---|
| = | – | valve stopped |
| 0 | – | valve opening |
| C | – | valve closing |

The valve position is displayed as a percentage of its full travel position (not displayed on boundless controllers). To adjust the valve position manually: select Manual control mode using the ⚙ key ('MAN' LED is illuminated), then use the ▲ and ▼ keys to set the required valve position (▲ key opens the valve and ▼ key closes the valve). With neither key pressed the valve is stopped.

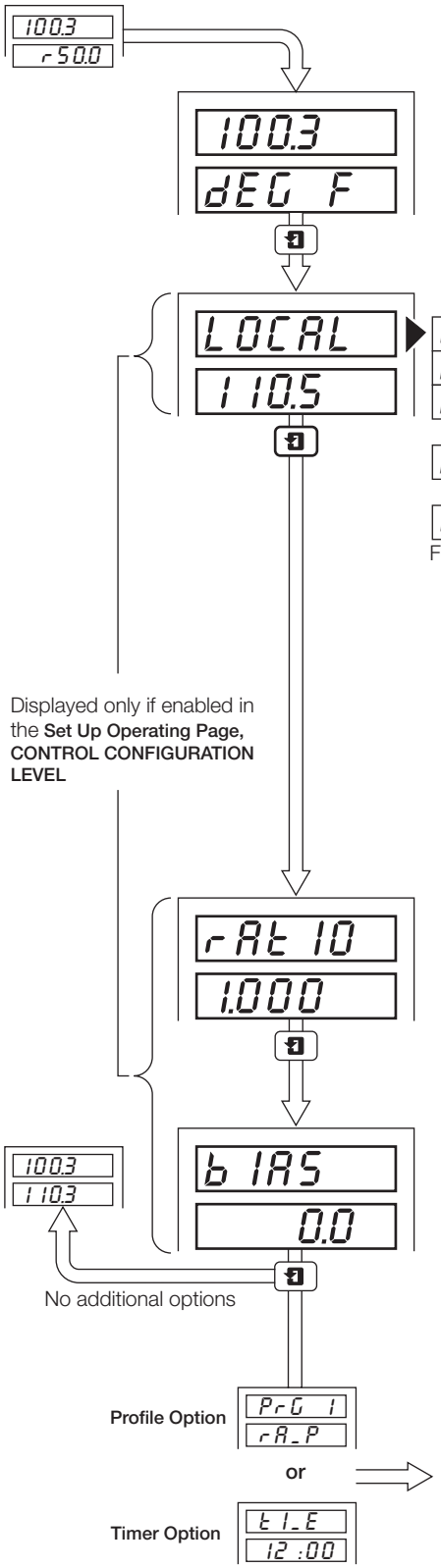



**PID Output (%)**
To adjust the output value manually: select Manual control mode using the ⚙ key ('MAN' LED is illuminated), then use the ▲ and ▼ keys to set the value required (between 0 and 100%).

**Heat Output (%)**
This frame is not displayed if the PID output is below the **Crossover Value**. The output can be adjusted using the ▲ and ▼ keys when in the Manual control mode.

**Cool Output (%)**
This frame is not displayed if the PID output is above the **Crossover Value**. The output can be adjusted using the ▲ and ▼ keys when in the Manual control mode.

## …5.2 Operating Page Displays




**Process Variable**

**Temperature Units**
The units are set in the **BASIC CONFIGURATION LEVEL.** Display is blank if '*NONE*' is selected.

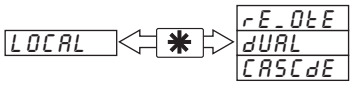
**Set Point Type Selection**
The **Balance** displays show the difference between the **Local** and **Second** set point values (remote, dual or cascade) when switching from local to second set point, i.e.

Balance = Second set point – Local set point.

If the difference is too great, press the ⏎ key to return to the **Control Set Point** frame and adjust the Local set point to obtain an acceptable difference.

If remote set point tracking is enabled (**Set Points Page, CONTROL CONFIGURATION LEVEL**), the local set point tracks the remote set point when the remote set point is selected.

The ✱ key (if programmed in the **ADVANCED CONFIGURATION LEVEL**) can also be used for **Local**/**Second** set point selection, but transfer takes place without display of the Balance value , i.e.




**Remote (or Cascade) Set Point Ratio**
The remote (or cascade) set point input (in engineering units) is multiplied by the ratio to obtain the control set point value, i.e.

Remote (or cascade) Set Point Value = Input x Ratio + Bias

Use the ▲ and ▼ keys to set the ratio required, between 0.010 and 9.999 in 0.001 increments

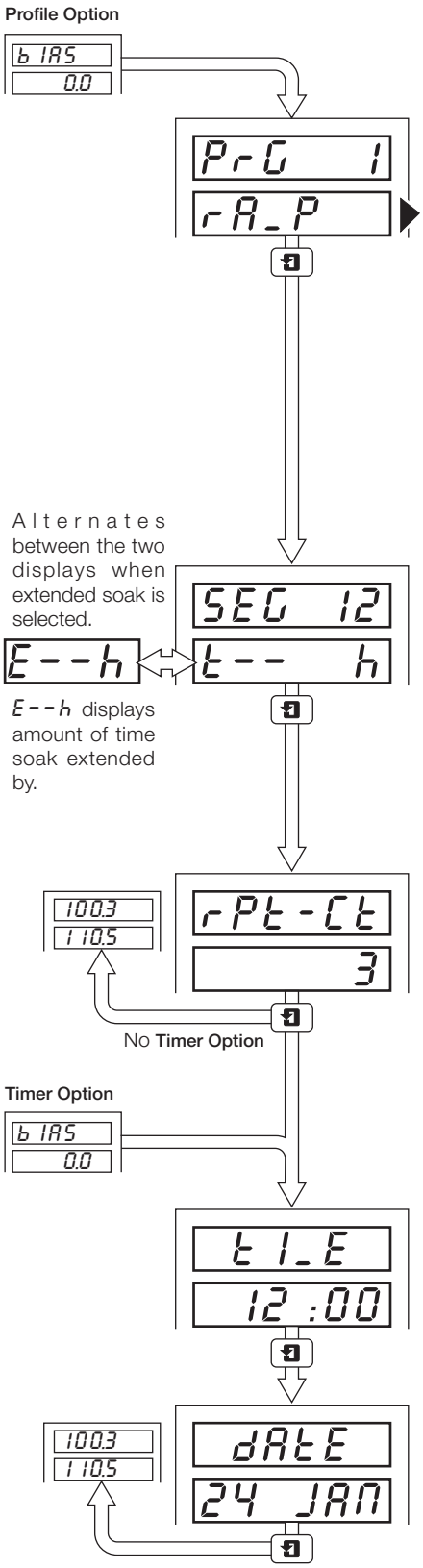
**Remote (or Cascade) Set Point Bias**
The bias value is added to the remote (cascade) set point value (see previous frame)

Use the ▲ and ▼ keys to set the bias required.

The bias can be set to either a positive or negative value (in engineering units).

Continued on next page.

## ...5.2 Operating Page Displays




**Profile Program Selected**

**Profile Status:**

- StOP – waiting for run command, profile is inactive
- rA_P – program is running and ramping
- SOAK. – program is running and soaking
- HOLd – operator hold or controller is in manual
- H-HOLd – holdback hold in hold, due to guaranteed ramp/soak hysteresis values being exceeded
- r-HOLd – retort function has placed controller in hold
- r-rA_P – retort function is ramping set point back to soak value
- End. – current program is completed but digital input signal is in 'Run' state.

**Current Profile Segment**

**Time Remaining**
Time remaining until the end of the current segment (in minutes or hours), depending on the **Ramp/Soak Time Units** set in the **Profile Control Page**, **Advanced Software Options Manual**. 'h' is displayed if hours are selected.

Use the ▲ or ▼ keys to add or subtract the extended time from the soak time. Refer to the **Profile Control Page**. If the extended soak value is set to '0' the **Time Remaining** feature is disabled.

**Repeat Count**
Remaining number of times the current profile is to be repeated.

**Current Time**

**Time** (displayed using 24hr clock)

Current Date

**Day and Month**

## 5.3 Alarm Acknowledge Page

### 5.3.1 Alarm Indications – Fig. 5.5

The definitions for alarm states (on, off or flashing) are detailed in Fig. 5.5.

### 5.3.2 Acknowledging Alarms

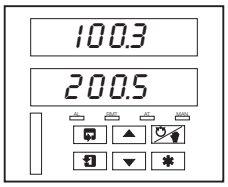
Unacknowledged alarms can be acknowledged from the faceplates on the front of the instrument in two ways:

In the **Operating Level** – by pressing the ✱ key at any frame (providing the key is programmed for this function – see Section 5.1 in the **Programming Manual**). The ✱ key acknowledges all alarms from either faceplate.

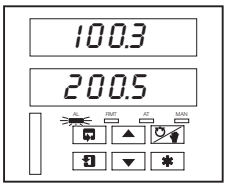
In the **Alarm Acknowledge Page** – by pressing the ▲ key – see Section 5.3.3 following.

**Note.** In the **Alarm Acknowledge Page** Channel 1 alarms can be acknowledged only from faceplate 1. Channel 2 alarms (if applicable) can be acknowledged only from faceplate 2.

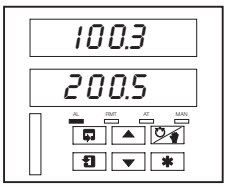
Control Faceplate




No LED illuminated indicates no alarms activer and the **Alarm Acknowledge Page** is not displayed in the **Operator Level**.



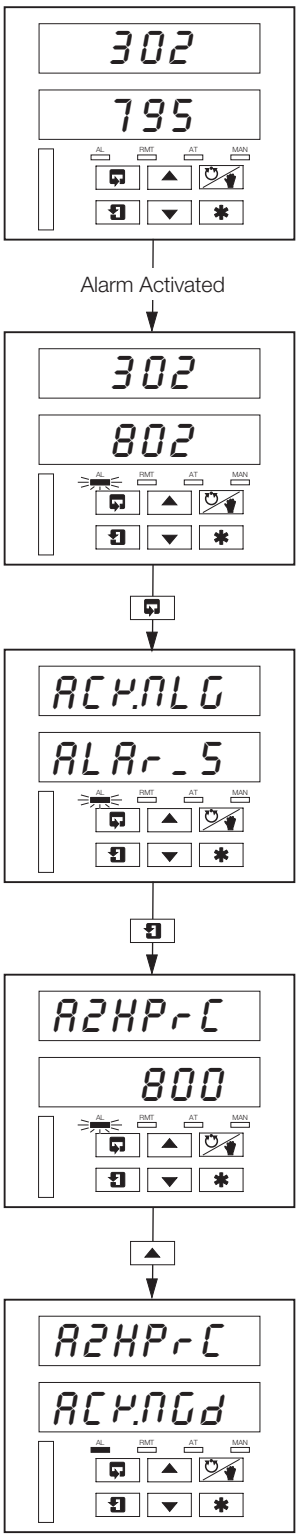

A flashing LED indicates that an unacknowledged alarm is active.




A constant LED indicates that all active alarms have been acknowledged.

**Fig. 5.5 Alarm LED Indications**

### 5.3.3 Using the Alarm Acknowledge Page




**No Alarm Active**
No LED indicators illuminated.

**Alarm Active**
**AL** LED indicator flashing, indicating an active alarm on this channel.

Use the ⏎ key to return to top of **Alarm Acknowledge Page**.

**Alarm Acknowledge Page**
Use the ⏎ key to advance to next frame.

**Alarm Identity**
**Upper display:** shows the alarm identity and type.

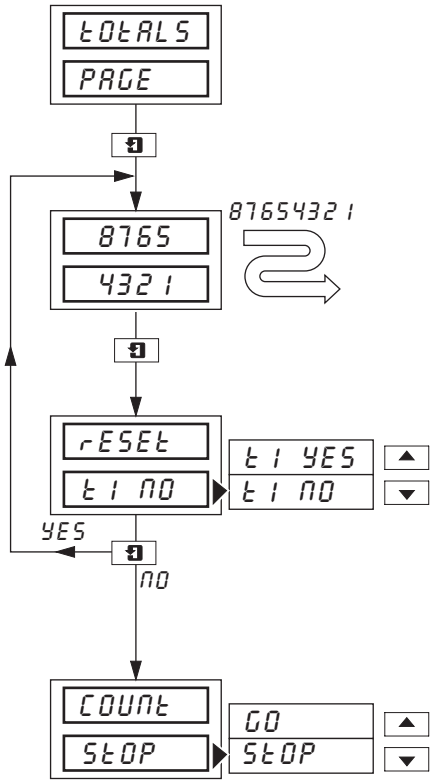
**Lower Display:** shows the trip level of the alarm identified in the upper display.

**Acknowledge Alarm**
Use the ▲ key to acknowledge the alarm. When the alarm is acknowledged, '*ACK.NGd*' is displayed and a constant LED indicates the acknowledged alarm.

If there are more active alarms on the selected channel the LED continues to flash until all alarms for this channel have been acknowledged.

## 5.4 Totals Page Displays

This page is omitted from both faceplates if the **Totalizer Option** is not fitted. The page is also omitted from faceplate 1 if **Total 1** is set to *OFF* and from faceplate 2 if **Total 2** is set to *OFF* – refer to the **Set Up Totals Page** in the **Advanced Software Options Manual**.




Page Header –**Totals Page**.

**Front Panel (Batch) Flow Total 1 (2)**
The batch flow total is calculated from process variable 1 (2).

The flow total can be reset in the next frame if **Reset Enable** in **Set Up Totals Page** is set to '*EnbL-Y*'.

**Counter Reset**
The Front (Batch) Flow Total can be reset to the **Preset Value** in **Set Up Totals Page** if required.

Select '*t1 YES*' to reset the counter ('*t1*' indicates **Flow Total 1**).

**Note.** If the Counter Reset is disabled in **Set Up Totals Page**, the counter reset frame is omitted.

**Counter Stop/Go**

Select '*GO*' to start the counter or '*StOP*' to stop it.

**Note.** If the Counter Stop/Go is disabled in **Set Up Totals Page**, the frame can be viewed but not altered. If a digital signal is assigned to **Totalizer Stop/Go**, an active digital signal sets the counter to *GO* and the Counter cannot be stopped from the front panel.

## 5.5 Access to Configuration Levels

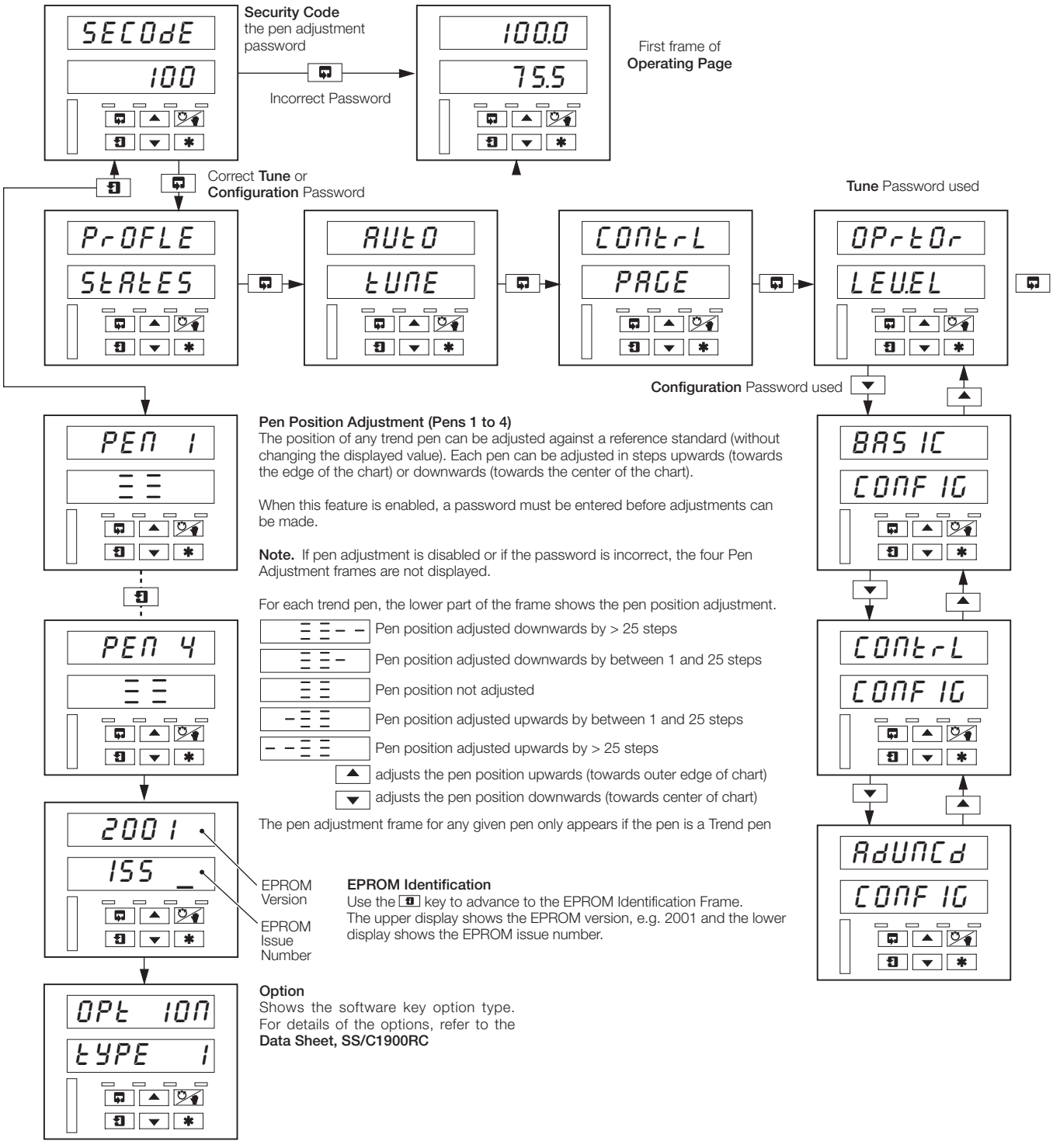
A security system is used to prevent tampering with the program parameters by utilizing a Tune password and a configuration password. A Tune password can be assigned to controller faceplates giving access to that faceplates controller settings.

A Configuration password gives access to all controller settings and programming pages – refer to the **Programming Manual**.

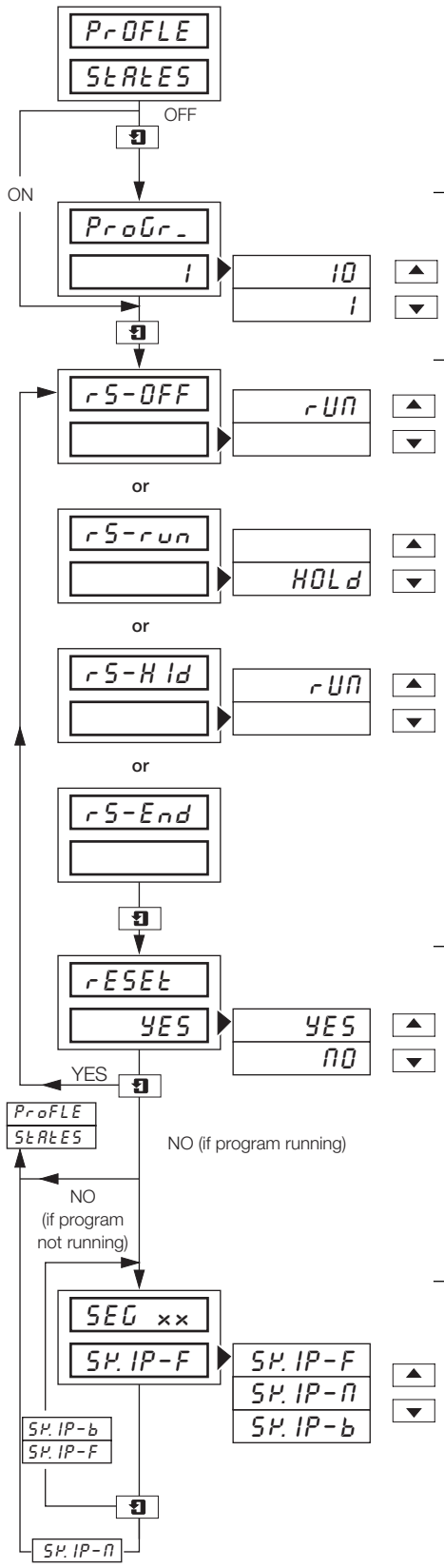
### 5.5.1 Security Code Page

Set the security code to the correct Tune or Configuration password using the ▲ and ▼ keys and use the ↵ key to advance to the controller settings or other programming levels (**OPERATOR**, **BASIC CONFIGURATION**, **CONTROL CONFIGURATION** and **ADVANCED CONFIGURATION**).

The passwords are programmed in the **Access Page** in the **BASIC CONFIGURATION LEVEL**.



## 5.6 Profile States Page




Page Header – **Profile States**

The ✱ key can be programmed to jump to this frame (**Set Up Function Keys Page**, **ADVANCED CONFIGURATION LEVEL**). If the key is used, the display reverts automatically to the first frame of the **Operating Page** when leaving this page.

**Program Select**
Select the program to be run (1 to 10).

**Profile Status (Ramp Soak)**

`rS-OFF/On` – (Ramp Soak Run/Off) select `rUN` to start selected program. Press the ⏎ key to activate.

`rS-rUN/HOLd` – (Ramp Soak Run/Hold) select `HOLd` to stop selected program at current level. Press the ⏎ key to activate.

`rS-Hld` – (Ramp Soak Hold) program is in the hold state, either as a result of an operator hold, the controller is in manual or the holdback facility (guaranteed ramp/soak). Select run to continue running the profile if operator has stopped program. Press the ⏎ key to activate.

`rS-HLd/End` – (Run/Hold End) the profile is completed, and the digital input assigned to the profile function is still in the 'Run' state. This frame is only displayed if a digital input is used to run and hold the profile.

**Note.** If a digital input is assigned to the run/hold function, the user is prevented from overriding the digital signal.

**Profile Reset**
If the profile is running and `YES` is selected, the profile returns to the beginning of the program and continues to run.

**Note.** To end a program, select `HOLd` 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.

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

`SH.IP-F` (skip forward) – abandon current segment and start next segment.

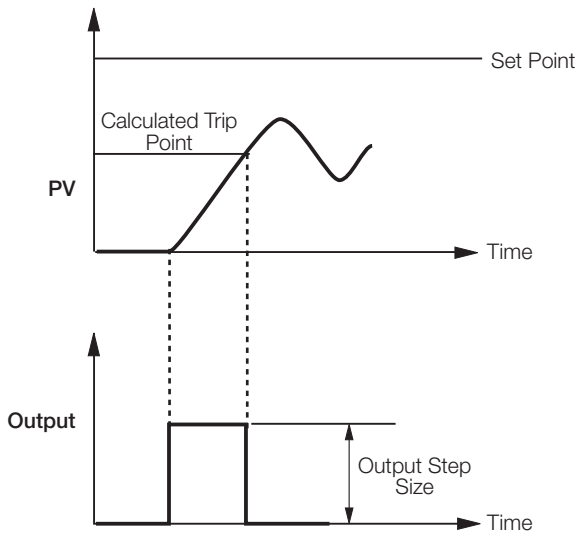
`SH.IP-n` (do not skip) – maintain control using current segment.

`SH.IP-b` (skip back) – return to beginning of current segment.

For multiple skip operations, the last selection (For b) is displayed for 3 seconds before reverting to `SH.IP-n`.

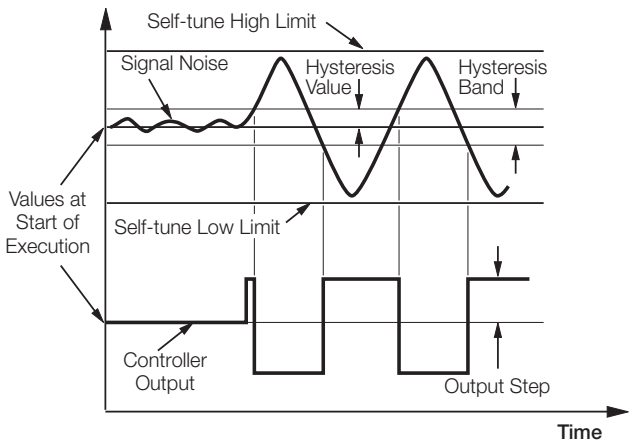
## 5.7 Auto-tuning Introduction

**Information.**
- **On demand user-activated tuning**.
- **Two types of auto-tuning** – initial **'Start-up'** and when close to **Set Point**.
- **Tuning for P, PI or PID control can be selected**.
- **Tuning for 1/4 wave damped or minimum overshoot can be selected.**
- **Automatic entry of calculated control terms** – unless an auto-tune error occurs.
- **Error and Caution messages** – indicate reason for tuning problems.




**Information.** The noise level of the process is monitored and then a step is applied to the control output value. The response of the process is recorded and these results are used to calculate the control terms.

**Fig. 5.6 'Start-up' Auto-tuning**



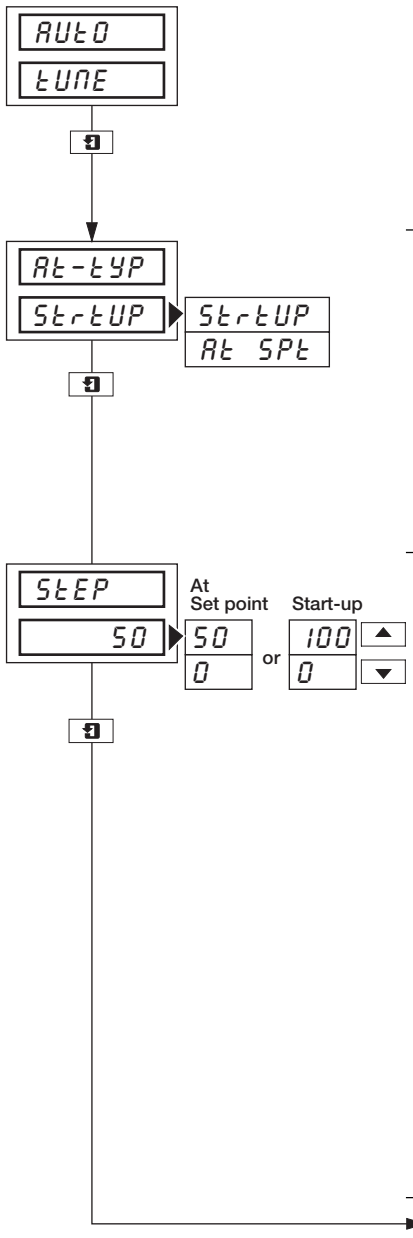

**Information.** 'At Set Point' auto-tuning automatically calculates the PID terms based on the process reaction during an auto-tuning cycle. The controller output is manipulated to give six process oscillations which are used to determine the tuning parameters.

**Fig. 5.7 'At Set Point' Auto-tuning**

### 5.7.1 Auto-tuning Page

**Information on Initial Conditions.**

- **'Start-up' Tuning** – the controller is placed in the Manual control mode with the control output value set to give a stable process variable at least 10% of the engineering range below the control set point.
- '**At Set Point**' **Tuning** – may be initialized in the automatic mode but the process variable must be close to the required set point and stable. The control output must also be stable. However, for best results the Manual control mode can be used to stabilize the output and the process value. The output must be adjusted slowly to allow process response to the change, to bring the process variable to the required control set point. The closer the process is to the set point, the more effective the auto-tuning cycle.




Page Header – **Auto-tune**.

The ✱ key can be programmed to jump to this frame (**Set Up Function Keys Page**, **ADVANCED CONFIGURATION LEVEL**). If the key is used, the display reverts to the first frame of the **Operating Page** on leaving this **Page**.

**Auto-tune Type**

The two tuning facilities (**'Start-up'** and **'At Set point'**) are used to calculate automatically the Proportional, Integral and Derivative terms required.

**'Start-up'** tuning is used from initial start-up or when there is a large change in set point value.

**'At Set point'** tuning is used when the process is close to the required set point.

Select the auto-tune type required.

**Output Step Size**

The output step size is a percentage of the control output.

**'Start-up' Tuning** – the larger the step size used the quicker the auto-tuning process is performed, but the greater the overshoot (above the calculated trip point). If too small a step size is used the response may be too slow for the auto-tuning to operate correctly. In practice, use as large a step size as can be tolerated.

**'At Set Point' Tuning** – the controller output changes by plus and minus the output step size from its initial starting value when auto-tuning is executed. If the output step size is too large to allow this its value is reduced,

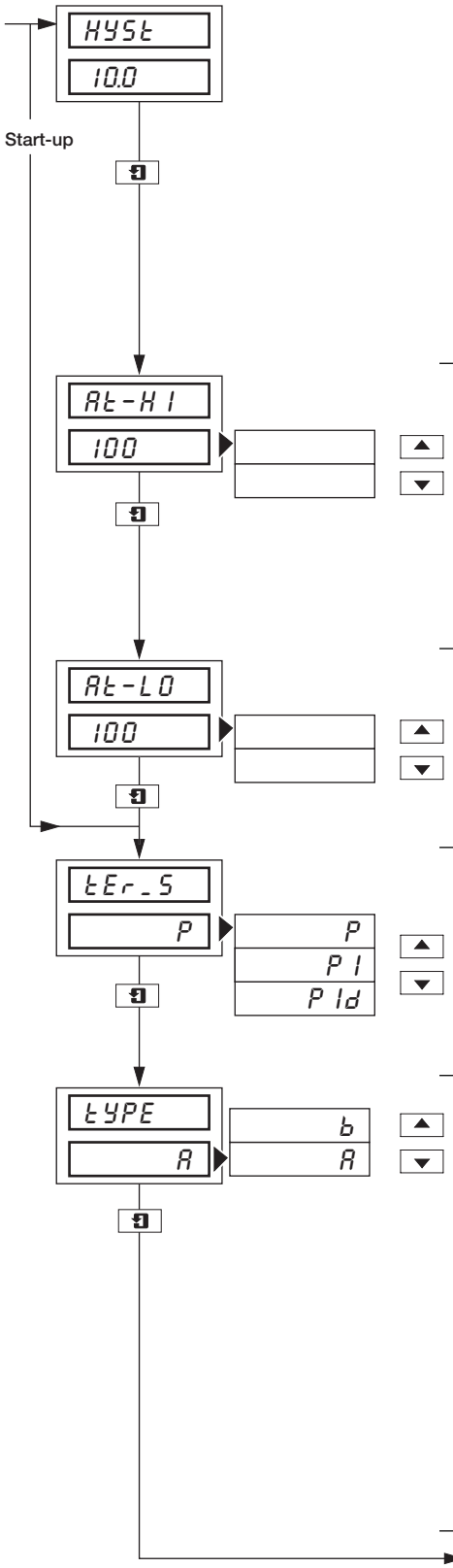
**Example** – If the controller output value = 30% and the selected step size = 50%. The step size is reduced to 30%.

The Step size should be large enough so that the amplitude of the process variable excursions are at least four times larger than the hysteresis parameter to allow the best possible response data. The output step size must be small enough to avoid crossing either of the auto-tune limits (see following frames).

Set the step size required.

Continued on next page.

### …5.7.1 Auto-tuning Page




**Hysteresis Value**
The hysteresis value is entered in engineering units and is used to determine when to change the controller output value.

**'At Set Point' Tuning only** – when the process variable crosses the hysteresis band (plus and minus the hysteresis value), the controller output changes by plus and minus the *StEP* value from its initial starting value. The hysteresis value should be set as small as possible but larger than the noise in the process variable signal, to allow the best possible response data.

Set the hysteresis value required (in engineering units).

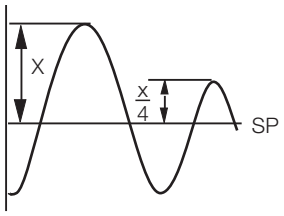
**Auto-tune High Limit**
The process variable must be between the high and low limits when auto-tuning is activated. If the process value exceeds one of these, the auto-tuning cycle is shut off automatically by reverting to the manual control mode and returning the controller output to the value set when the auto-tuning was activated. The high and low values are the limits for cancelling auto-tune execution.

Set the value required (in engineering units), the decimal point is set automatically.

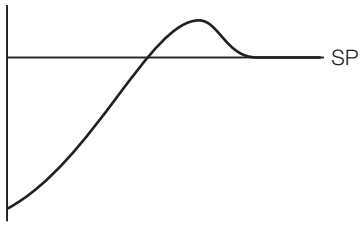
**Auto-tune Low Limit**
Set the value required.

**Three Term Control Parameters**
Select the Proportional, Integral and Derivative terms required.

**Control Type**
Select:
'*A*' for quickest response with ¼ wave damping.
or
'*B*' for quickest response with minimum overshoot.



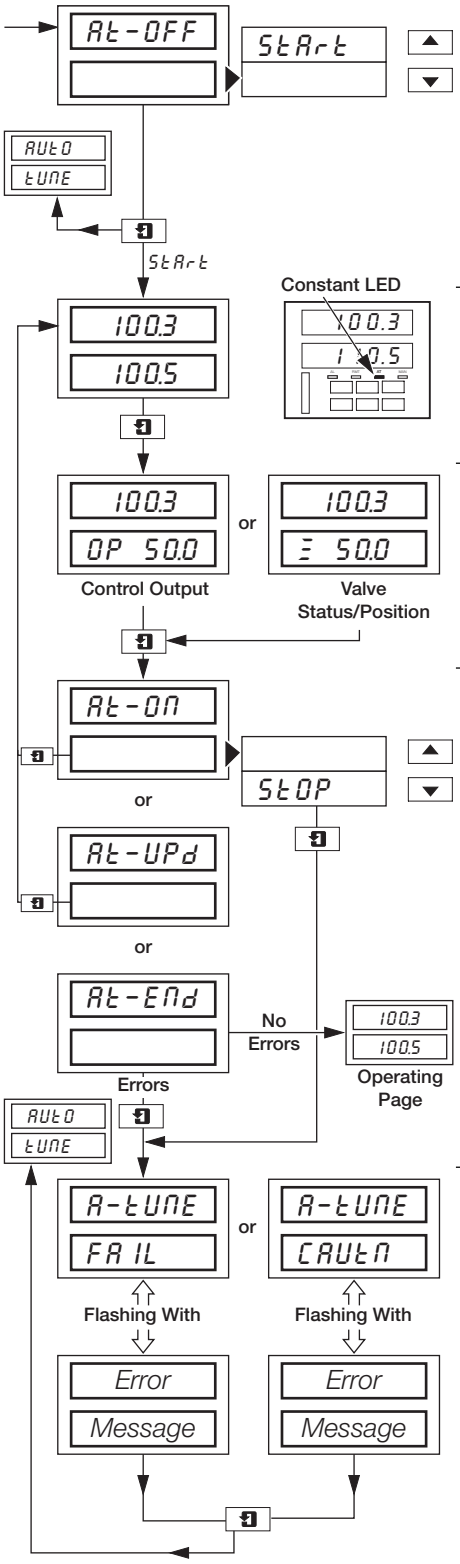

**Type A – ¼ Wave Damping**




**Type B – Minimum Overshoot**

Continued on next page.

## ...5.7.1 Auto-tuning Page




**Auto-tune Status/Enable**
Select StArt to enable auto-tune cycle. The 'AT' (auto-tune) LED is illuminated. The time taken for completion of auto-tuning is dependent on the speed of response of the controlled process.

**Note.** If **Auto-tune** is selected it is not possible to exit the **Auto-tuning Page** until the auto-tune cycle is complete or ended by the operator.

**Process Variable** (upper display)

**Control Set Point Value** (lower display)
The set point is displayed for monitoring only and cannot be changed at this frame.

**Process Variable** (upper display)

**Control Output** (lower display)
The output value is displayed for monitoring only and cannot be changed at this frame.

**Auto-tune Status and Enable/Disable**

AT-On – (Auto-tune On) auto-tuning can be switched off by pressing the ▼ key to select StOP and then pressing the ⏎ key.

AT-UPd – (Auto-tune Update) the auto-tune cycle is complete and the calculated terms are being written to memory.

AT-End – (Auto-tune End) the auto-tune cycle is complete. If no failures occur during the cycle, the calculated values are loaded into memory as new control terms and the instrument returns automatically to the **Operating Page**. If failures or cautions occur during auto-tuning, error messages are displayed in the next frame.

**Auto-tune Error Messages**
If a **Failure** occurs the controller reverts to the manual control mode, the old control terms are retained and the auto-tune LED flashes.

If a **Caution** occurs the calculated control terms are loaded into memory and control continues in the automatic mode. Any errors are acknowledged when exiting this frame and the auto-tune LED flashes.

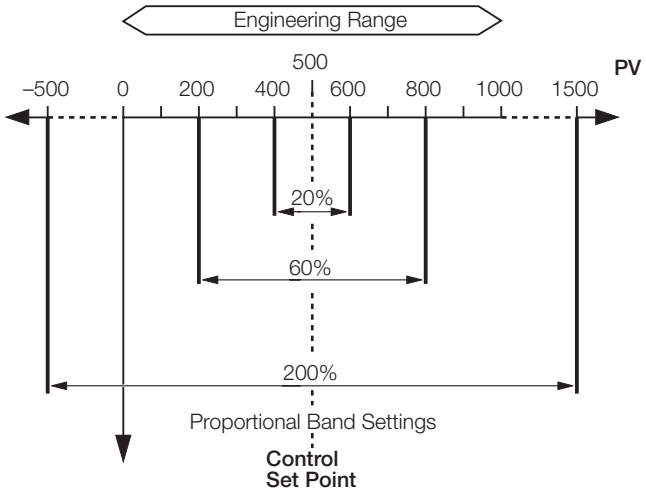
For an explanation of error messages – refer to Table 5.1 overleaf.

## 5.8 Auto-tune Diagnostic Messages

| Message | Explanation | Action |
|---|---|---|
| A-tUNE / CAUtN Flashing with Pb- INt / HI- L_t | The auto-tune process has selected a proportional band or integral action time above the high limits of these parameters so the high value has been used. | Because of the process characteristics, re-trying the auto-tuning process is unlikely to improve the calculated control parameters. |
| or SP tOO / CLOSE | With '**Start-up'** tuning, although the control set point was >10% of the display range above the process variable, it may still be too close to allow the auto-tune facility to determine the process characteristics accurately. | If desired, allow the process variable to move further below the control set point (by changing the control output in the manual control mode) before re-trying '**Start-up**' auto-tuning. Alternatively, use the '**At Set Point**' auto-tune facility. |
| or INCrSE / StEP | With '**At Set Point'** tuning, the ratio of process oscillation to hysteresis value is too small for best results. | Restart auto-tune with a larger output step size or a smaller hysteresis value. Hysteresis must be at least equal to and preferably greater than process noise. |
| A-tUNE / FAIL Flashing with SLO / PrCESS | The process is too slow for the auto tuning to work correctly. | If possible, use a larger output step value. |
| or NOISY / PrCESS | The process variable signal is excessively 'noisy'. | Check input wiring to try and find the source of the problem. If the process is changing rapidly then allow it to settle before re-trying the auto-tuning process. |
| or SP tOO / CLOSE | With '**Start-up'** tuning, the process variable is <10% of the display range, below the control set point. | Allow the process variable to move further below the control set point before re-trying '**Start-up**' auto-tuning. Alternatively, use the '**At Set Point**' auto-tune facility. |
| or INPUt / L I_ It5 | The input failure level has been exceeded, possibly due to a broken sensors or the process has exceeded one of the auto-tune limits. | Check input wiring to find the cause of the failure or restart auto-tuning with a smaller output step size. |
| or USEr / Abort | Operator has stopped auto-tune process. | None. |
| or UPdAtE / Error | Non-volatile memory failure while updating control parameters. | Re-try auto-tune, if error persists contact local Service Organization. |
| or t I_E / OUt | The auto-tune process is too slow. | If possible, use a larger output step value. Otherwise, for '**Start-up'** auto-tuning, move the process closer to the set point, or, for '**At Set Point**' auto-tuning, reduce the hysteresis value. |

**Table 5.1 Auto-tuning Error and Diagnostic Messages**

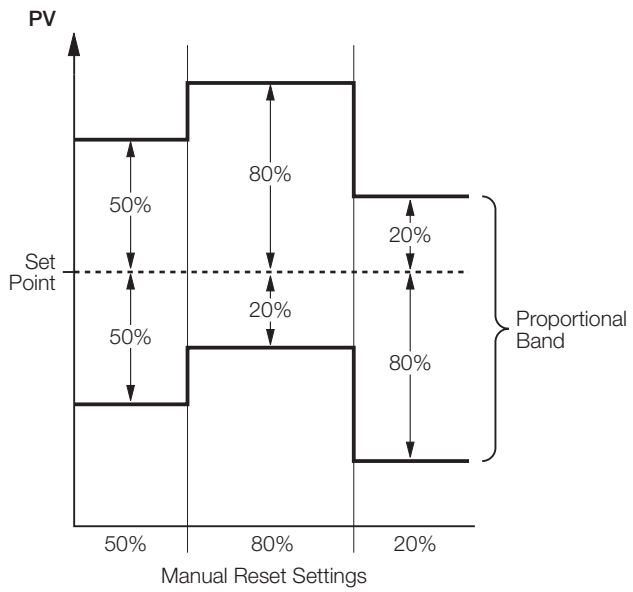
## 5.9 Introduction to Standard Control




Examples shown with a Proportional Band Offset of 50%

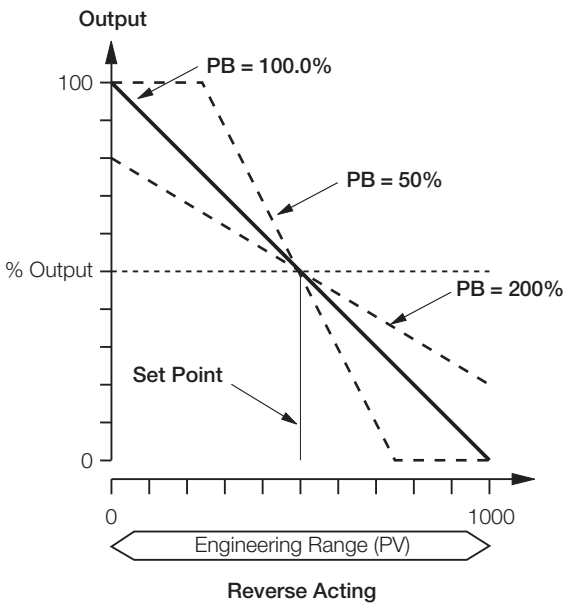
**Information.** Proportional control gives an output that is proportional to the deviation of the process variable from the set point. The range over which the output is adjusted from 0 to 100% is called the proportional band and this is expressed as a percentage of the engineering range span.

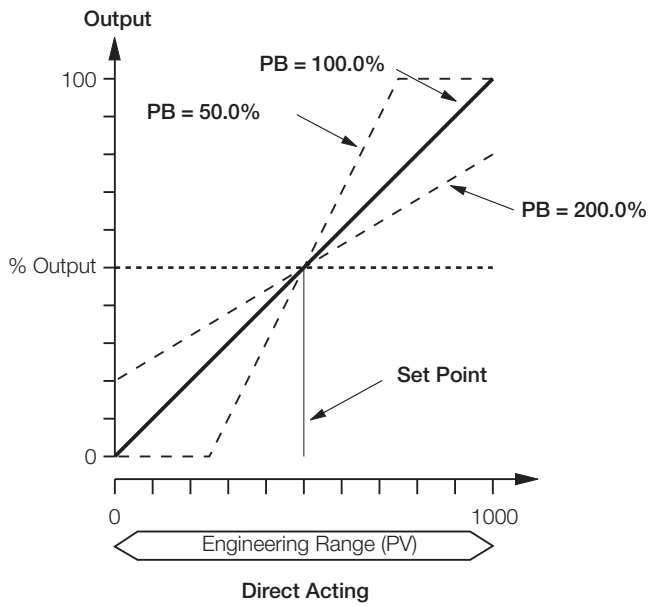
**Fig. 5.8 Proportional Control**




**Information.** With Proportional Control (P only or P and D) the controller may stabilize the process at a value which is offset from the set point. This offset can be removed using the manual reset adjustment which effectively shifts the Proportional Band.

**Fig. 5.9 Manual Reset**

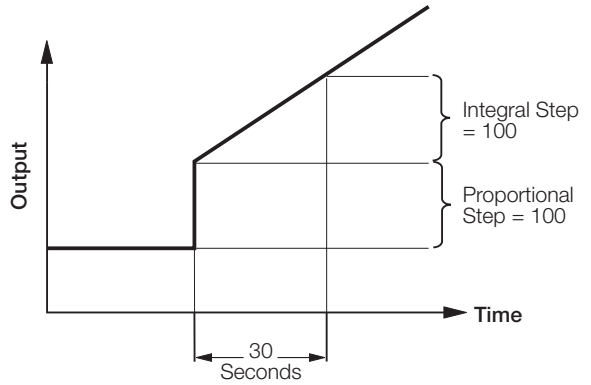



**Information.**
- **Reverse Acting** – the output decreases as the process variable increases.
- **Direct Acting** – the output increases as the process variable increases.

**Fig. 5.10 Control Action**

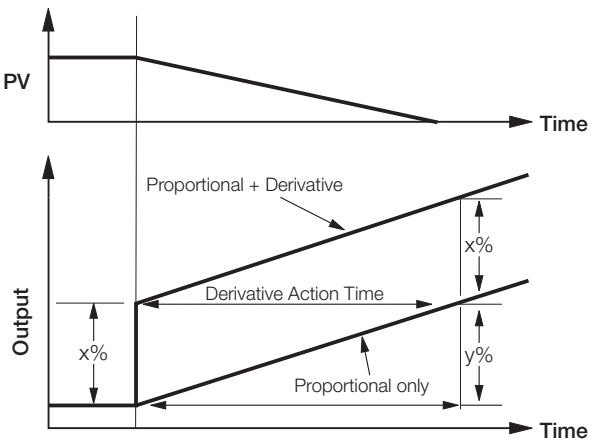
## …5.9 Introduction to Standard Control




Example shows an Integral Action Time of 30 seconds

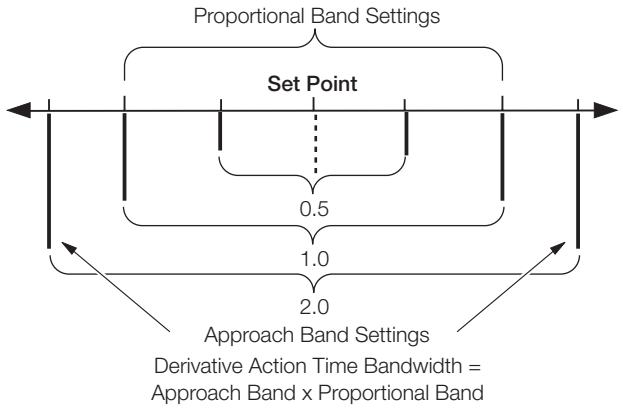
**Information.** The integral action time is the time in which the output signal due to the integral action increases by an amount equal to the part of the output signal due to the proportional action when a constant deviation is present.

**Fig. 5.11 Integral Action Time**



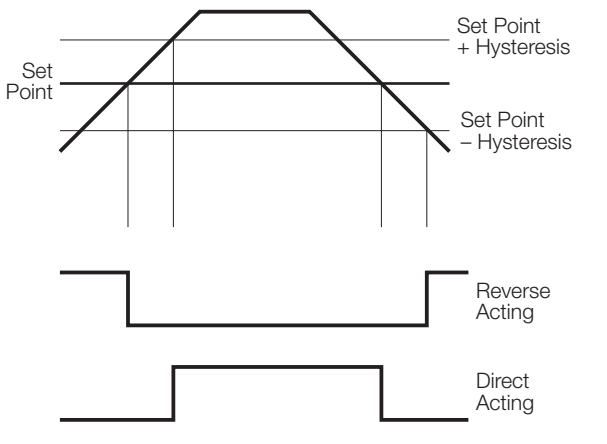

**Information.** With the process variable changing at a constant rate, the derivative action produces a change in output proportional to this rate of change. The derivative time constant, is the time interval in which the part of the output signal due to proportional action increases by an amount (y%) equal to the part of the output signal due to derivative action (x%). The derivative acting on the process variable instead of the deviation (process variable-set point) prevents unwanted derivative action when the set point is changed.

**Fig. 5.12 Derivative Action**




**Information.** The approach band can be used to introduce the derivative term before the proportional band is reached, i.e. using settings above 1.0. This has the effect of slowing down the rate of rise. However, if the rate of rise is very slow, the introduction of the derivative term can be delayed, i.e. using settings below 1.0.

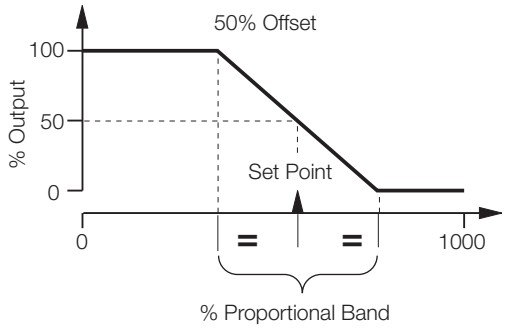
**Fig. 5.13 Approach Band**

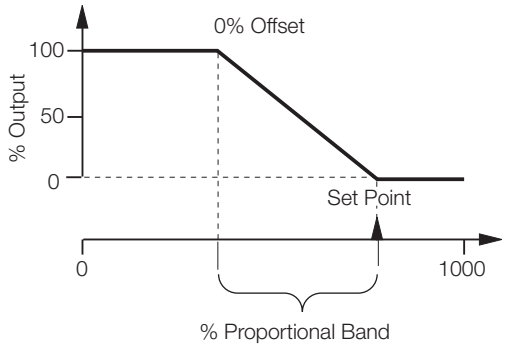



**Information.** Hysteresis is used with on/off control to give acceptable control without causing the output to switch too rapidly.

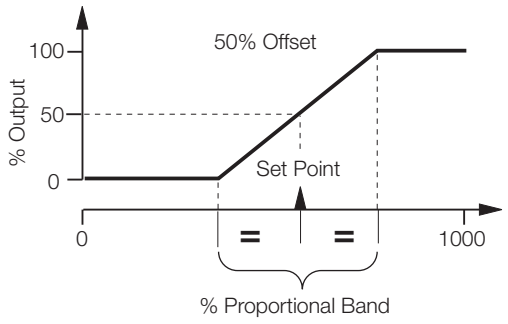
**Fig. 5.14 On/Off Hysteresis**

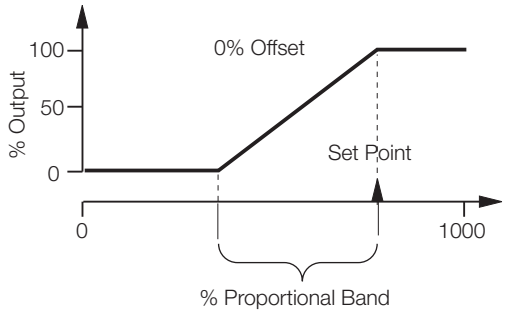
## ...5.9 Introduction to Standard Control




**Reverse Acting**



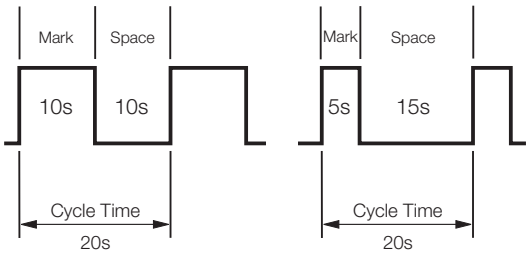




**Direct Acting**

**Information.** A control offset of 0% allows early control of the output and reduces the overshoot on initial start-up. Control offset is set in the **Control Page** in the **CONTROL CONFIGURATION LEVEL**, **Programming Guide**.

**Fig. 5.15 Offset**

Example shows a Cycle Time of 20 seconds




$$\% \text{ Output} = \frac{10}{20} \times 100$$

$$\% \text{ Output} = 50\%$$

$$\% \text{ Output} = \frac{5}{20} \times 100$$

$$\% \text{ Output} = 25\%$$

$$\textbf{\% Output} = \frac{\textbf{On Time}}{\textbf{Cycle Time}} \textbf{ x 100}$$

**Information.** The cycle time is the period of oscillation (in seconds) of the output for time proportioning mark/space ratio control. The optimum value is a function of the process characteristics.

**Fig. 5.16 Cycle Time**

**Information.**

- **On/Off Control** – use for applications where precise control is not required or where frequent switching of a contactor using time proportioning control causes premature wear.
- **Proportional Control** – use where:
  cycling action of on/off control is unacceptable
  load changes are small or infrequent
  offset can be tolerated or eliminated using manual reset.
- **Integral Action** – introduce to the control system:
  to eliminate offset automatically
  if set point or load changes frequently
- **Derivative Action** – introduce to the control system:
  to enable faster approach to the set point
  (by enabling use of a smaller proportional band) to minimize overshoot.

## …5.9 Introduction to Standard Control

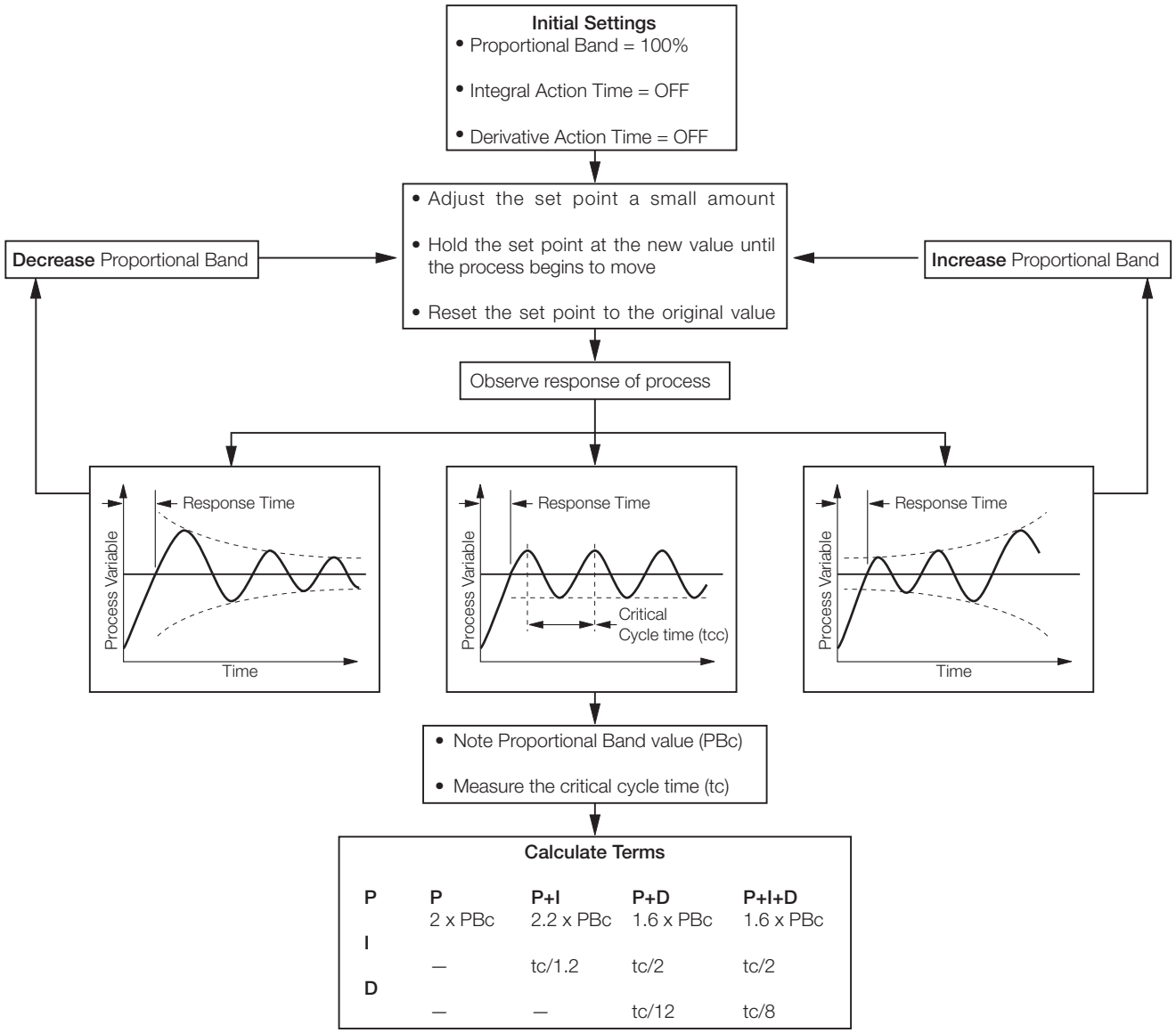



**Fig. 5.17 Manual Tuning**

## …5.9 Introduction to Standard Control

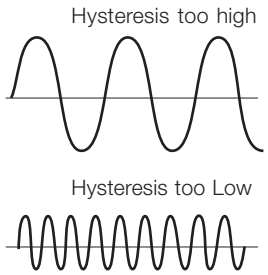
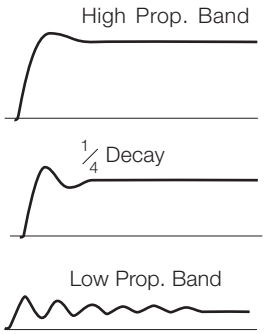
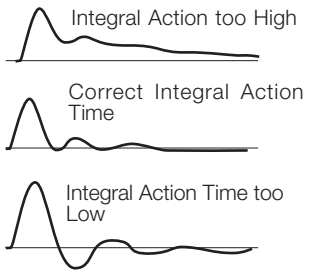
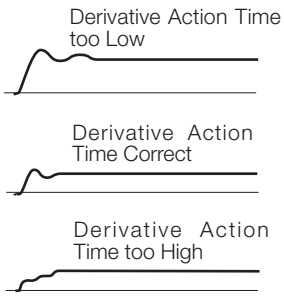
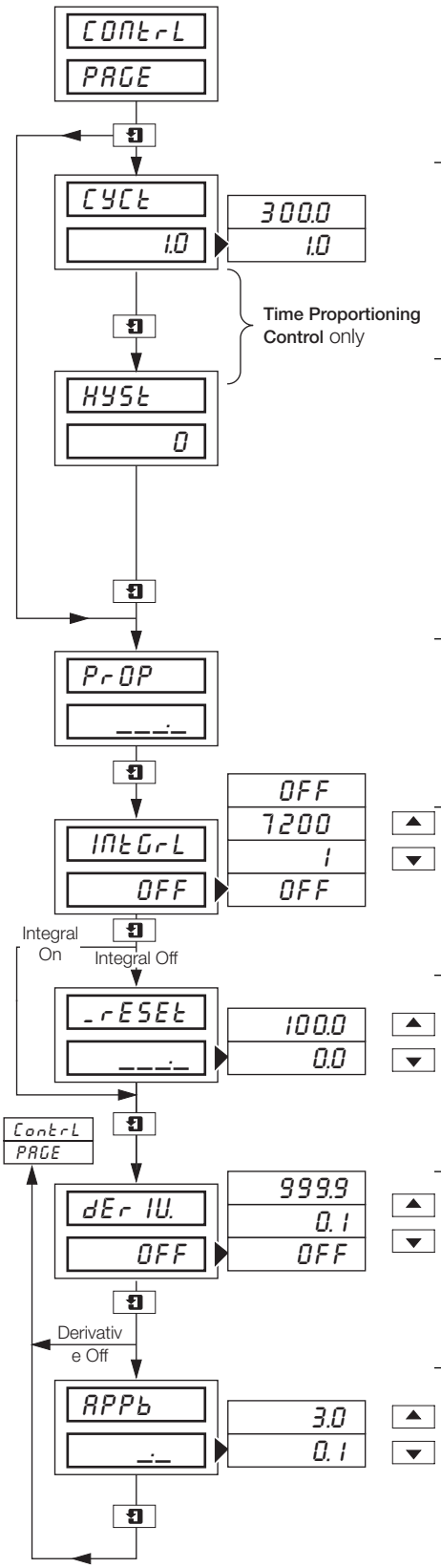
| Response | Contributions | Effect Of Response Settings | | |
|---|---|---|---|---|
| | | Too High | Too Low | |
| **On/Off Hysteresis** | Helps to prevent rapid switching of output | Process swings too far above and below set point | Output switches too rapidly |  |
| **Proportional Band** | Stable control with the minimum offset and minimum period of oscillation consistent with stability. | • More stable<br>• Longer period<br>• Larger offset | Stability decreases |  |
| **Integral** | Eliminates offset between Process and Set Point. | Time for variable to return to set point increases | • Stability decreases<br>• Period of oscillation increases |  |
| **Derivative** | Increases stability, permitting smaller proportional band and larger integral action times to be used.<br>Reduces height of first peak.<br>Reduces period of oscillation. | • Stability decreases<br>• Process noise is amplified | Maximum contribution not realized |  |

**Table 5.2 Effect of Control Responses on Processes**

### 5.9.1 Control Page (Standard Control)




Page Header – **Control Page**

**Cycle Time** (applicable only for control using relay output)
This setting can be ignored for analog control outputs.

Set the required cycle time for time proportioning control, from 1.0 to 300.0 in 0.1 second increments (300 seconds = 5 minutes) – see Fig. 5.16 on page 27.

**Hysteresis** (applicable only for control using relay output)
This setting can be ignored for analogue control outputs.

The hysteresis is operational above or below (depending on the control action, direct or reverse) the set point and is only applicable for ON/OFF control – see Fig. 5.14 on page 26.

Set the hysteresis value required for on/off control in engineering units (between 0 and 10% of engineering range span).

**Proportional Band**

Set the proportional band value required, between 0.1 and 999.9% in 0.1% increments.

**Integral Action Time**

Set the required time between 1 and 7200 in 1 second increments (7200 seconds = 120 minutes). '*OFF*' is selected above 7200 or below 1.

**Manual Reset**

Set the required proportional band offset on the lower display, between 0.0 and 100.0% of the engineering range span in 0.1% increments.

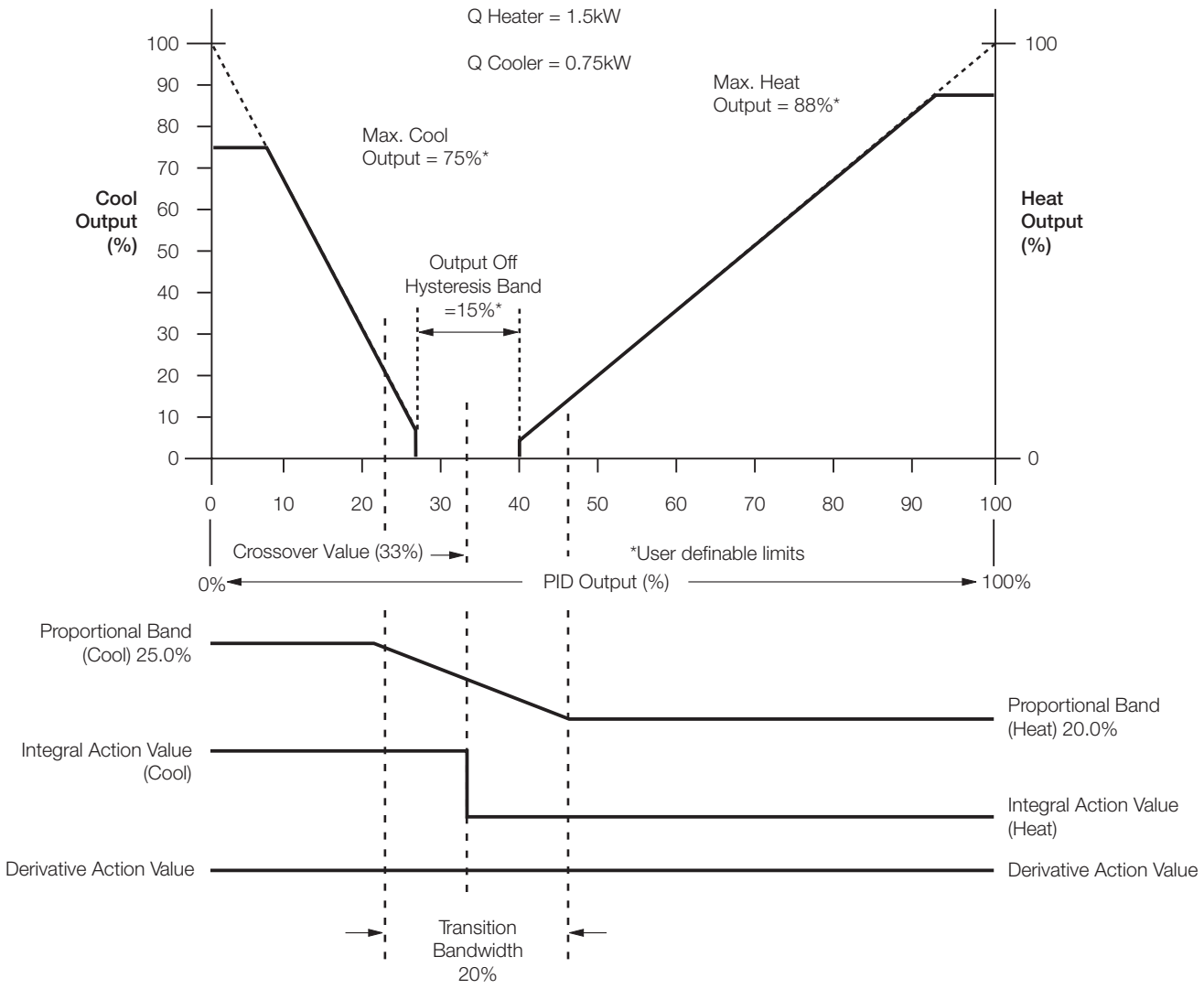
**Derivative Action Time**

Set the required time between 0.1 and 999.9 in 0.1 second increments (999.9 seconds = 16.67 minutes). '*OFF*' is selected below 0.1.

**Approach Band**

Set the required value between 0.1 and 3.0 in 0.1 increments. (Set 1.0 initially).

## 5.10 Introduction to Heat/Cool Control



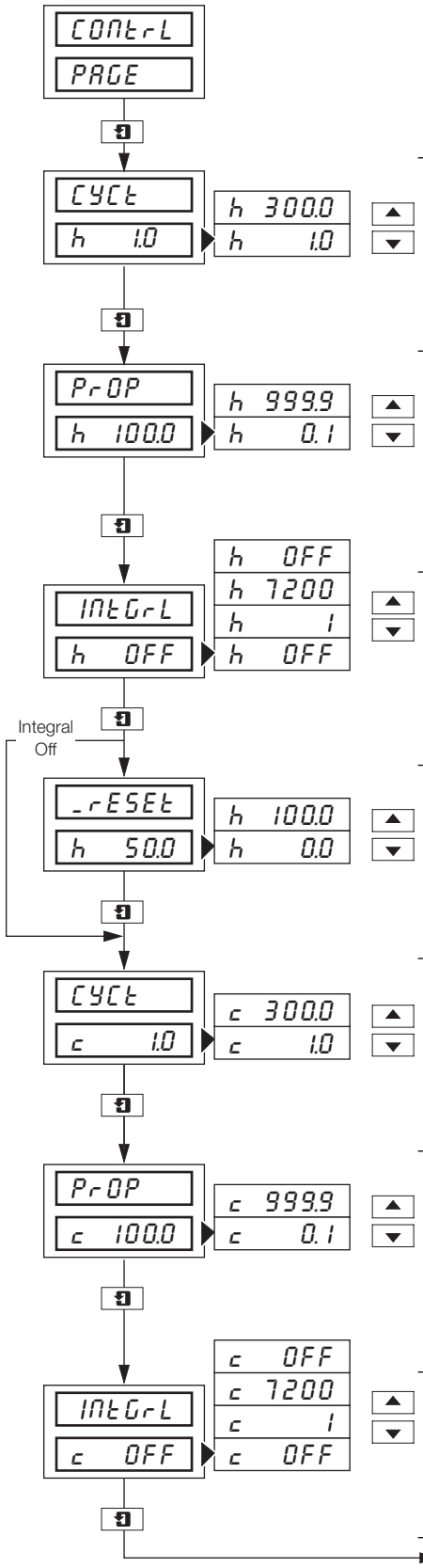

**Note.** Refer to Sections 5.10.2 and 5.10.3 for Crossover Value and Transition Bandwidth Value examples.

**Information.**

- **PID Output** – is the output value calculated by the controller. The output is divided into two different control elements one for raising the product temperature (heat output) and one for lowering the product temperature (cool output).
- **Transition Bandwidth** – used to transfer smoothly from one set of control terms to the other.
- **Crossover Value** – defines the changeover point between heat output active and cool output active. The crossover value is also the centre of the transition and off hysteresis bands.
- **Output Off Hysteresis Band** – for the majority of applications Outputs 1 and 2 have opposing control actions i.e. one is direct acting and the other is reverse. In this configuration both outputs are at 0% within the off hysteresis band. The band setting is used to prevent oscillation of control changes.
- **Heat/Cool Outputs** – refer to **PID Output**, above.

**Fig. 5.18 Heat/Cool Control – Principle of Operation**

### 5.10.1 Control Page (Heat/Cool Control)




Page Header – **Control Page**

**Cycle Time (heat output)**
This setting can be ignored for analog control outputs.

Set the required cycle time for time proportioning control, from 1.0 to 300.0 in 0.1 second increments (300 seconds = 5 minutes).

**Proportional Band (heat output)**

Set the proportional band value required, between 0.1 and 999.9% in 0.1% increments.

**Integral Action Time (heat output)**

Set the required time between 1 and 7200 in 1 second increments (7200 seconds = 120 minutes). '*OFF*' is selected below 1 and above 7200.

**Manual Reset (heat output)**

Set the required proportional band offset on the lower display, between 0.0 and 100.0% of the engineering range span in 0.1% increments.

**Cycle Time (cool output)**
This setting can be ignored for analog control outputs.

Set the required cycle time for time proportioning control, from 1.0 to 300.0 in 0.1 second increments (300 seconds = 5 minutes).

**Proportional Band (cool output)**

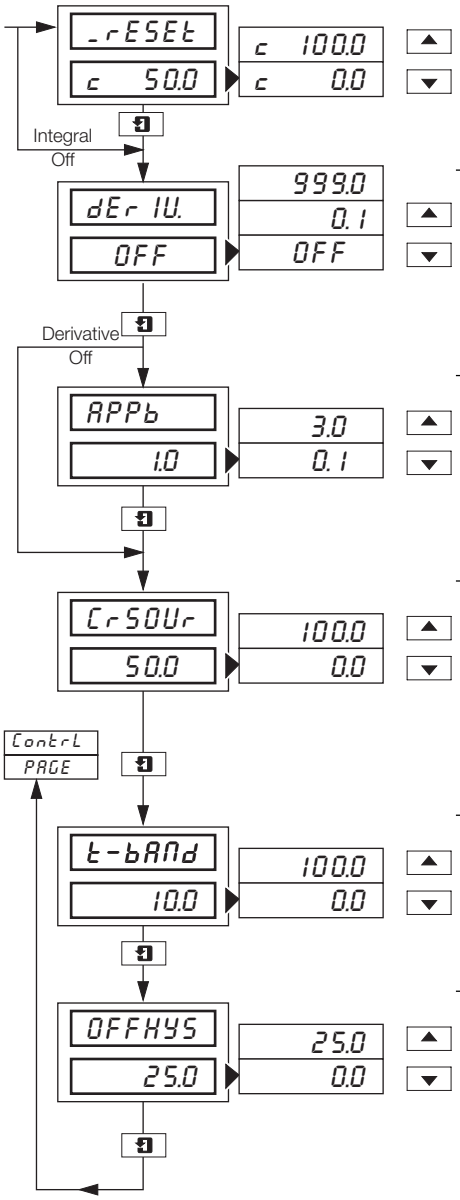
Set the proportional band value required, between 0.1 and 999.9% in 0.1% increments.

**Integral Action Time (cool output)**

Set the required time between 1 and 7200 in 1 second increments (7200 seconds = 120 minutes). '*OFF*' is selected below 1 and above 7200.

Continued on next page.

## ...5.10.1 Control Page (Heat/Cool Control)




**Manual Reset (cool output)**

Set the required proportional band offset, between 0.0 and 100.0% of the engineering range span in 0.1% increments.

**Derivative Action Time**

Set the required time between 0.1 and 999.9 in 0.1 second increments (999.9 seconds = 16.67 minutes). '*OFF*' is selected below 0.1.

**Approach Band**

Set the required value between 0.1 and 3.0 in 0.1 increments. (Set 1.0 initially).

**Crossover Output Value**

Set the required value between 0.0 and 100.0% of the PID output, in 0.1% increments – see Section 5.10.2.

**Transition Bandwidth**

Set the required value between 0.0 and 100.0% of the PID output, in 0.1% increments – see Section 5.10.3.

**Output Off Hysteresis Band**

Set the required value which prevents oscillation of control changes, between 0.0 and 25.0% of the PID output, in 0.1% increments.

### 5.10.2 Calculating the Crossover Value – Fig. 5.18

The crossover value is calculated from the expression:

$$\text{Crossover Value} = \frac{100}{\text{Gh/Gc} + 1}$$

Where Gh/Gc is the ratio of the two output driver gains.

The most common method for determining the Gh/Gc term is by using 'nameplate' values from the heat/cool device(s).

If a heat/cool application can produce a maximum of 1.5kW and absorb 0.75kW:

$$\text{Output Gain Ratio} = \frac{1.5}{0.75} = 2$$

$$\text{Crossover Value} = \frac{100}{2 + 1} = 33.3\%$$

### 5.10.3 Calculating the Transition Bandwidth Value – Fig 5.18

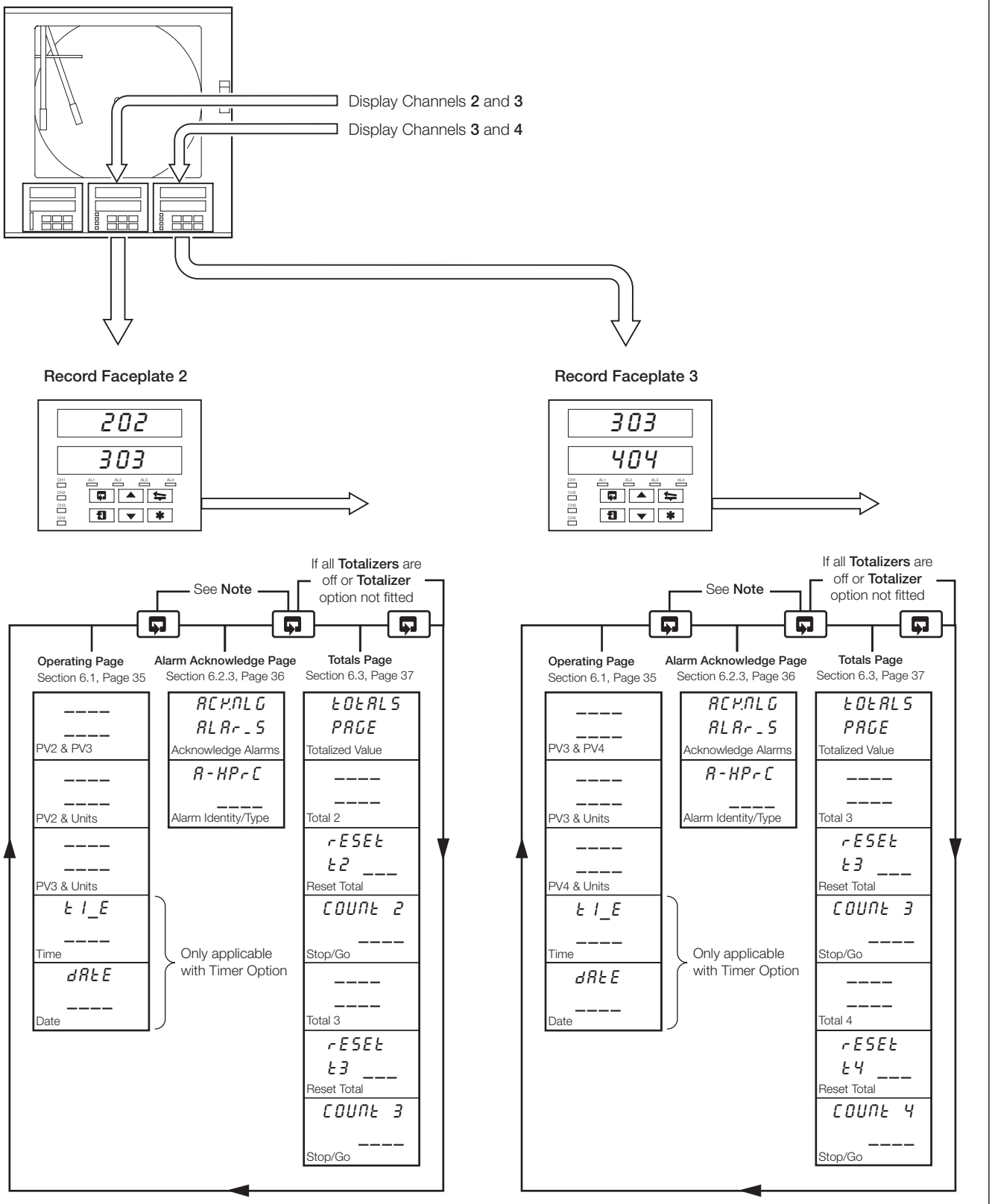
The Transition Bandwidth is the percentage difference of the proportional band settings.

**Example** – if the proportional band settings for the heat output is 20% and for the cool output is 25%:

$$\text{Transition Bandwidth (\%)} = \frac{25 - 20}{25} \times 100$$

Transition Bandwidth = 20%

If the proportional band settings for both outputs are equal, the bandwidth is 0%. As a general rule, the Transition Bandwidth should not exceed 30%.



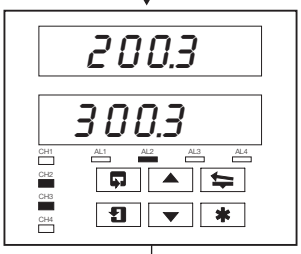

**Note.** The Alarm Acknowledge pages are displayed only if an alarm is active.

**Fig. 6.1 Summary of Operating Level Frames (Record Faceplates 2 and 3)**

## 6.1 Operating Page Displays

Faceplate 2 for channels 2 and 3

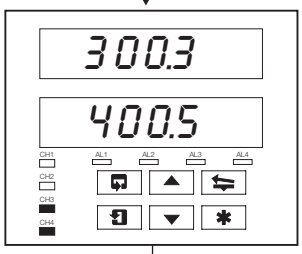
Faceplate 3 for channels 3 and 4




**Process Variable 2 (PV2)**

**Process Variable 3 (PV3)***

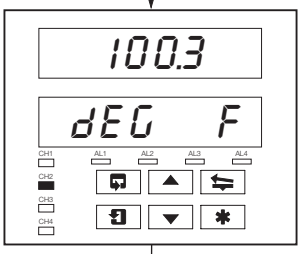
*Not displayed on two pen instruments.




**Process Variable 3 (PV3)**

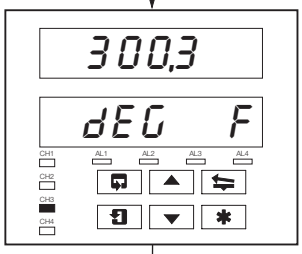
**Process Variable 4 (PV4)***

*Not displayed on three pen recorders.



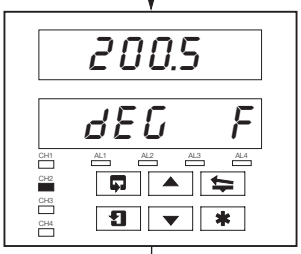

**Process Variable 2 (PV2)**

**Temperature Units for PV2** as set in the **Set Up Inputs Page, BASIC CONFIGURATION LEVEL**. Display is blank if '*nONE*' is selected.




**Process Variable 3 (PV3)**

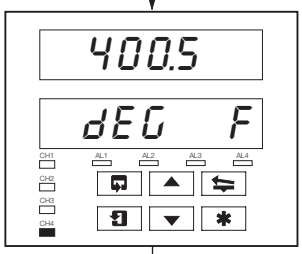
**Temperature Units for PV3** as set in the **Set Up Inputs Page**, **BASIC CONFIGURATION LEVEL**. Display is blank if '*nONE*' is selected.




**Process Variable 3 (PV3)**

**Temperature Units for PV3** as set in the **Set Up Inputs Page**.

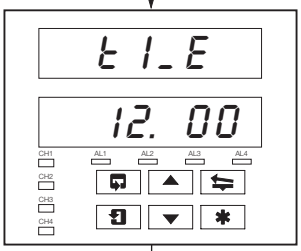
Display is blank if '*nONE*' is selected.




**Process Variable 4 (PV4)**

**Temperature Units for PV4** as set in the **Set Up Inputs Page**.

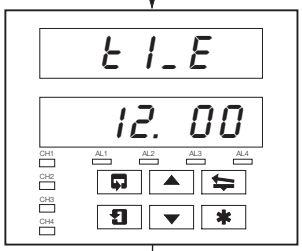
Display is blank if '*nONE*' is selected.




**Current Time***

**Time*** (displayed using 24hr clock)

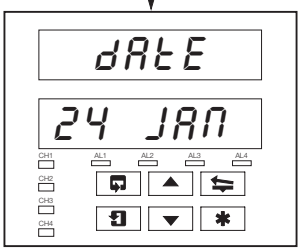
*Displayed only when timer option is fitted.




**Current Time***

**Time*** (displayed using 24hr clock)

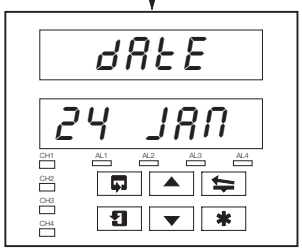
*Displayed only when timer option is fitted.




**Current Date***

**Day and Month***

*Displayed only when timer option is fitted.




**Current Date***

**Day and Month***

*Displayed only when timer option is fitted.

## 6.2 Alarm Acknowledge Page

### 6.2.1 Alarm Indications – Fig. 6.2

The definitions for alarm states (on, off or flashing) are detailed in Fig. 6.2.

### 6.2.2 Acknowledging Alarms

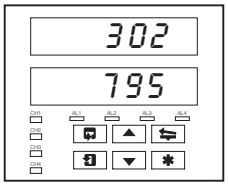
Unacknowledged alarms can be acknowledged from the faceplate controls on the front panel in two ways:

In the **Operating Level** – by pressing the ✱ key at any frame (providing the key is programmed for this function – see Section 5.1 in the **Programming Manual).** The ✱ key acknowledges all alarms from either faceplate.

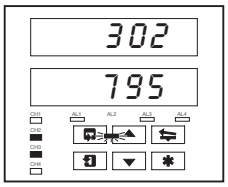
In the **Alarm Acknowledge Page** – by pressing the ▲ key – see Section 6.2.3 following.

**Note.** In the **Alarm Acknowledge Page** Channel 2 and 3 alarms can be acknowledged only from faceplate 2. Channel 3 and 4 alarms (if applicable) can be acknowledged only from faceplate 3.

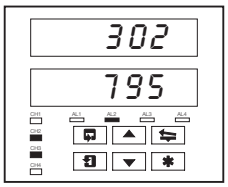
Record Faceplate




No LED illuminated indicates no alarms active and the **Alarm Acknowledge Page** is not displayed in the **OPERATOR LEVEL**.



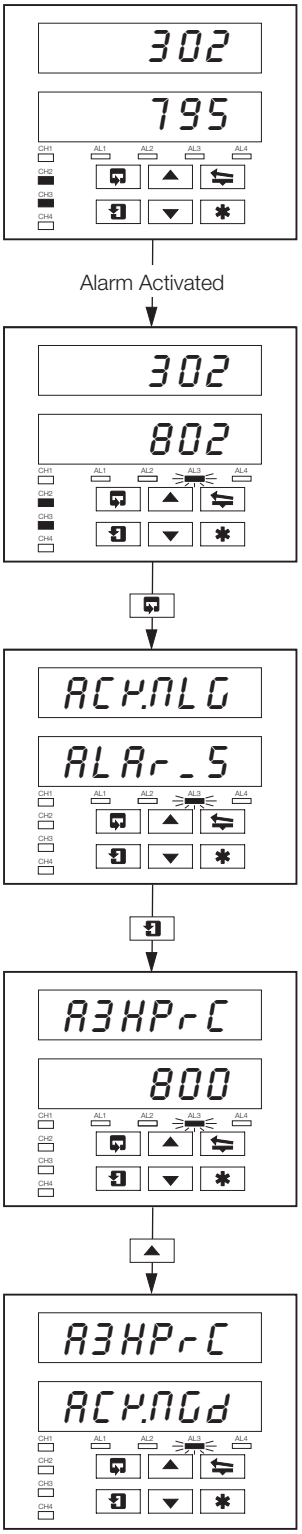

A flashing LED indicates that an unacknowledged alarm is active on that channel. For example, a flashing **AL2** LED indicates an active alarm on channel 2.




A constant LED indicates that all active alarms have been acknowledged on that channel.

**Fig. 6.2 Alarm LED Indication**

### 6.2.3 Using the Alarm Acknowledge Page




**No Alarm Active**
No LED indicators illuminated.

**Alarm Active**
**AL3** LED indicator flashing, indicating an active alarm on channel 3.

Use ◘ key to return to top of **Alarm Acknowledge Page**.

**Alarm Acknowledge Page**
Use the ◨ key to advance to next frame.

**Alarm Identity**
**Upper display:** shows the alarm identity and type.

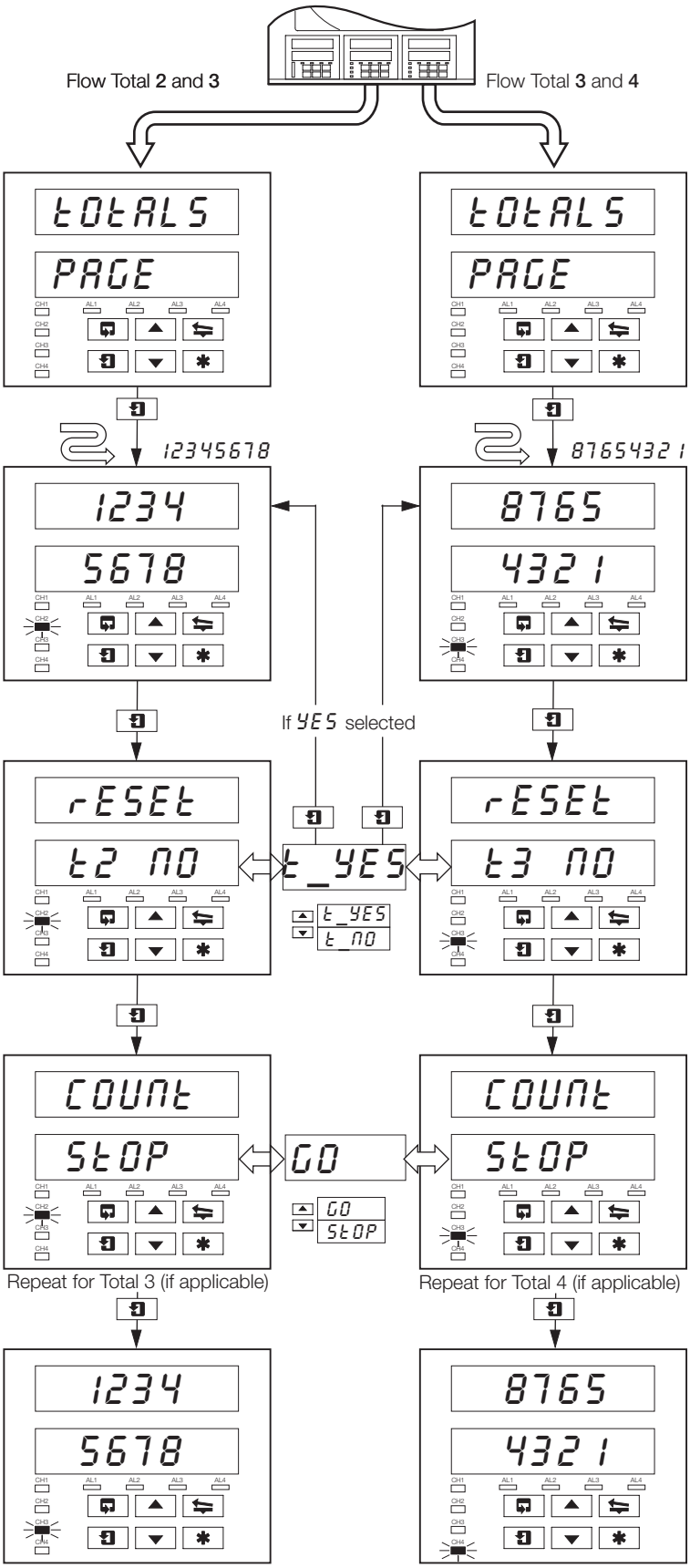
**Lower Display:** shows the trip level of the alarm identified in the upper display.

**Acknowledge Alarm**
Use the ▲ key to acknowledge the alarm. When the alarm is acknowledged, '*ACK.ACd*' is displayed and a constant LED indicates the acknowledged alarm.

If there are more active alarms on channel 3 the LED continues to flash until all alarms for that channel have been acknowledged.

## 6.3 Totals Page Displays

This page is omitted from both faceplates if the **Totalizer Option** is not fitted. The page is also omitted from faceplate 2 if both Totals 2 and 3 are set to *OFF* and from faceplate 3 if both Totals 3 and 4 are set to *OFF* – refer to the **Set Up Totals Page** in the **Advanced Software Options Manual**.




**Front Panel (Batch) Flow Total 2 (3)**
The batch flow total is calculated from process variable 2 (3).

The flashing channel LED indicates the flow total displayed.

**Example** – a flashing channel 2 LED indicates **Flow Total 2** parameters displayed.

**Counter Reset**
The Front (Batch) Flow Total can be reset to the **Preset Value** in **Set Up Totals Page** if **Reset Enable** in **Set Up Totals Page** is set to '*EnbL-Y*'.

Select '*t2 YES*' to reset the counter ( '*t2*' indicates **Flow Total 2** ).

**Note.** If the Counter Reset is disabled in **Set Up Totals Page**, the counter reset frame is omitted.

**Counter Stop/Go**

Select '*GO*' to start the counter or '*StOP*' to stop it.

**Note.** If the Counter Stop/Go is disabled in **Set Up Totals Page**, the frame can be viewed but not altered. If a digital signal is assigned to the **Totalizer Stop/Go source**, an active digital signal sets the counter to *GO* and the Counter cannot be stopped from the front panel.

**Front Panel (Batch) Flow Total 3 (4)**
Repeat the above procedure for **Flow Total** 3 (4).

**Note.** The number of totalizers is dependent on the number of pens fitted to the instrument e.g. a 3 pen instrument has 3 totalizers.

# 7 SIMPLE FAULT FINDING

| Symptom | Possible Cause | Action |
|---|---|---|
| Does not power up | a) Internal fuse (if fitted) is blown<br>b) Internal power switch (if fitted) is OFF<br>c) Power supply connections are incorrect | a) Check wiring, rectify fault and replace fuse<br>b) Turn power switch ON<br>c) Check connections |
| Chart does not appear to move | a) Very slow chart speed selected<br>b) Chart stop function enabled | a) Select required chart speed in **Set Up Chart Page**<br>b) De-activate source being used to stop chart – see **Set Up Chart Page** |
| Pens in recording position but do not drop onto paper | Chart stop function enabled | De-activate source used to stop chart – see **Set Up Chart Page** |
| Red pen does not move beyond 94% position on chart | When real time event pen is fitted the red pen cannot go beyond 94% to prevent pens clashing | Use chart range which prevents the need to go beyond 94% of maximum on chart |
| Pen lift switch on front panel does not work | Pen lift switch is disabled | Enable pen-lift switch in **Set Up Chart Page** |
| Pens do not remain lifted when pen lift key is used | Auto pen drop feature is enabled | Disable auto pen drop in **Set Up Chart Page** if this is not required |
| Analog inputs are slow to respond | A large filter time has is set | Set digital filter value to give required response in **Set Up Inputs** |
| Time or date incorrect | Not set for correct local time | Set correct time and date in **Set Up Clock Page** – refer to **Advanced Software Manual** |
| Totalizers cannot be set to STOP or GO | Operator STOP/GO selection is not enabled in the **OPERATOR LEVEL** | Enable counter STOP/GO in the **Set Up Totals Page** |
| Totalizer cannot be set to STOP | Digital signal assigned to the total STOP/GO function is active | De-activate digital signal assigned to total STOP/GO function |
| External relays connected to relays in instrument fail to de-energize | Arc suppression capacitors are provided across the relay contacts and capacitor leakage current may be sufficient to prevent an external relay from de-energizing | Remove the arc suppression components – IC4 and IC5 on mainboard<br>IC6 and IC7 on standard I/O and analog relay<br>IC3 to IC10 on 4 relay module |
| Pens return to a different position after a pen-lift or power down | Pens are interfering with one another due to incorrect setting of pens | Each pen requires the force of 1 gram to lift it off the paper. Carefully bend arm (up or down) close to the plastic moulding to give correct setting |

# 8 SPARES LIST

| Item | Part No. |
|---|---|
| **Pen Capsules** (pack of 3) | |
| Black | C1900/0119 |
| Blue | C1900/0120 |
| Red | C1900/0121 |
| Green | C1900/0122 |
| Violet* | C1900/0123 |
| | |
| **Pen Arm Assemblies** | |
| ER/C Type Chart (J or R in Code Number) – Standard Pen | C1900/0076 |
| ER/C Type Chart (J or R in Code Number) – Event Pen | C1900/0078 |
| PX105 and PXR105 Type Chart (K or S in Code Number) – Standard Pen | C1900/0075 |
| PX105 and PXR105 Type Chart (K or S in Code Number) – Event Pen | C1900/0077 |
| | |
| **Fuses** | |
| 24V | B11071 (4A) |
| 115V | B11070 (1A) |
| 230V | B11069 (500mA) |

*True time line event option only.

# NOTES

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Service

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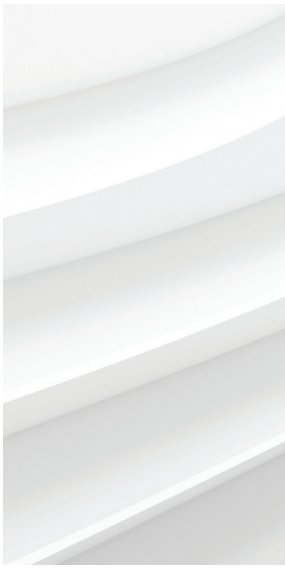
**abb.com/measurement**



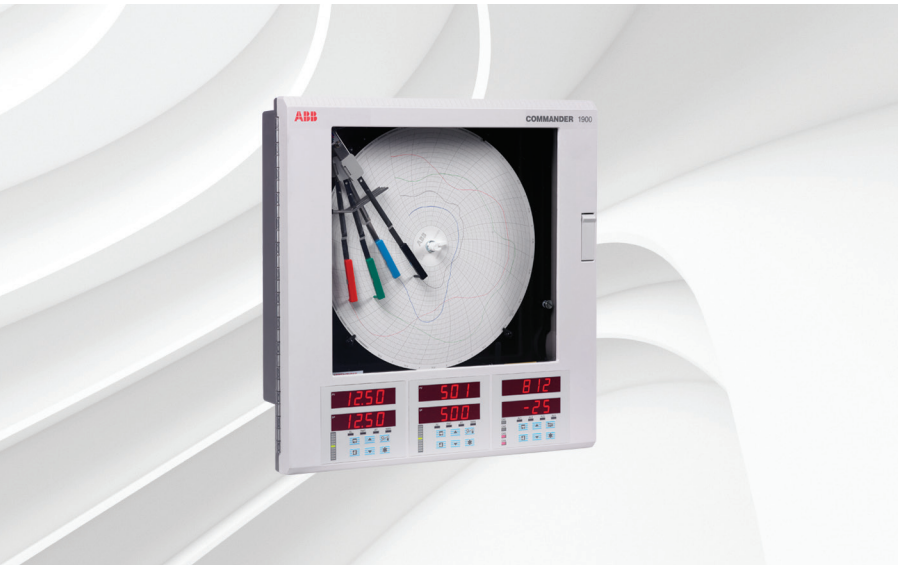


IM/C1900-OGC Rev. J 09.2018

ABB MEASUREMENT & ANALYTICS | PROGRAMMING GUIDE | IM/C1900-PGC REV. L

# C1900

## Circular chart recorder/controller




## Measurement made easy

C1900
circular chart
recorder/controller

## For more information

Further publications are available for free download from:

www.abb.com/recorders

or by scanning this code:

| | Search for or click on |
|---|---|
| Data Sheet<br>C1900<br>Circular chart recorder/controller | DS/C1900RC-EN |
| Quick Reference Guide<br>Circular chart recorder/controller | IM/C1900-QC |
| Installation Guide<br>C1900<br>Circular chart recorder and recorder/controller | IM/C1900-INS |
| Operating Guide<br>C1900<br>Circular chart recorder/controller | IM/C1900-OGC |
| Operating Instructions<br>C1900<br>Circular chart recorder and recorder/controller | IM/C1900-MOD |
| User Guide<br>C1900<br>Circular chart recorder and recorder/controller | IM/C1900-ADV |

## 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 |
|  | Alternating current supply only |
|  | Both direct and alternating current supply |
|  | The equipment is protected through double insulation |

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:

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

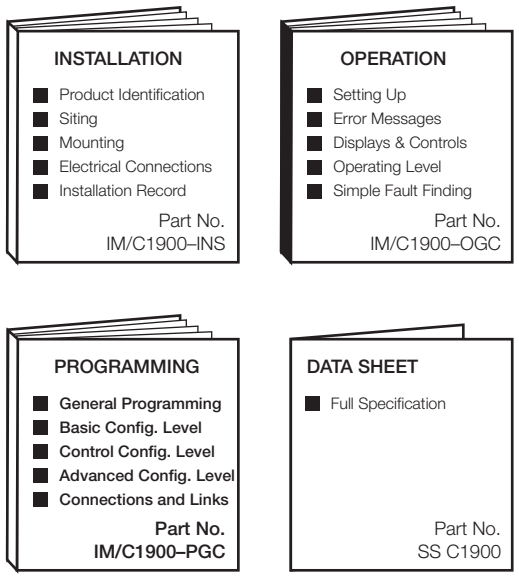
Safety advice concerning the use of the equipment described in this manual or any relevant hazard data sheets (where applicable) may be obtained from the Company address on the back cover, together with servicing and spares information.

# CONTENTS

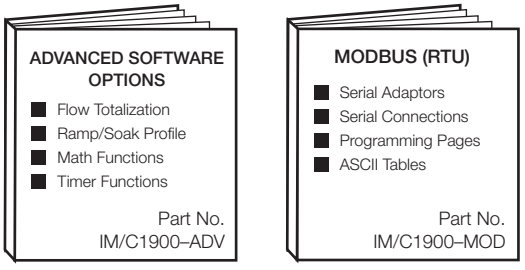


# 1 INTRODUCTION

The documentation for the C1900 series of circular chart recorders is shown in Fig. 1.1. The **Standard Manuals**, including the data sheet, are supplied with all instruments. The **Supplementary Manuals** supplied depend on the specification of the instrument.




**A – Standard Manuals**




**B – Supplementary Manuals**

**Fig. 1.1 C1900 Documentation**

# 2 GENERAL PROGRAMMING

The programming procedures are used to make changes to the operating parameter values and for scale adjustment.

The programming of all channels is performed using faceplate 1 – see Fig. 2.1

When changing the input type it may be necessary to reposition the input selector links accordingly – see Section 6, **CONNECTIONS & LINKS**.

## 2.1 Preparation for Changes to the Parameters

Ensure that the external alarm/control circuits are isolated if inadvertent operation during programming is undesirable.

Any change to the operating parameters are implemented using the ▲ or ▼ keys – see Section 3 of the **Operating Guide**.

> **Note.** The recorder responds instantly to parameter changes which are saved automatically when leaving the current frame.

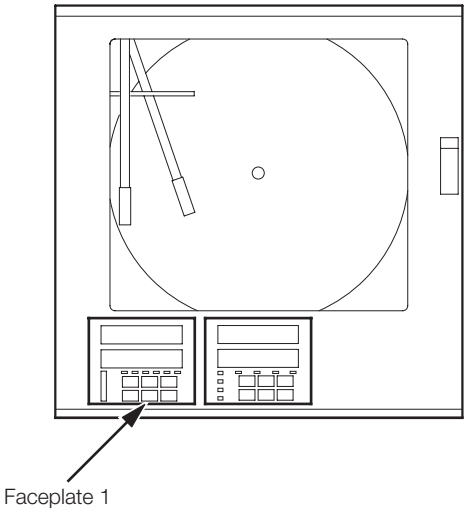



**Fig. 2.1 Location of Faceplate 1**

## 2.2 Security System

A security system is used to prevent tampering with the programmed parameters by utilizing a Tune password and a Configuration password.

A Tune password can be assigned to controller faceplates giving access to that faceplate's controller settings. A configuration password gives access to all controller settings and programming pages. The passwords can be set to any value from 0 to 9999. The instrument is despatched with the passwords set to '0' – see Section 5.5 of the **Operating Guide**.

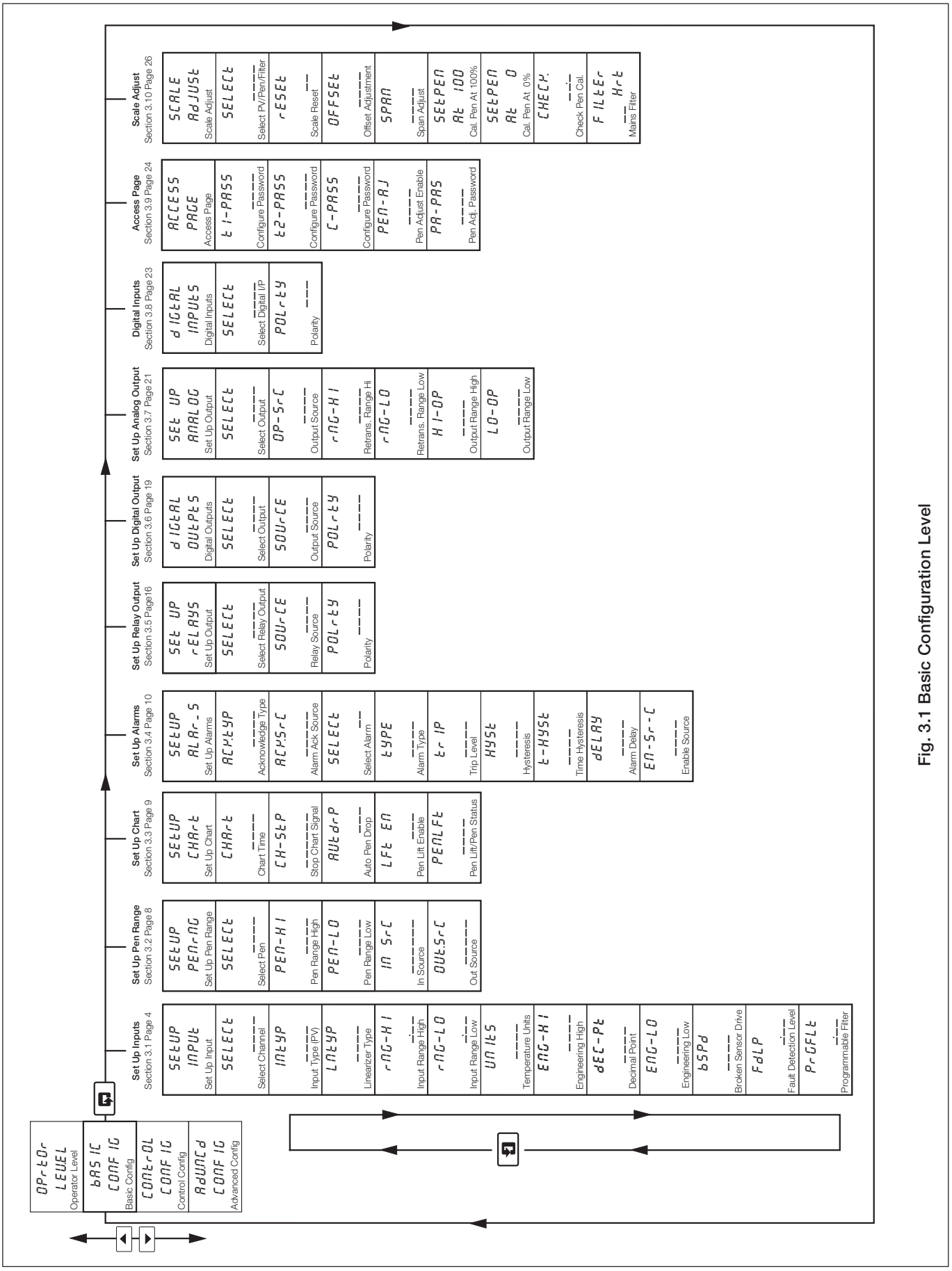
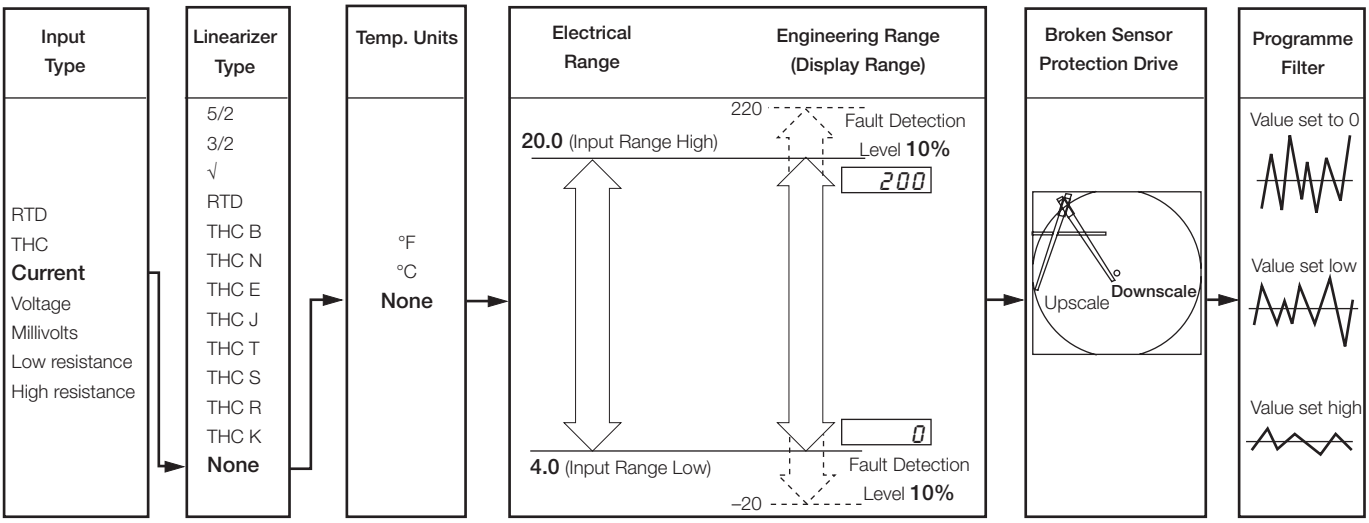



**Fig. 3.1 Basic Configuration Level**

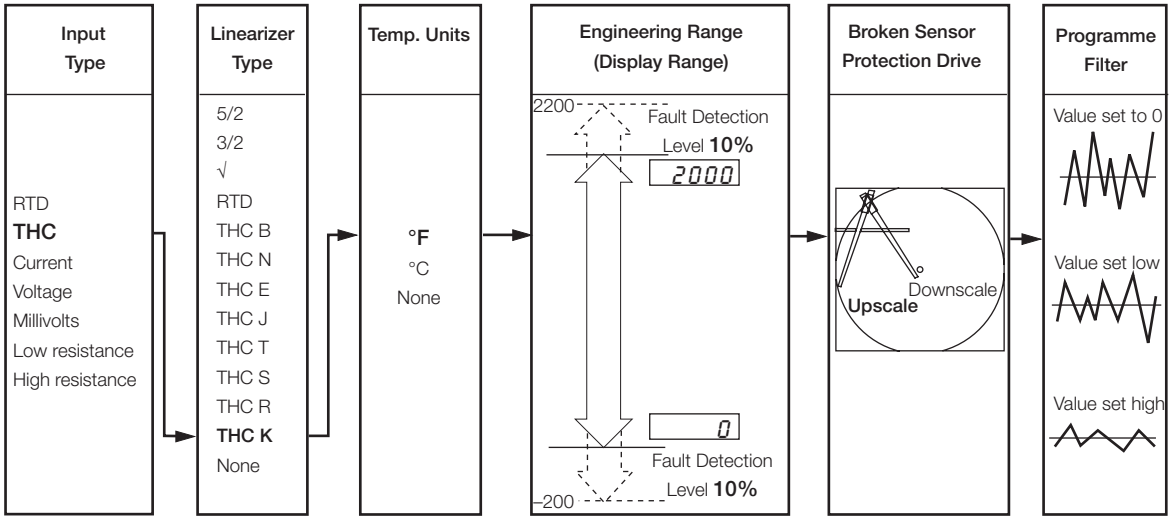
## 3.1 Set Up Input (Process Variable, Remote Set Point and Position Feedback)

**Information.**
- **Universal inputs** – mV, mA, V, THC, RTD and resistance.
- **Internal cold junction compensation**.
- **Linearization** – of temperature sensors to allow use of non-linearizing transmitters or any electrical input.
- **Programmable fault levels and actions**.
- **Digital filter** – reduces the effect of noise on inputs.

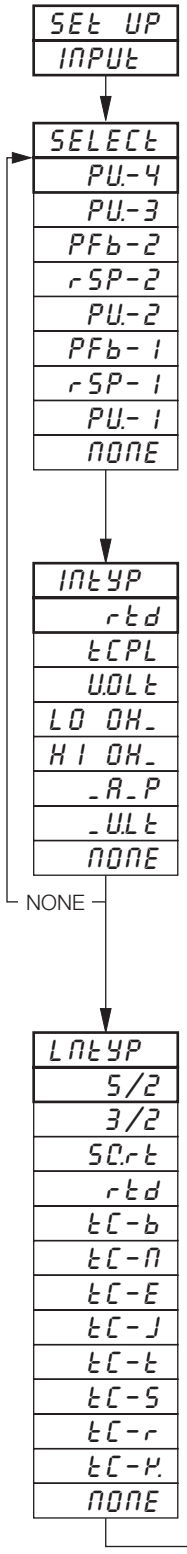
**Example A** – setting up:
- a current input of 4 to 20mA
- displaying a range of 0 to 200psi
- a fault detection level 10% above 200psi (engineering/display range) and 10% below 0psi (engineering/display range)
- in the event of a fault being detected and/or the fault detection level being exceeded the process variable is driven downscale.




**Example B** – setting up:
- a Type K thermocouple
- displaying temperature in °F
- displaying a range of 0 to 2000°F
- a fault detection level 10% above 2000°F (engineering/display range) and 10% below 0°F (engineering/display range)
- in the event of a fault being detected and/or the fault detection level being exceeded the process variable is driven upscale.



## ...3.1 Set Up Input




Page Header – **Set Up Input (Process Variable)**

To advance to **Set Up Pen Range Page** press the ⏎ key.

---

**Select Channel**

Select the channel to be programmed:

- PU-4 – process variable on channel 4
- PU-3 – process variable on channel 3
- PFb-2 – valve position feedback on controller 2 } displayed only if selected in the **Input Asignment Page**
- rSP-2 – remote set point on controller 2 } displayed only if selected in the **Input Asignment Page**
- PU-2 – process variable on channel 2
- PFb-1 – valve position feedback on controller 1 } displayed only if selected in the **Input Asignment Page**
- rSP-1 – remote set point on controller 1 } displayed only if selected in the **Input Asignment Page**
- PU-1 – process variable on channel 1
- NONE – None

**Note.** In the remaining frames press the ✱ key to view the channel selected.

---

**Input Type (Process Variable)**

**Caution.** Ensure the correct input link positions are selected and the input is wired correctly – see Section 6, **CONNECTIONS & LINKS**.

Select the input type required:

- rtd – Resistance thermometer } Not available on position feedback input
- tCPL – Thermocouple } Not available on position feedback input
- U.OLt – Voltage
- LO OH_ – Low resistance (≤750Ω)
- HI OH_ – High resistance (>750Ω)
- _A_P – Current
- _U.Lt – Millivolt (≤150mV)
- NONE – None

---

**Linearizer Type**

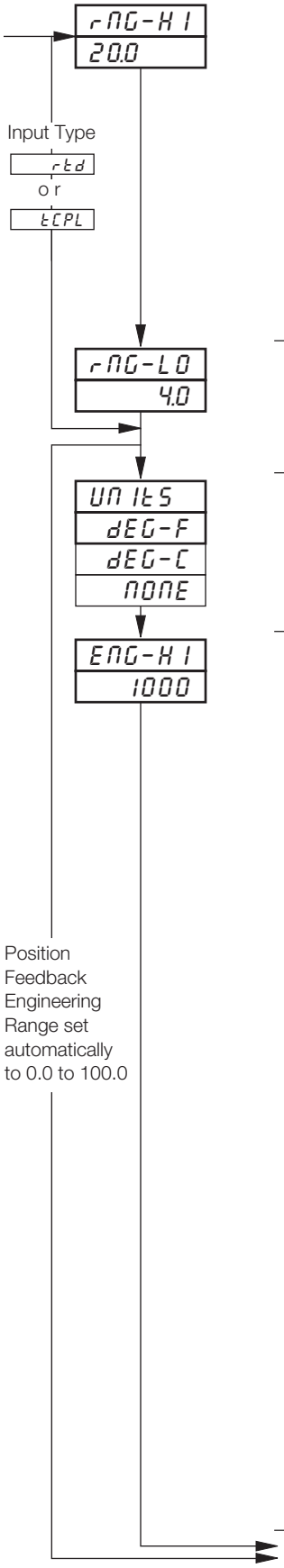
Select the linearizer type required:

- 5/2 – $x^{5/2}$ } Open channel flow applications
- 3/2 – $x^{3/2}$ } Open channel flow applications
- SQ.rt – Square Root
- rtd – Resistance thermometer
- tC-b – Type B thermocouple
- tC-n – Type N thermocouple
- tC-E – Type E thermocouple
- tC-J – Type J thermocouple
- tC-t – Type T thermocouple
- tC-S – Type S thermocouple
- tC-r – Type R thermocouple
- tC-K. – Type K thermocouple
- NONE – No linearizer

---

Continued on next page.

## …3.1 Set Up Input




**Input Range High**
Set the maximum electrical input value required (in electrical units).

**Note.** The value set must be within the limits detailed in the table below.

| Input Type | Range Low Min. | Range High Max. | Min. Range (Low to High) |
|---|---|---|---|
| Millivolts | 0 | 150 | 5.0 |
| Volts | 0 | 5 | 0.1 |
| Milliamps | 0 | 50 | 1.0 |
| Resistance Low | 0 | 750 | 20 |
| Resistance High | 0 | 9999 | 400 |

**Input Range Low**
Set the minimum electrical input value required (in electrical units).

**Note.** The value set must be within the limits detailed in the above table.

**Temperature Units**
Select units required.

**Engineering Range High**
Set the maximum engineering (display) value required.

**Note.** The value set must be within the limits detailed in the tables below.

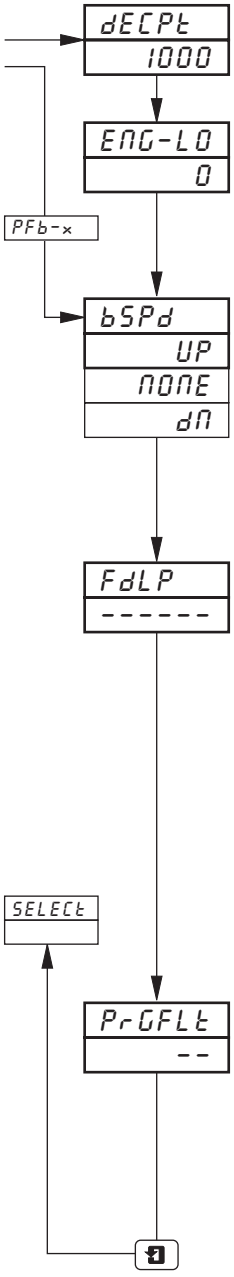
| Linearizer Type | Degrees Fahrenheit | | | Degrees Celsius | | |
|---|---|---|---|---|---|---|
| | Min. | Max. | Min. Span | Min. | Max. | Min. Span |
| **Type B** | 0 | 3272 | 1278 | –18 | 1800 | 710 |
| **Type E** | –148 | 1652 | 81 | –100 | 900 | 45 |
| **Type J** | –148 | 1652 | 90 | –100 | 900 | 50 |
| **Type K** | –148 | 2372 | 117 | –100 | 1300 | 65 |
| **Type N** | –328 | 2372 | 162 | –200 | 1300 | 90 |
| **Type R & S** | 0 | 3092 | 576 | –18 | 1700 | 320 |
| **Type T** | –418 | 572 | 108 | –250 | 300 | 60 |
| | | | | | | |
| **RTD** | –328 | 1112 | 45 | –200 | 600 | 25 |

Performance accuracy is not guarateed below 725°F/400°C for types B, R and S thermocouples
Minimum span below zero Type T 126°F/70°C
Minimum span below zero type N 189°F/105°C
THC standard DIN 4730 IEC 584
RTD standard DIN 43760 IEC 751

| Linearizer Type | Engineering Range High and Low | |
|---|---|---|
| | Min. | Max. |
| **5/2** | –9999 | +9999 |
| **3/2** | | |
| **Square Root** | | |
| **None** | | |

Continued on next page.

## ...3.1 Set Up Input




**Decimal Point**
Set the decimal point position required for **both** the engineering range high and engineering range low values.

**Engineering Range Low**
Set the minimum engineering (display) value required,

**Note.** The value set must be within the limits detailed in **Engineering Range High** tables opposite.

**Broken Sensor Protection Drive**
In the event of a fault being detected on the input and/or if the **Fault Detection Level Percentage** is exceeded (see next frame), the process variable is driven in the direction of the drive selected.

Select the broken sensor drive required:

- NONE – No drive
- UP – Upscale drive
- dN – Downscale drive.

**Fault Detection Level Percentage**
A fault level percentage can be set to detect a deviation above or below the display limits.

For example, if FdLP is set at 10.0%, a fault is detected if an input goes more than 10% above **Engineering Range High** or more than 10% below **Engineering Range Low**.

On some ranges the input circuitry may saturate before the fault level set is reached. In this case an error is detected below the level set.

Set the level required, between 0.0 and 100.0% of engineering span (range low to high) in 0.1% increments.

**Note.** If an input exceeds the minimum or maximum value for the linearizer selected an error is detected regardless of any fault level.

**Programmable Filter**
Filters the process variable input, i.e. if the input is stepped it smooths the transition between steps and may also be used for some degree of cleaning of noisy inputs. The filter time represents the time a step in the input takes to change the displayed process variable from 10 to 90% of the step.

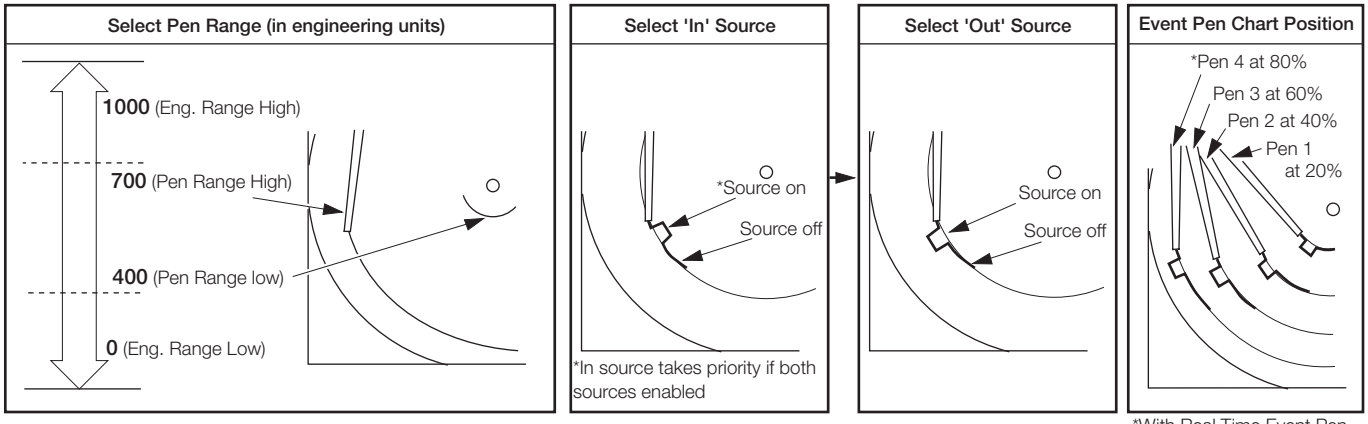
Set the value required, between 0 and 60 in 1 second increments.

Return to **Select Channel** frame.

## 3.2 Set Up Pen Range/Event Source

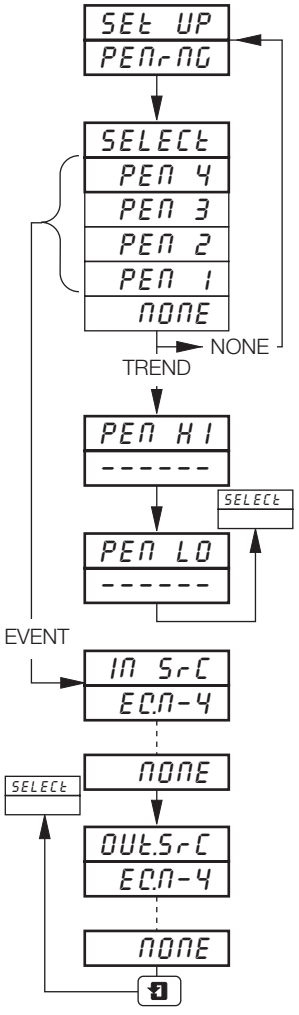
**Information.**

- **Trend pens** – have an independent chart range allowing a selected part of the engineering (display) range to be used for extra resolution on the chart.
- **Three position event pen function** – can be driven by digital inputs, alarms, logic equation results, real time events (timer option), control modes, set points, ramp/soak profile segments or programs (profile option).




**Record Function** **Event Function**

*With Real Time Event Pen option fitted, Pen 4 is above 100%




Page Header – **Set Up Pen Range**

To advance to **Set Up Chart Page** press the ⏎ key.

**Select Pen**
Select the pen to be programmed

**Note.**

- In the remaining frames press the ✱ key to view the pen selected.
- Record (trend) or event pen function is set in the **ADVANCED CONFIGURATION LEVEL** (if True Time Event Pen option is selected, the fourth pen is fitted with a special pen arm and is set automatically for event pen function) – see Section 4.3, **Set Up Pen Functions**.

**Pen Range High**
Set the maximum value required on the chart, in engineering units (the value must be within the engineering range set in **Set Up Input Page** – see Section 3.1).

**Pen Range Low**
Set the minimum value required on the chart, in engineering units (the value must be within the engineering range set in **Set Up Input Page**).

**In Source**
Select a source to move the pen inwards on the chart.

For a description of sources – see **Table 3.1** on page 18.

**Out Source**
Select a source to move the pen outwards on the chart.

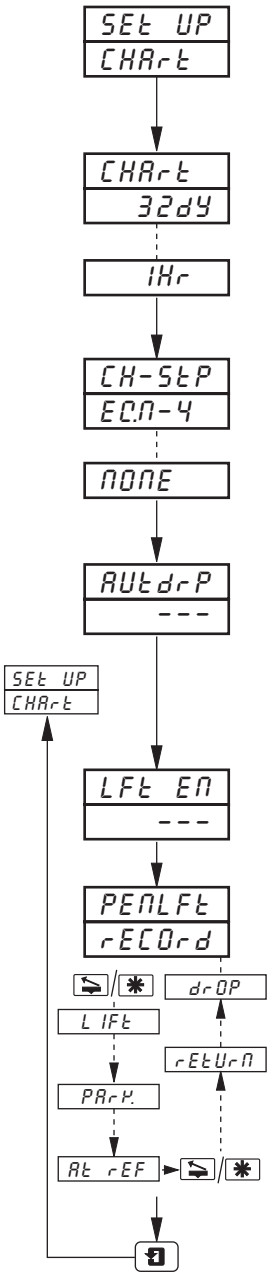
For a description of sources – see **Table 3.1** on page 18.

Return to **Select Pen** frame.

## 3.3 Set Up Chart

**Information.**

- **Programmable chart duration** – between 1 and 167 hours or 7 and 32 days.
- **Chart stop function** – the chart can be stopped by an alarm, digital input, logic equation result or a real time event (if timer option is fitted).
- **Auto pen drop** – automatically drops the pen(s) onto the chart after a 5 minute delay to ensure recording is not left disabled inadvertently




Page Header – **Set Up Chart**

To advance to **Set Up Alarms Page** press the ⏎ key.

**Chart Duration**
Select the chart duration required per revolution of the chart; between 1 and 167 hours or 7 and 32 days.

**Stop Chart Source**
Select the source required for stopping the chart.

For description of sources, refer to **Table 3.1** on page 18.

**Auto Pen Drop**
Select '*YES*' to enable or '*nO*' to disable.

If '*YES*' selected, pen(s) drop automatically onto the chart 5 minutes after they are lifted.
If '*nO*' selected, the pen(s) remain lifted until they are manually dropped by the operator.

**Pen Lift Enable/Disable**
The ⇆ key (record faceplate only) or ✱ key (control faceplate – if programmed for pen lift) can be disabled if required. Select '*YES*' to enable or '*nO*' to disable.

**Pen Lift/Pen Status**
To raise pen(s) press ⇆ or ✱ key. The following status displays are shown:

- *rECOrd* – pen records on chart
- *L IFt* – pen lifts off chart
- *PArK.* – pen moves to park position
- *At rEF* – pen at reference position

To lower pen(s) press ⇆ or ✱ key. The following status displays are shown:

- *rEtUrn* – pen returns to record position
- *drOP* – drops (lowers) onto chart
- *rECOrd* – pen records on chart

Return to top of **Set Up Chart Page**.

## 3.4 Set Up Alarms

**Information.**

- **Four alarms per channel** – identified A1 to D1 (for channel 1) up to A4 to D4 (for channel 4).
- **Three operator acknowledge options**.
- **Global alarm acknowledgment** – by digital input, alarm, logic equation result or real time event (if option fitted).
- **High/low process alarms**.
- **Delayed high/low process alarms**.
- **High/low output alarms**.
- **High/low deviation alarms**.
- **Fast/slow rate of change** – of process variable alarms.
- **Adjustable hysteresis value** – to prevent oscillation of alarm state.
- **Time hysteresis** – to allow delayed triggering of alarms.

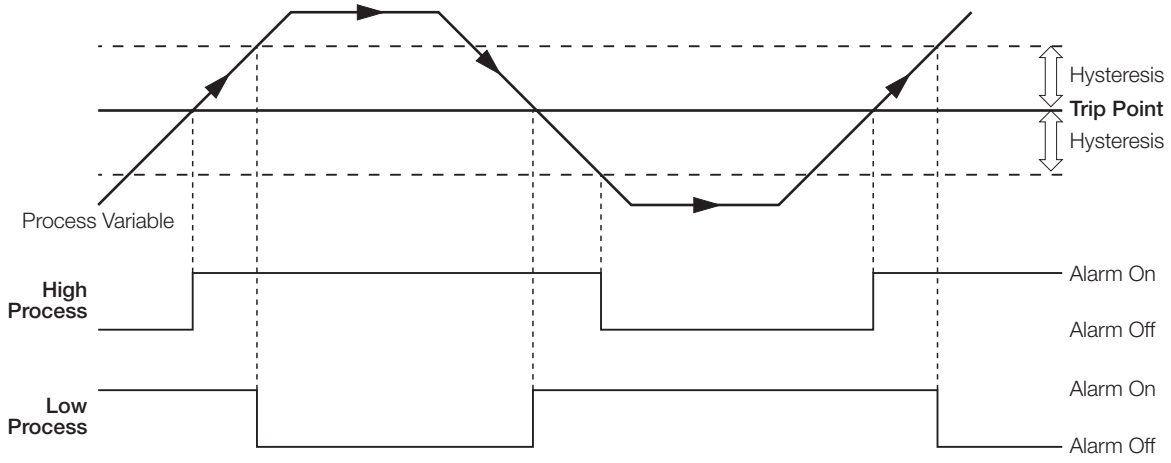



**Fig. 3.2 High and Low Process with Hysteresis**

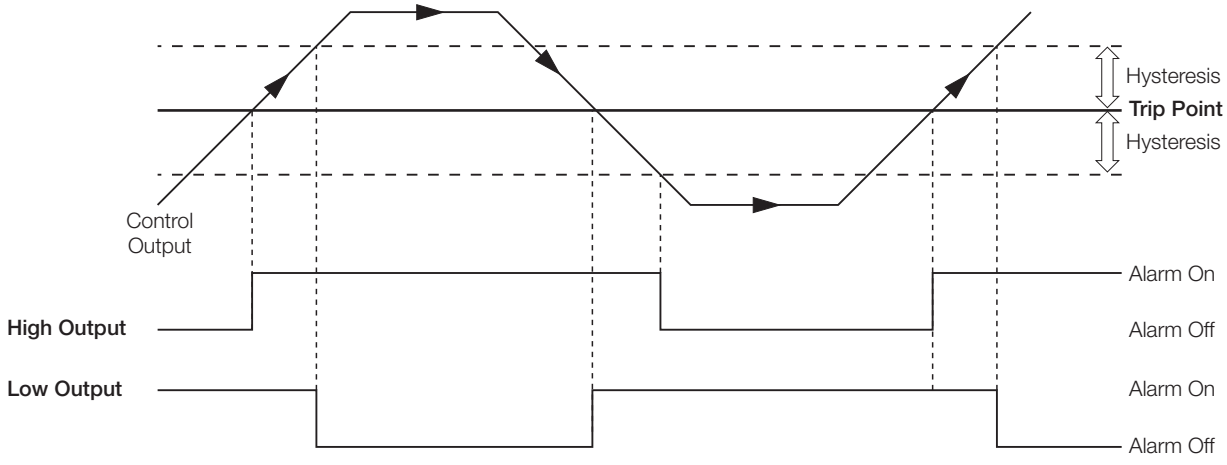



**Fig. 3.3 High and Low Output with Hysteresis**

## ...3.4 Set Up Alarms

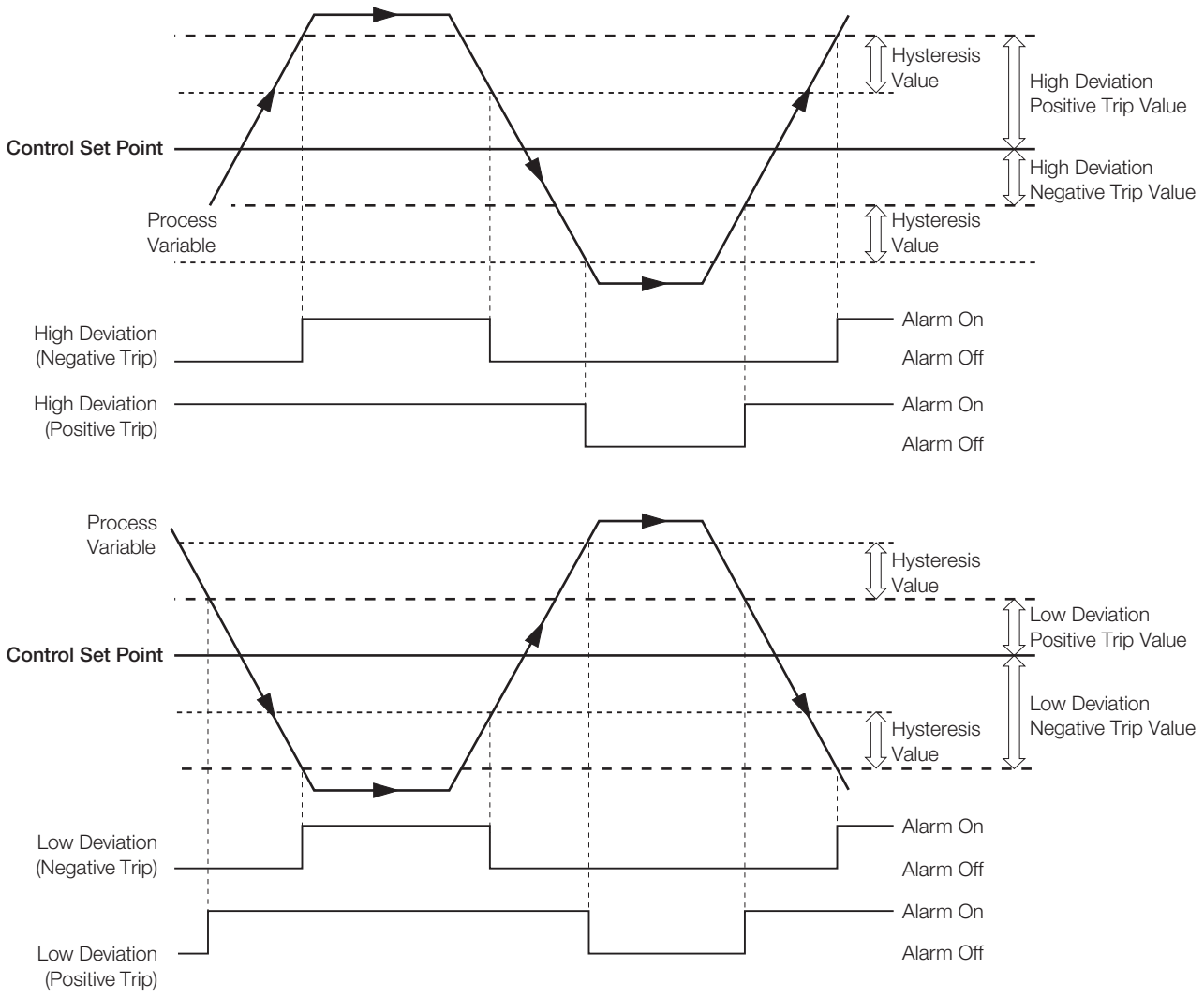
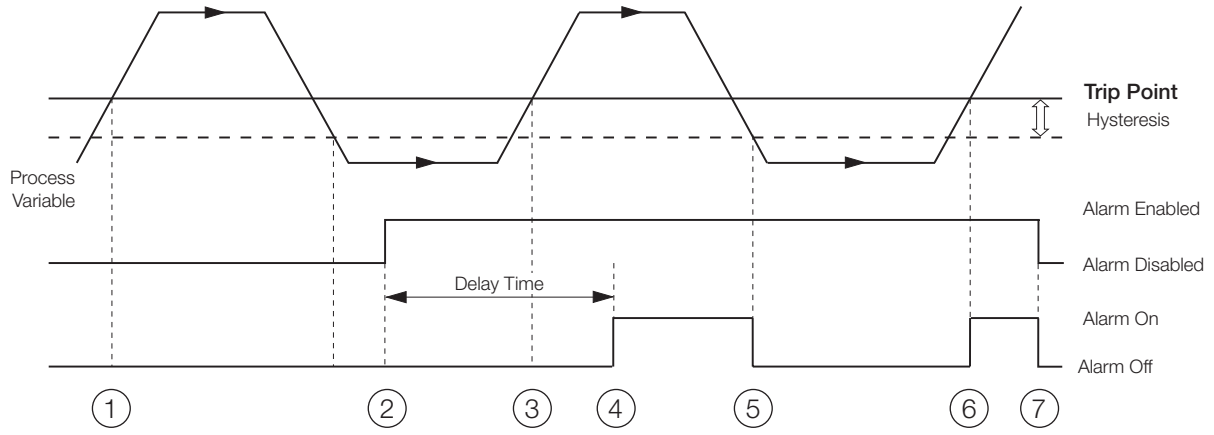



**Fig. 3.4 High and Low Deviation with Hysteresis**

## …3.4 Set Up Alarms

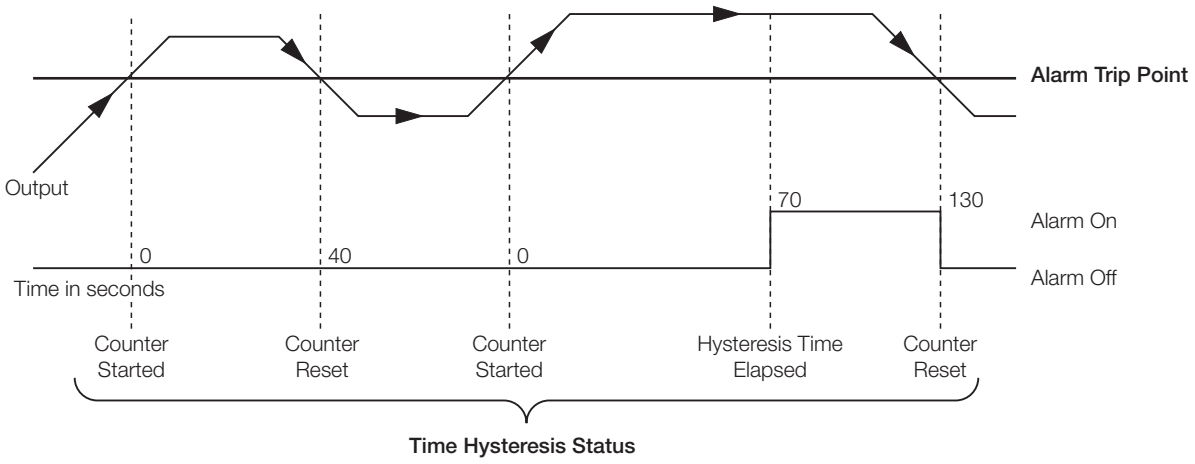



The operation of a delayed high/low process alarm is identical to that of the standard high/low process alarm but the alarm can be enabled/disabled by use of a digital signal.

The alarm state is held off whilst the enable signal is off and continues to be held off for a pre-configured period of time after the enable signal is switched ON (irrespective of the process variable value). Once the pre-configured alarm delay time has expired then the alarm operates in the same manner as a standard high/low process alarm.

1. Process variable goes above trip point but alarm is not activated because enable signal is low (Alarm Disable).
2. Alarm Enable signal is switched On. Alarm delay timer started.
3. Process variable goes above trip point but alarm is not activated because alarm delay time has not expired.
4. Alarm delay timer expires, alarm is now enabled. Alarm is activated because process variable is above trip point.
5. Process variable goes below trip (hysteresis) point therefore alarm is de-activated.
6. Process variable goes above trip point, alarm is activated (alarm is enabled and delay time has expired).
7. Alarm Enable signal is switched Off. Alarm is disabled immediately. Alarm de-activates.

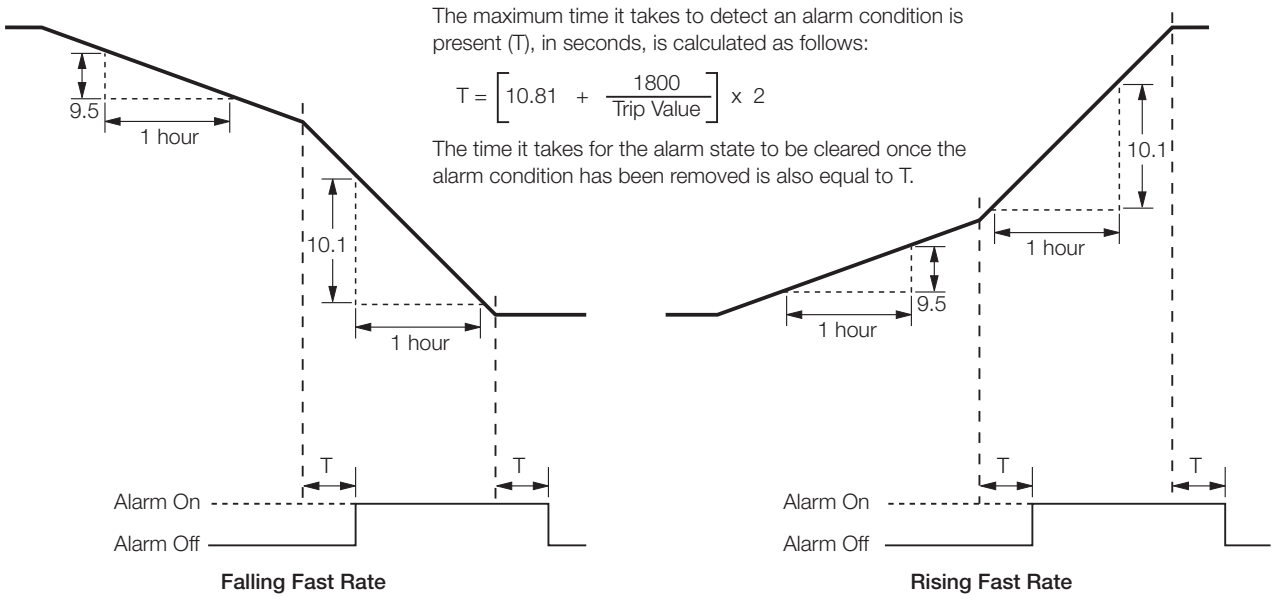
**Fig. 3.5 Delayed High Process Alarm**




Example shows time hysteresis set to 70 seconds used with a high process alarm

**Fig. 3.6 Time Hysteresis Alarm**

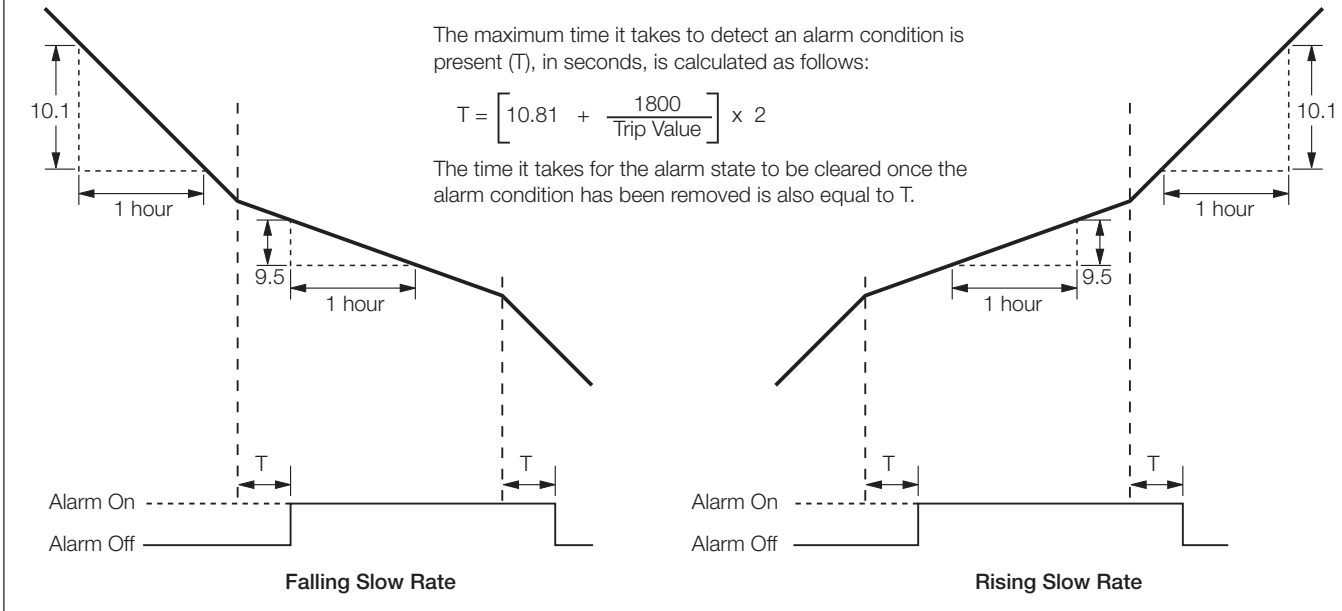
## ...3.4 Set Up Alarms




Examples shown are for a trip value of 10%/hour on a PV engineering range of 0.0 to 100.0

$$T = \left[10.81 + \frac{1800}{10}\right] \times 2 \qquad T = 382 \text{ seconds}$$

**Fig. 3.7 Slow Rate Alarms with Hysteresis**

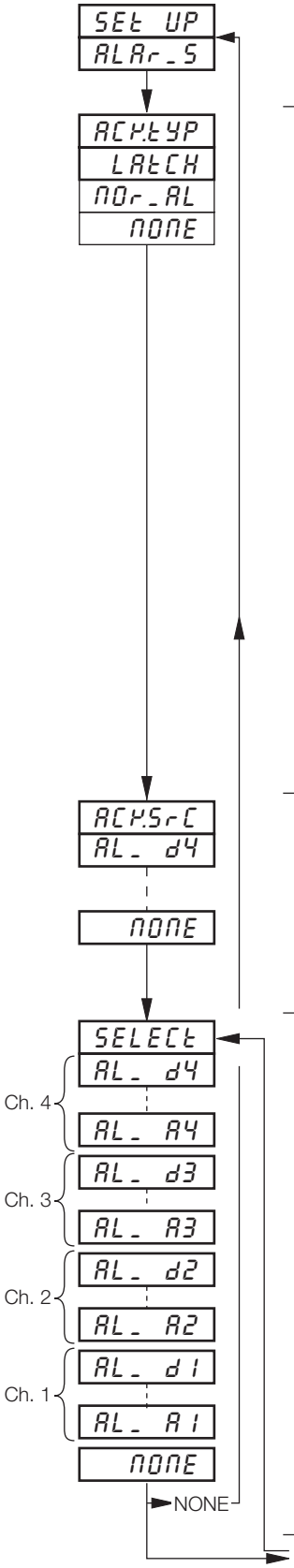



Examples shown are for a trip value of 10%/hour on a PV engineering range of 0.0 to 100.0

$$T = \left[10.81 + \frac{1800}{10}\right] \times 2 \qquad T = 382 \text{ seconds}$$

**Fig. 3.8 Fast Rate Alarms with Hysteresis**

## …3.4 Set Up Alarms




Page Header – **Set Up Alarms**

To advance to **Set Up Relay Output Page** press the ⏎ key.

**Alarm Acknowledge Type**
Alarms may be acknowledged while they are displayed.
Select the alarm acknowledge type:

*nONE* – no acknowledge facility. If the cause of the alarm no longer exists, the alarm state and display are cleared automatically.

| Alarm cause | LED | Alarm State |
|---|---|---|
| Present | Flashing | Active |
| Not Present | Off | Inactive |

*nOr_AL* and *LAtCH* – if the cause of the alarm no longer exists, the alarm display remains until it has been acknowledged.

| Alarm cause | Acknowledge | LED | Alarm State |
|---|---|---|---|
| Present | No | Flashing | Active |
| Present | Yes | Steady | Active |
| Not Present | Previously acknowledged | Off | Inactive |
| Present | No | Flashing | Active |
| Not Present | No | Flashing | Active/Inactive* |
| Not Present | Yes | Off | Inactive |

*Alarm state is active if *LAtCH* is selected or inactive if *nOr_AL* is selected.

**Global Alarm Acknowledge Source**
Select the alarm acknowledgment source required.

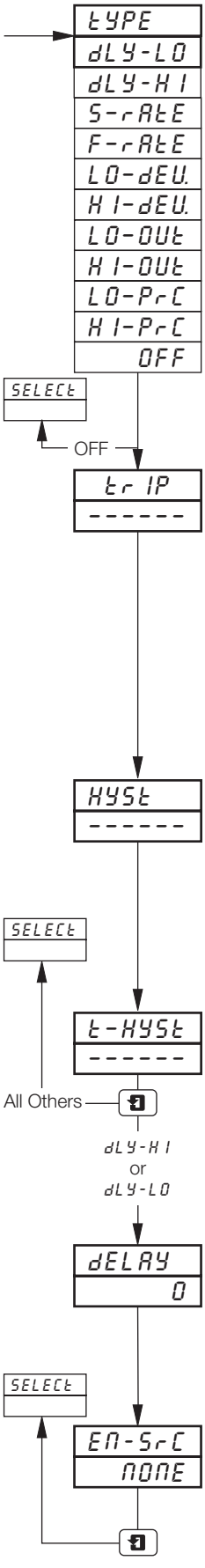
For a description of sources – see **Table 3.1** on page 18.

**Select Alarm**
Select the alarm to be programmed.

**Note.** In the remaining frames press the ✱ key to view the alarm selected.

Continued on next page.

## ...3.4 Set Up Alarms




**Alarm Type**
Select the alarm type required for the alarm selected.

| | | |
|---|---|---|
| dLY-LO | – | delayed low process |
| dLY-HI | – | delayed high process |
| S-rtE | – | slow rate (rate of change of process variable) |
| F-rtE | – | fast rate (rate of change of process variable) |
| LO-dEU. | – | low deviation |
| HI-dEU. | – | high deviation |
| LO-OUt | – | low output |
| HI-OUt | – | high output |
| LO-PrC | – | low process |
| HI-PrC | – | high process |
| OFF | – | alarm off |

Displayed only on Controller faceplate

---

**Trip Level**
Set the trip value required for the alarm selected.

The following are displayed in engineering units:
HPrC, LPrC, HI-dEU. and LO-dEU..
The following are displayed as percentage (0.0 to 100.0%):
HI-OUt and LO-OUt.

The following are displayed as a percentage of the engineering span (engineering range high – engineering range low) per hour between ±0.5 and ±500%:
FrtE and SrtE.

---

**Hysteresis**
Hysteresis is operational when the alarm is active.

Set the hysteresis value required for high/low process or high/low deviation in engineering units (within the engineering range) or in 0.1% increments for fast/slow rate and high/low output alarms. The alarm is activated at the trip level but is only turned off after the alarm variable has moved into the safe region by an amount equal to the hysteresis value. For rate alarms this setting is a percentage of the trip rate – see FrtE and SrtE in previous frame.

---

**Time Hysteresis**
Set the time hysteresis value required between 0 and 9999 seconds.

**Note.** The alarm condition must be present continually for the time set, before the alarm becomes active. If a hysteresis level is also set, the alarm condition remains active until the process variable moves outside the hysteresis band. When the alarm condition no longer exists the alarm becomes inactive, i.e. time hysteresis does not affect turning off of alarm states.

---

**Alarm Delay**
After a transition of the enable signal from disabled to enabled, the alarm remains disabled for this period of time.

Set 0 to 250 minutes.

---

**Enable Source**
Any digital signal can be assigned as the signal to enable/disable the alarm.

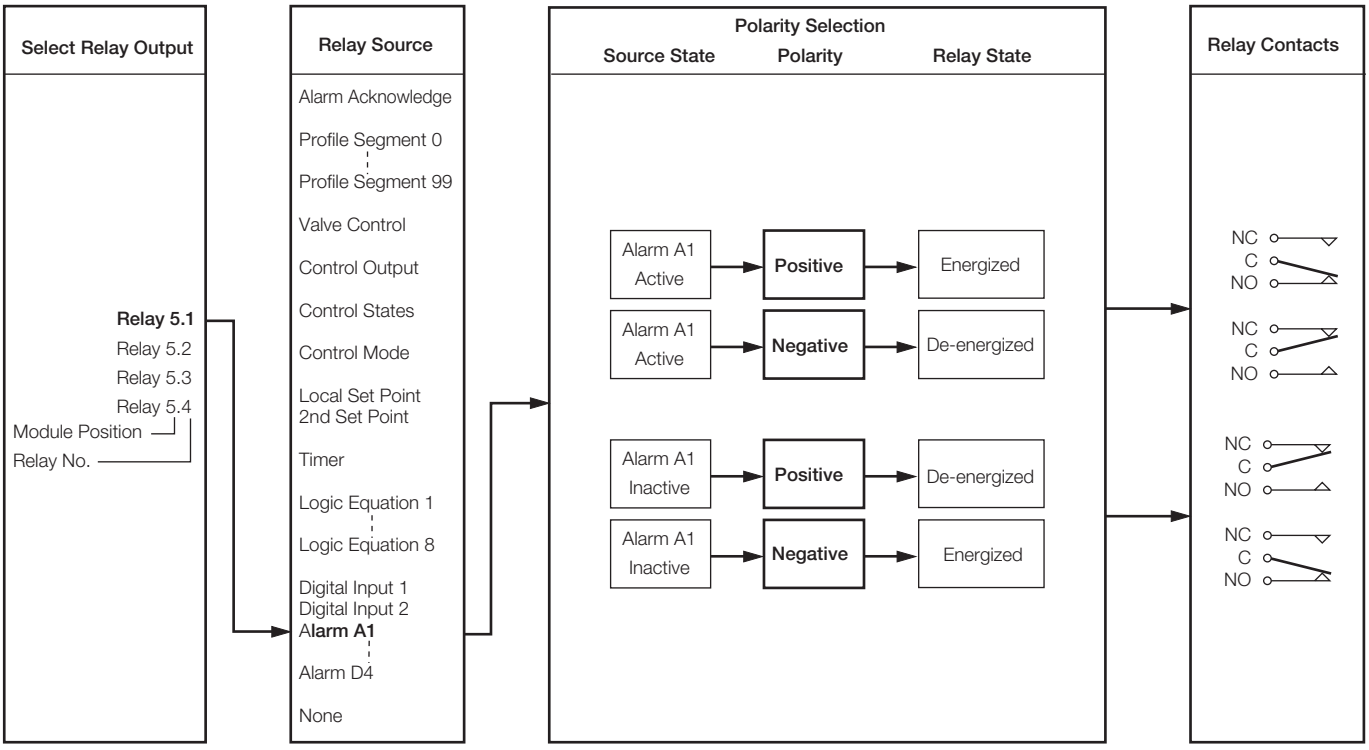
---

Return to **Select Alarm** frame.

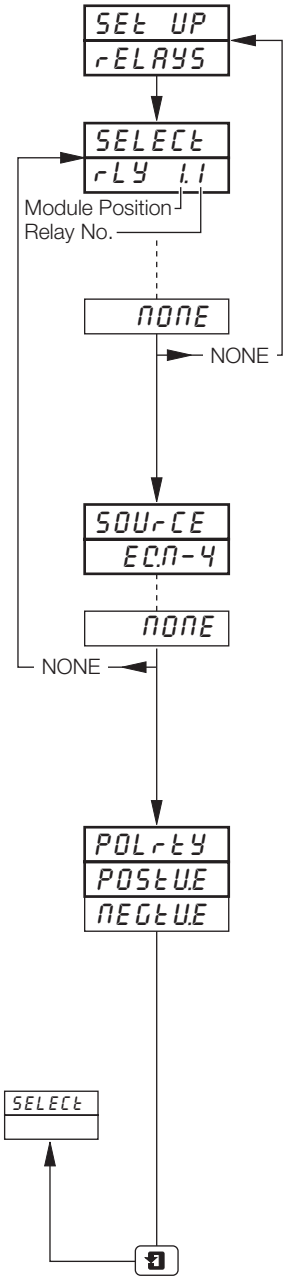
## 3.5 Set Up Relay Output

**Information.**

- **Relays** – can be energized by alarms, logic equation results, digital inputs, control and set point modes, real time events, (timer option), totalizer wrap signal (totaliser option) and ramp/soak programs/segments (profile option).
- **External Totalizer count function** – external counter can only be driven by relays fitted on module type 3 (4 relay module) in module positions 3, 4 and 5.
- **Polarity** – to allow failsafe settings.
- **Control outputs** – time proportioning (on type 1 and 2 modules or the first 2 relays only on type 3 module), valve open/close or on/off control.



## ...3.5 Set Up Relay Output




Page Header – **Set Up Relays**

To advance to **Set Up Digital Output Page** press the ↵ key.

**Select Relay Output**
Select the output to be programmed. The selections in this frame relate to the number of fitted modules with relays and their relative module positions.

**Example** – for a type 3 (four relays) module fitted in position five the following selections are also programmable:

- rELAY 5.1 (position 5, relay 1)
- rELAY 5.2 (position 5, relay 2)
- rELAY 5.3 (position 5, relay 3)
- rELAY 5.4 (position 5, relay 4)

**Note.** In the remaining frames press the ✱ key to view the relay selected.

**Relay Source**
Select the source required to activate the selected relay.

For description of sources, refer to **Table 3.1** on page 18.

**Notes.**

- Time proportioning control can be allocated only to the first two relays on a type 3 (4 relay) module or the relay on types 1 and 2 modules (standard I/O and analog + relay).
- To drive an external counter COUNt.x must be selected.

**Polarity**
The polarity selection is used to invert the effect of the digital source state on the relay state as shown in the following table:

| Source State | Polarity | Relay State |
|---|---|---|
| Active | Positive<br>Negative | Energized<br>De-energized |
| Non-active | Positive<br>Negative | De-energized<br>Energized |

Select the polarity required.

**Caution.** Check connections before operating – see Section 6, **CONNECTIONS & LINKS**.

Return to **Select Relay Output** frame.

| Source | Description |
|---|---|
| AL_ACK | Alarm Acknowledge – Unacknowledged process alarm anywhere in the unit |
| SEG-99<br>⋮<br>SEG-0<br>PG-2.10<br>⋮<br>PG-1.01<br>run-x<br>HOLd-x<br>**PFAIL | Profile segment 99<br>⋮<br>Profile segment 0<br>Profile program 10, Controller 2<br>⋮<br>Profile program 1, Controller 1<br>Profile 1 or 2 running<br>Profile 1 or 2 in Hold mode<br>Power failure<br>} Profile (ramp/soak) control for controller 1 or 2 |
| *OPEN-x<br>CLSE-x | Motorized valve 1 or 2 open<br>Motorized valve 1 or 2 closed<br>} Motorized valve control for controller 1 or 2 (available only on relay and digital outputs) |
| *OnOFFx<br>OP-x<br>OP-xc<br>OP-xh | Control output 1 or 2 on/off<br>Control output 1 or 2 (time proportioning)<br>Control output cool 1 or 2 (time proportioning)<br>Control output heat 1 or 2 (time proportioning)<br>} Available only on relay and digital outputs |
| 2Nd-x<br>LOC-x | Second set point<br>Local set point<br>Set point selected for controller 1 or 2 |
| _AN-x<br>AUtO-x | Manual control<br>Automatic control<br>Control mode selected for controller 1 or 2 |
| t1_Er.2<br>t1_Er.1 | Real time event 2<br>Real time event 1<br>} Real time events (available only if timer option fitted – see **Advanced Software Options Manual** |
| EQN-8<br>⋮<br>EQN-1 | Programmable logic equation 8<br>⋮<br>Programmable logic equation 1<br>} Programmable logic equations – see Section 5.2, **Set Up Logic** |
| rAP-4<br>COUNt. 4<br>⋮<br>rAP-1<br>COUNt.1 | Wrap around on total 4<br>Total 4 external counter drive<br>⋮<br>Wrap around on total 1<br>Total 1 external counter drive<br>} Wrap around and count (available only if totalizer option fitted) |
| dIG-6.8<br>⋮<br>dIG-1.1 | Digital Input 6.8<br>⋮<br>Digital input 1.1<br>**Digital Input number**<br>**Module number** |
| AL-d4<br>AL-C4<br>AL-b4<br>AL-A4 | Alarm D<br>Alarm C<br>Alarm B<br>Alarm A<br>} Channel 4 Alarms (if applicable) |
| AL-d3<br>AL-C3<br>AL-b3<br>AL-A3 | Alarm D<br>Alarm C<br>Alarm B<br>Alarm A<br>} Channel 3 Alarms (if applicable) |
| AL-d2<br>AL-C2<br>AL-b2<br>AL-A2 | Alarm D<br>Alarm C<br>Alarm B<br>Alarm A<br>} Channel 2 Alarms (if applicable) |
| AL-d1<br>AL-C1<br>AL-b1<br>AL-A1 | Alarm D<br>Alarm C<br>Alarm B<br>Alarm A<br>} Channel 1 Alarms |
| NONE | No source required |

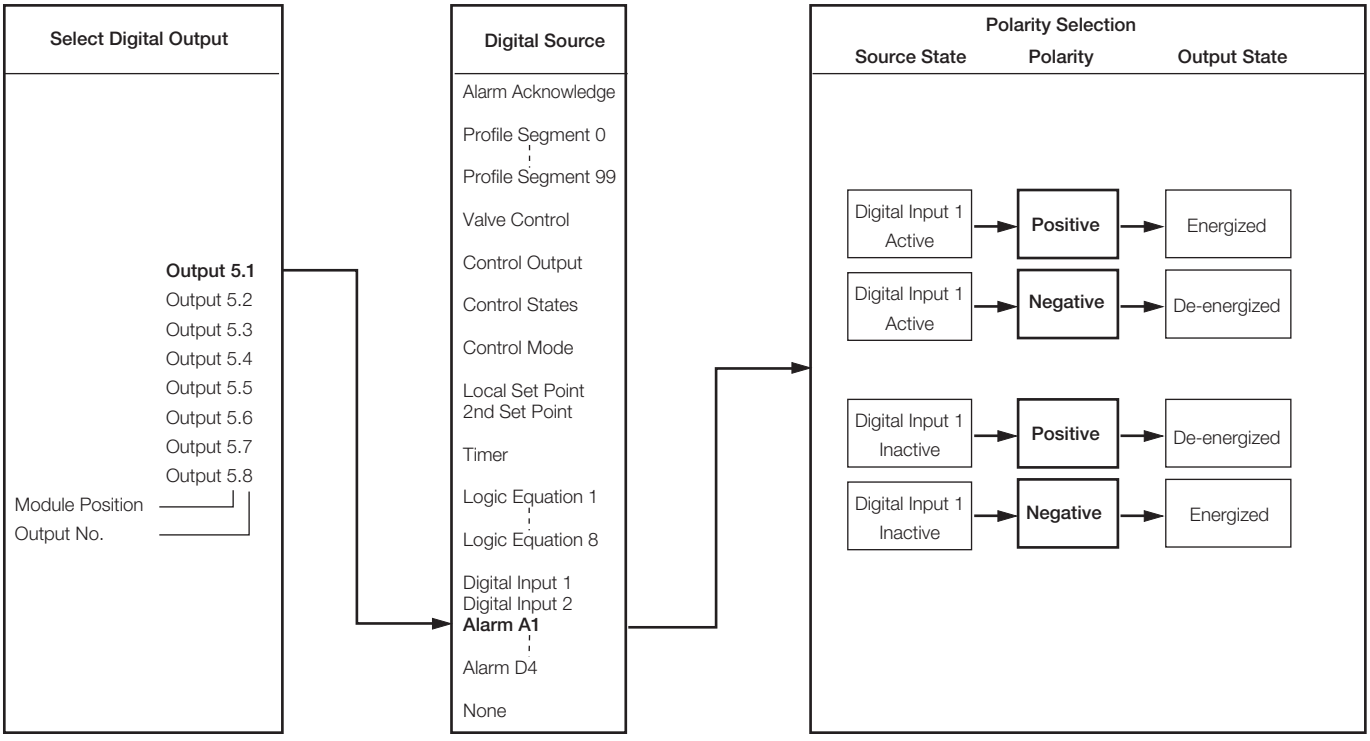
* Available only on 4-relay and 8-digital output modules (types 3 and 5), fitted in module positions 4,5 and 6.
** Available only for relay assignment.

**Table 3.1 Description of Sources**

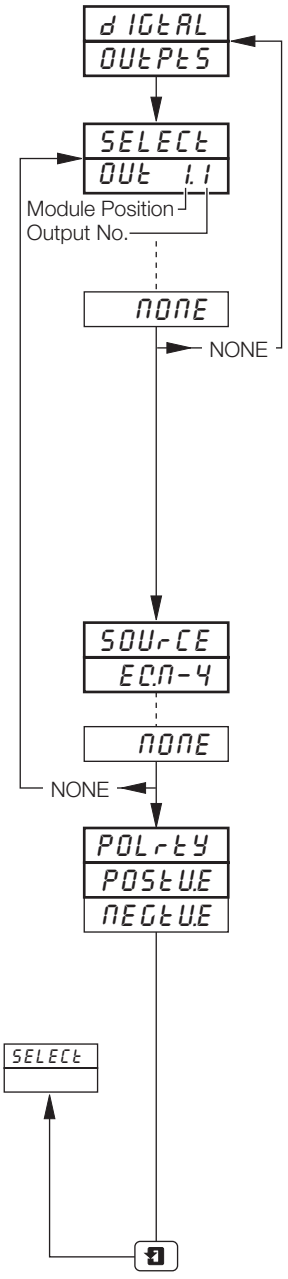
## 3.6 Set Up Digital Output

**Information.**

- **This page is not displayed if there are no digital outputs fitted**.
- **Up to 24 digital outputs are available** – depending on the module types fitted.
- **Digital outputs** – can be energized by alarms, logic equations results, digital inputs, real time events (if timer option is fitted), control modes, set points, ramp/soak profile segments or programs (if fitted) and totalizer wrap signal (if fitted).
- **Control outputs** – time proportioning (on first two digital outputs of any module), valve open/close and on/off control.
- **External Totalizer count function** – external counter can only be driven by a type 5 module (8 digital outputs) fitted in module positions 4, 5 or 6.
- **Polarity** – inverts the effect of the selected source on the output state.



## …3.6 Set Up Digital Output




Page Header – **Set Up Digital Outputs**

To advance to **Set Up Analog Output Page** press the ↵ key.

**Select Digital Output**
Select the output to be programmed – the selections in this frame relate to the number of fitted digital output modules and their relative module positions.

**Example** – for a type 5 (eight digital outputs) module fitted in position five the following selections are also programmable:

- OUt 5.1 (position 5, output 1)
- OUt 5.2 (position 5, output 2)
- OUt 5.3 (position 5, output 3)
- OUt 5.4 (position 5, output 4)
- OUt 5.5 (position 5, output 5)
- OUt 5.6 (position 5, output 6)
- OUt 5.7 (position 5, output 7)
- OUt 5.8 (position 5, output 8)

**Note.** In the remaining frames press the ✱ key to view the output selected.

**Output Source**
Select the source required to activate the selected digital output.

For description of sources, refer to **Table 3.1** on page 18.

**Note.** To drive an external counter COUNt.x must be selected.

**Polarity**
The polarity selection is used to invert the effect of the source state on the output as shown in the following table:

| Source State | Polarity | Output State |
|---|---|---|
| Active | Positive<br>Negative | Energized<br>De-energized |
| Non-active | Positive<br>Negative | De-energized<br>Energized |

Select the polarity required.

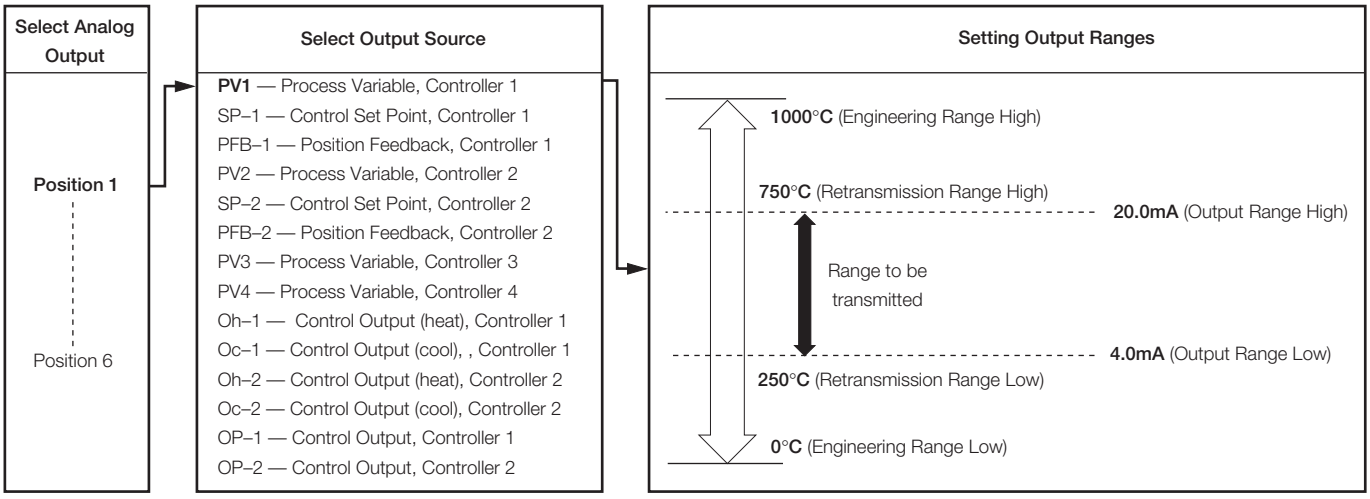
**Caution.** Check connections before operating – see Section 6, **CONNECTIONS & LINKS**.

Return to **Select Digital Output** frame.

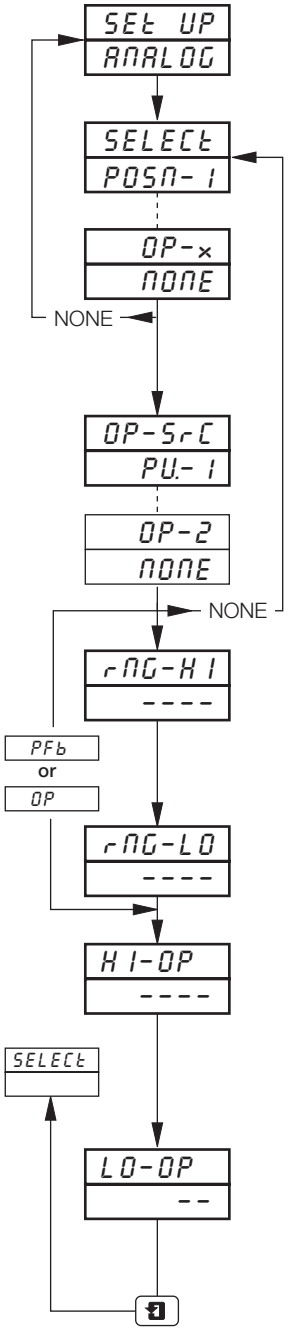
## 3.7 Set Up Analog Output

**Information.**
- **Fitted analog outputs** – assignable to retransmit any input (process variable, remote set point or position feedback) or provide the control output.
- **Selectable retransmission range** – allows maximum resolution on range of interest.
- **Adjustable output range** – for non-standard and reversed outputs.

**Note.** The example below shows analog output 1 set to retransmit part of process variable 1's engineering range (250 to 750°C) as a 4.0 to 20.0mA current output.



## …3.7 Set Up Analog Output




Page Header – **Set Up Analog Output**

To advance to **Digital Inputs Page** press the ⊡ key.

**Select Analog Output**
Select the analog output position to be programmed. The selections in this frame relate to the number of fitted modules with analog output.

**Example** – Output 1 is the analog output in position 1 (fitted on the main board), output 3 is the analog output fitted in module position 3.

**Note.** In the remaining frames press the ✱ key to view the analog output selected.

---

**Output Source**
Select output source required. The selections in this frame correspond to the inputs (Process Variable, Set Point and Position Feedback) and controller outputs available.

---

**Retransmission Range High**
Set the engineering range value (in engineering units) at which maximum output is required.

---

**Retransmission Range Low**
Set the engineering range value (in engineering units) at which minimum output is required.

---

**Output Range High**
Set the maximum current output required for the **Retransmission Range** programmed between 2.0 and 20.0mA.

---

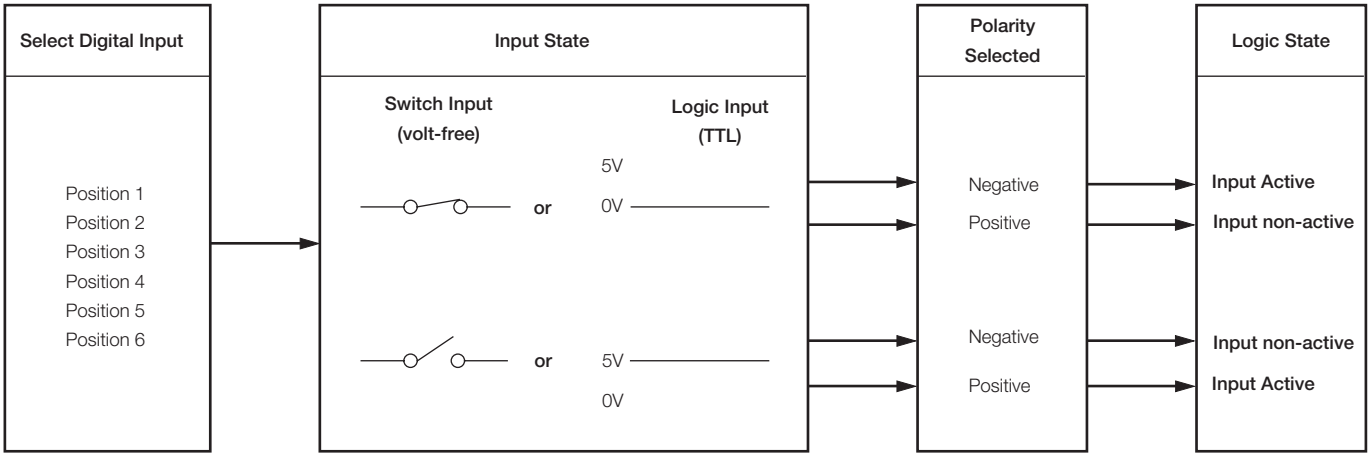
**Output Range Low**
Set the minimum current output required for the **Retransmission Range** programmed between 2.0 and 20.0mA.

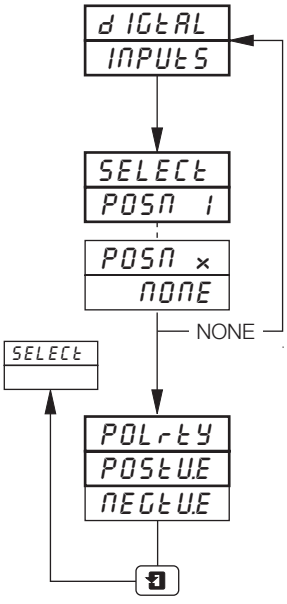
---

Return to **Select Analog Output** frame.

## 3.8 Digital Inputs

**Information.**
- **Up to 30 digital inputs are available** – depending on the module types fitted.
- **Volt-free contacts or TTL levels**.
- **Polarity** – sets the logic state (unchanged or inverted) for the module position(s).




Page Header – **Digital Inputs**

To advance to **Access Page** press the ⏎ key.

**Select Digital Input**
Select digital module position to be programmed.

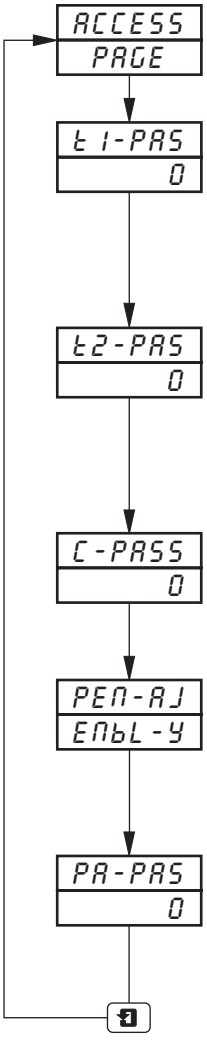
**Note.** In the remaining frames press the ✱ key to view the module position selected.

**Polarity**
Select the polarity required for the module position selected above:
- POStUE – logic input state unchanged
- nEGtUE – logic input state inverted

Return to **Select Digital Input** frame.

## 3.9 Access Page

**Information.**
- **Configurable password protection** – of programming levels.
- **Internal security link** – enable/disable password protection.




Page Header – **Access Page**.

To advance to **Scale Adjust Page** press the ⏎ key.

**Tune Passsword 1 (Controller 1)**
A tune password can be assigned to controller 1 to prevent access to its control settings.

Set the required password, between 0 and 9999.

Not available if channel 1 is not a controller.

**Tune Password 2 (Controller 2)**
A tune password can be assigned to controller 2 to prevent access to its control settings.

Set the required password, between 0 and 9999.

Not available if channel 2 is not a controller.

**Configuration Password**
Prevents access to the programming pages.

Set the required password, between 0 and 9999.

**Pen Adjust Enable**
Enables / Disables the pen adjustment feature.

This allows the position of any trend to be adjusted for checking against a reference standard. The displayed value is not changed.

**Pen Adjust Password**
Prevents access to the pen adjustment.

Set the required password, between 0 and 9999.

Return to top of **Access Page**.

## ...3.9 Access Page

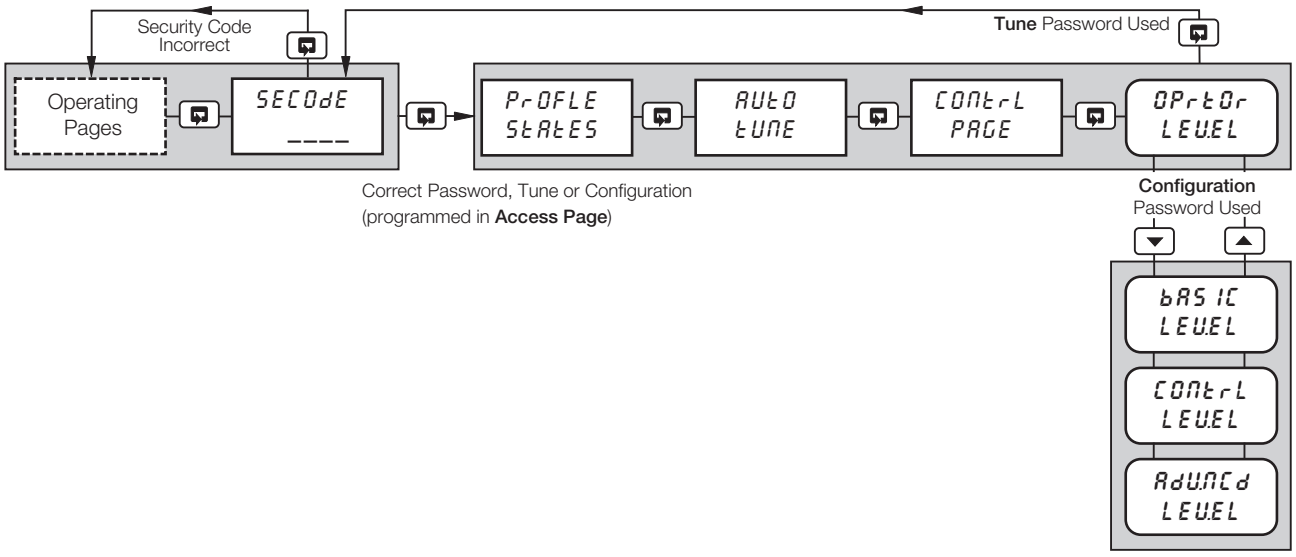



Fig. 3.9 Use of Security Code in Operator Level

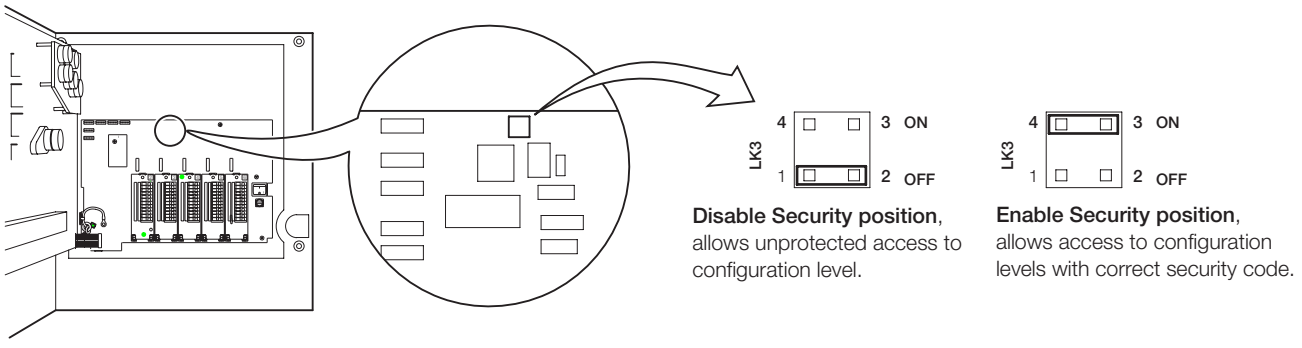
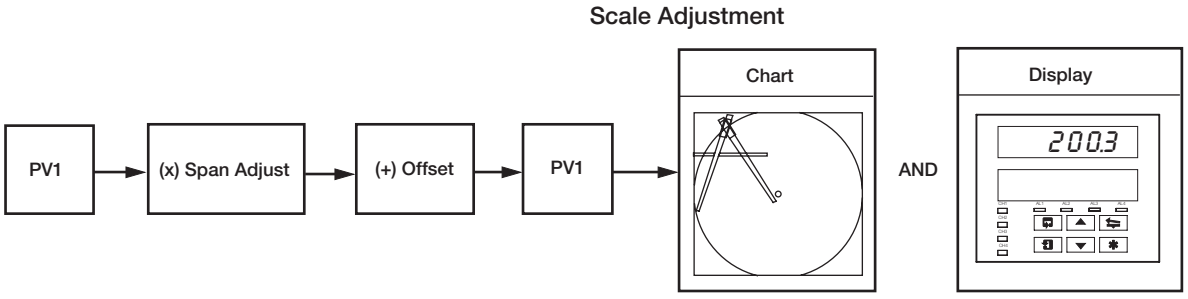


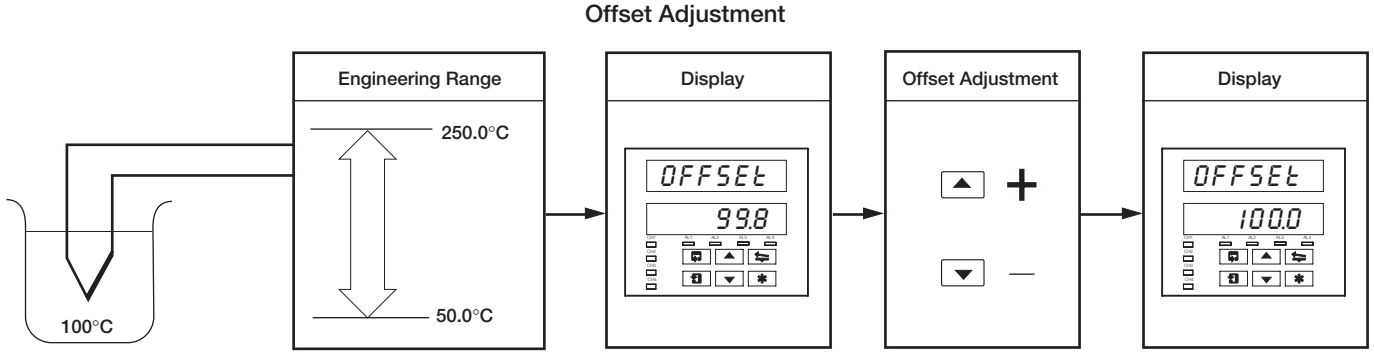

Fig. 3.10 Location of Security Link

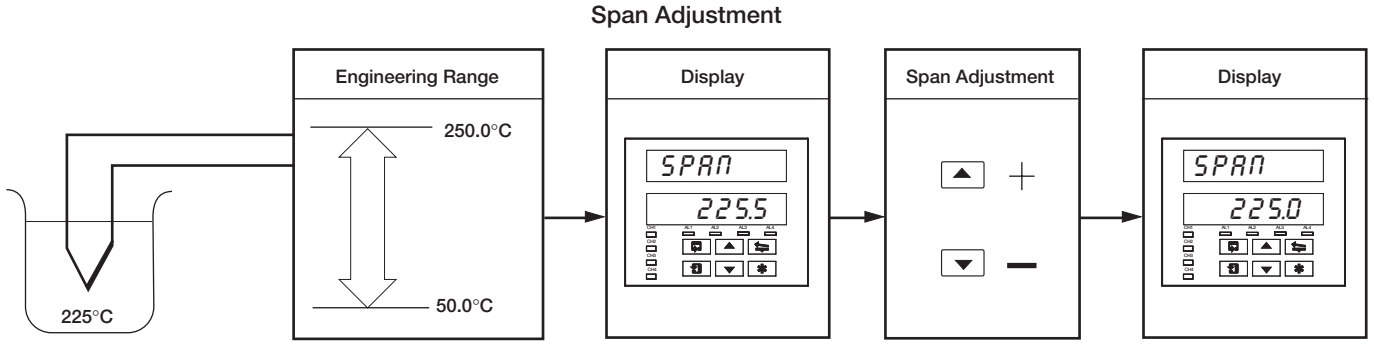
## 3.10 Scale Adjust

**Information.**

- **Analog Inputs** – do not require re-calibrating when the input type or range is changed.
- **Span and offset adjust reset** – removes any previously programmed Offset or Scale Adjustment settings.
- **System offsets errors** – can be removed from Process Variables, Remote Set Points and Position Feedback inputs using Scale Offset Adjustment.
- **System scale errors –** can be removed from Process Variables, Remote Set Points and Position Feedback inputs using span adjustment.
- **Offset/span adjustment** – can be used to perform spot calibration.
- **Pen(s)** – can be independently calibrated and checked across the full range of the chart.
- **Mains filter** – selectable for maximum noise rejection.
- **Pen Linearity Check** – automatically draws a pen linearity test pattern.



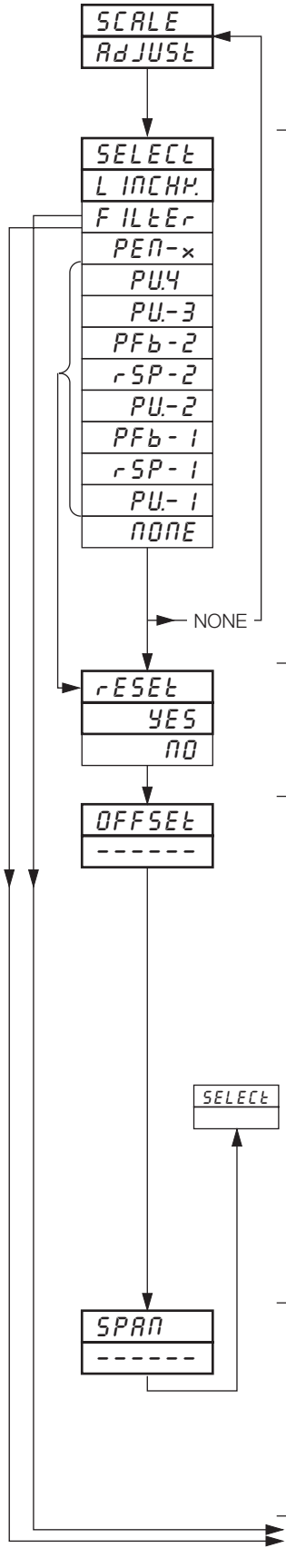




**Note. As a general rule:**

use **Offset** adjustment for spot calibration at **<50%** of engineering range span.
use **Span** adjustment for spot calibration at **>50%** of engineering range span.

## ...3.10 Scale Adjust




Page Header – **Scale Adjust**

To advance to **BASIC CONFIGURATION LEVEL** frame use the [↵] key.

**Select Process Variable/Pen**

Select process variable or pen required:

- L INCHK. – the pens automatically draw a test pattern to check pen linearity. dONE is displayed on completion
- FILtEr – mains frequency filter
- PEn x – pens 1 to 4
- PU.-4 – process variable on channel 4 } displayed only if selected in the
- PU.-3 – process variable on channel 3 } **Input Asignment Page**
- PFb-2 – valve position feedback on controller 2
- rSP-2 – remote set point on controller 2 } displayed only if selected in the
- PU.-2 – process variable on channel 2 } **Input Asignment Page**
- PFb-1 – valve position feedback on controller 1
- rSP-1 – remote set point on controller 1
- PU.-1 – process variable on channel 1
- nONE – None

**Note.** In the remaining frames press the [✱] key to view the input or pen selected. Only pens assigned to trend fuctions are displayed in this frame.

**Scale Adjustment Reset**

Set YES to reset the offset and span values to their nominal values (values are reset on advancing to the next frame).

**Offset Adjustment**

**Electrical and resistance inputs**: apply the correct input for the spot calibration required.

**RTD inputs:** use resistance values obtained from standard tables.

**Thermocouple Inputs:** measure the ambient temperature at the output terminals of the signal source (calibrator). From thermocouple tables obtain the millivolt equivalent of this temperature (a) and that for the spot calibration temperature (b). Subtract (a) from (b) and set the signal source to the resultant value. (The voltage is negative if the spot calibration temperature is below the measured ambient temperature).

**Note.** The displayed units are engineering units.

Set the value required. The decimal point position is set automatically.

**Example** – If the display range is 50.0 to 250.0 and a spot calibration is required at 100 and 225, inject a signal equivalent to 100 and set the display to 100.0 using the [▲] and [▼] keys.

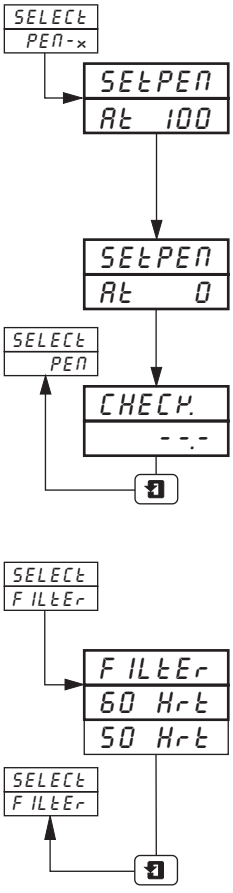
**Span Adjust**

Proceed as for **Offset Adjustment** above and apply the correct input for the spot calibration required. The displayed units are engineering units. Set the value required. The decimal point is set automatically.

For the example above, inject a signal equivalent to 225 and then set the display to 225.0.

Continued on next page.

## …3.10 Scale Adjust




**Calibrate Pen At 100%**
Drives the pen automatically to the full scale position on the chart.

Use the ▲ and ▼ keys to set pen to 100% on the chart.

**Calibrate Pen At 0%**
Drives the pen automatically to the zero position on the chart.

Use the ▲ and ▼ keys to set pen to 0% on the chart.

**Check Pen Calibration**
The pen calibration can be checked at any point on the chart.

Use the ▲ and ▼ keys to move the selected pen from the zero point up to the 100% position on the chart.

**Note.** If the true time event option is fitted the red pen does not move beyond the 94% position on the chart.

**Select Filter**
Select the mains frequency of the supply used to ensure maximum noise rejection on analog inputs.

Return to **Select Process Variable/Pen** frame.

# 4 CONTROL CONFIGURATION LEVEL

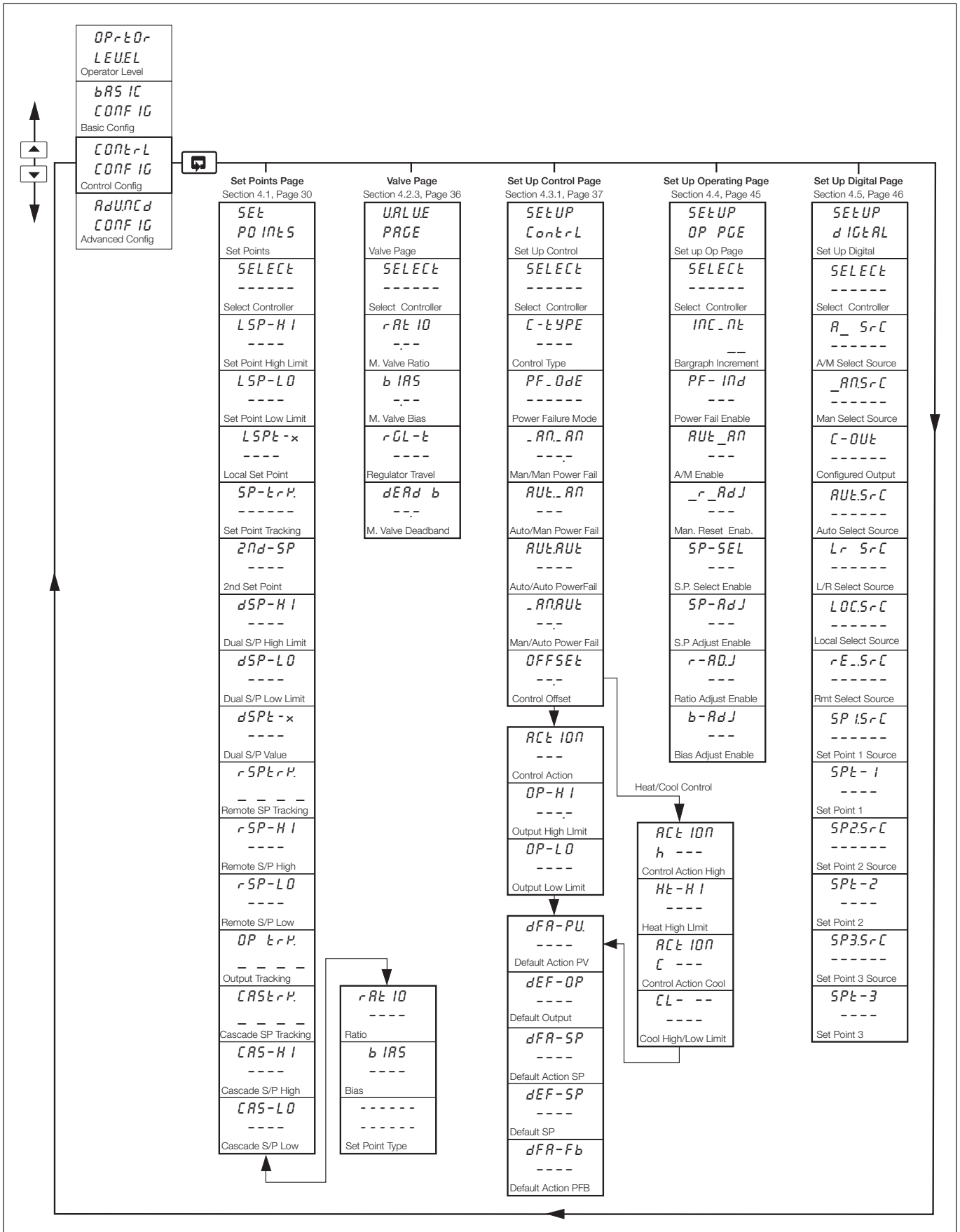



**Fig. 4.1 Control Configuration Level**

## 4.1 Set Points

**Information.**

- **Two local set points** – Local and Dual.
- **Remote set point facility** – with Ratio and Bias.
- **Remote set point tracking options** – for bumpless Remote-to-Local set point transfers.
- **Cascade control on second controller with optional output tracking**.
- **Adjustable high and low limits for all set point types**.
- **Set point tracking for bumpless Manual-to-Auto transfers**.

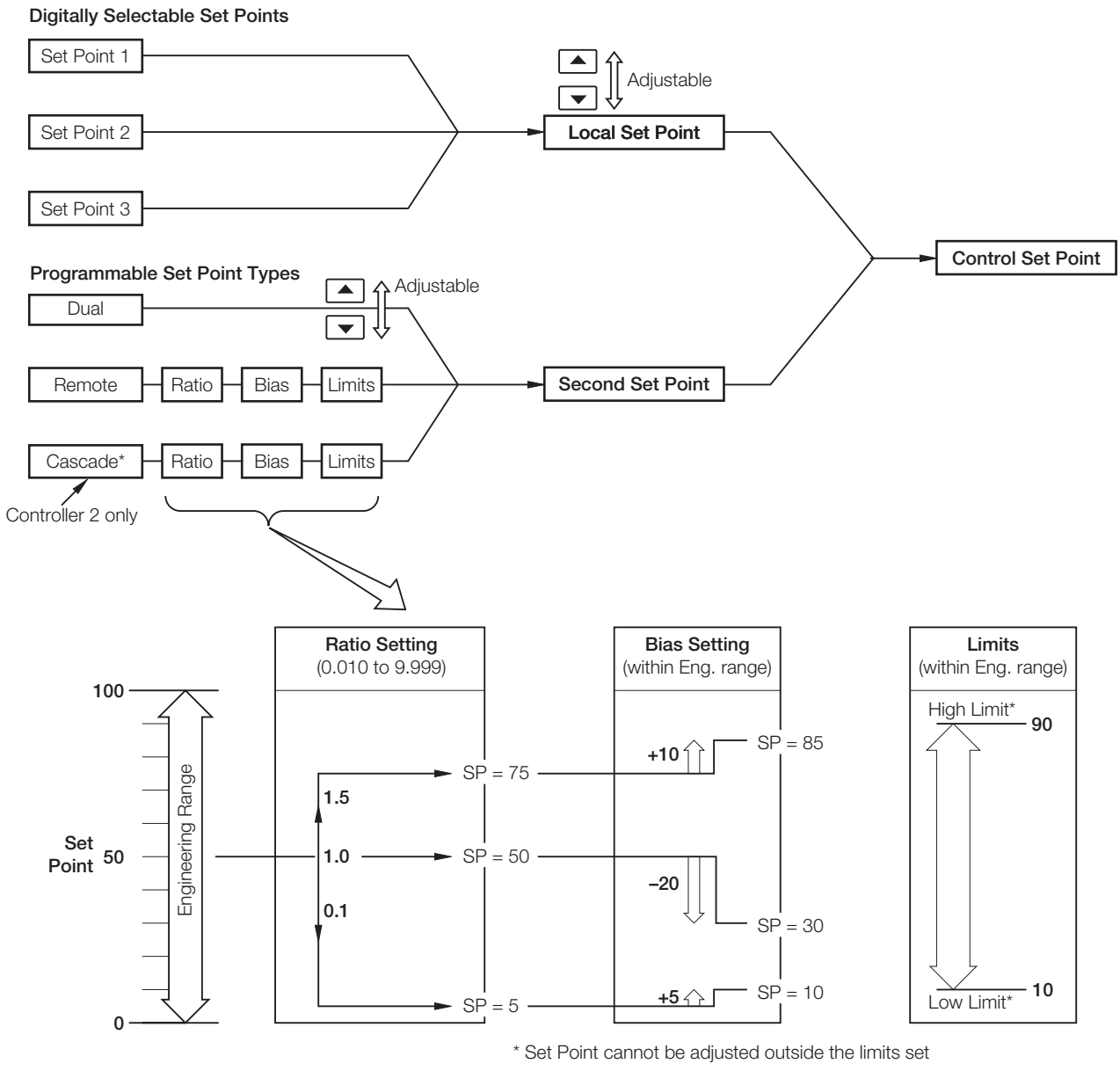


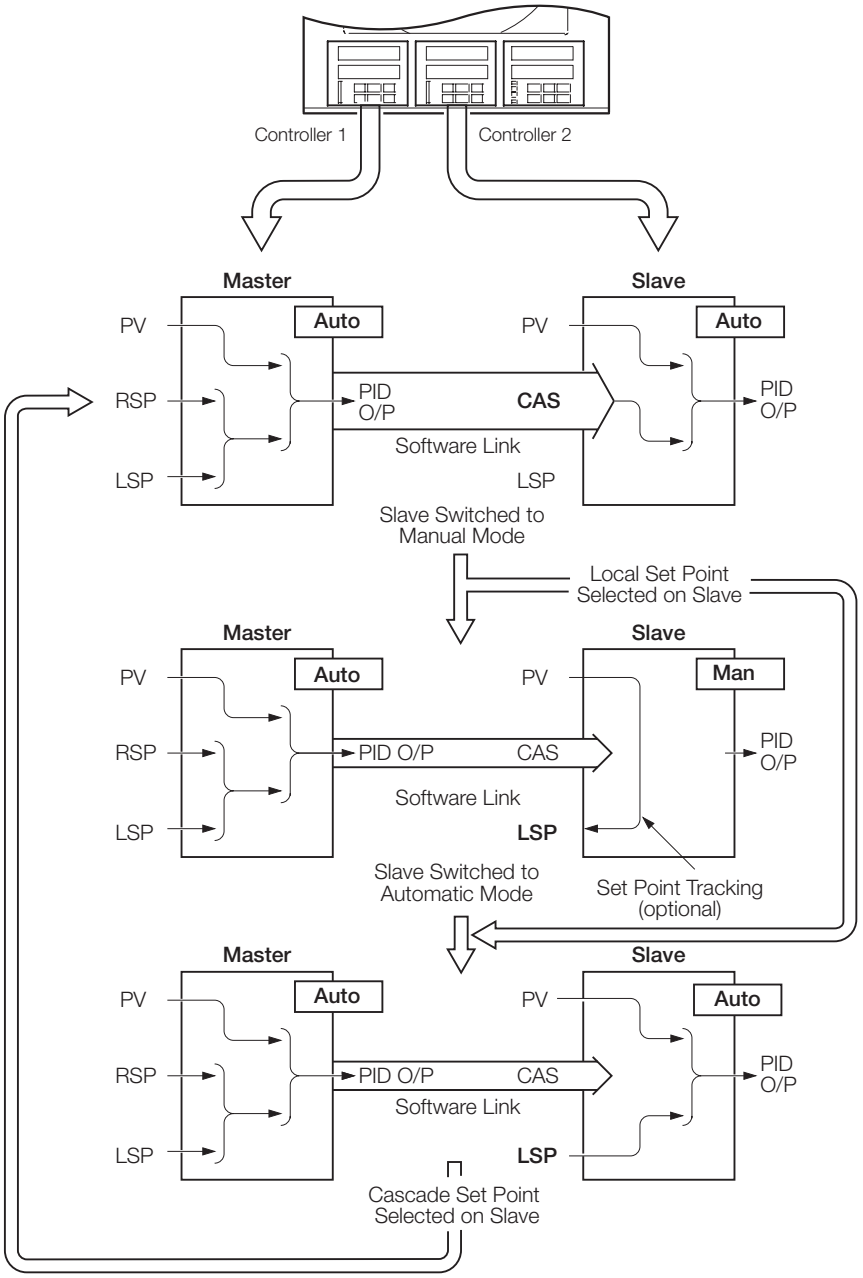

**Fig. 4.2 Set Point Types**

## ...4.1 Set Points

**Information.**

- **Cascade control** – comprises two series-connected controllers (master and slave), each containing a complete measuring and controlling system operating on a single regulating device. Cascade control is only available when two control front panels are fitted (channel 1 and channel 2) and channel 2 has no Remote set point facility. Channel 1 is the 'Master' controller and channel 2 is the 'Slave' controller.
- **Cascade control with output tracking** – ensures bumpless transfer when switching between auto/manual modes, i.e. when the slave is switched to Manual it switches the Master to Manual, automatically.
- **Cascade control with set point tracking** – ensures bumpless transfer when switching between local/cascade set points modes.

### 4.1.1 Cascade Control (without output tracking)




**Full Automatic Cascade Control Mode**
A ratio and bias can be applied to the cascade set point (derived from the master output) to give the required slave set point.

To switch to **Manual Mode**, press the key to select manual mode on the slave.
To switch to **Local Set Point Mode**, select local set point in **Operating Page** of the slave.

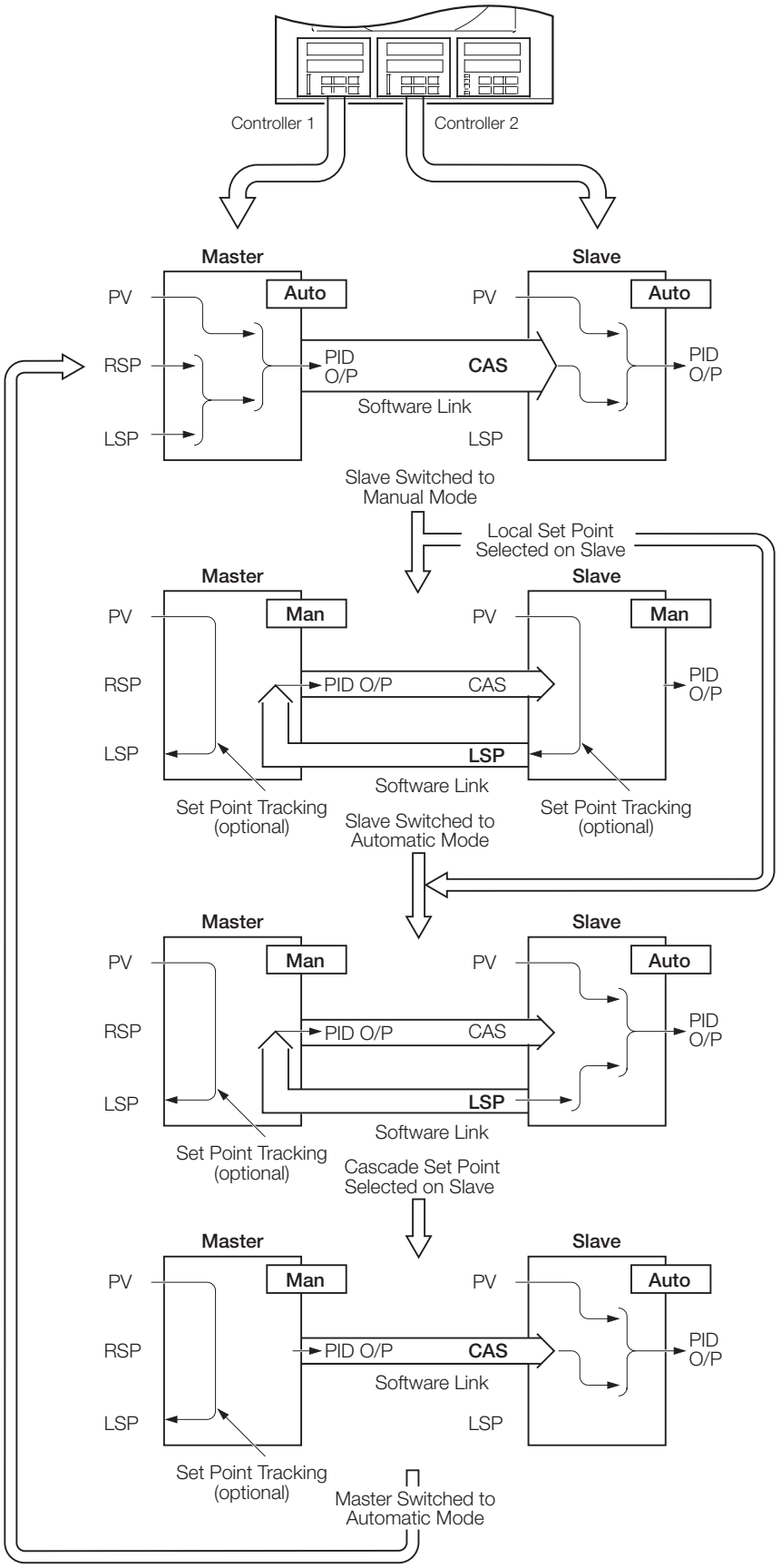
**Manual Mode**
If the slave is switched from automatic control to manual control, with cascade set point selected, the set point type automatically reverts to local, irrespective of the output tracking setting.

**Local Set Point Mode**
If local set point is selected on the slave when in **Full Automatic Cascade Mode**, operation of the master is not affected.

To return to **Full Automatic Cascade Mode**:

Press the key to select automatic mode on the slave and select cascade set point in **Operating Page** of the slave.

### 4.1.2 Cascade Control (with output tracking)




**Full Automatic Cascade Control Mode**
A ratio and bias can be applied to the cascade set point (derived from the master output) to give the required slave set point.

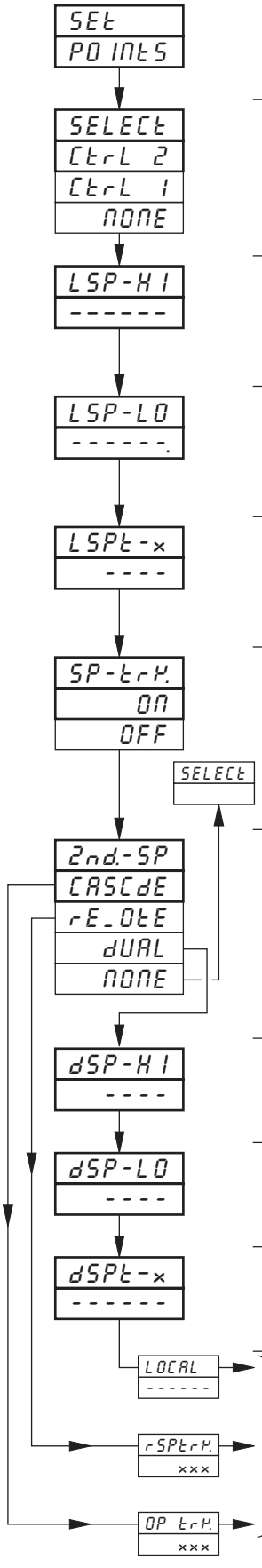
To switch to **Manual Mode**, press the ⚿ key to select manual mode on the slave.
To switch to **Local Set Point Mode**, select local set point in **Operating Page** of the slave.

**Manual Mode**
If the slave is switched from automatic control to manual control, with cascade set point selected, the set point type automatically reverts to local, irrespective of the output tracking setting. The master is automatically switched to manual control.

**Local Set Point Mode**
If local set point is selected on the slave when in **Full Automatic Cascade Mode**, the master is automatically switched to manual mode.

To return to **Full Automatic Cascade Mode**: press the ⚿ key to select automatic mode on the slave, select cascade set point in **Operating Page** of the slave and press the ⚿ key to select automatic mode on the master.

### 4.1.3 Set Points Page




Page Header – **Set Points**.

To advance to **Valve Page** press the [⏎] key.

---

**Select Controller**
Select the controller to be programmed (1 or 2).

**Note.** In the remaining frames press the [✱] key to view the controller selected.

---

**Local Set Point High Limit**
The high limit is the maximum value to which the local set point can be adjusted.
Set the value required. The decimal point position is set automatically.

---

**Set Point Low Limit**
The low limit is the minimum value to which the local set point can be adjusted.
Set the value required. The decimal point position is set automatically.

---

**Local Set Point Value**
Set the value required, within the limits set above. The decimal point position is set automatically to that of the engineering range (**Set Up Input Page**, **BASIC CONFIGURATION LEVEL**).

---

**Set Point Tracking Enable**
If Set Point Tracking is enabled and the controller is in Manual mode the local set point tracks the process variable. When the controller is in Set Point Tracking mode the local set point limits can be exceeded. If the local set point is outside of its limits when automatic control mode is selected, the local set point value can only be adjusted towards its limits. Once within the limits they apply as normal. Select *ON* to enable or *OFF* to disable.

---

**Second Set Point Type:**
enables the setting up of a second set point in addition to the local set point.
Select the second set point type, *NONE* (no second set point), *dUAL* (a second local set point), *rE_OtE* (remote set point), or *CASCdE* (only available on controller 2).

**Note.** The *rE_OtE* selection is displayed only if enabled in the **Input Assignment Page**, **ADVANCED CONFIGURATION LEVEL**.

---

**Dual Set Point High Limit**
The high limit is the maximum value to which the dual set point can be adjusted.
Select the value required. The decimal point position is set automatically.

---

**Dual Set Point Low Limit**
The low limit is the minimum value to which the dual set point can be adjusted.
Select the value required. The decimal point position is set automatically.

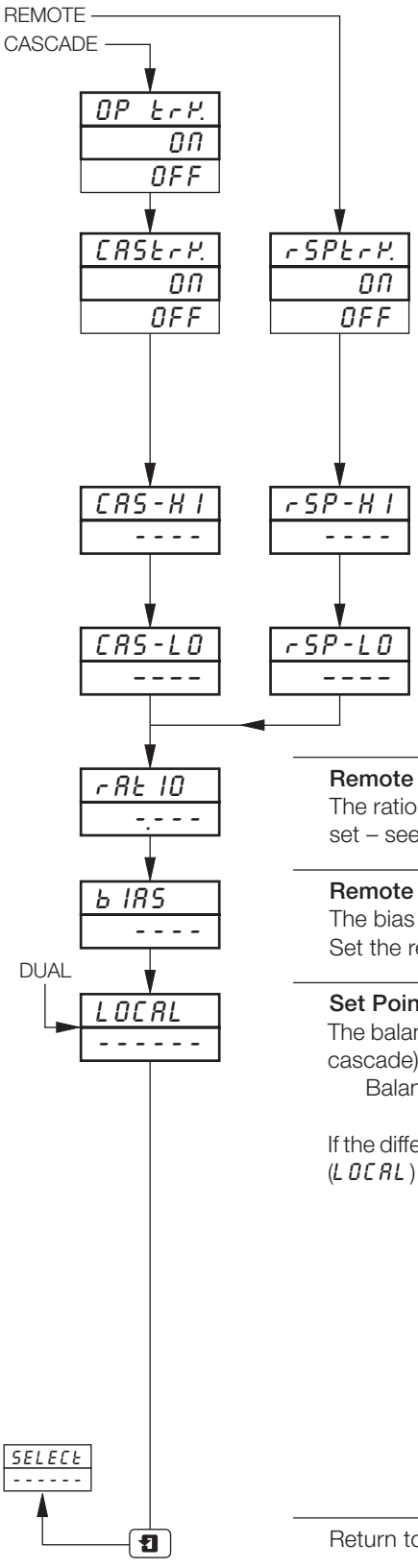
---

**Dual Set Point Value**
Set the value required, within the limits set above. The decimal point position is set automatically to that of the engineering range (**Set Up Input Page**, **BASIC CONFIGURATION LEVEL**).

---

Continued on next page.

### …4.1.3 Set Points Page




**Output Tracking Enable**
With Output Tracking enabled, if the slave controller is changed to local set point, the Master output tracks the local set point value of the slave.

**Remote (Cascade) Set Point Tracking Enable**
If Remote (Cascade) Set Point Tracking is enabled and the controller is in Remote (Cascade) mode the local set point tracks the remote set point. When the controller is in Remote (Cascade) Set Point Tracking mode the local set point limits can be exceeded. If the local set point is outside of its limits when selected, the set point can only be adjusted towards its limits. Once within the limits they apply as normal. With remote set point tracking enabled; if the controller is put into manual mode, the set point reverts from remote to local. Select *ON* to enable or *OFF* to disable.

**Remote (Cascade) Set Point High Limit**
The high limit is the maximum value to which the remote (cascade) set point can be adjusted.
Select the value required. The decimal point position is set automatically.

**Remote (Cascade) Set Point Low Limit**
The low limit is the minimum value to which the remote (cascade) set point can be adjusted.
Select the value required. The decimal point position is set automatically.

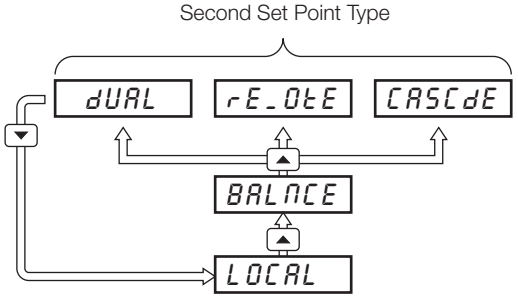
**Remote (Cascade) Set Point Ratio**
The ratio is a scaling factor, i.e. multiplies the remote (or cascade) set point input by the ratio value set – see Fig. 4.2. Set the required ratio, between 0.010 and 9.999 in 0.001 increments.

**Remote (Cascade) Set Point Bias**
The bias is an offset which is added to the remote (cascade) set point value – see Fig. 4.2.
Set the required bias, in engineering units.

**Set Point Type Selection**
The balance (*bALnCE*) display shows the difference between the local and second (remote, dual or cascade) values, i.e.

Balance = Second set point – Local set point

If the difference is too great, press the ⇧ or ⇩ key to exit this frame, select the local set point frame (*LOCAL*) in this page or the **Operating Page** and adjust to an acceptable balance.




Return to **Select Controller** frame.

## 4.2 Motorized Valve Control

**Information.**

- **This page is not displayed if position proportioning or boundless control is not enabled on either controller**.
- **Motorized valve control with or without feedback** – position-proportioning (with feedback) or boundless (without feedback).
- **Ratio and bias settings** – can be applied to adjust the range of valve travel (position-proportioning only).
- **Deadband setting** – adjustable to minimize hunting of the motorized valve.

### 4.2.1 Motorized Valve with Feedback (Position-Proportioning) – Fig. 4.3

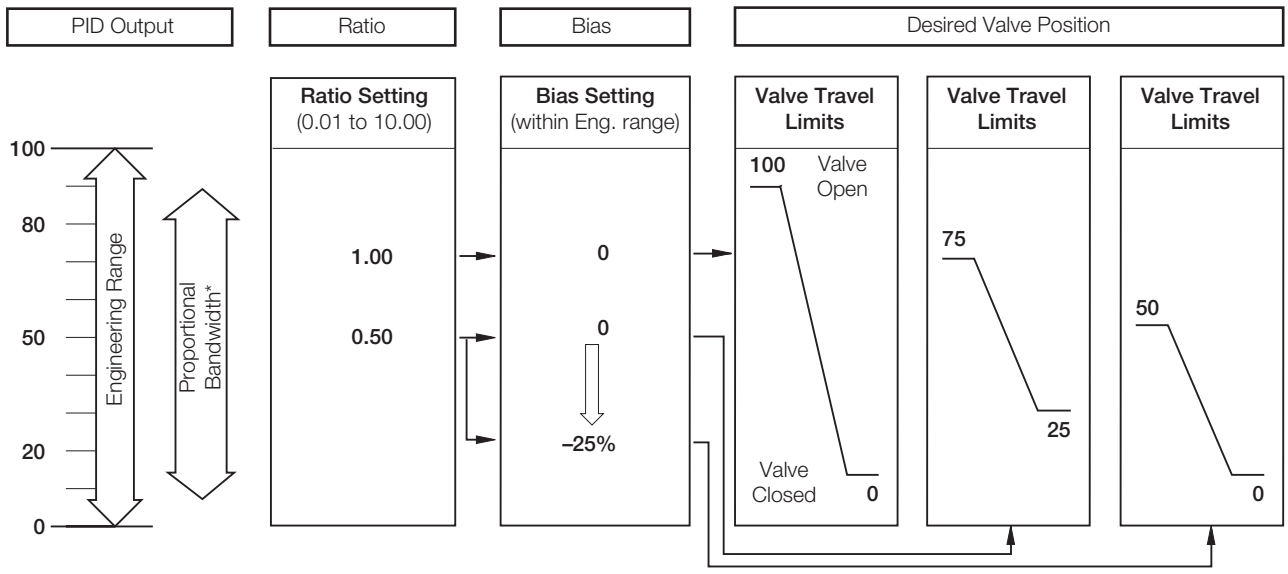



**Fig. 4.3 Position-Proportioning Schematic Diagram**

### 4.2.2 Motorized Valve Control without Feedback (Boundless) – Fig. 4.4

A 'boundless' process controller provides an output that is effectively the time derivative of the required regulator position, i.e. the controller 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 controller does not need to know the absolute regulator position and is unaffected when the regulator reaches the upper or lower limit, as determined by the regulator's limit switches (giving rise to the term 'boundless').

In this system, the final regulator must act as an integrator, integrating both the raise and lower pulses in direction and duration so that the final position of the regulator reproduces the required 2 or 3 term control function, and must remain stationary indefinitely in the absence of raise or lower commands.

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.

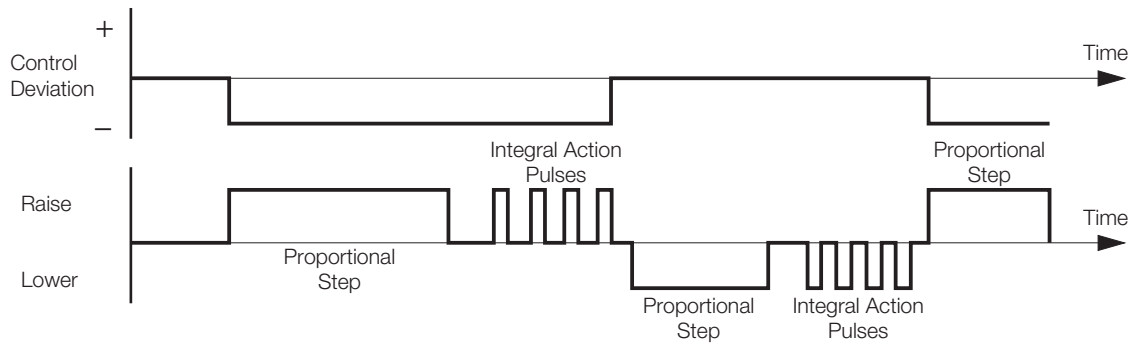
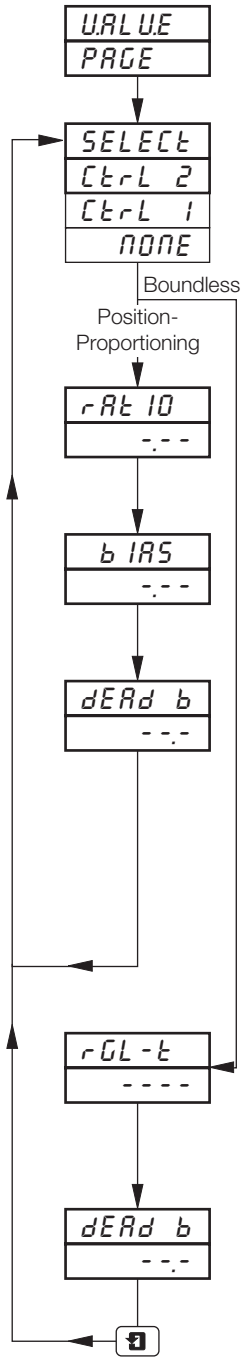



**Fig. 4.4 Boundless Control Action**

### 4.2.3 Valve Page




Page Header – **Valve Page**.

To advance to **Set Up Control Page** press the ⏎ key.

**Select Controller**
Select the controller to be programmed (1 or 2).

**Note.** In the remaining frames press the ✱ key to view the controller selected.

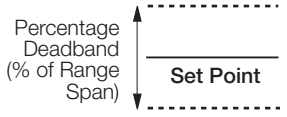
**Ratio**
The Ratio is a scaling factor, i.e. multiplies the position feedback input by the value set here.

Set the required feedback ratio, between 0.01 and 10.00 in 0.01 increments.

**Bias**
The Bias is an offset set as a percentage of the display full scale.

Set the required feedback bias, between –100.0 and +100.0% in 0.1% increments.

**Dead Band**




Deadband is set as a percentage of the position feedback span, between 0.0 and 10.0%, to produce a deadband around the valve control value. This gives minimum 'hunting' of the motorized valve.

**Example** – if the valve is to be driven to 50% open position and the deadband is set to 4.0%, the motor stops driving when the position feedback is 48%. The deadband is between 48% and 52%.

Return to **Select Controller** frame.

**Regulator Travel Time**
This is the time set for the regulator to travel from the fully open to the fully closed position or from the fully closed to the fully open position.

Set the value required in seconds, between 1 and 5000 seconds.

**Dead Band**
Deadband is set as a percentage of the engineering range. Set a value which gives minimum hunting of the regulator, between 0.0 and 10.0 in 0.1% increments.

Return to **Select Controller** frame.

### 4.2.4 Calculation for Control Pulses, Steps and Deviation (Boundless Control only)

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

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

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

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

Duration of the proportional step

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

% Control Deviation

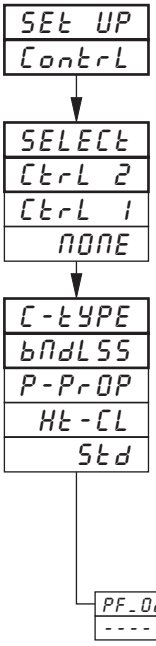
$$= \frac{\text{Set Point – Process Variable}}{\text{Span}} \text{ x 100\%}$$

## 4.3 Set Up Control

**Information.**

- **Control types** – Current Proportioning, Time Proportioning (and On/Off), Position-proportioning (motorized valve control with feedback), Boundless and Heat/Cool.
- **Programmable power-up control modes and outputs**.
- **Reverse and direct control actions**.
- **High and low output limits**.
- **Programmable fault actions** – enable fault actions on any of the inputs (process variable, remote set point and position feedback) to be controlled.

### 4.3.1 Set Up Control Page (control type)




Page Header – **Set Up Control**.

**Select Controller**
Select the controller to be programmed (1 or 2).

**Note.** In the remaining frames press the ✱ key to view the controller selected.

**Control Type**
Select the control type required:

- bNdLSS – (Boundless) for motorized valve control, without position feedback
- P-PrOP – (Position-Proportioning) motorized valve control, with position feedback
- Ht-CL – (Heat/Cool) dual output control
- Std – (Standard) current proportioning, time proportioning and on/off

Continued on page 39.

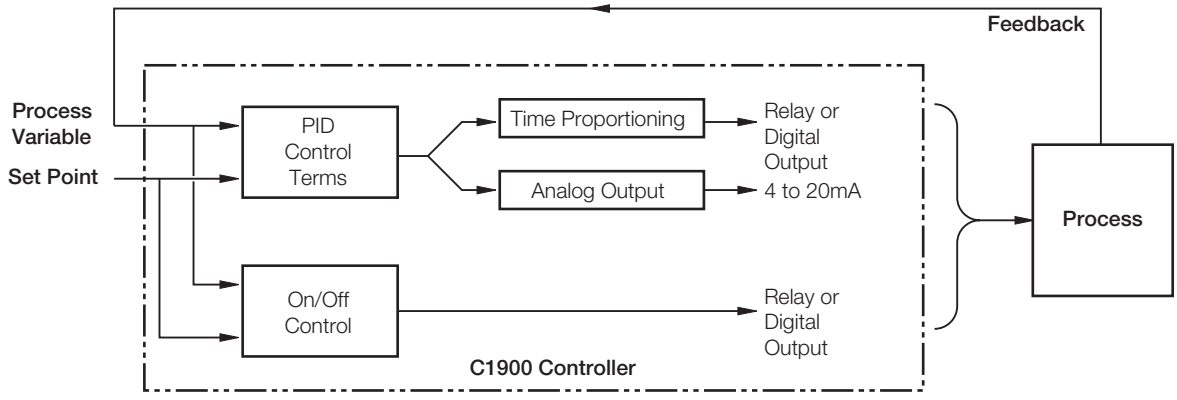



**Fig. 4.5 Standard Control Schematic Diagram**

### ...4.3.1 Set Up Control Page (control type)

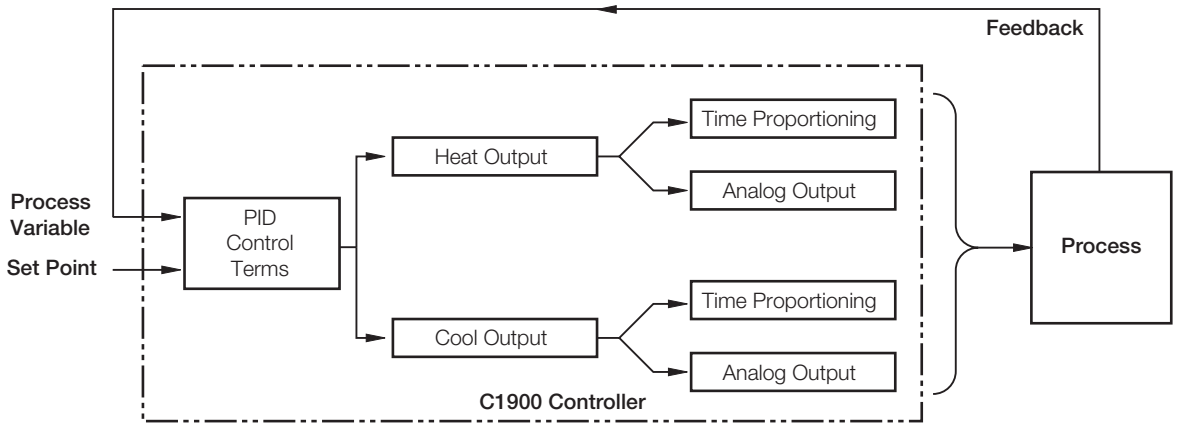



Fig. 4.6 Heat/Cool Control Schematic Diagram

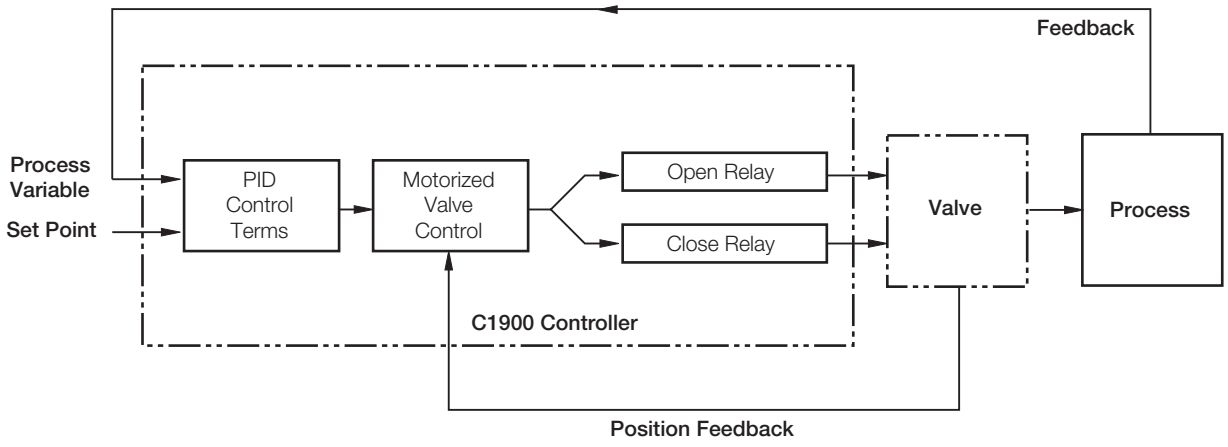



Fig. 4.7 Proportional Control Schematic Diagram

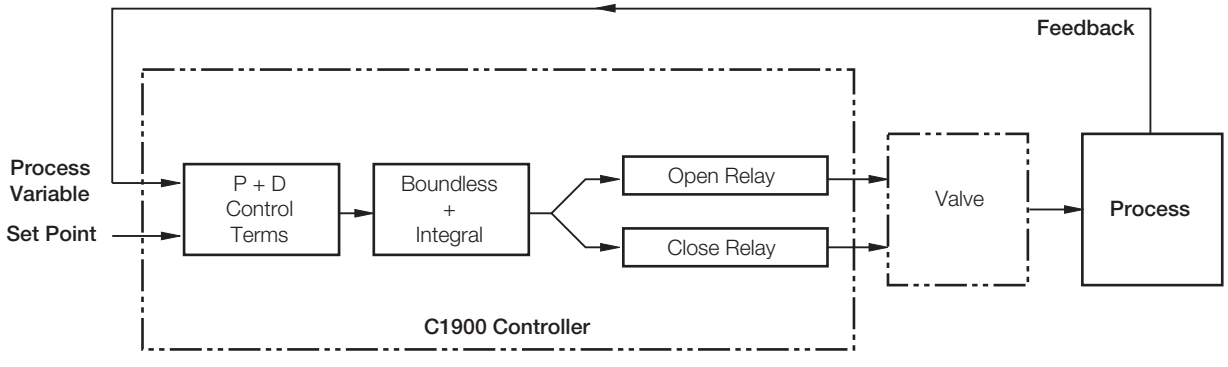
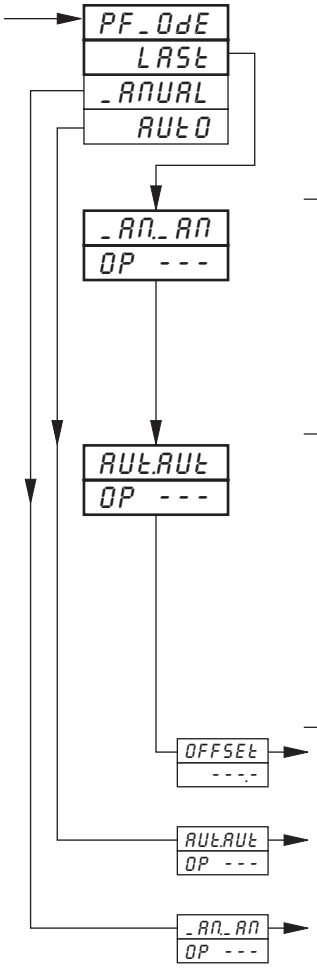



Fig. 4.8 Boundless Control Schematic Diagram

### 4.3.2 Set Up Control Page (power-fail mode)

**Information.**
- **Programmable power-up mode**.
- **Programmable output (or valve position) values**.




**Power Failure Mode**
Select the default power fail mode required following a power interruption or failure:
- LASt – restart in the **same mode** existing prior to power failure.
- _ANUAL – restart in **Manual mode**.
- AUtO – restart in **Auto mode**.

**Manual-to-Manual Power Fail Output:**
is the control output value required when power-down state is Manual and power-up state is Manual.

Set the control output value (or valve position) required following a power failure, between 0 and 100% in increments of 1%, or LASt . If LASt is selected the percentage control output present prior to the power failure is retained.

**Auto-to-Auto Power Fail Output:**
is the control output value required when power-down state is Auto and power-up state is Auto.

On power-up the controller presets the Integral component to give bumpless operation on power-up, at the selected output value, using the current process variable and set point values. If AUtO is selected the Integral component is not preset.

Set the control output value (or valve position) required following a power failure, between 0 and 100% in increments of 1%, or LASt .

Continued on page 41.

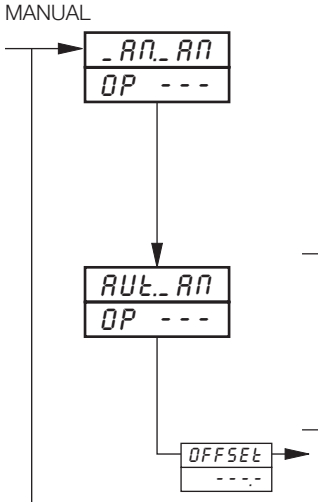
Continued on next page.

Continued on next page.

| Power Fail Mode | Mode on Power Down | Mode on Power Up | Control Output (Valve Position) on Power Up |
|---|---|---|---|
| Auto | Auto | Auto | Integral component of the control output is preset to give bumpless operation at power-up at the value set in the Auto-to-Auto frame. |
| | Manual | Auto | Integral component of the control output is preset to give bumpless operation at power-up at the value set in the Manual-to-Auto frame (or LAST) |
| Manual | Auto | Manual | Value set in Auto-to-Manual Output frame (or LAST) |
| | Manual | Manual | Value set in Manual-to-Manual Output frame or output value prior to power-down (if LAST selected) |
| Last | Auto | Auto | Integral component of the control output is preset to give bumpless operation at power-up at the value set in the Auto-to-Auto frame (or LAST) |
| | Manual | Manual | Value set in Manual-to-Manual Output frame or output value prior to power-down (if LAST selected) |

**Table 4.1 Power-up and Power-down Control Modes**

### …4.3.2 Set Up Control Page (power-fail mode)




**Manual-to-Manual Power Fail Output:**
is the control output value required when power-down state is Manual and power-up state is Manual.

Set the control output value (or valve position) required following a power failure, between 0 and 100% in increments of 1%, or LASt. If LASt is selected the percentage control output present prior to the power failure is retained.

**Auto-to-Manual Power Fail Output:**
is the control output value required when power-down state is Auto and power-up state is Manual.

Set the control output value (or valve position) required following a power failure, between 0 and 100% in increments of 1%.

Continued on next page.

**Auto-to-Auto Power Fail Output:**
is the control output value required when power-down state is Auto and power-up state is Auto.

On power-up the controller presets the Integral component to give bumpless operation on power-up, at the selected output value, using the current process variable and set point values. If AUtO is selected the Integral component is not preset.

Set the control output value (or valve position) required following a power failure, between 0 and 100% in increments of 1%, or AUtO.

**Manual-to-Auto Power Fail Output:**
is the control output value required when power-down state is Manual and power-up state is Auto.

On power-up the controller presets the Integral component to give bumpless operation on power-up, at the selected output value (or output prior to power-down, if LASt is selected), using the current process variable and set point values. If AUtO is selected the Integral component is not preset.

Set the control output value (or valve position) required following a power failure, between 0 and 100% in increments of 1%, or AUtO.

Continued on next page.

### 4.3.3 Set Up Control Page (control actions and limits – non heat/cool)

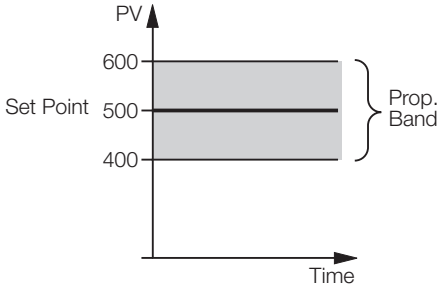
**Information.**
- **Two control offsets**.
- **Programmable control actions for all outputs**.
- **High/low output (or valve position) limits, when in auto control mode**.

OFFSET
---.-

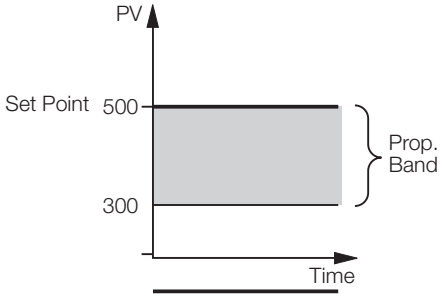
HEAT/COOL

dFA-PU.
------
Refer to page 44

**Control Offset**
Select the offset required, 0 or 50%.



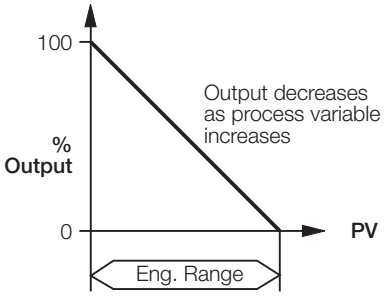
**Offset = 50%**



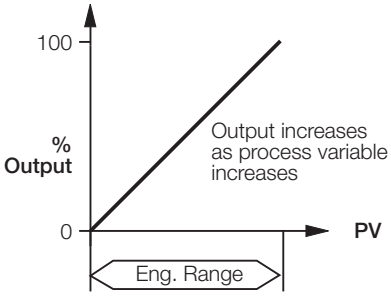
**Offset = 0%**

ACTION
dIr
rEU.

**Control Action**
Select the action for the PID control output.
dIr – direct acting
rEU. – reverse acting



**Reverse Acting**



**Direct Acting**

OUt-HI
---.-

**Output High Limit:**
limits the high level of the control output value (or valve position) when in automatic mode. If the control output is above this limit when automatic mode is selected, the output is allowed to stay at its current level but is not allowed to go any higher. Once the control output returns to, or below, this limit the limit then applies. When the controller is in manual mode the output limits do not apply.

Select the output high limit value (or valve position) required, between 0.0 and 100.0 in 0.1 increments.

OUt-LO
OP ---

**Output Low Limit:**
limits the low level of the control output value (or valve position) when in automatic mode. If the control output is below this limit when automatic mode is selected, the output is allowed to stay at its current level but is not allowed to go any lower. Once the control output returns to, or above, this limit the limit then applies. When the controller is in manual mode the output limits do not apply.

Select the output low limit value (or valve position) required, between 0.0 and 100.0 in 0.1 increments.

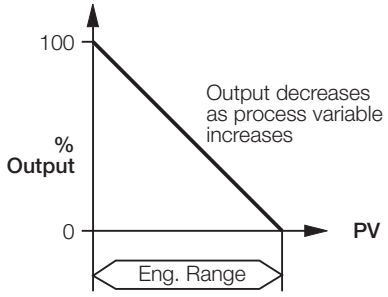
dFA-PU.
------
Continued on page 44.

### 4.3.4 Set Up Control Page (control actions and limits – heat/cool)

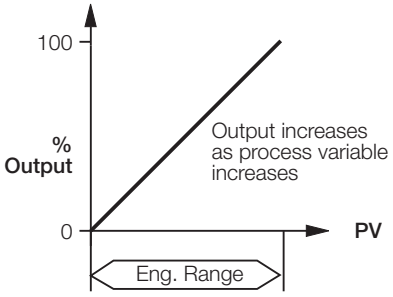
**Information.**
- **Independently programmable control actions for heat and cool outputs** – direct or reverse.
- **Output limits for heat and cool outputs**.

ACTION
h dIr
rEU.

**Control Action (Heat)**
Select the action for the heat and PID control outputs:
h dIr – direct acting
rEU. – reverse acting.




Reverse Acting




Direct Acting

Ht-H1
----

**Heat Output High Limit:**
limits the high level of the heat control output value when in automatic mode. If the control output is above this limit when automatic mode is selected, the output is allowed to stay at its current level but is not allowed to go any higher. Once the control output returns to, or below, this limit the limit then applies. When the controller is in manual mode the output limits do not apply. Select the heat output high limit value required, between 0.0 and 100.0 in 0.1 increments.

ACTION
C dIr
rEU.

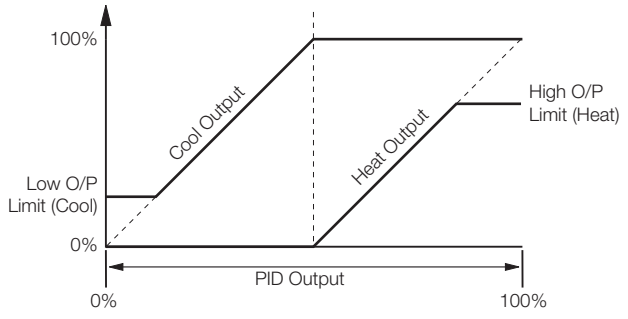
**Control Action (Cool)**
Select the action for the cool control output (see also **Control Action (Heat)**, above):
C dIr – direct acting
rEU. – reverse acting.

CL- xx
------

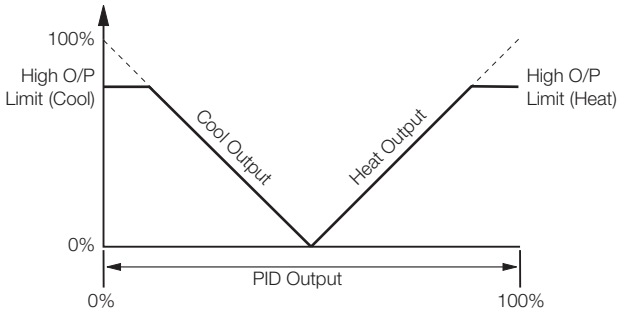
**Cool Output High/Low Limit:**
limits the high or low level of the cool control output when in automatic mode, depending on the Control Action (Cool) setting (rEU. is the low and dlr is the high setting). If the control output exceeds this limit when automatic mode is selected, the output remains at its current level but is not allowed to go any further away from the limit. Once the control output returns to, or within, this limit, the limit then applies. When the controller is in manual mode the output limits do not apply. Select the cool output high (low) limit required, between 0.0 and 100.0 in 0.1 increments.

dFA-PU.
------

Continued on next page.




Heat Output Action – Direct or Reverse
Cool Output Action – Reverse



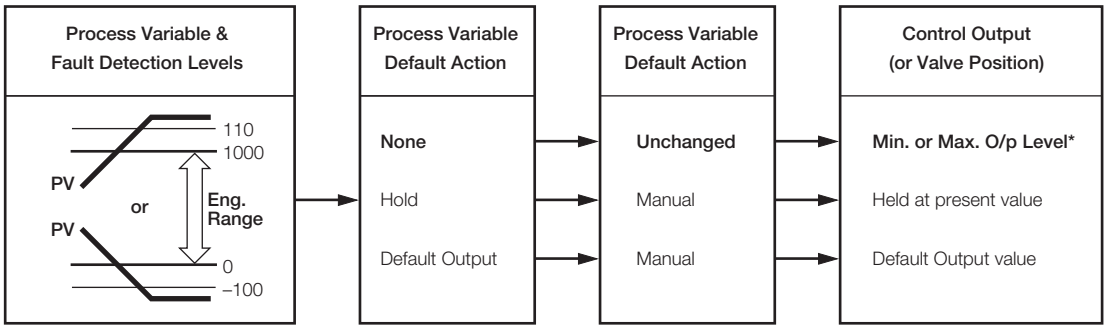

Heat Output Action – Direct or Reverse
Cool Output Action – Direct

**Fig. 4.9 Heat/Cool Control Actions**

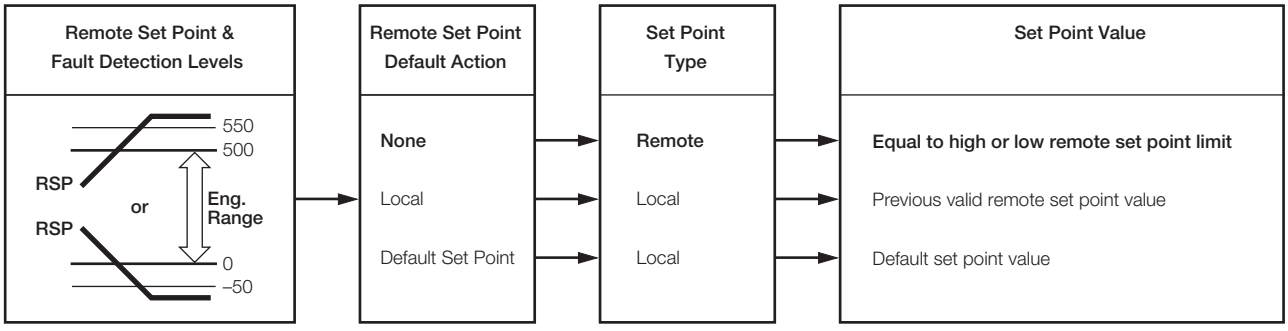
### 4.3.5 Set Up Control Page (default control actions)

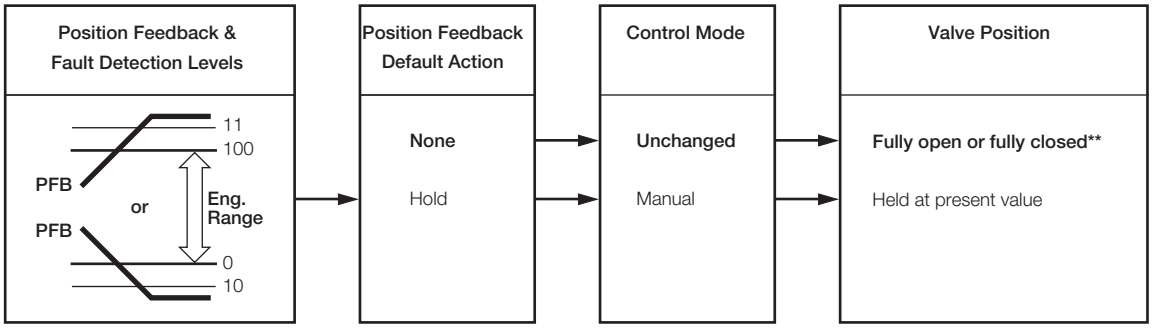
**Information.** Programmable default control action if input exceeds fault levels – independently programmable for all inputs (process variable, remote set point and position feedback).

Examples show fault detection levels of 10%




* Controller output is driven to either the maximum or minimum output limit, depending on the **Broken Sensor Protection Drive** setting– see **Set Up Inputs Page**, **BASIC CONFIGURATION LEVEL**.

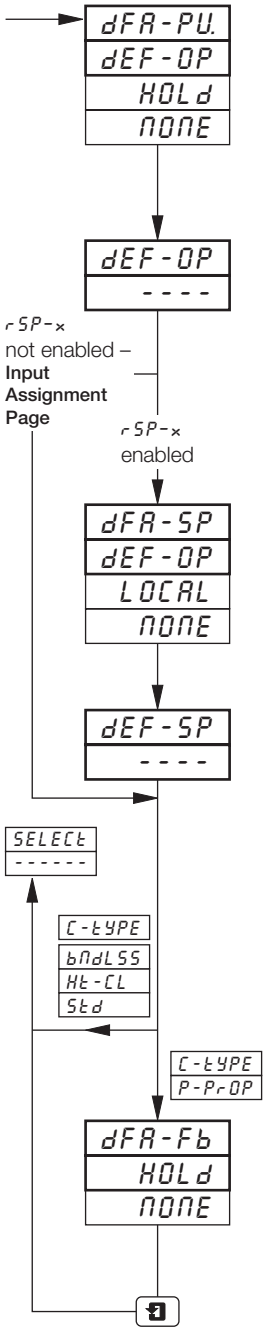



** Valve is driven to either fully open or fully closed, depending on the **Broken Sensor Protection Drive** setting– see **Set Up Inputs Page**, **BASIC CONFIGURATION LEVEL**.

**Fig. 4.10 Default Control Actions for Input Fault Detection Levels**

### …4.3.5 Set Up Control Page (default control actions)




**Default Action (Process Variable)**
Select the default control action required if the process variable exceeds its fault detection level (set in the **Set Up Input Page**, **BASIC CONFIGURATION LEVEL**):

- dEF-OP – revert to manual control mode and change the control output to the **Default Output** value (see next frame).
- HOLd – revert to manual control mode and hold the output at its current value.
- NONE – no action.

**Default Output**
Set the default control output value used if the process variable exceeds the fault detection level (between 0 and 100% in 1 % increments).

**Note.** For boundless motorized valve control, the default output setting can be only 0 **or** 100%.

**Default Action (Set Point)**
Select the default control action required if the remote set point exceeds its fault detection level (set in the **Set Up Input Page**, **BASIC CONFIGURATION LEVEL**):

- dEF-SP – revert to local set point and use the **Default Set Point** value (see next frame).
- LOCAL – revert to local set point.
- NONE – no action.

**Default Set Point**
Set the default control set point value used if the remote set point exceeds the fault detection level (in engineering units).

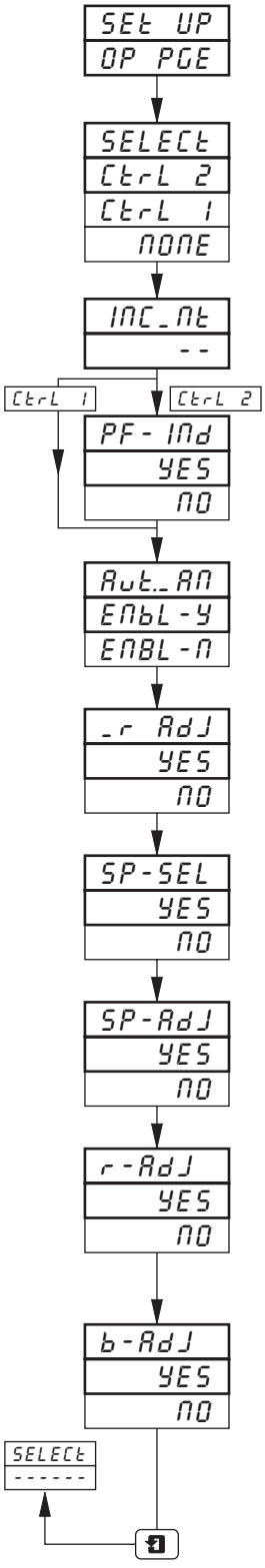
**Default Action (Position Feedback)**
Select the default control action required if the position feedback exceeds its fault detection level (set in the **Set Up Input Page**, **BASIC CONFIGURATION LEVEL**):

- HOLd – revert to manual control mode and hold the valve at its current position.
- NONE – no action.

Return to **Select Controller** frame.

## 4.4 Set Up Operating Page

**Information.**
- **Customized display of parameters in the Operating Page**.
- **Power-fail indication** – if enabled, `LINE FAILED` is displayed to indicate that a power failure has occurred.
- **Auto/Manual key** [M/A] – enable or disable.




Page header – **Set Up Operating Page**.

To advance to **Set Up Digital Page** press the [Page] key.

**Select Controller**
Select the controller to be programmed (1 or 2).

**Note.** In the remaining frames press the [*] key to view the controller selected.

**Bargraph Increment**
The deviation from set point is shown on the bargraph on the faceplate.
Set the percentage deviation represented by each bar, between 1 and 10% in 1% increments.

**Power Fail Indication Enable**
Enable or disable power failure indication:
`YES` – enable
`NO` – disable

**Auto/Manual Select Enable**
Enable or disable the [M/A] key on the faceplate:
`EnbL-Y` – enable
`EnbL-N` – disable

**Manual Reset Adjustment Enable**
Enable or disable display and adjustment of the **Manual Reset** frame in the **Operating Page**:
`YES` – enable
`NO` – disable

**Set Point Select Enable**
Enable or disable adjustment of the **Set Point Type Selection** frame in the **Operating Page**:
`YES` – enable
`NO` – disable

**Set Point Adjust Enable**
Enable or disable adjustment of the **Control Set Point** value in the **Operating Page**:
`YES` – enable
`NO` – disable

**Remote (or Cascade) Set Point Ratio Adjust Enable**
Enable or disable display and adjustment of the **Remote (or Cascade) Set Point Ratio** in the **Operating Page**.
`YES` – enable
`NO` – disable

**Remote (or Cascade) Set Point Bias Adjust Enable**
Enable or disable display and adjustment of the **Remote (or Cascade) Set Point Bias** in the **Operating Page**.
`YES` – enable
`NO` – disable

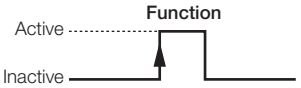
Return to **Select Controller** frame.

## 4.5 Set Up Digital Page

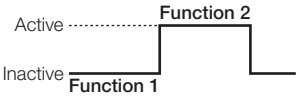
**Information.**
- **Digitally selectable control modes and set point types**.
- **Up to 3 digitally selectable local set points**.
- **Digital signal sources** – can be from external digital inputs, internal alarms, logic equations, control modes, ramp/soak events or totalizer signals.

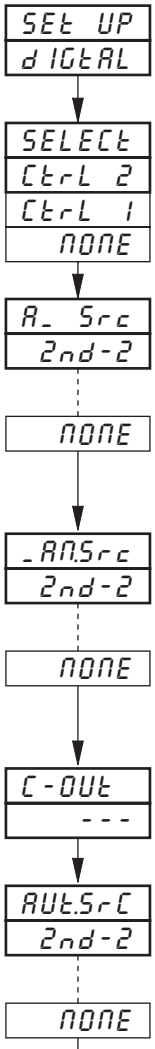
**Note.**
- The complete list of digital sources is shown in Table 3.1 on page 18.
- Digital sources can be either leading edge triggered or level triggered, depending on the parameter function (single or dual).

**Single function parameters**, e.g. set point 1 selection, are **leading edge triggered**, i.e. the active logic state can be removed after the function is selected.




**Dual function parameters**, e.g. auto/manual control mode selection, are **level triggered**, i.e. the active logic state must be maintained to select the alternative function.



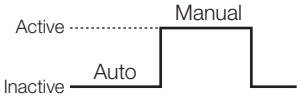

Page header – **Set Up Digital**.

To advance to **Control Configuration Level** frame press the [↵] key.

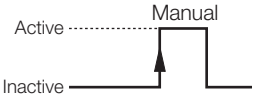
**Select Controller**
Select the controller to be programmed (1 or 2).

**Note.** In the remaining frames press the [✱] key to view the controller selected.

**Auto/Manual Control Mode Source**
Select a source to switch between Auto and Manual control modes. When Manual control mode is selected, the output reverts automatically to the value set in the **Configured Output** frame (see below).

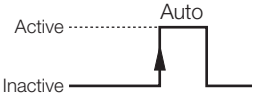



**Manual Control Mode Source**
Select a source to switch to Manual control mode. When Manual control mode is selected, the output reverts automatically to the value set in the **Configured Output** frame (see below).



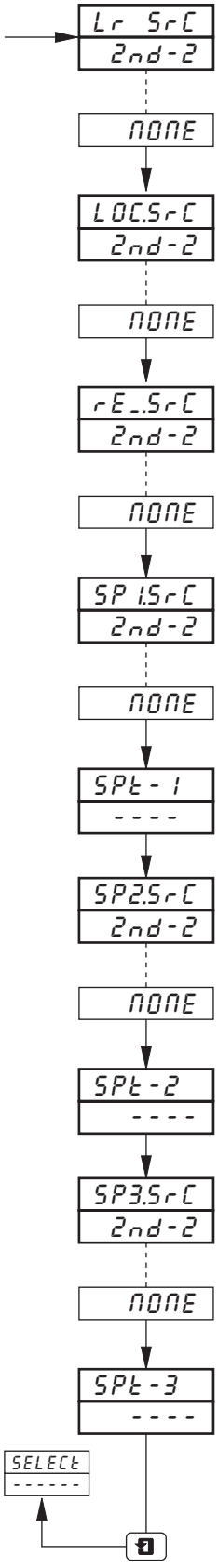

**Configured Output**
Set the control output value required when Manual control mode is selected.

**Auto Control Mode Source**
Select a source to switch to Auto control mode.

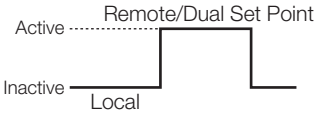



Continued on next page.

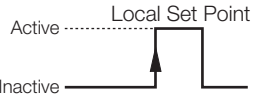
## 4.6 Set Up Digital Inputs



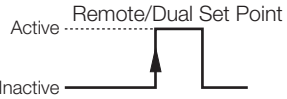

**Local/Remote (or Dual) Set Point Source**
Select a source to switch between Local and Remote set points.



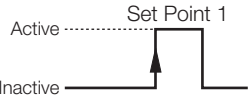

**Local Set Point Source**
Select a source to switch to the Local set point.




**Remote/Dual Set Point Source**
Select a source to switch to the Remote set point.

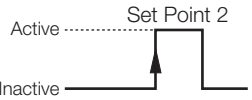



**Set Point 1 Source**
Select a source to make the Local set point value equal to Set Point 1.



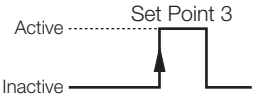

**Set Point 1 Value**
Set the Set Point 1 value.

**Set Point 2 Source**
Select a source to make the Local set point value equal to Set Point 2.




**Set Point 2 Value**
Set the Set Point 2 value.

**Set Point 3 Source**
Select a source to make the Local set point value equal to Set Point 3.




**Set Point 3 Value**
Set the Set Point 3 value.

Return to **Select Controller** frame.

# 5 ADVANCED CONFIGURATION LEVEL

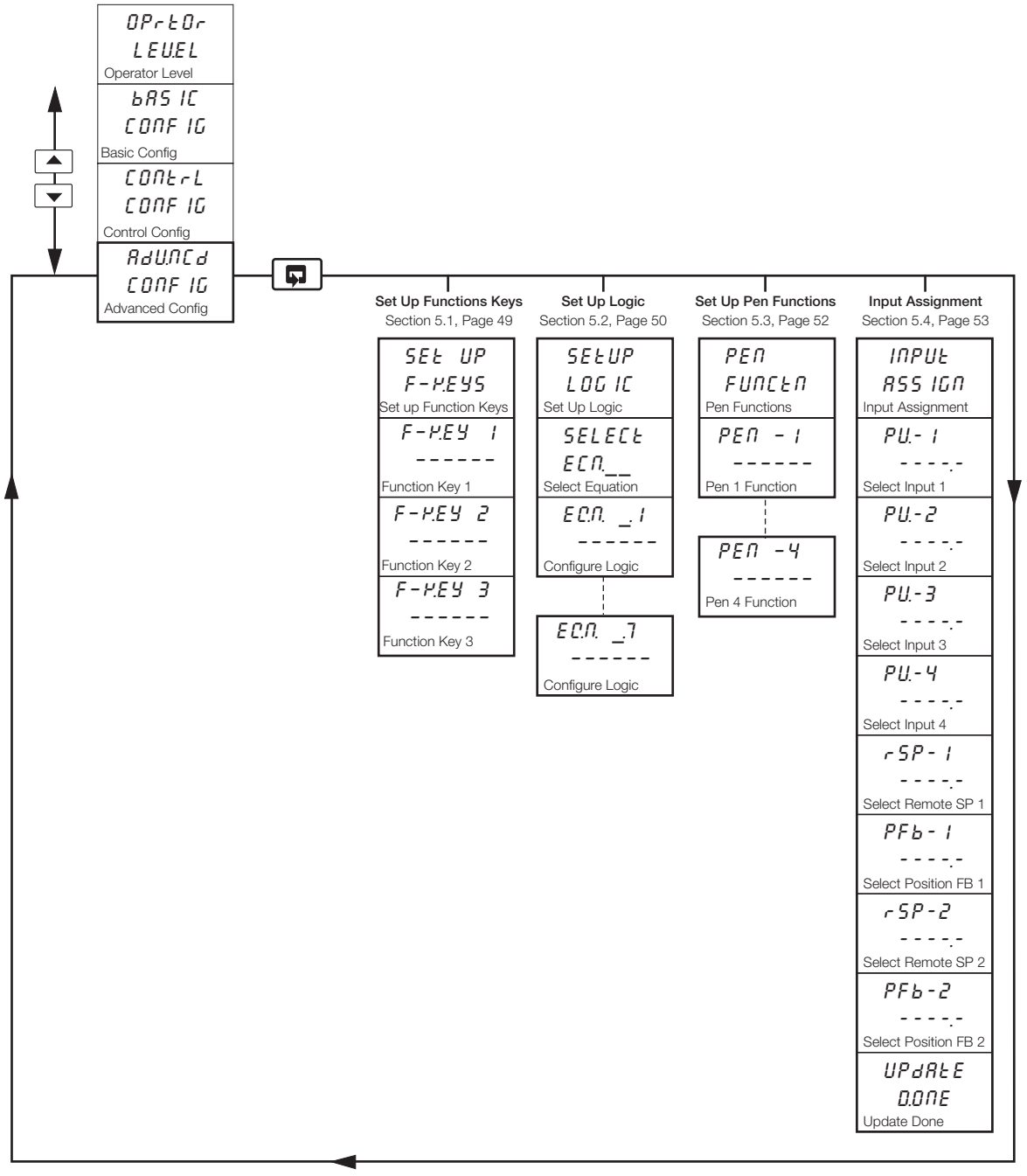
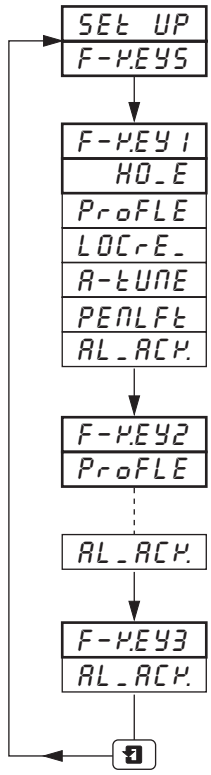



**Fig. 5.1 Advanced Configuration Level**

## 5.1 Set Up Function Keys

**Information.**

- **Programmable function key** – on each faceplate.
- **Home function** – returns the instrument display to the start of the **Operating Page** when at the top of any page.
- **Global alarm acknowledge function** – acknowledges any unacknowledged alarms on all channels.
- **Penlift function** – raises and lowers pens (for use on controller faceplates which do not have a dedicated penlift key).
- **Local/Remote set point selection**.
- **Quick access to auto-tuning** – reverts to the top of the **Auto-tuning Page**.
- **Quick access to profile operator controls** – reverts to the top of the **Profile Control Page**.




Page Header – **Set Up Function Keys**

To advance to the **BASIC CONFIGURATION LEVEL** frame press the [ ] key.

**Function Key 1**
Select function required.

- HO_E – home (return to **Operating Page** in the **OPERATOR LEVEL**)
- ProFLE – revert to top of **Profile States Page**
- LOCrE_ – local/remote set point selection
- A-tUNE – auto tune (reverts to top of **Auto Tune Page** in the **OPERATOR LEVEL**)
- PENLFt – pen lift/drop (lifts and lowers pens)
- AL_ACK. – acknowledge alarm

**Function Key 2**
Select function required (if applicable).

**Function Key 3**
Select function required (if applicable).

Return to **Set Up Function Keys** frame.

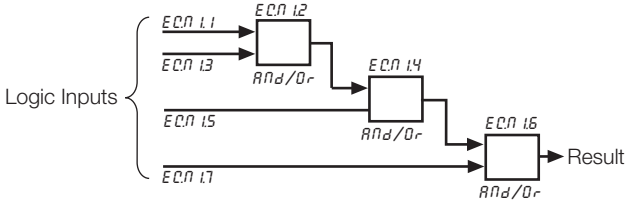
## 5.2 Set Up Logic

**Information.**
- **8 logic equations**.
- **7 elements per equation**.
- **OR/AND operators**.
- **Can combine internal and external digital signals** – i.e. alarms, digital inputs, other logic equation results, real time events (if timer option is fitted), control modes set point modes and profile segments and programs (if option is fitted).

For each equation, the logic elements 1 to 7 are arranged sequentially, as shown. Odd numbered elements are used for logic inputs and even numbered elements for logic gates.

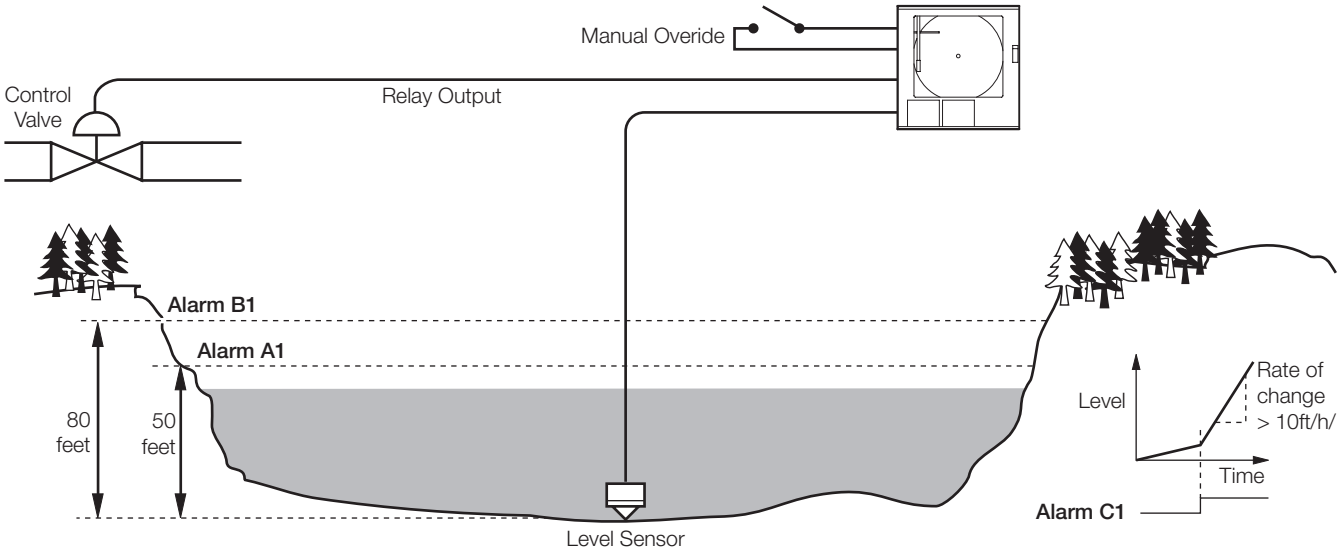
Logic inputs must be set to one of the digital sources listed in Table 3.1 on page 18.

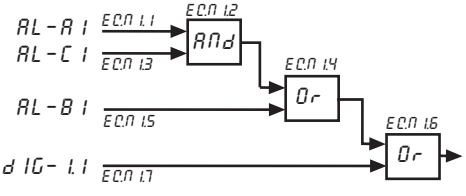
Logic gates must be set to *And*, *Or* or *End*. Setting an element to *End* terminates the equation.



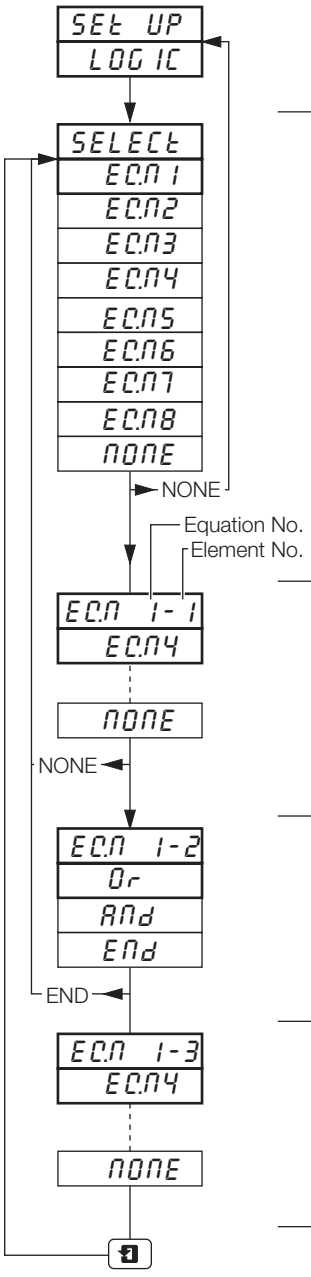

**Note.** Elements on each equation are calculated sequentially, i.e. elements 1, 2 and 3 are evaluated first and this result is then combined with elements 4 and 5. Similarly, this resultant is then combined with elements 6 and 7 to give the logic equation result.

**Example –** Reservoir level monitoring using:
- process variable 1 with an engineering range 0 to 100 feet
- logic equation 1 result assigned to relay 1.1 which is used to operate the control valve.




| Flow Conditions | Input Elements | Entering the Logic Equation |
|---|---|---|
| Close reservoir control valve if:<br>• Reservoir level >50 feet AND rate of change >10 ft/hr<br>OR<br>• Reservoir level >80 ft<br>OR<br>• Manual override switch operated | • **Alarm A1** – set to high process trip at 50 ft<br>• **Alarm B1** – set to high process trip at 80 ft<br>• **Alarm C1** – set to fast rate trip at 10% of range per hour (10 ft/hr)<br>• **Manual override switch**:<br>Connected to digital input 1.1<br>Digital input number<br>Module number<br>Negative polarity<br>Volt-free switching |  |

## ...5.2 Set Up Logic




Page Header – **Set Up Logic**

To advance to **Set Up Pen Functions Page** press the key.

---

**Select Equation**
Select equation to be constructed.

**Note.** In the remaining frames press the ✱ key to view the equation selected.

---

**Equation n/Element 1**
Select the source required for element 1.

For description of sources, refer **to Table 3.1** on page 18.

---

**Equation n/Element 2**
Select the operator required to combine elements 1 and 3:

- Or – Or
- AND – And
- End – Ends equation

---

**Equation n/Element 3**
Repeat previous two steps for elements 3 to 7.

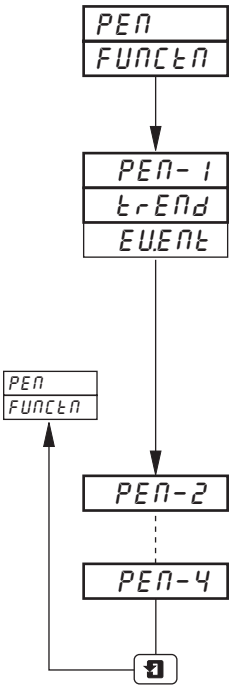
Odd numbered elements = sources
Even numbered elements = operators

---

Return to **Select Equation** frame.

## 5.3 Set Up Pen Functions

**Information. Any fitted pen can be assigned to a trend or an event function.**




Page Header – **Pen Functions**

To advance to **Advanced Configuration** frame press the ↵ key.

**Pen 1**
Select pen function required:
- trEND – Trend pen
- EVENT – Event pen

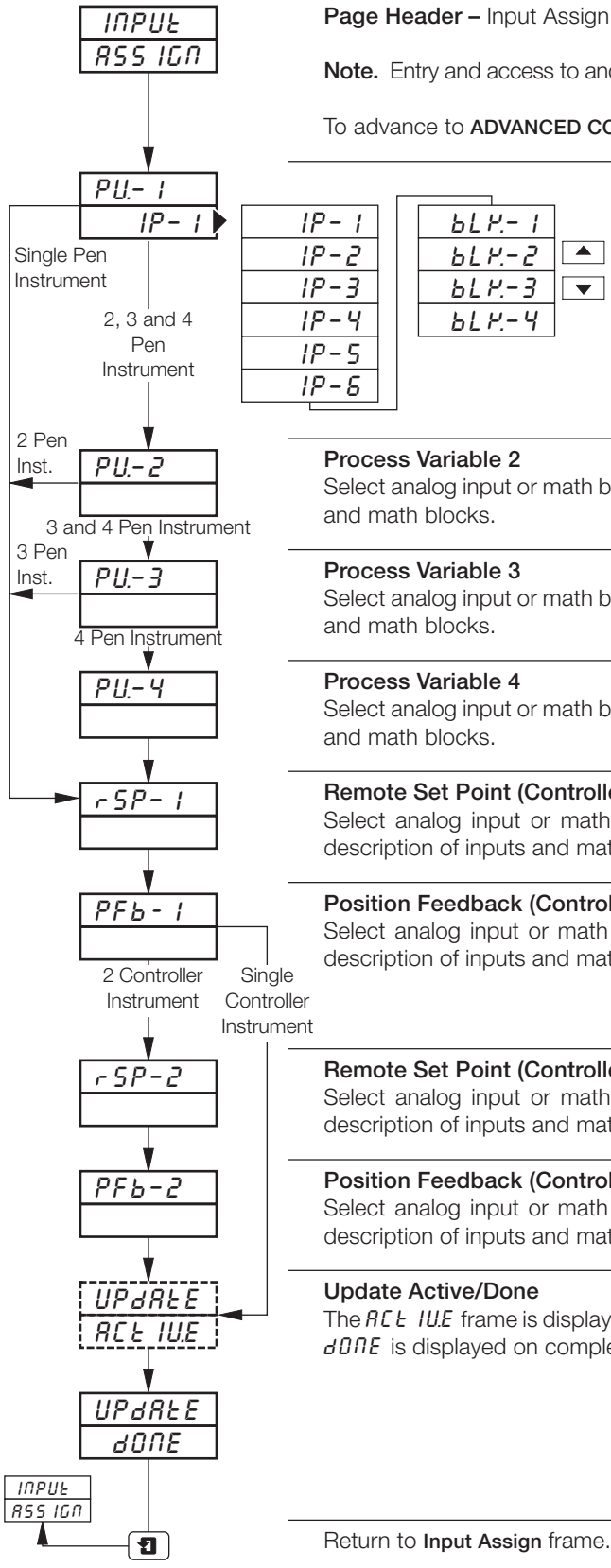
**Note.** The event pen and true time line event pen are separate functions and only the event pen can be selected in this page. The true time line event pen option allows marking on the same time line as the red pen and requires a special pen arm and motor assembly. Refer to the order code in the **Specification Sheet**.

**Pens 2 to 4**
Repeat as for **Pen 1**, if applicable.

Return to **Pen Function** frame.

## 5.4 Input Assignment

**Information. Assignment Process Variables, Remote Set Points and Position Feedbacks** – can all be assigned to any analog input or math block result (if fitted).




**Page Header –** Input Assign

**Note.** Entry and access to and from this page can only be implemented from the page header.

To advance to **ADVANCED CONFIGURATION LEVEL** frame press the ⏎ key.

**Process Variable 1**
Select analog input or math block result for Process Variable 1.

IP- 1 to IP-6 – analog input 1 to 6 (if available)
bLK.- 1 to bLK.-4 – math block 1 to 4 (if available)

**Process Variable 2**
Select analog input or math block result for Process Variable 2 – see PU.- 1 for description of inputs and math blocks.

**Process Variable 3**
Select analog input or math block result for Process Variable 3 – see PU.- 1 for description of inputs and math blocks.

**Process Variable 4**
Select analog input or math block result for Process Variable 4 – see PU.- 1 for description of inputs and math blocks.

**Remote Set Point (Controller 1)**
Select analog input or math block result for remote set point for Controller 1 – see PU.- 1 for description of inputs and math blocks.

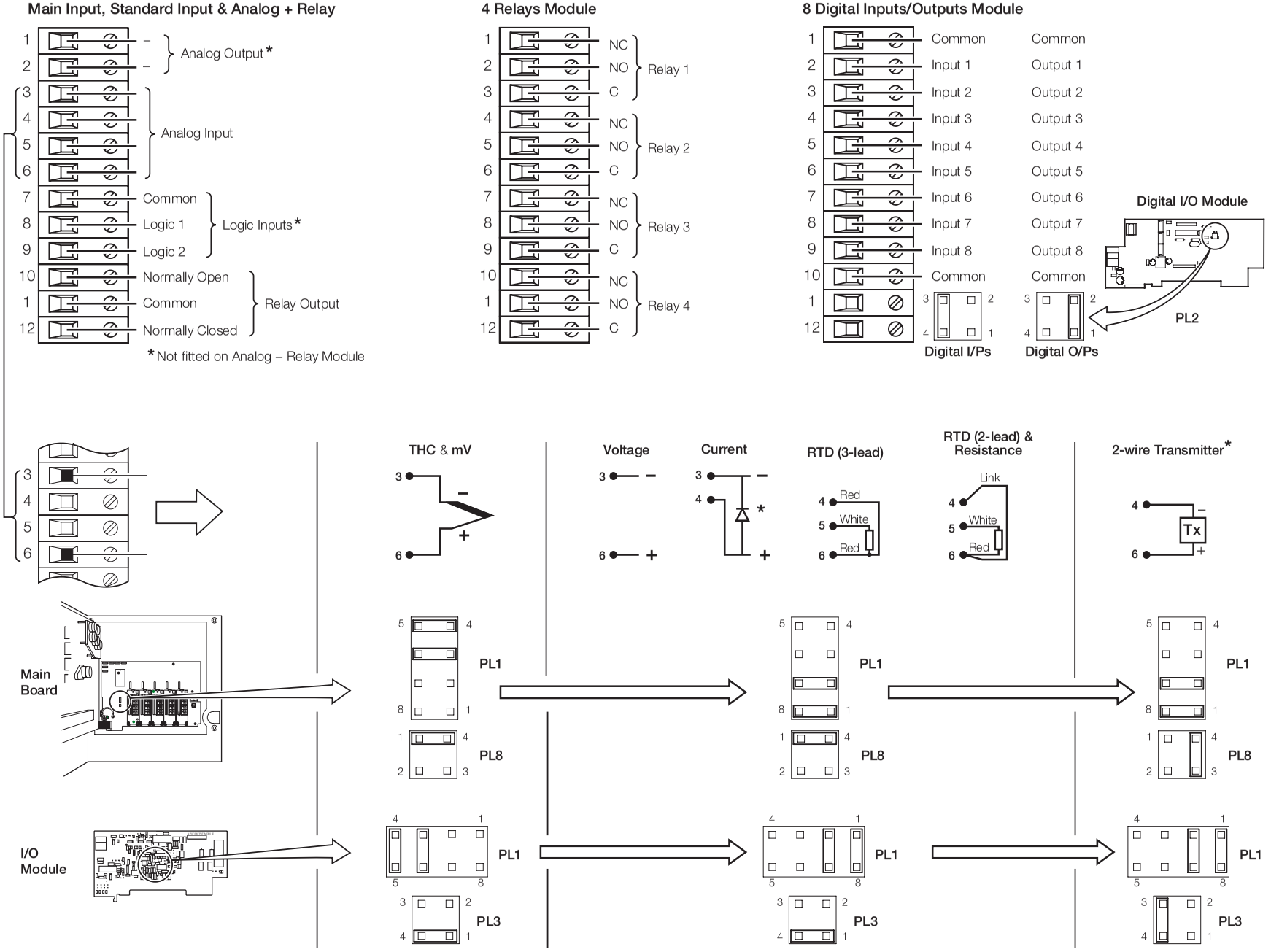
**Position Feedback (Controller 1)**
Select analog input or math block result for position feedback for Controller 1 – see PU.- 1 for description of inputs and math blocks.

**Remote Set Point (Controller 2)**
Select analog input or math block result for remote set point for Controller 2 – see PU.- 1 for description of inputs and math blocks.

**Position Feedback (Controller 2)**
Select analog input or math block result for position feedback for Controller 2 – see PU.- 1 for description of inputs and math blocks.

**Update Active/Done**
The ACt IUE frame is displayed momentarily as any changes are stored in the non-volatile memory. dOnE is displayed on completion.

Return to **Input Assign** frame.




* **Recommended Diode**: Diode forward voltage > 0.8 V @ 20 mA or use 2 x 1N4001 general purpose diodes in series.

# NOTES

Sales

Service

Software

**ABB Limited**
**Measurement & Analytics**
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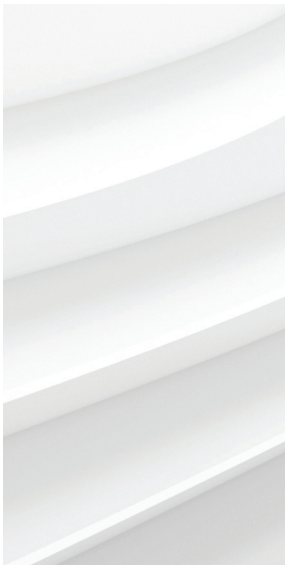




IM/C1900-PGC Rev. L 09.2018

ABB MEASUREMENT & ANALYTICS | DATA SHEET

# C1900 series

## Circular chart recorder/controller

# Measurement made easy

C1900 – dependable recording and full PID control united in a rugged, functional instrument

**1 to 4 pen recording**
- full application flexibility

**1 or 2 controllers**
- integrated control and recording

**Analog, relay outputs, digital inputs and transmitter power supply as standard**
- range of inputs and outputs built-in

**PID autotune on demand**
- optimum loop control

**20 programmable ramp/soak profiles**
- multiple recipe capability

**NEMA 4X/IP66 construction**
- hose-down protection

**0.1 % measurement accuracy**
- precise process information

**RS485 Modbus serial communications**
- open system compatibility

## C1900

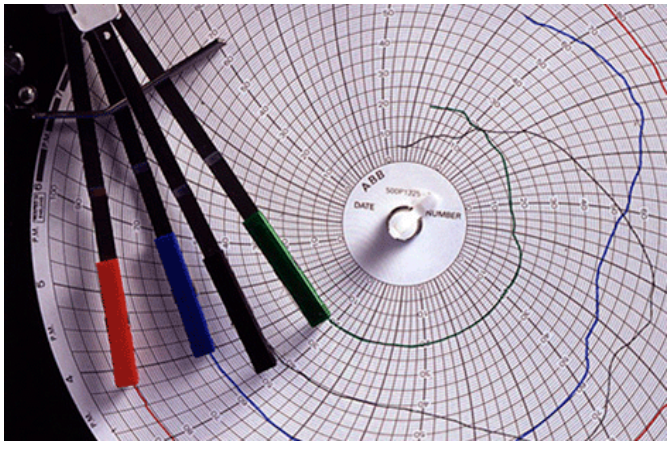
The C1900 is a fully programmable circular chart recorder/controller combining two PID control loops with 4-pen recording. The C1900's straightforward operator controls and robust construction make it suitable for a variety of industrial environments. Excellent standard facilities are complemented by a powerful range of options to give the flexibility to match your application.

## Comprehensive process information

The C1900 lets you see the status of your process at a glance: high visibility 6-digit LED displays provide a clear indication of all process signals. Dedicated operator stations for each controller give continuous displays of set points, measured values and high-visibility deviation bargraphs. Active alarms are signalled by flashing LEDs below the main displays.


## 4-pen recording

The chart is easily set up to show the information you need in the way you want. Pen ranges are individually set to give the best resolution for each signal; additionally, a true-time event pen facility enables one pen to be set up as a 3-position event marker on the same time line as Pen 1.



## Straightforward operation

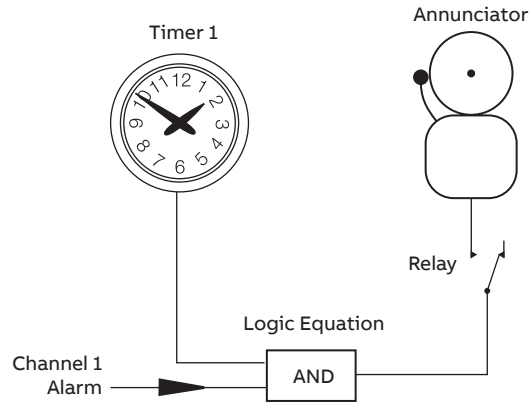
The clearly-labelled tactile keypads permit operator adjustments and configuration programming without the need to open the recorder's door. Separate operator panels for each controller provide a direct route for accessing individual control loops. Clear text prompts on the digital displays guide the user around the various menus. A password-protected security system prevents unauthorized access to configuration adjustment menus.

## Flexibility to solve problems

The C1900 offers seamless integration of loop functionality to solve process problems, eliminating the need for auxiliary devices.

## Totalizers, math, logic and timers

Integrating fluid flow to calculate total volume is performed by the built-in totalizers, available for each channel. Relays can be assigned to increment or reset external counters to match the recorder's totalizer values.




Alarm annunciation enabled during night hours only

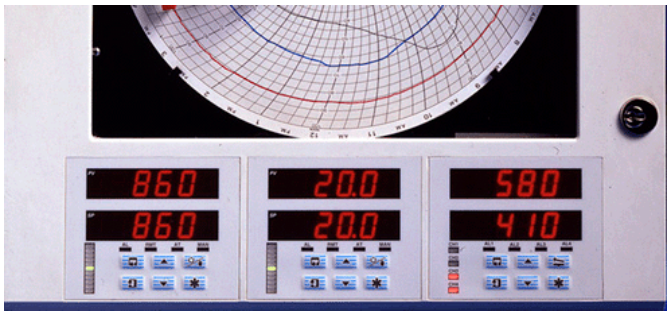
User configurable math functions, mass flow calculations, RH tables and logic equations are all fully supported. The C1900 also offers two event timers driven by the recorder's real-time clock.

## Modbus RS485 communications

Communications with PCs or PLCs are achieved via the RS485 serial communications link. Using MODBUS RTU protocol, all process inputs and other variables can be continuously read by a host PC running any of a wide variety of standard SCADA packages.

## Versatile process control

The C1900 provides full PID control of one or two process loops in addition to its powerful recording facilities. The control loops can operate independently or be soft-linked together to implement Cascade or Master/Slave control strategies. Each loop has a dedicated ¼ DIN-style operator panel for ease of operation and clarity of display.




## Analog, relay or valve positioning output

The control output is selectable to fit any application with a choice of analog, time proportioning or valve positioning relays; use of a feedback potentiometer to ensure precise valve control is fully supported. Heat/cool operation is available on both loops.

## Autotune

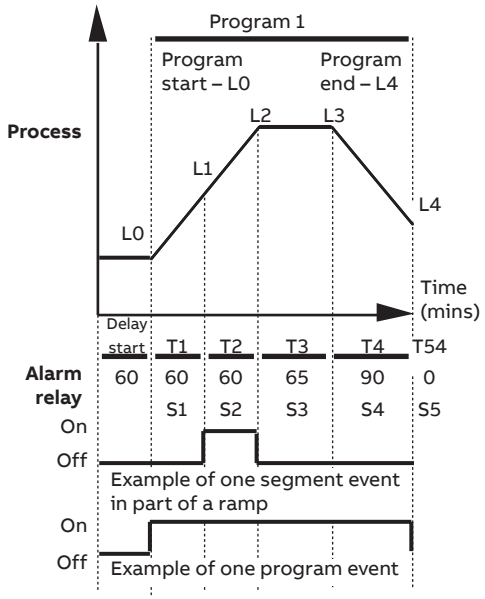
Operation of the autotune function on either loop instigates a tuning routine which allows the C1900 to calculate the optimum PID parameters for that particular loop. Following the completion of autotune, the PID values are automatically updated.

## Auto/Manual and local/remote

Dedicated membrane keys on each operator panel enable one-touch operation for selection between manual and automatic loop control and for switching from local to remote set point.

## Extensive ramp/soak programming

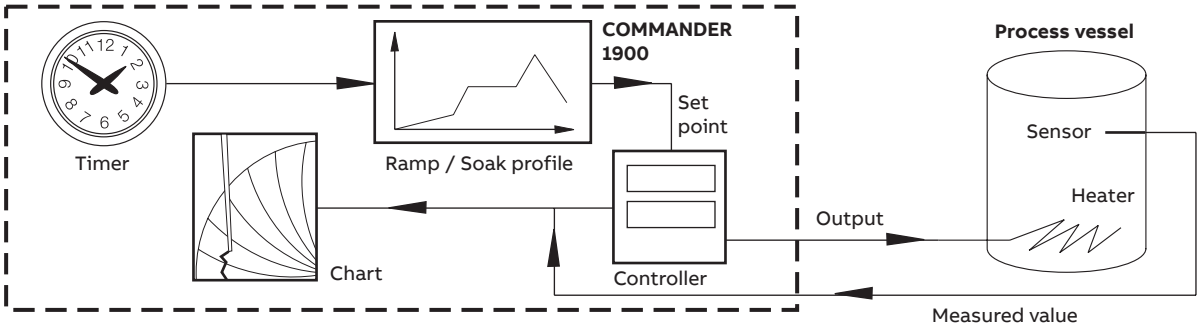
Full control of temperature profiles is provided by 10 program recipes for each controller. A total of 99 ramp/soak segments are available for allocation to these programs. Segment events can be incorporated into the recipes to perform specific functions (e.g. operate relays) at predefined points within the program.




Ramp/Soak program with time event relay sequences

## Remote program selection

External panel switches can be connected to the C1900's digital inputs to allow remote selection of stored profiles and to initiate ramp/soak programs.




Programmed process warm-up triggered by real-time clock

## Built to meet your needs

The C1900's modular architecture gives a high level of hardware choice: up to five I/O modules can be added to the basic instrument.

The standard input/output module supplied with every pen comes complete with a fully isolated analog input, a relay output, transmitter power supply, isolated analog output and two digital inputs. Further input and output capability is provided by a range of plug-in modules:

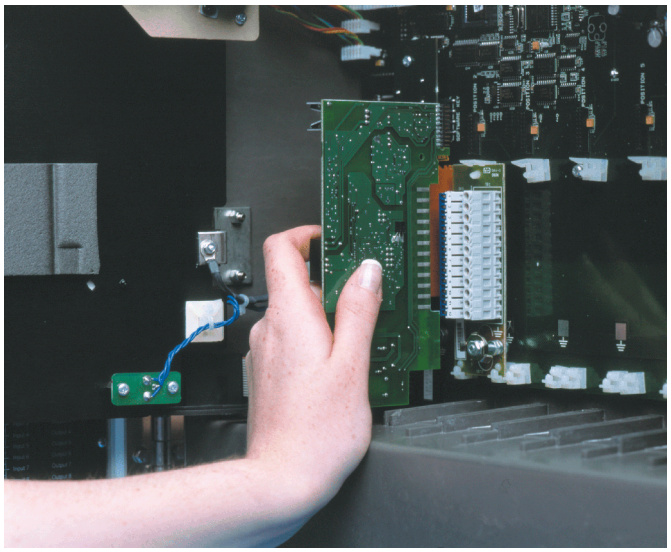
- **Analog input and relay** – remote set point
- **Four relays** – channel alarm outputs
- **Eight digital inputs** – linked using logic equations
- **Eight digital outputs** – TTL level alarm outputs
- **MODBUS RS485 communications** – interfaces with PCs

## Expandable for the future

The C1900 may be quickly upgraded to meet your changing process requirements.

Additional recording channels, math capability or input and output functions can be retrofitted on-site using plug-in cards and easily fitted pen arms. Input calibration data is stored on each card, allowing quick changes to input cards without the need for recalibration.

Changes to input sensors or recording procedures are accommodated by reconfiguration using the main keypad.



## Designed to survive

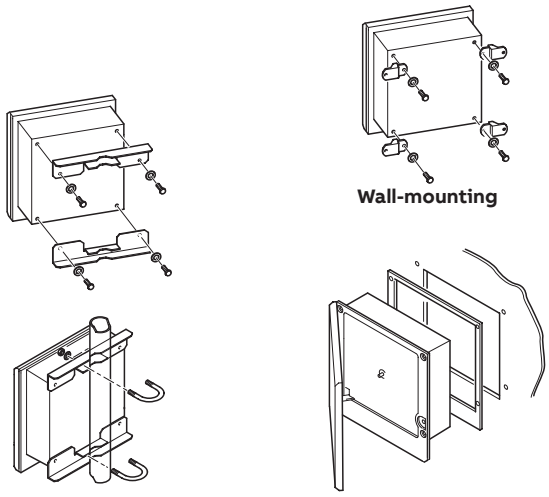
NEMA 4X protection ensures the C1900 can survive in the harshest environments and makes the recorder ideal for use in panels which are regularly hosed down. The tough, acid-resistant case and secure cable-entry glands maintain the NEMA 4X rating for wall-mounted or pipe-mounted instruments.

## Noise immunity

Recording accuracy is maintained in noisy industrial environments due to the advanced EMC shielding within the recorder. The power supply has been designed to give excellent protection from power spikes and brownouts and all configuration and status information is held in nonvolatile memory to ensure rapid recovery after a power failure.

## Easy to install

A choice of mounting options enables simple installation of the recorder in a panel, on a wall or on a pipe. Detachable terminal blocks allow for trouble-free connection of input and output wiring, with mains isolation provided by an optional power switch within the instrument.



**Wall-mounting**

**Pipe-mounting**

**Panel-mounting**

## Minimal maintenance

Excellent long-term stability keeps recalibration to a minimum, cutting the costs of ownership. User-selectable chart speeds and long-life pens combine to limit usage of consumables.

## Built-in quality

The C1900 is designed, manufactured and tested to the highest quality standards, including ISO 9001, and is guaranteed by a 2 year parts and labour warranty.

# Specification

## Summary

1, 2, 3 or 4 pens
1 or 2 PID control loops
10 in. chart size
Standard I/O with each pen includes:

- Analog input, analog output, transmitter power supply, relay output and 2 digital inputs.

## Construction

**Size (h x w x d)**
386.8 x 382.0 x 141.5 mm (15.23 x 15.04 x 5.57 in.)
**Weight**
8.2 kg (18 lb)
**Case material**
Glassfiber-filled reinforced polyester
**Window material**
Polycarbonate
**Door latch**
High-compression with optional lock

## Environmental

**Operational temperature range**
0 to 55 °C (32 to 130 °F)
**Operational humidity range**
5 to 95 %RH (non-condensing)
5 to 80 %RH (chart only)
**Case sealing**
NEMA 4X (IP66)
**Fast transients**
IEC 801-4 Level 3

## Installation

**Mounting options**
Panel, wall or pipe
**Terminal type**
Screw
**Wire size (max.)**
14 AWG (I/O), 12 AWG (power)

## Operation and configuration

**Programming method**
Via front panel keys
**Security**
Password-protected menus

## Safety

**General safety**
IEC348
**Isolation**

- 500 V DC (channel/channel)
- 2 kV DC (channel/ground)

**Memory protection**
Nonvolatile EEPROM
**Approvals**

- CSA
- UL
- CSA/FM Class 1 Div. 2
- CE

## Power supply

**Voltage**
100 to 240 V AC ±10 % (90 V min. to 264 V max. AC), 50/60Hz
**Consumption**
<30 VA (typical for full spec. unit)
**Line interruption**
Up to 60ms

## Analog input performance

| Type | Range Lo | Range Hi | Min. Span | Accuracy |
|---|---|---|---|---|
| mV | 0 | 150 | 5 | ±0.1 % reading or 10 µV |
| V | 0 | 5 | 0.1 | ±0.1 % reading or 20 mV |
| mA | 0 | 50 | 1 | ±0.2 % reading or 0.2 µA |
| Ω (high) | 0 | 10 k | 400 | ±0.2 % reading or 0.1 Ω |
| Ω (low) | 0 | 10 k | 400 | ±0.5 % reading or 10 Ω |

## …Analog input performance

| Type | °C | | | °F | | | Accuracy (excl. CJC) |
|---|---|---|---|---|---|---|---|
| | Range Lo | Range Hi | Min. span | Range Lo | Range Hi | Min. span | |
| B | –18 | 1800 | 1278 | 0 | 3270 | 710 | ±2 °C (above 200 °C) (3.6 °F above 434 °F) |
| E | –100 | 900 | 81 | –140 | 1650 | 45 | ±0.5 °C (±0.9 °F) |
| J | –100 | 900 | 90 | –140 | 1650 | 50 | ±0.5 °C (±0.9 °F) |
| K | –100 | 1300 | 117 | –140 | 2350 | 65 | ±0.5 °C (±0.9 °F) |
| N | –200 | 1300 | 162 | –325 | 2350 | 90 | ±0.5 °C (±0.9 °F) |
| R | –18 | 1700 | 576 | 0 | 3000 | 320 | ±1 °C (above 300 °C) (1.8 °F above 572 °F) |
| S | –18 | 1700 | 576 | 0 | 3000 | 320 | ±1 °C (above 200 °C) 1.8 °F above 572 °F) |
| T | –250 | 300 | 108 | –400 | 550 | 60 | ±0.5 °C (±0.9 °F) |
| PT100 | –200 | 600 | 45 | –325 | 1100 | 25 | ±0.5 °C (±0.9 °F) |

## Process inputs and outputs – general

**Noise rejection**

Common mode >120 dB at 50/60Hz

Normal (series) mode >60 dB at 50/60Hz:

**CJC rejection ratio**

<0.05°C/°C

**Sensor break protection**

Upscale or downscale drive

**Out of range detection**

0 to 100 % of engineering span

**Temperature stability**

<0.02 % of reading/°C or 1 µV/°C

**Long-term drift**

<0.01 % of reading 10 µV annually

**Input impedance**

- >10 MΩ (mV and V inputs)
- 39 Ω (mA inputs)

## Analog Inputs

**Signal types**

mV, V, mA, Ω

**Thermocouple types**

B, E, J, K, N, R, S, T

**Resistance thermometer**

Pt100

**Other linearizations**

$x^{1/2}$, $x^{3/2}$, $x^{5/2}$, linear

**Sample interval**

250 ms per channel

**Isolation**

500 V DC channel/channel

**Digital filter**

0 to 60s programmable

## 2-wire transmitter power supply

**Number**

1 per channel

**Voltage**

24 V DC nominal

**Drive**

Up to 25 mA

**Isolation**

500 V DC channel/channel

## Analog outputs

**Type**

4 to 20 mA

**Accuracy**

±0.1 %

**Maximum load**

750 Ω

**Dielectric**

500 V DC

## Relay outputs

**Type**

SPDT

**Rating (with non-inductive load)**

5 A at 115/230 V AC

## Digital inputs

**Type**

TTL or volt-free

**Minimum pulse**

250 ms

**Dielectric**

50 V DC between modules, no isolation within module

# … Specification

## Digital outputs

**Type**
5 V TTL
**Rating**
5 mA per output
**Isolation**
500 V DC between modules, no isolation within module

## Serial communications

**Connections**
RS485, 4-wire
**Protocol**
Modbus RTU

## Recording system

**Pens**
**Number**
1, 2, 3, or 4 (red, blue, green, black)
**Response**
7 seconds (full scale)
**Resolution**
0.1 % steps
**Pen lift**
Motor-driven, with optional auto-drop

**Event pens**
**Standard**
3-position event recording on any channel
**Real time**
3-position event recording on the same time line as Pen 1

**Chart**
**Chart size**
Approx. 254 mm (10 in.) diameter
**Chart speed**
1 to 167 hours or 7 to 32 days per revolution
**Rotation accuracy**
<0.5 % of rotation time

## Display and operator panels

**Displays**
**Number**
Dual display for process value and set point for each controller, plus individual display for each record-only channel
**Type**
6-digit red LED, 14 mm (0.56 in.) high
**Status indicators**
- Indicate channel number on display (on record-only channel)
- Indicate remote set point, autotune or manual operation

**Alarm indicators**
Indicate channels with active alarms

**Panel keys**
**Function**
Programming access, increment/decrement, pen lift and user-defined function key.

## Alarms and logic

**Alarms**
**Number**
4 per channel
**Type**
High/Low process, fast/slow rate of change, deviation high/low, output high/low, high/low process time delay
**Adjustments**
Hysteresis, time delay

**Logic equations**
**Number**
8
**Function**
OR, AND
**Inputs**
Alarm states, digital inputs, totalizers, logic
**Outputs**
Relays, digital outputs, chart stop, alarm acknowledge

## EMC

**Design & Manufacturing Standards**
- CSA General Safety: Approved
- UL General Safety: Approved
- CSA/FM Class 1 Div. 2: Approved

**Emissions and Immunity**
Meets requirements of:
- EN 50081-2
- EN 50082-2
- IEC 61326 for an Industrial Environment
- CE Mark

## Advanced software functions

**Totalizers**
**Number**
1 per pen
**Size**
99,999,999 max.
**Output**
External counter driver, 'wrap' pulse signal

**Math**
**Number of equations**
4
**Type**
+, –, x, ÷, low & high select, max., min., average, mass flow, RH

**Timers**
**Number**
2
**Type**
Real-time clock driven event, adjustable duration
**Output**
Relay, digital output, logic equation

**PID control**
**No. of loops**
1 or 2
**Control outputs**
Relay, logic or DC analog
**Control types**
Time-proportioning, analog
**Control action**
PID, on/off, motorized valve position, boundless
**Autotune**
On demand, at start-up or at set point

**Option modules**
**Number**
5 plus 1 x standard input/output module
**Connection**
Plug-in cards with detachable connection blocks

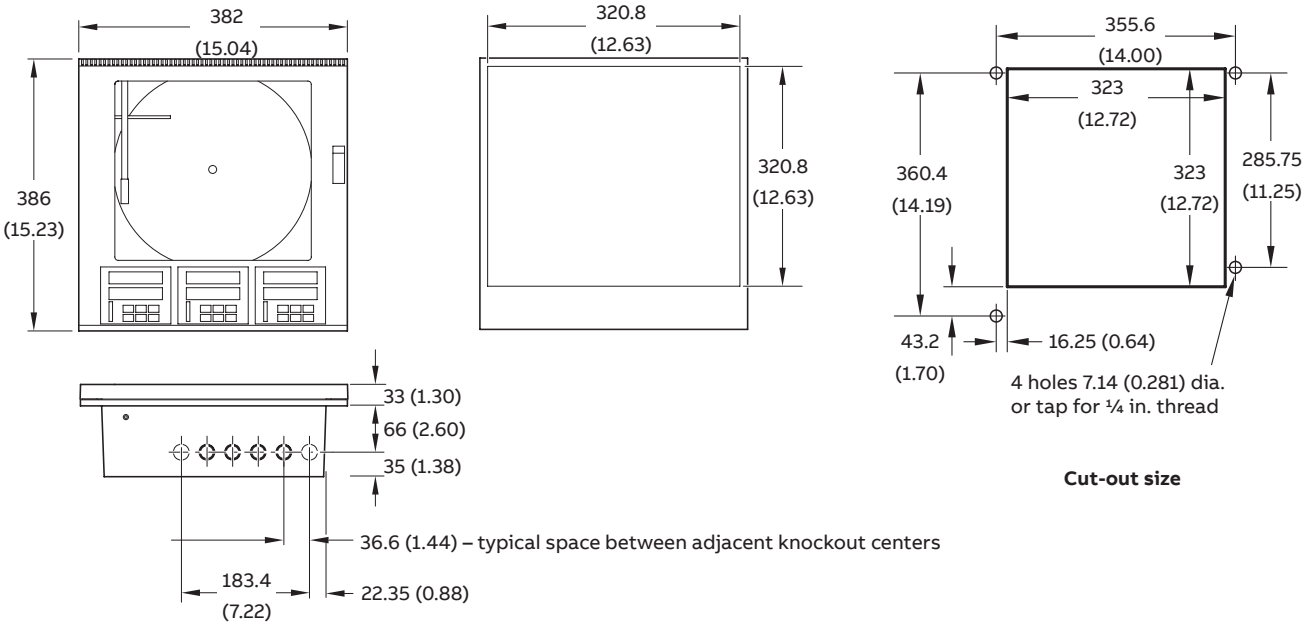
**General**
All modules isolated from each other 500 V DC
**Module specific**
- Analog O/P isolated from all other I/Ps and O/Ps
- Common of digital I/Ps not isolated from –ve of PV I/P

## Option module types

| Option module types | I/O per module | | | | | | | Max. no. per instrument |
|---|---|---|---|---|---|---|---|---|
| | Analog I/P | Analog O/P | Trans. PSU | Relays | Digital I/P | Digital O/P | Comms. | |
| Standard I/O | 1 | 1 | 1 | 1 | 2 | | | 3 |
| Analog I/P + relay | 1 | | | 1 | | | | 5 |
| 4 relays | | | | 4 | | | | 2 |
| 8 digital I/P | | | | | 8 | | | 3 |
| 8 digital O/P | | | | | | 8 | | 3 |
| RS485 communications | | | | | | | 1 | 1 |

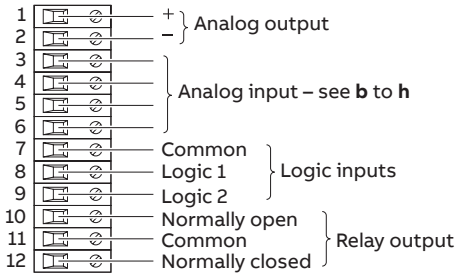
## Overall dimensions

Dimensions in mm (in.)

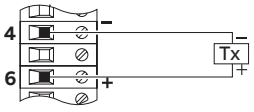



**Cut-out size**

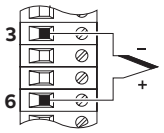
# Electrical connections



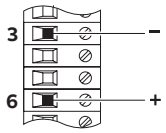

**Summary of connections**



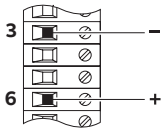

**d – 2-wire transmitter**



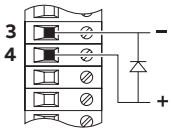

**e – Thermocouple**



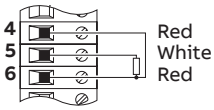

**g – Low voltage (mV)**



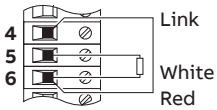

**b – Voltage**




**c – Current (non 2-wire transmitters)**

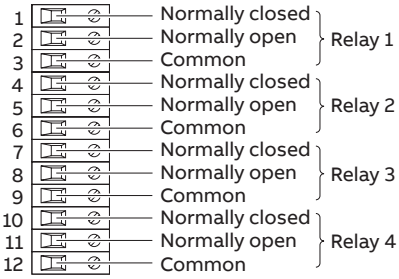



**f – 3-wire RTD**

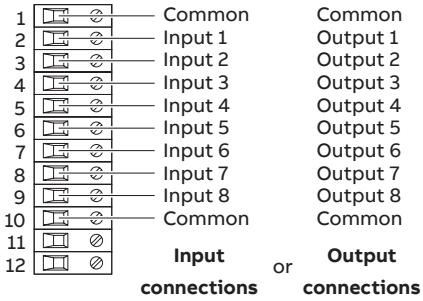



**h – 2-wire RTD and resistance**

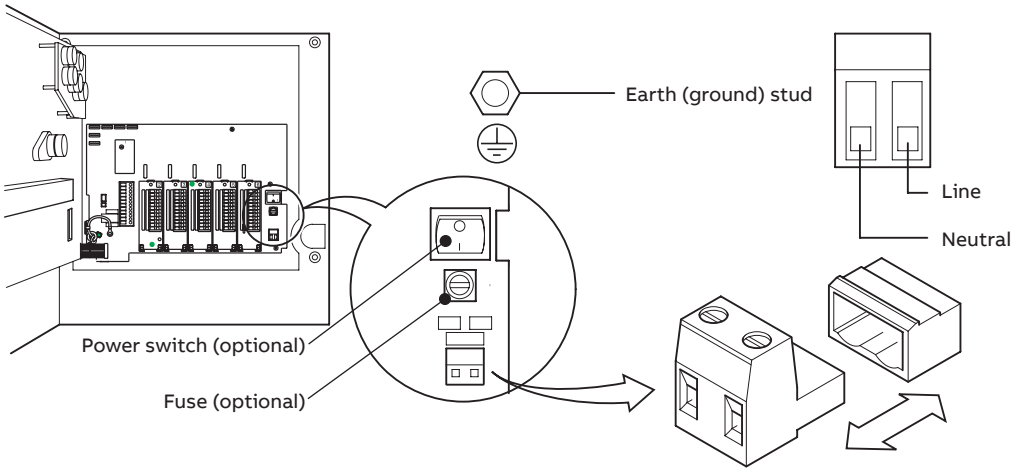
**Standard input/output modules**




**4-relay output module**




**Digital input / output module**




**Power supply connections**

# Ordering information

**Part 1**

| C1900 Recorder/Controller | 19XX | X | X | X | X | X | X | X | X | X | X | XXX | OPT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Recorder/Controllers *** | | | | | | | | | | | | | |
| One control unit, one pen (red) | 11 | | | | | | | | | | | | |
| One control unit, two pens (red, green) | 12 | | | | | | | | | | | | |
| One control unit, three pens (red, green, blue) | 13 | | | | | | | | | | | | |
| One control unit, four pens (red, green, blue, black) | 14 | | | | | | | | | | | | |
| Two control units, two pens (red, green) | 22 | | | | | | | | | | | | |
| Two control units, three pens (red, green, blue) | 23 | | | | | | | | | | | | |
| Two control units, four pens (red, green, blue, black) | 24 | | | | | | | | | | | | |
| **Chart type** | | | | | | | | | | | | | |
| Taylor ER/C charts | | R | | | | | | | | | | | |
| KPC 105 PX and PXR type charts | | S | | | | | | | | | | | |
| Chessell Brand charts | | D | | | | | | | | | | | |
| **Electrical code** | | | | | | | | | | | | | |
| Standard | | | A | | | | | | | | | | |
| CSA approved | | | B | | | | | | | | | | |
| UL approved | | | U | | | | | | | | | | |
| CSA/FM Class 1 Div. 2 approval | | | F | | | | | | | | | | |
| **Option module** | | | | | | | | | | | | | |
| None | | | | 0 | | | | | | | | | |
| Additional modules – complete Part 2 | | | | A | | | | | | | | | |
| **Options** | | | | | | | | | | | | | |
| None | | | | | 0 | | | | | | | | |
| Totalizer | | | | | 3 | | | | | | | | |
| Ramp/Soak profile | | | | | 5 | | | | | | | | |
| Math and timer | | | | | A | | | | | | | | |
| Totalizer, math and timer | | | | | B | | | | | | | | |
| Totalizer, ramp/soak profile, math and timer | | | | | C | | | | | | | | |
| **Door lock** | | | | | | | | | | | | | |
| Not fitted | | | | | | 1 | | | | | | | |
| Fitted | | | | | | 2 | | | | | | | |
| **Power supply** | | | | | | | | | | | | | |
| 115 V AC | | | | | | | 1 | | | | | | |
| 230 V AC | | | | | | | 2 | | | | | | |
| 115 V AC with on/off switch | | | | | | | 4 | | | | | | |
| 230 V AC with on/off switch | | | | | | | 5 | | | | | | |

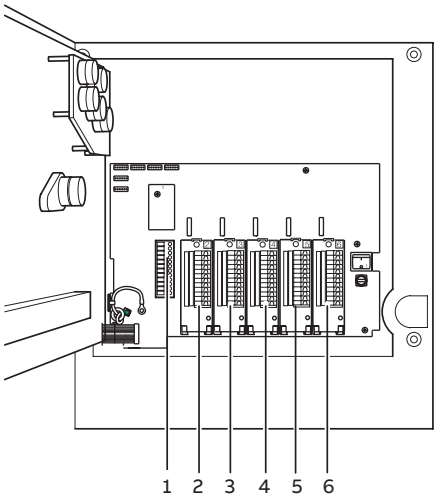
| Part 2 additional modules | Module type | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Module position 2/channel 2 input* | 0 | 1 | 2 | | | | | | | | | | |
| Module position 3/channel 3 input* | 0 | 1 | 2 | | | | | | | | | | |
| Module position 4/channel 4 input* | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | | | | |
| Module position 5 | 0 | | 2 | 3 | 4 | 5 | | | | | | | |
| Module position 6 | 0 | 2 | 4 | 5 | 8 | | | | | | | | |
| **Special settings** | | | | | | | | | | | | | |
| Company standard | | | | | | | | | | | | STD | |
| Custom configuration (customer to complete and supply C1900RC custom configuration sheet – INF08/032) | | | | | | | | | | | | CUS | |
| Special | | | | | | | | | | | | SXX | |
| Engineered configuration (customer to supply configuration details required) | | | | | | | | | | | | ENG | |
| Calibration certificate ** | | | | | | | | | | | | | C1 |

* Each pen fitted has an associated standard input/output module comprising analog input, analog output, relay, transmitter power supply and two digital inputs.
Additional input/output modules may be fitted in the unused module positions as required. These additional modules should be specified in Part 2 of the ordering information.

** When a calibration certificate is ordered it is performed according to the specified configuration type:
CUS/ENG – Inputs and outputs calibrated according to the customer supplied configuration details and ranges.
STD – Inputs and outputs calibrated according to the instrument factory standard configuration and ranges.

## Accessories

| | |
|---|---|
| Case-to-panel gasket | C1900/0149 |
| Wall-mount kit | C1900/1712 |
| Pipe-mount kit | C1900/0713 |
| Pack of red pens | C1900/0121 |
| Pack of green pens | C1900/0122 |
| Pack of blue pens | C1900/0120 |
| Pack of black pens | C1900/0119 |
| Pack of purple pens | C1900/0123 |
| After-sales engineered configuration service | ENG/REC |




Module positions

**Key to module types**

| | |
|---|---|
| 0 | No module fitted/pen input channel * |
| 1 | Standard input/output |
| 2 | Analog input (math input) + relay |
| 3 | Four relays |
| 4 | Eight digital inputs |
| 5 | Eight digital outputs |
| 6 | True time event pen (violet) |
| 8 | Modbus RS485 communications |

* On 2, 3 or 4 pen instruments a standard I/O module is always fitted in the corresponding module position (enter '0' in the corresponding order code field).

**Example.** 1 9 2 2 R A A 0 1 1 0 2 3 0 0 STD

2 control, 2 pen

Remote set point + relay

4 relays

## Acknowledgements and trademarks

Modbus™ is a trademark of Modicon, Inc.

## Notes

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Service

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**abb.com/recorders**



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