ABB MEASUREMENT & ANALYTICS | USER GUIDE | IM/AX4PH REV. P

AX416, AX436, AX460, AX466 and AX468

Single and dual input analyzers for pH/Redox (ORP)

Measurement made easy

AX400 series
pH/Redox (ORP)
analyzers

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Data Sheet AX460, AX466 and AX416 Single and dual input analyzers for pH/Redox (ORP)	DS/AX4PH-EN
User Guide Supplement | PID control AX460 Single input pH/Redox (ORP) analyzer	IM/AX4PID
User Guide Supplement | PROFIBUS® AX400 series Single and dual input analyzers	IM/AX4/PBS

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
	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

1.1 System Description

The AX460 single input and AX466 dual input pH/Redox (ORP) analyzers and associated electrode systems have been designed for continuous monitoring and control of pH and Redox (ORP). The electrode system can be standardized to the analyzer using the built-in calibration facility and a single point buffering facility provides easy re-calibration after initial standardization.

The analyzer is available in wall-/pipe-mount or panel-mount versions with either one or two programmable, pH or Redox (ORP) input channels, each with its own associated temperature input channel. When making temperature compensated measurements, the sample temperature is sensed by a resistance thermometer (Pt100, Pt1000 or Balco 3K) mounted in the electrode system.

The analyzer can be configured for, and connected to, either a standard pH input (single, high impedance input $>10^{13}\ \Omega$) or differential pH input (dual, high impedance inputs, both $>10^{13}\ \Omega$).

Differential pH input is designed for use with pH electrode systems that incorporate a solution earth (ground) rod. The measuring electrode and reference electrode signals are measured separately using two, high impedance amplifiers and compared with the solution earth (ground) potential. The difference between the results is the value used for the pH measurement.

All models incorporate a wash facility for system cleaning; the Alarm 3 relay can be configured to control the wash system either automatically or manually. The relay can be programmed to deliver either a continuous or pulsed signal to control an external power supply to a solenoid or pump and the frequency, duration and recovery time for the wash cycle are also programmable. During a wash cycle, the analog output value is held in its pre-cycle condition.

Analyzer operation and programming are performed using five tactile membrane keys on the front panel. Programmed functions are protected from unauthorized alteration by a four-digit security code.

1.2 PID Control

The AX460 single input pH analyzer incorporates Proportional Integral Derivative (PID) control as standard. Refer to the *PID Control Supplementary User Guide, IM/AX4PID* for a full description and instructions on how to configure and operate PID control.

1.3 AX400 Series Analyzer Options

Table 1.1 shows the range of configurations that are possible for the AX400 Series analyzers. The analyzer detects the type of input board fitted for each input automatically and displays only the operating and programming frames applicable to that input board type. If no input board is fitted for a second input (Sensor B), Sensor B frames are not displayed.

Model	Analyzer Description	Sensor A	Sensor B
AX410	Single Input 2-Electrode Conductivity (0 to 10,000 µS/cm)	2-Electrode Conductivity	–
AX411	Dual Input 2-Electrode Conductivity (0 to 10,000 µS/cm)	2-Electrode Conductivity	2-Electrode Conductivity
AX413	Dual Input 2-Electrode Conductivity and 4-Electrode Conductivity	2-Electrode Conductivity	4-Electrode Conductivity
AX416	Dual Input 2-Electrode Conductivity and pH/Redox (ORP)	2-Electrode Conductivity	pH/Redox (ORP)
AX418	Dual Input 2-Electrode Conductivity and Dissolved Oxygen	2-Electrode Conductivity	Dissolved Oxygen
AX430	Single Input 4-Electrode Conductivity (0 to 2,000 mS/cm)	4-Electrode Conductivity	–
AX433	Dual Input 4-Electrode Conductivity (0 to 2,000 mS/cm)	4-Electrode Conductivity	4-Electrode Conductivity
AX436	Dual Input 4-Electrode Conductivity and pH/Redox (ORP)	4-Electrode Conductivity	pH/Redox (ORP)
AX438	Dual Input 4-Electrode Conductivity and Dissolved Oxygen	4-Electrode Conductivity	Dissolved Oxygen
AX450	Single Input 2-Electrode Conductivity (USP)	2-Electrode Conductivity	–
AX455	Dual Input 2-Electrode Conductivity (USP)	2-Electrode Conductivity	2-Electrode Conductivity
AX456	Dual Input 2-Electrode Conductivity (USP) and pH/Redox (ORP)	2-Electrode Conductivity	pH/Redox (ORP)
AX460	Single Input pH/Redox (ORP)	pH/Redox (ORP)	–
AX466	Dual Input pH/Redox (ORP)	pH/Redox (ORP)	pH/Redox (ORP)
AX468	Dual Input pH/Redox (ORP) and Dissolved Oxygen	pH/Redox (ORP)	Dissolved Oxygen
AX480	Single Input Dissolved Oxygen	Dissolved Oxygen	–
AX488	Dual Input Dissolved Oxygen	Dissolved Oxygen	Dissolved Oxygen

Table 1.1 AX400 Series Analyzer Options

2 Operation

2.1 Powering Up the Analyzer

Warning. Ensure all connections are made correctly, especially to the earth stud – see Section 6.3, page 47.

1. Ensure the input sensors are connected correctly.
2. Switch on the power supply to the analyzer. A start-up screen is displayed while internal checks are performed, then the Operating Page (Section 2.3) is displayed as the pH or Redox (ORP) monitoring operation starts.

2.2 Displays and Controls

The display comprises two rows of 4½ digit, 7-segment digital displays, that show the actual values of the measured parameters and alarm set points, and a 6-character dot matrix display showing the associated units. The lower display line is a 16-character dot matrix display showing operating and programming information.

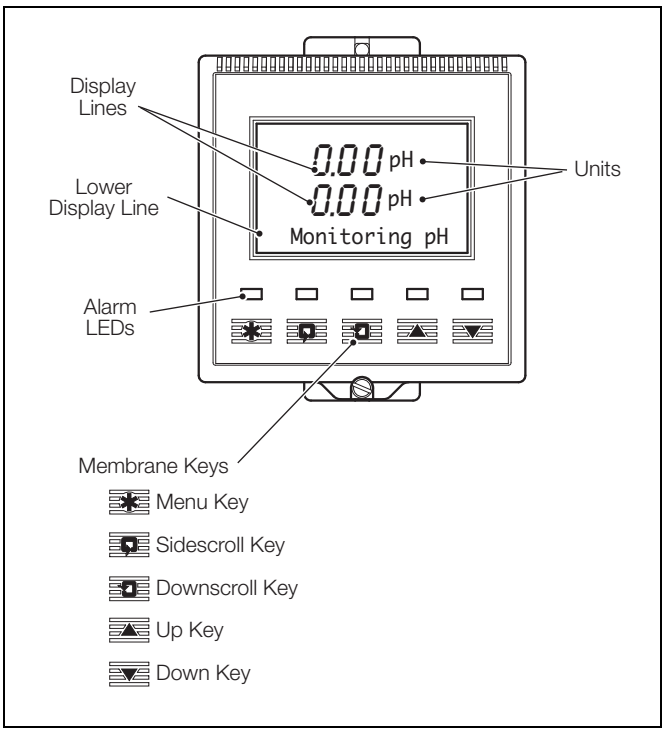


Fig. 2.1 Location of Controls and Displays

2.2.1 Membrane Key Functions

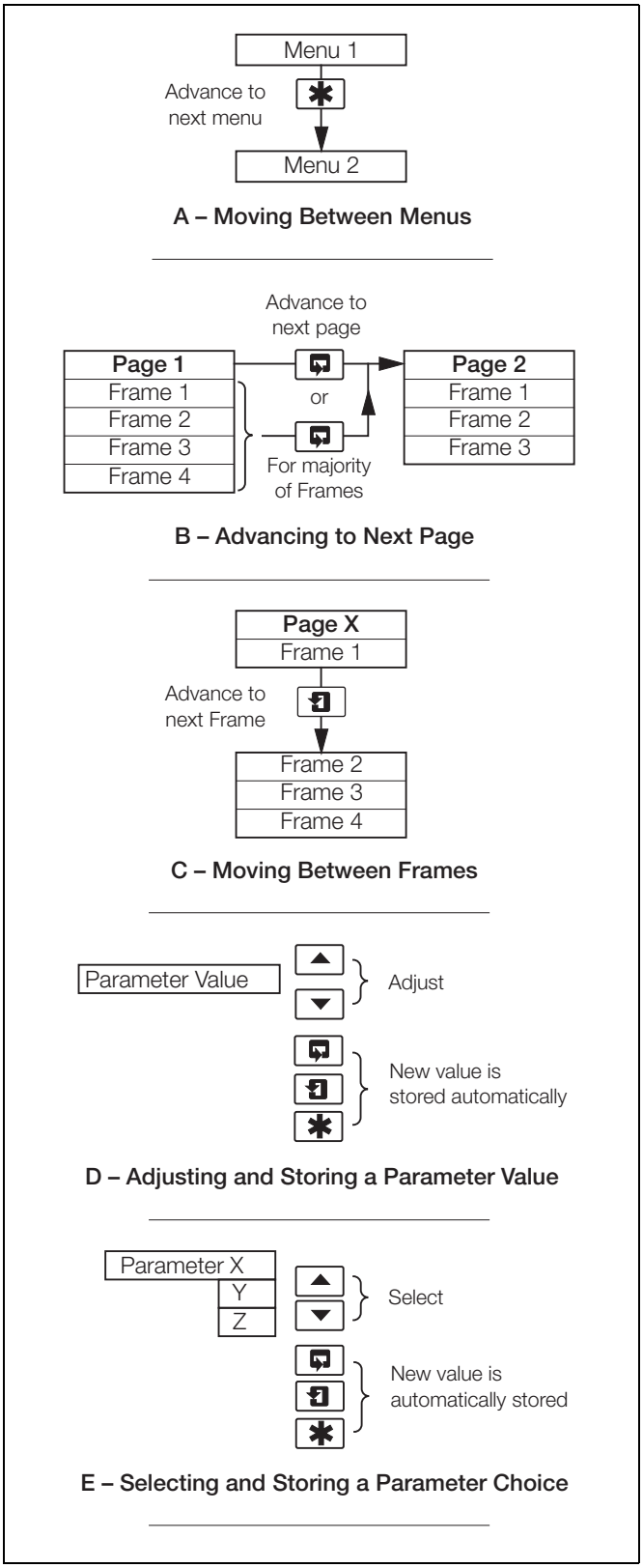


Fig. 2.2 Membrane Key Functions

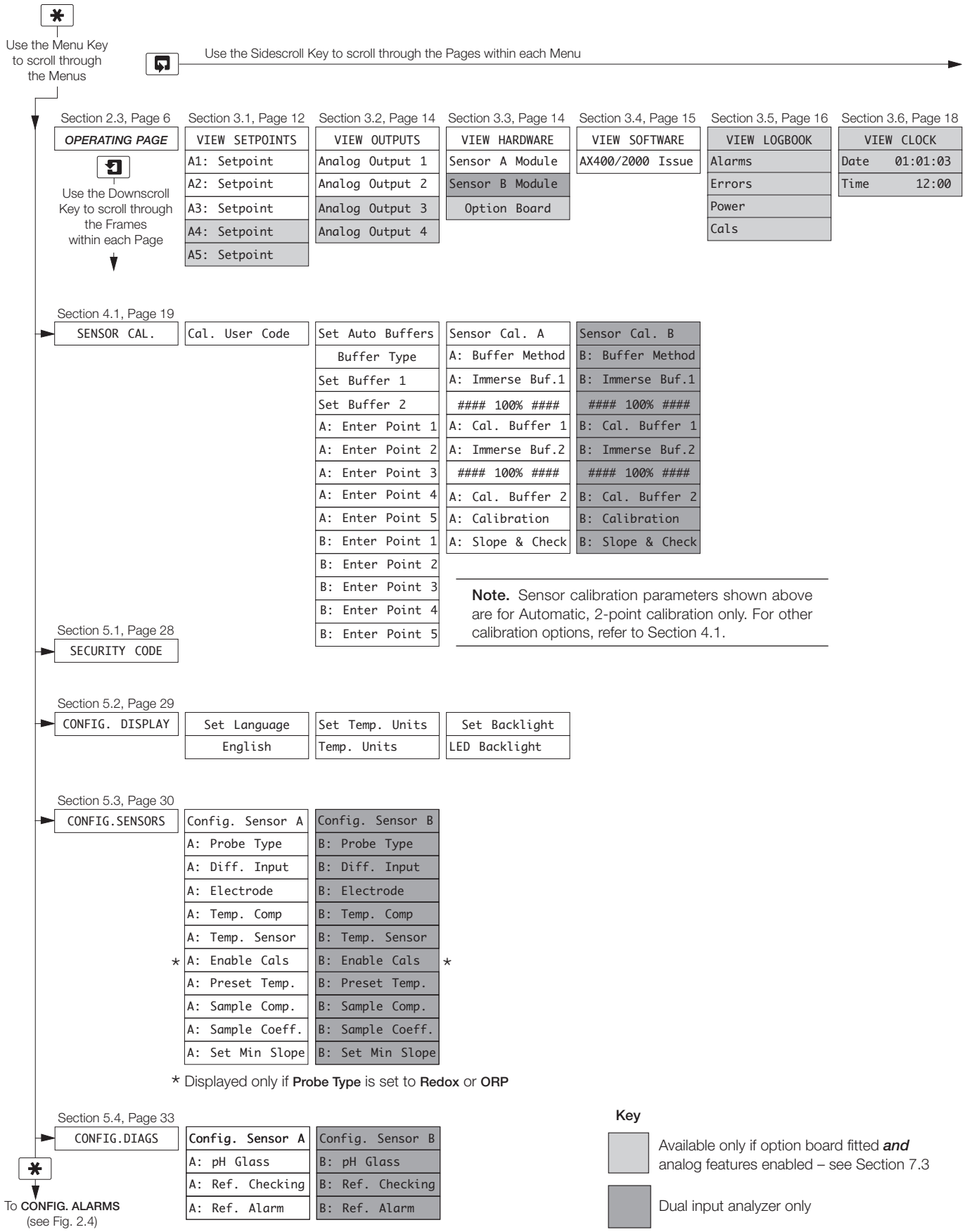


Fig. 2.3 Overall Programming Chart

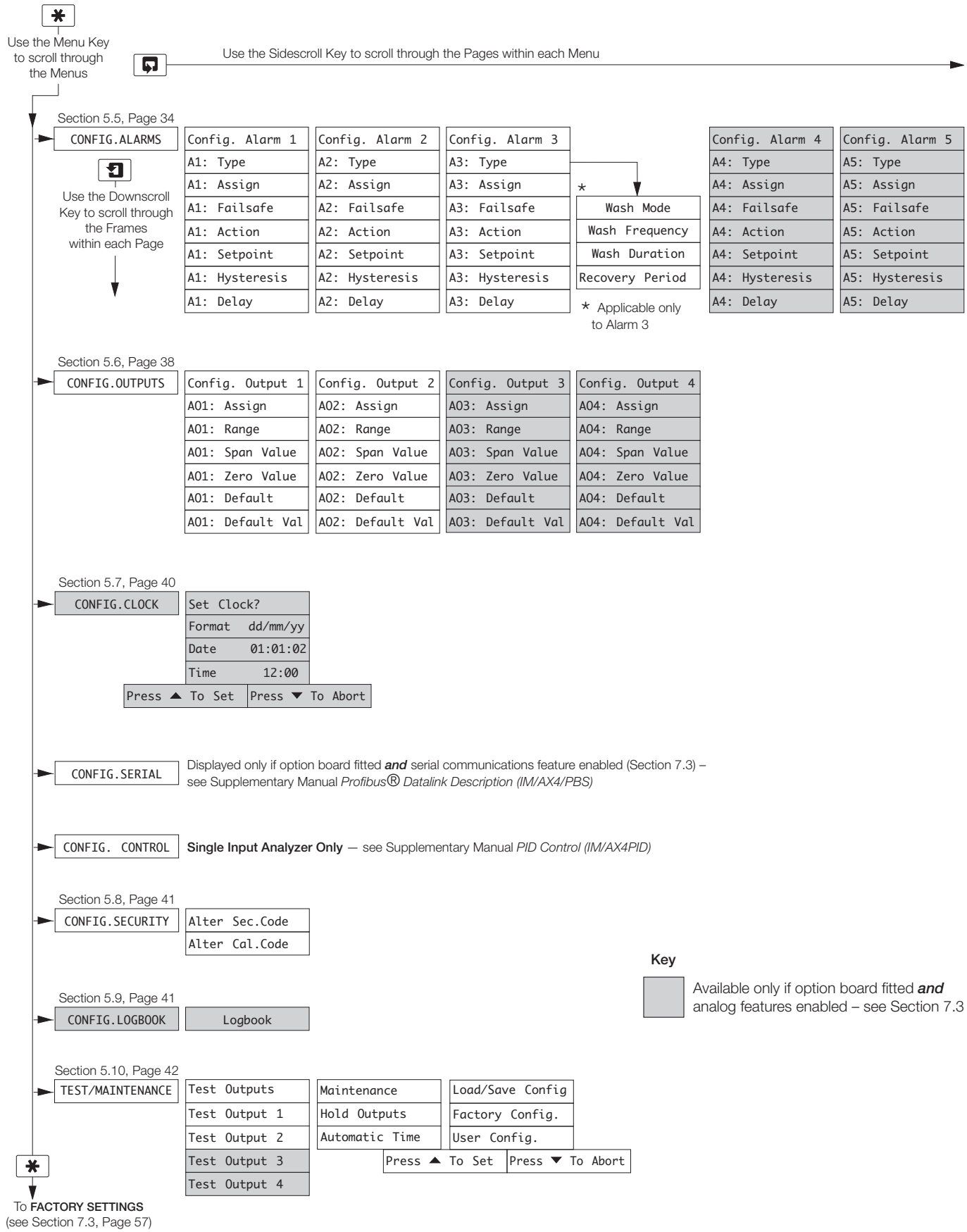
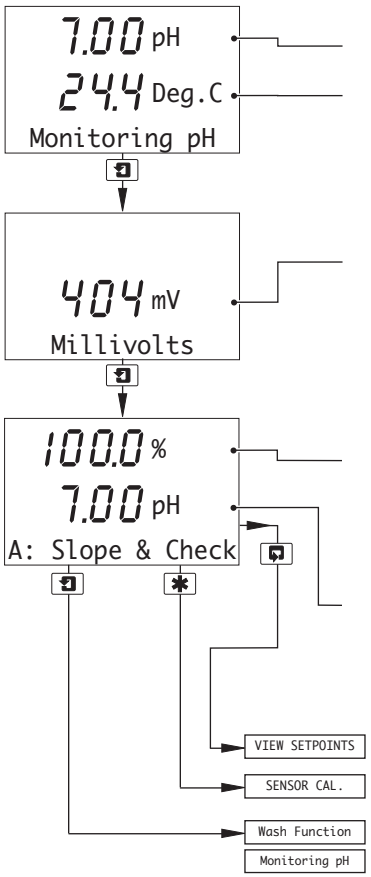


Fig. 2.4 Overall Programming Chart (Continued)

2.3 Operating Page

2.3.1 Single Input pH



Measured Values

pH.

Temperature.

Measured Millivolts

Millivolts.

% Slope and pH Check Value

% slope value.

A value between the programmed minimum % slope value (see **Set Min Slope** – see Section 5.3, page 30) and 105% is displayed. If the value is outside these limits, check the electrode system.

pH check value (zero point).

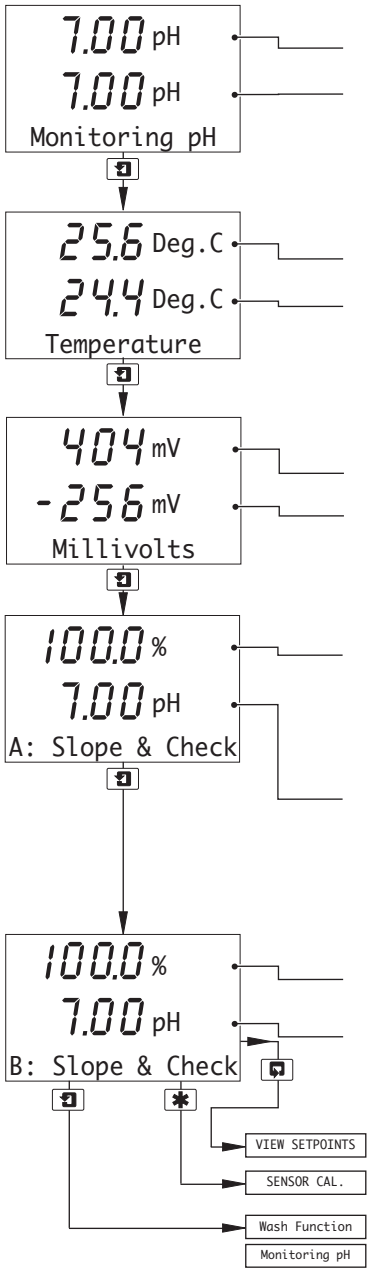
Displayed as an additional indication of pH electrode system condition; 7 pH is the optimum value for glass electrodes and 0 ph for Antimony electrodes.

See Section 3.1, page 12.

See Section 4.1, page 19.

A3: Type set to **Wash** (Section 5.5) – see Section 2.3.6, page 11.
A3: Type not set to **Wash** (Section 5.5) – return to top of page.

2.3.2 Dual Input pH



Measured pH

Sensor A.

Sensor B.

Measured Temperature

Sensor A.

Sensor B.

Measured Millivolts

Sensor A.

Sensor B.

% Slope and pH Check Value – Sensor A

% slope value.

A value between the programmed minimum % slope value (see **Set Min Slope** – see Section 5.3, page 30) and 105 % is displayed. If the value is outside these limits, check the electrode system.

pH check value (zero point).

Displayed as an additional indication of pH electrode system condition; 7 ph being the optimum value for glass electrodes and 0 ph for Antimony electrodes.

% Slope and pH Check Value – Sensor B

% slope value. } See Sensor A above.

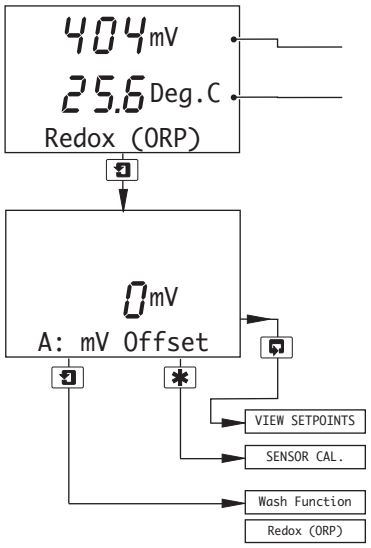
pH check value (zero point). }

See Section 3.1, page 12.

See Section 4.1, page 19.

A3: Type set to **Wash** (Section 5.5) – see Section 2.3.6, page 11.
A3: Type not set to **Wash** (Section 5.5) – return to top of page.

2.3.3 Single Input Redox (ORP)



Measured Values

Millivolts.

Temperature.

Offset – Sensor A

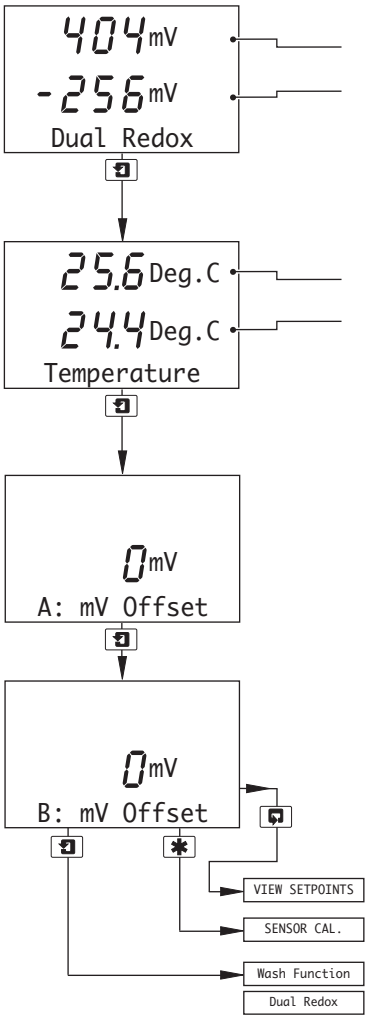
Displays the offset value for the sensor set in **A: Adjust Offset** – see Section 4.1.3, page 22.

See Section 3.1, page 12.

See Section 4.1, page 19.

A3: Type set to **Wash** (Section 5.5) – see Section 2.3.6, page 11.
A3: Type not set to **Wash** (Section 5.5) – return to top of page.

2.3.4 Dual Input Redox (ORP)



Measured Millivolts

Sensor A.

Sensor B.

Note. If **Probe Type** for ***both*** Sensor A ***and*** Sensor B is set to **ORP** (Section 5.3), the lower display line shows **Dual ORP**.

Sample Temperature

Sensor A.

Sensor B.

Note. The measured temperature is displayed only if **Temp. Sensor** is not set to **None** – see Section 5.3, page 30.

Offset – Sensor A

Displays the offset value for Sensor A set in **A: Adjust Offset** – see Section 4.1.3, page 22.

Offset – Sensor B

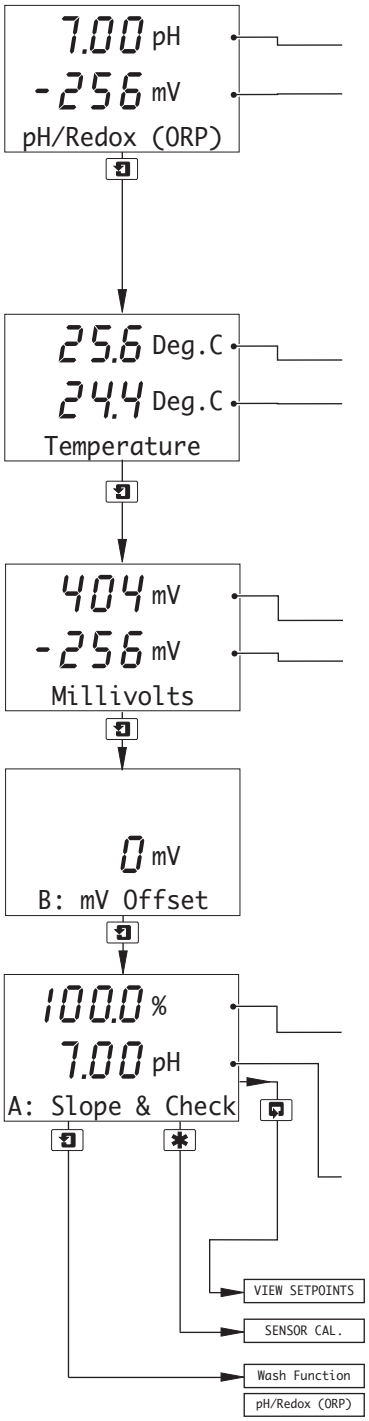
Displays the offset value for Sensor B set in **B: Adjust Offset** – see Section 4.1.3, page 22.

See Section 3.1, page 12.

See Section 4.1, page 19.

A3: Type set to **Wash** (Section 5.5) – see Section 2.3.6, page 11.
A3: Type not set to **Wash** (Section 5.5) – return to top of page.

2.3.5 Dual Input pH and Redox (ORP)



Measured pH and Millivolts

Sensor A.

Sensor B.

Note. The **Probe Type** for Sensors A and B can be set to any combination of **pH**, **Redox** or **ORP** – see Section 5.3, page 30. The display indications change depending on **Probe Type** settings, e.g. if Sensor A is set to **Redox** and Sensor B to **pH**, the lower display shows **Redox (ORP)/pH**.

Measured Temperature

Sensor A.

Sensor B.

Note. The measured temperature is displayed only if **Temp. Sensor** is not set to **None** – see Section 5.3, page 30.

Measured Millivolts

Sensor A.

Sensor B.

Offset – Sensor B

Displays the offset value for Sensor B set in **B: Adjust Offset** – see Section 4.1.3, page 22.

% Slope and pH Check Value – Sensor A

% slope value.

A value between the programmed minimum % slope value (see **Set Min Slope** – Section 5.3) and 105 % is displayed. If the value is outside these limits, check the electrode system.

pH check value (zero value).

Displayed as an additional indication of pH electrode system condition; 7 ph is the optimum value for glass electrodes and 0 ph for Antimony electrodes.

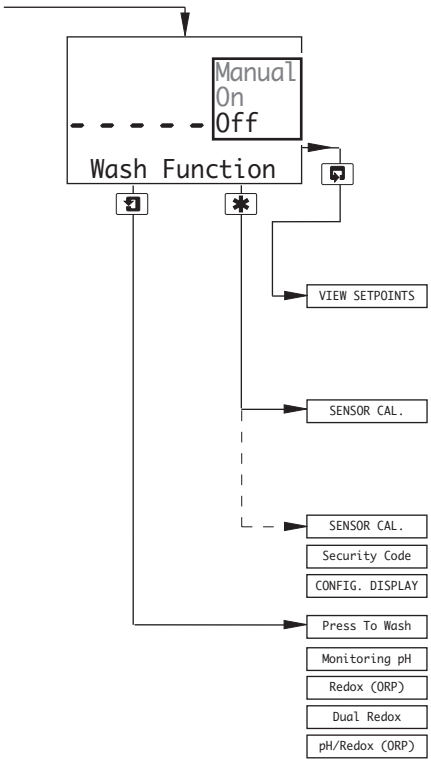
See Section 3.1, page 12.

See Section 4.1, page 19.

A3: Type set to **Wash** (Section 5.5) – see Section 2.3.6, page 11.
A3: Type not set to **Wash** (Section 5.5) – return to top of page.

2.3.6 Wash Function

Note. The Wash function is available only if **A3: Type** is set to **Wash** – see Section 5.5, page 34.



Wash Function

`Off` – Wash function off. Lower display line of *Operating Page* shows `WASH INHIBITED`.

`On` – Wash function controlled automatically. Lower display line of *Operating Page* shows `WASH IN PROGRESS`.

`Manual` – Enables wash function to be initiated manually – see below.

Note. Set **Wash Function** to **Off** before removing the sensor from the process.

See Section 3.1, page 12.

Probe Type set to **pH** (for ***either*** sensor if dual input analyzer) – see Section 5.3, page 30.

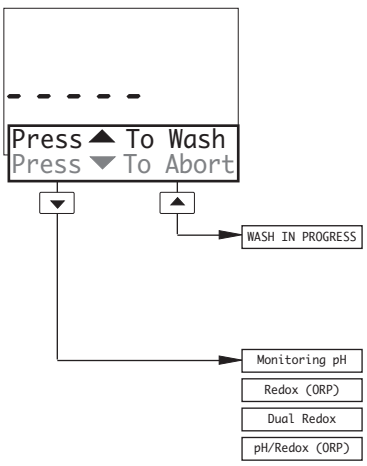
See Section 4.1, page 19.

Probe Type set to **Redox** or **ORP** (for ***both*** sensors in any combination if dual input analyzer) – see Section 5.3, page 30.

Enable Cals set to **Yes** (Section 5.3) – see Section 4.1, page 19.
Alter Sec. Code not set to zero (Section 5.8) – see Section 5.1, page 28.
Alter Sec. Code set to zero (Section 5.8) – see Section 5.2, page 29.

Wash Function set to **Manual** – see below.

Wash Function not set to **Manual**. The display returns to the top of the *Operating Page*.



Press to Wash (Manual Wash only)

Press ▲ to Wash and **Press ▼ to Abort** are shown alternately on the lower display line.

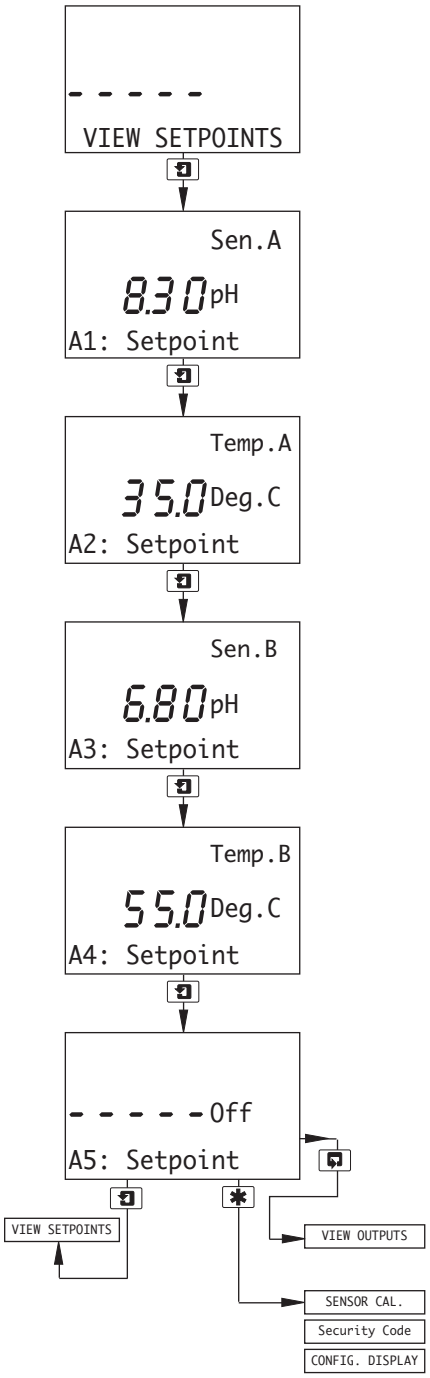
Press the ▲ key to initiate the wash cycle. The display returns to the top of the *Operating Page* and the lower display line shows `WASH IN PROGRESS` until the wash cycle is completed. The **Wash Function** selection reverts to the one that was set before **Manual** was selected.

Press the ▼ key to abort the wash cycle. The display returns to the top of the *Operating Page*.

3 Operator Views

3.1 View Set Points

Note. The parameter names and units of measurement displayed in the **View Set Points** page depend on the **Probe Type** settings for Sensors A and B – see Section 5.3, page 30. Those shown below are given as examples only.



View Set Points

This page shows alarm set points. The value of each of the set points is shown, together with the name of the parameter it is assigned to.

Alarm assignments, set point values and relay/LED actions are programmable – see Section 5.4, page 33.

Sensor A (pH), Alarm 1 Set Point

Sensor A (Temperature), Alarm 2 Set Point

Sensor B (pH), Alarm 3 Set Point – Dual input analyzers only

Sensor B (Temperature), Alarm 4 Set Point – Dual input analyzers only

Note. Alarm 4 available only if option board fitted and analog features enabled – see Section 7.3, page 57.

Alarm 5 Set Point

Note. Alarm 5 available only if option board fitted and analog features enabled – see Section 7.3, page 57.

See Section 3.2, page 14.

See Note on next page.

Note. The menu displayed when pressing the [✱] key from the Operator View pages depends on analyzer configuration, i.e.:

Single Input Analyzers

SENSOR CAL. **Probe Type** set to **pH**
or
Probe Type set to **Redox** or **ORP** ***and*** **Enable Cals** set to **Yes** (Section 5.3) – see Section 4.1, page 19.

Security Code **Probe Type** set to **Redox** or **ORP** ***and*** **Enable Cals** set to **No** (Section 5.3) ***and*** **Alter Sec. Code** not set to zero (Section 5.8) – see Section 5.1, page 28.

CONFIG. DISPLAY **Probe Type** set to **Redox** or **ORP** ***and*** **Enable Cals** set to **No** (Section 5.3) ***and*** **Alter Sec. Code** set to zero (Section 5.8) – see Section 5.2, page 29.

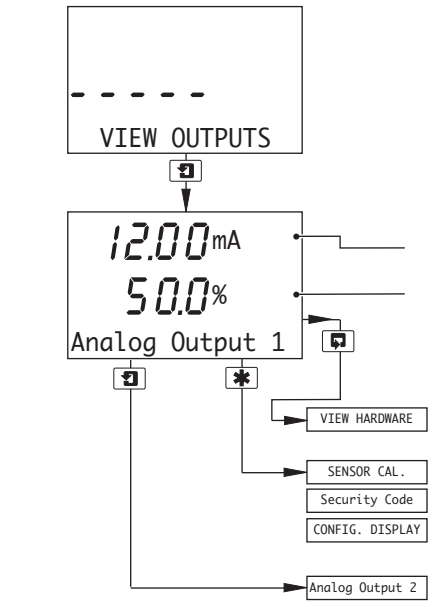
Dual Input Analyzers

SENSOR CAL. **Probe Type** for ***either*** sensor set to **pH**
or
Probe Type for ***both*** sensors set to **Redox** or **ORP** ***and*** **Enable Cals** for ***either*** sensor set to **Yes** (Section 5.3) – see Section 4.1, page 19.

Security Code **Probe Type** for ***both*** sensors set to **Redox** or **ORP** ***and*** **Enable Cals** for ***both*** sensors set to **No** (Section 5.3) ***and*** **Alter Sec. Code** not set to zero (Section 5.8) – see Section 5.1, page 28.

CONFIG. DISPLAY **Probe Type** for ***both*** sensors set to **Redox** or **ORP** ***and*** **Enable Cals** for ***both*** sensors set to **No** (Section 5.3) ***and*** **Alter Sec. Code** set to zero (Section 5.8) – see Section 5.2, page 29.

3.2 View Outputs



Theoretical Analog Output

There are up to four analog outputs, each showing information for one sensor.

Note. Analog outputs 3 and 4 available only if option board fitted ***and*** analog features enabled – see Section 7.3, page 57.

Live current output value being retransmitted.

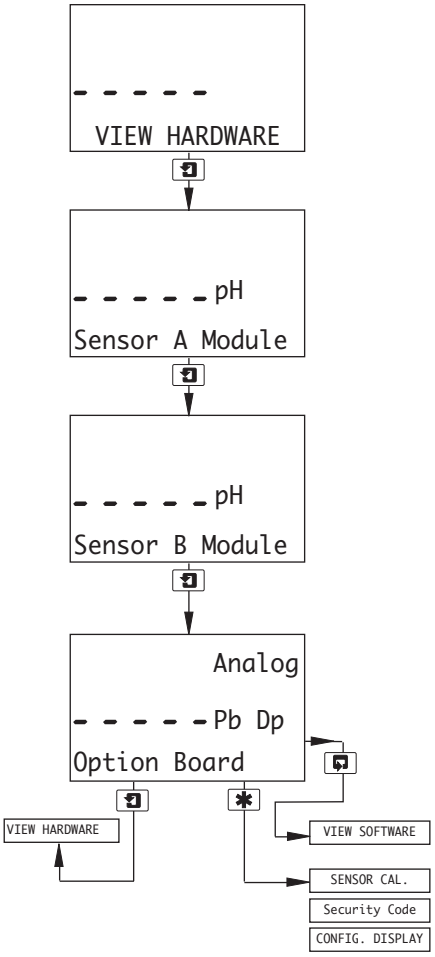
Current output shown as a percentage of full scale for the output range set in **CONFIG. OUPUTS** – see Section 5.6, page 38.

See Section 3.3, below.

See Note on Page 13.

Advance to analog output 2 (and outputs 3 and 4 if option board fitted ***and*** analog features enabled – see Section 7.3, page 57).

3.3 View Hardware



Sensor A Module

Shows the type of input board fitted to the analyzer for the Sensor A input.

Sensor B Module – Dual input analyzers only

Shows the type of input board fitted to the analyzer for the Sensor B input.

Option Board

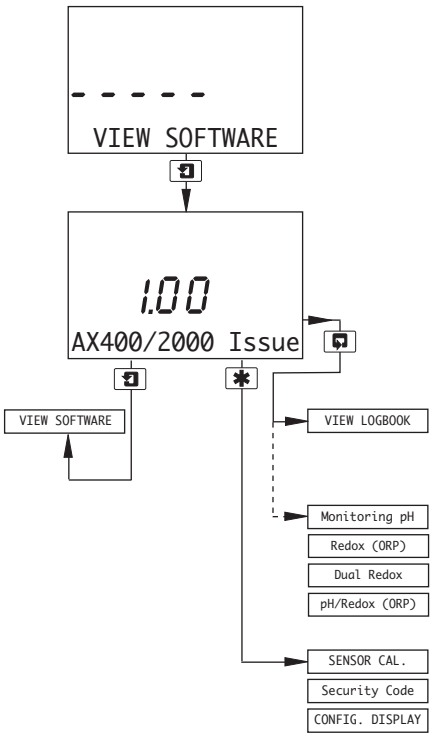
Note. Displayed only if the option board is fitted.

Displays the optional features enabled in the **Factory Settings** page – see Section 7.3, page 57.

See Section 3.4, page 15.

See Note on Page 13.

3.4 View Software



Issue

Shows the version number of the operating software.

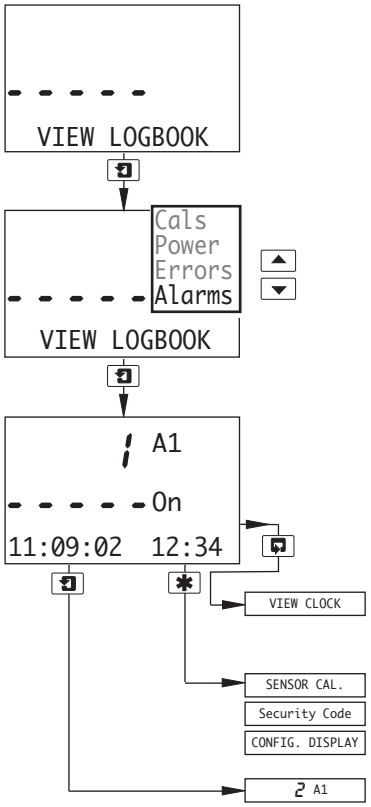
Option board fitted ***and*** analog features enabled (Section 7.3) ***and*** **Logbook** set to **On** (Section 5.9) – see Section 3.5, page 16.

Operating Page (option board not fitted) – see Section 2.3, page 6.

See Note on Page 13.

3.5 View Logbook

Note. The View Logbook function is available only if the option board is fitted ***and*** analog features enabled (see Section 7.3, page 57) ***and*** **Logbook** is set to **On** (see Section 5.9, page 41).



The logbook stores data entries for alarm events, sensor errors, power failures and pH calibration information.

View Logbook

Use the ▲ and ▼ keys to access the **Alarms** logbook.

Note. If no entries are stored in the Alarms logbook, the display shows **No More Entries**.

Alarms

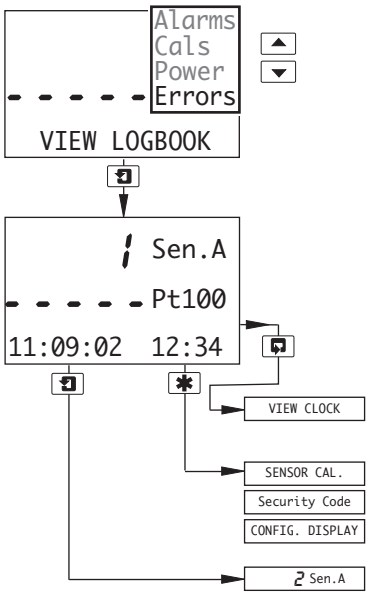
The **Alarms** logbook contains up to 10 entries (entry 1 is the most recent), each comprising an alarm number, alarm state (On or Off) and the date/time of the occurrence.

Option board fitted ***and*** analog features enabled (Section 7.3) – see Section 3.6, page 18.

See Note on Page 13.

Advance to entries 2 to 10.

Note. If no more entries are stored, the display shows **No More Entries**.



View Logbook

Use the ▲ and ▼ keys to access the **Errors** logbook.

Note. If no entries are stored in the **Errors** logbook, the display shows **No More Entries**.

Errors

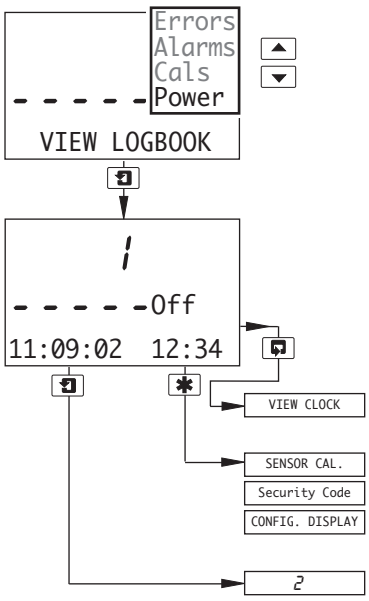
The **Errors** logbook contains up to 5 entries (entry 1 is the most recent), each comprising the sensor letter, error number and the date/time of the occurrence.

Option board fitted ***and*** analog features enabled (Section 7.3) – see Section 3.6, page 18.

See Note on Page 13.

Advance to entries 2 to 5.

Note. If no more entries are stored, the display shows **No More Entries**.



View Logbook

Use the ▲ and ▼ keys to access the **Power** logbook.

Note. If no entries are stored in the **Power** logbook, the display shows **No More Entries**.

Power

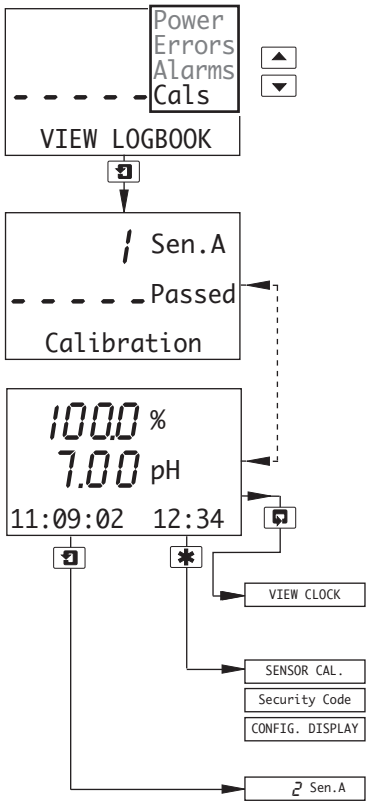
The **Power** logbook contains up to 2 entries (entry 1 is the most recent), each comprising the power state (On or Off) and the date/time of the occurrence.

Option board fitted and analog features enabled (Section 7.3) – see Section 3.6, page 18.

} See Note on Page 13.

Advance to entry 2.

Note. If no more entries are stored, the display shows **No More Entries**.



View Logbook

Use the ▲ and ▼ keys to access the **Cals** logbook.

Note. If no entries are stored in the **Cals** logbook, the display shows **No More Entries**.

Calibration

The **Cals** logbook contains up to 5 entries (entry 1 is the most recent), each comprising 2 frames. Frame 1 contains the entry number, sensor letter and the calibration pass/fail indication.

Frame 2 contains the % slope value, the pH check value and the date/time of the occurrence.

Option board fitted and analog features enabled (Section 7.3) – see Section 3.6, page 18.

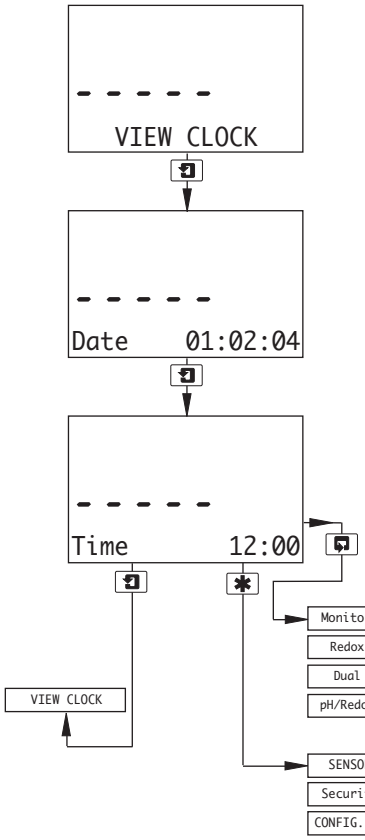
} See Note on Page 13.

Advance to entries 2 to 5.

Note. If no more entries are stored, the display shows **No More Entries**.

3.6 View Clock

Note. The View Clock function is available only if the option board is fitted ***and*** analog features enabled – see Section 7.3, page 57.



Date

Shows the current date.

Time

Shows the current time.

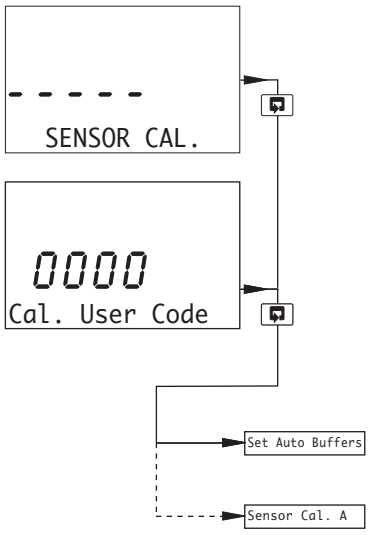
Operating Page – see Section 2.3, page 6.

See Note on Page 13.

4 Setup

4.1 Sensor Calibration

Note. If **Probe Type** for either sensor (Sensor A only if single input) is set to **Redox** or **ORP**, the sensor can be calibrated only if **Enable Cals**. for that sensor is set to **Yes** – see Section 5.3, page 30.



Sensor Calibration

Sensor Calibration Security Code

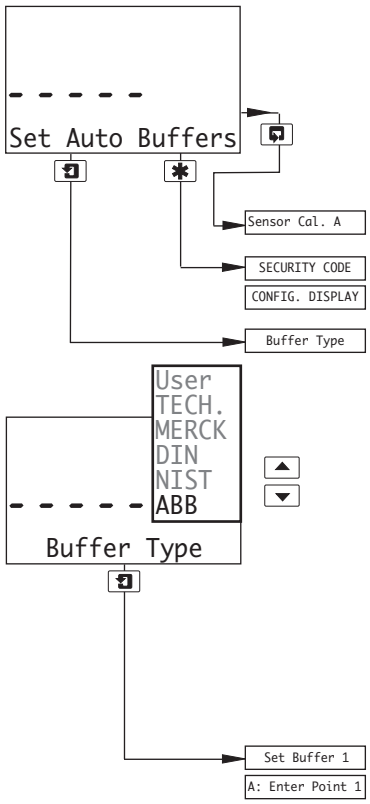
Note. This frame is displayed only if **Alter Cal. Code** is not set to zero – see Section 5.8, page 41.

Enter the required code number (between 0000 and 19999) to access the sensor calibration pages. If an incorrect value is entered, access to the calibration pages is prevented and the display reverts to the **SENSOR CAL.** menu.

Probe Type set to **pH** (for ***either*** sensor if dual input analyzer – see Section 5.3, page 30) – continued below.

Probe Type set to **Redox** or **ORP** (for both sensors if dual input analyzer – see Section 5.3, page 30) – continued on page 22.

4.1.1 Set Buffer Type (pH Only)



Set Auto Buffers

Continued on Page 22.

Alter Sec. Code not set to zero (Section 5.8) – see Section 5.1, page 28.
Alter Sec. Code set to zero (Section 5.8) – see Section 5.2, page 29.

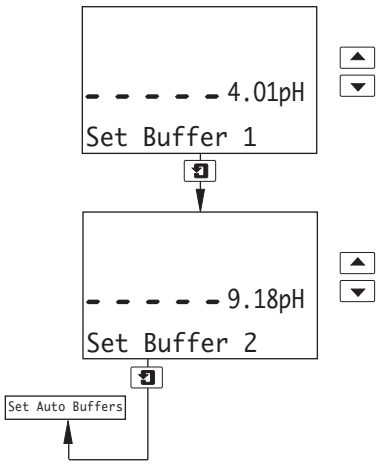
Continued below.

Buffer Type

Select the relevant type of buffer solution (see Appendix A):

ABB	–	ABB supplied buffer solution.
NIST	–	NIST buffer solution.
DIN	–	DIN 19266 buffer solution.
MERCK	–	MERCK buffer solution
TECH	–	US Technical buffer solution
User	–	Buffer solution with a user defined pH value – see Section 4.1.2, page 21.

Buffer Type not set to **User** – continued on next page.
Buffer Type set to **User** – see Section 4.1.2, page 21.



Set Buffer 1

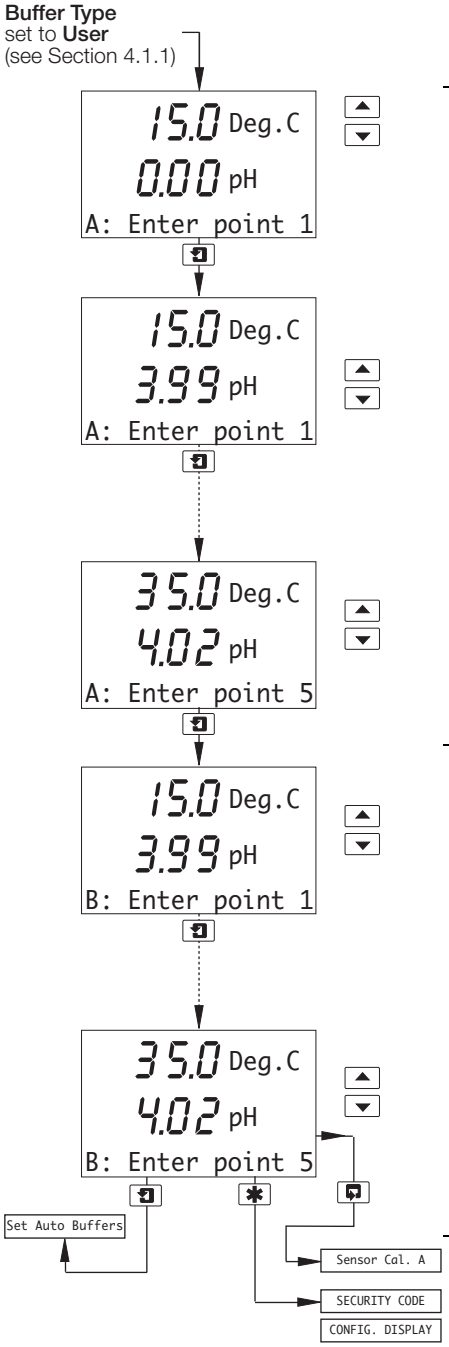
Set the pH value of the buffer 1 solution – see Appendix A for pH tables.

Set Buffer 2

Set the pH value of the buffer 2 solution.

Note. The solution selected for buffer 2 must be at least 2 ph greater than that selected for buffer 1, e.g. if buffer 1 is set to 7 pH, buffer 2 must be set to at least 9 pH.

4.1.2 Set Up User Defined Buffers (pH Only)



Solution A: Enter point 1 (to 5)

Deg.C and **Adjust** are shown alternately on the upper display line. Using the ▲ and ▼ keys, adjust the temperature reading (in 5 ° increments) to the first of the temperatures on the pH/temperature curve.

pH and **Adjust** are shown alternately on the center display line. Using the ▲ and ▼ keys, adjust the pH reading (in 0.01 ph increments) to the pH reading that corresponds to the temperature reading entered above.

Notes.

1) For accurate calibration, it is important to repeat the above for buffer solution A at all 5 points along the pH/temperature curve.
2) The displayed temperature value increases automatically by 5 ºC from the value set for the previous point. The setting may be increased but not decreased.

Solution B: Enter point 1 (to 5)

Solution B set up is identical to solution A set up.

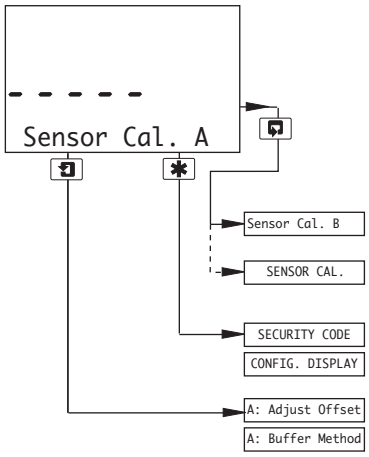
Note. For accurate calibration, it is important to repeat the above for buffer solution B at ***all*** 5 points along the pH/temperature curve.

The analyzer calculates the pH/temperature relationship from the data entered.

See Section 4.1.3 page 22.

Alter Sec. Code not set to zero (Section 5.8) – see Section 5.1, page 28.
Alter Sec. Code set to zero (Section 5.8) – see Section 5.2, page 29.

4.1.3 Adjust Offset (Redox/ORP Only)



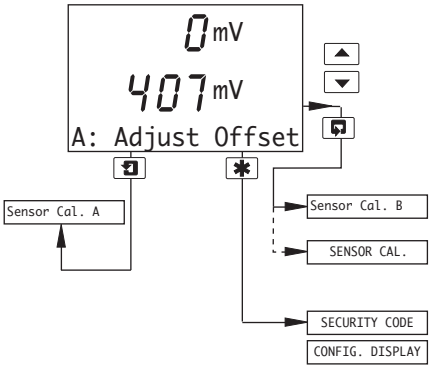
Calibrate Sensor A

Sensor B (dual input analyzers only) calibration is identical to Sensor A calibration.

Probe Type for Sensor B (dual input analyzers only) set to **Redox** or **ORP** ***and*** **Enable Cals.** set to **No** (Section 5.3) – return to top of page.

Alter Sec. Code not set to zero (Section 5.8) – see Section 5.1, page 28.
Alter Sec. Code set to zero (Section 5.8) – see Section 5.2, page 29.

Probe Type set to **Redox** or **ORP** (Section 5.3) – continued below.
Probe Type set to **pH** (Section 5.3) – see Section 4.1.1, page 19.



Adjust Offset (ORP/Redox probes only)

mV and **Adjust** are shown alternately on the upper display line. Use the ▲ and ▼ keys to adjust the upper display line to the required offset value for the process.

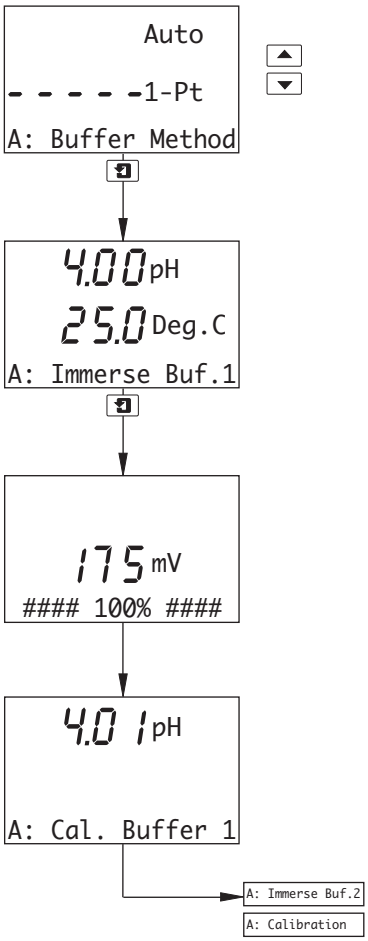
The offset value is adjustable between –240 and +240 mV.

Sensor B (dual input analyzers only) calibration is identical to Sensor A calibration.

Probe Type for Sensor B (dual input analyzers only) set to **Redox** or **ORP** ***and*** **Enable Cals.** set to **No** (Section 5.3) – return to top of page.

Alter Sec. Code not set to zero (Section 5.8) – see Section 5.1, page 28.
Alter Sec. Code set to zero (Section 5.8) – see Section 5.2, page 29.

4.1.4 Automatic, Single- and Two-Point Calibration (pH Only)



Sensor A: Buffer Method (pH probes only)

Select the type of automatic calibration required:

`Auto 1-Pt` – Automatic, single-point calibration
`Auto 2-Pt` – Automatic, two-point calibration

Calibrate Buffer (Single-Point Calibration) or Calibrate Buffer 1 (Two-Point Calibration)

Immerse Sensor A in the buffer solution.

Press the [↵] key to initiate calibration.

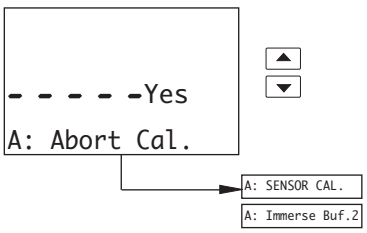
Note. To abort calibration, press the [↵] key again at any time before calibration is complete – see below.

The center display line shows the measured sensor output in millivolts.

As calibration proceeds, a progress indicator appears in the lower display line. When the measured sensor output stabilizes, the lower display line shows `##### 100 % #####`.

The display then changes for 2 seconds to show the temperature-corrected buffer value in the upper display line, then advances automatically to the next frame.

Two-point calibration selected – continued on next page.
Single-point calibration selected – continued on next page.



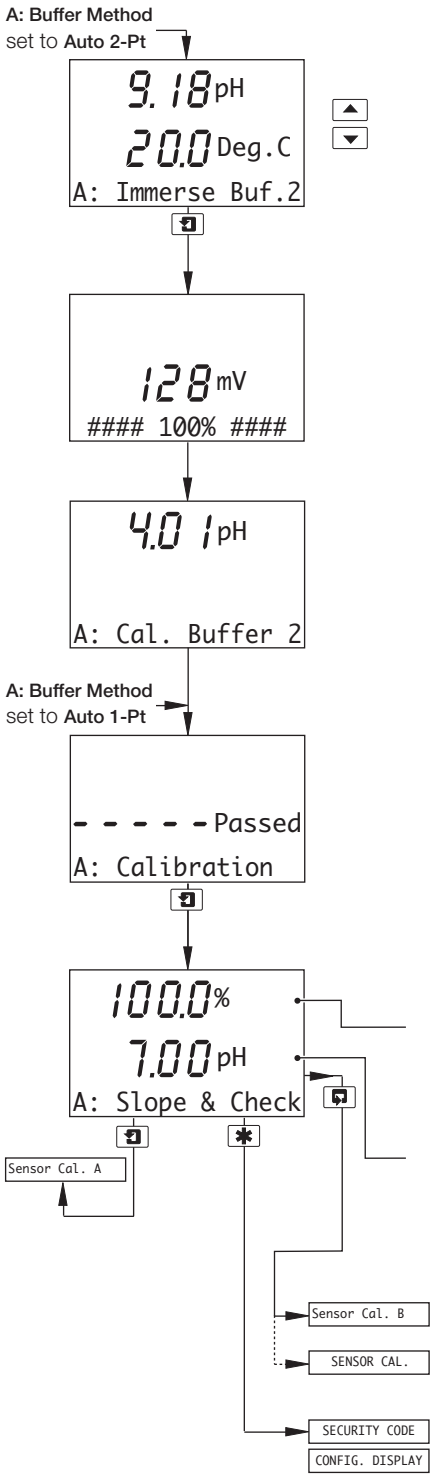
Abort Calibration

Select Yes or No.

Yes selected – return to the main menu.
No selected – calibration continues.

Calibration Message	Min.	Max.	Explanation	Action
`Calibration Passed`	40 to 70 %	105 %	The new calibration coefficients are accepted	None
`Calibration Low Slope`	60 to 90 %	60 to 90 %	The new calibration coefficients are accepted	The electrode pair are becoming fatigued – replacement is recommended
`Calibration Failed`	0%	40 to 70 %	The new calibration coefficients are ignored and the last known valid calibration coefficients are used	Check buffer values and repeat buffering. If the fault persists, replace the electrodes

Table 4.1 Calibration Messages



Calibrate Buffer 2 (Two-Point Calibration only)

Immerse Sensor A in the second buffer solution.

Press the ⏎ key to initiate calibration.

Note. To abort calibration, press the ⏎ key again at any time before calibration is complete – see previous page.

The center display line shows the measured sensor output in millivolts.

As calibration proceeds, a progress indicator appears in the lower display line. When the measured sensor output stabilizes, the lower display line shows ##### 100 % #####.

The display then changes for 2 seconds to show the temperature-corrected buffer value in the upper display line, then advances automatically to the next frame.

Calibration Message

See Table 4.1 for details of calibration messages.

Slope Value

% slope value.
A value between the programmed minimum % slope value (see **Set Min Slope** in the **CONFIG. SENSORS** page – Section 5.3) and 105 % is displayed. If the value is outside these limits, check the electrode system.

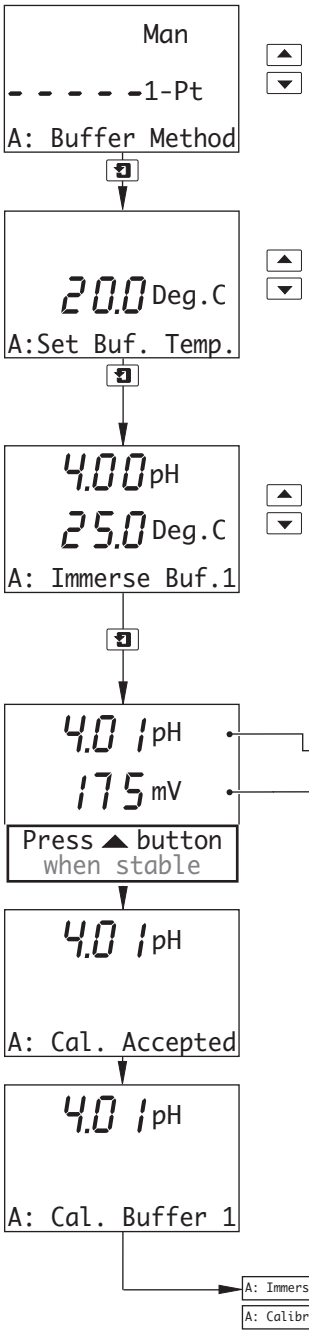
pH check value.
Displayed as an additional indication of electrode system condition; 7 ph is the optimum value for glass electrodes and 0 ph for Antimony electrodes.

Sensor B (dual input analyzers only) calibration is identical to Sensor A calibration.

Probe Type for Sensor B (dual input analyzers only) set to **Redox** or **ORP** ***and*** **Enable Cals.** set to **No** (Section 5.3) – return to top of page.

Alter Sec. Code not set to zero (Section 5.8) – see Section 5.1, page 28.
Alter Sec. Code set to zero (Section 5.8) – see Section 5.2, page 29.

4.1.5 Manual, Single- and Two-Point Calibration (pH Only)



Sensor A: Buffer Method (pH probes only)

Select the type of manual calibration required:

`Man 1-Pt` – Manual, single-point calibration
`Man 2-Pt` – Manual, two-point calibration

Set Buffer Temperature

Deg.C (or **Deg.F**) and Adjust are shown alternately on the center display line. Use the ▲ and ▼ keys to adjust the displayed temperature value to the required buffer temperature (–20 to150 ºC or –4 to 302 ºF).

Note. If **A: Buffer Method** is set to **Man 2-Pt**, the temperature selected is used for both buffers.

Calibrate Buffer (Single-Point Calibration) or Calibrate Buffer 1 (Two-Point Calibration)

Immerse Sensor A in the buffer solution.

pH and **Adjust** are shown alternately on the upper display line. Use the ▲ and ▼ keys to set the displayed pH value to the temperature-corrected pH value of the chosen solution (see the data sheet provided with the solution).

Press the ⏎ key to initiate calibration.

Note. To abort calibration, press the ⏎ key again at any time before calibration is complete – see below.

Measured pH value from the last successful calibration.

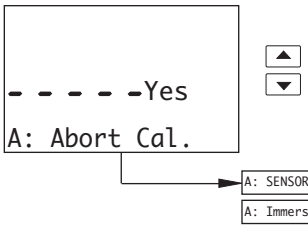
Measured sensor output in millivolts.

When the measured sensor output stabilizes, press the ▲ key to accept the calibration.

Cal. Accepted is shown for 2 seconds to confirm that the calibration has been accepted, the display then advances automatically to the next frame.

The display then changes for 2 seconds to show the temperature-corrected buffer value in the upper display line, then advances automatically to the next frame.

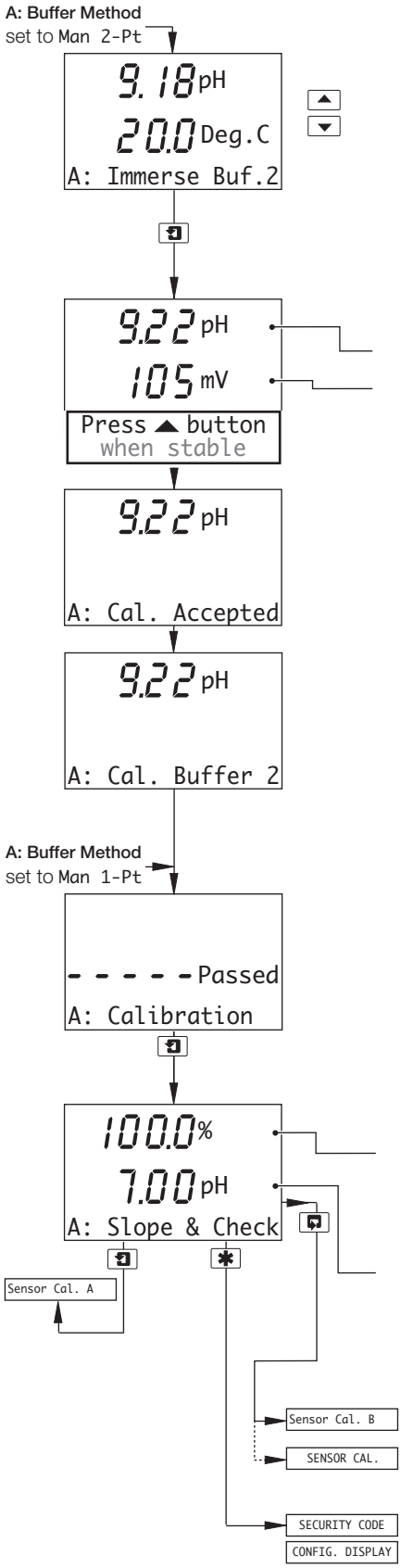
Two-point calibration selected – continued on next page.
Single-point calibration selected – continued on next page.



Abort Calibration

Select Yes or No.

Yes selected – return to the main menu.
No selected – calibration continues.



Calibrate Buffer 2 (Two-Point Calibration only)

Immerse Sensor A in the second buffer solution.

pH and **Adjust** are shown alternately on the upper display line. Use the ▲ and ▼ keys to set the displayed pH value to the temperature-corrected pH value of the chosen solution (see the data sheet provided with the solution).

Press the ◨ key to initiate calibration.

Note. To abort calibration, press the ◨ key again at any time before calibration is complete – see previous page.

Measured pH value from the last successful calibration.

Measured sensor output in millivolts.

When the measured sensor output stabilizes, press the ▲ key to accept the calibration.

Cal. Accepted is shown for 2 seconds to confirm that the calibration has been accepted, the display then advances automatically to the next frame.

The display then changes for 2 seconds to show the temperature-corrected buffer value in the upper display line, then advances automatically to the next frame.

Calibration Message

See Table 4.1 for details of calibration messages.

Slope Value

% slope value.
A value between the programmed minimum % slope value (see **Set Min Slope** – Section 5.3) and 105 % is displayed. If the value is outside these limits, check the electrode system.

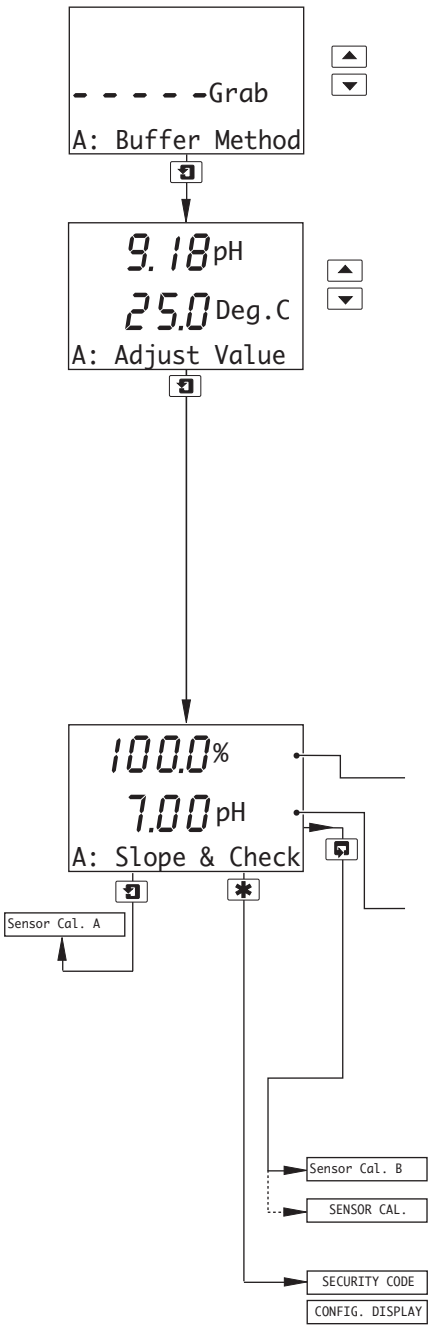
pH check value.
Displayed as an additional indication of electrode system condition; 7 ph is the optimum value for glass electrodes and 0 ph for Antimony electrodes.

Sensor B calibration (dual input analyzers only) is identical to Sensor A calibration.

Probe Type for Sensor B (dual input analyzers only) set to **Redox** or **ORP** ***and*** **Enable Cals.** set to **No** (Section 5.3) – return to top of page.

Alter Sec. Code not set to zero (Section 5.8) – see Section 5.1, page 28.
Alter Sec. Code set to zero (Section 5.8) – see Section 5.2, page 29.

4.1.6 Grab Calibration (pH Only)



Sensor A: Buffer Method (pH probes only)

Select Grab calibration method.

Adjust Value

ph and **Adjust** are shown alternately on the upper display line. The displayed pH value is the reading sampled by the analyzer as this frame is selected and is held until the display is advanced to the next frame. Use the ▲ and ▼ keys to adjust the displayed value (in 0.01 pH increments) to match the pH value of the measured grab sample.

Notes.

- If the displayed value is adjusted by more than ±3pH, WARNING - OFFSET is shown on the lower display line. If the measured grab sample value is correct and the analyzer reading has not been over-adjusted, clean the electrode, check the sensor connections and try again.
- If the displayed value is adjusted by ±5pH, OUT OF RANGE is shown on the lower display line, indicating that maximum adjustment has been reached. Further adjustment is not possible.

Slope Value

% slope value.
The value generated during the last valid two-point calibration, between the programmed minimum % slope value (see **Set Min Slope** – Section 5.3) and 105 %, is displayed.

pH check value.
The value generated during the last valid two-point calibration, adjusted by the value applied in **Adjust Value** (above), is displayed.

Note. The pH check value is reset to the previous, valid check value if a single- or two-point calibration is carried out after a grab calibration.

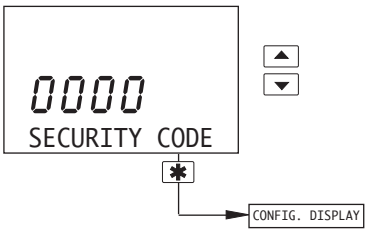
Sensor B calibration (dual input analyzers only) is identical to Sensor A calibration.

Probe Type for Sensor B (dual input analyzers only) set to **Redox** or **ORP** ***and*** **Enable Cals.** set to **No** (Section 5.3) – return to top of page.

Alter Sec. Code not set to zero (Section 5.8) – see Section 5.1, page 28.
Alter Sec. Code set to zero (Section 5.8) – see Section 5.2, page 29.

5 Programming

5.1 Security Code

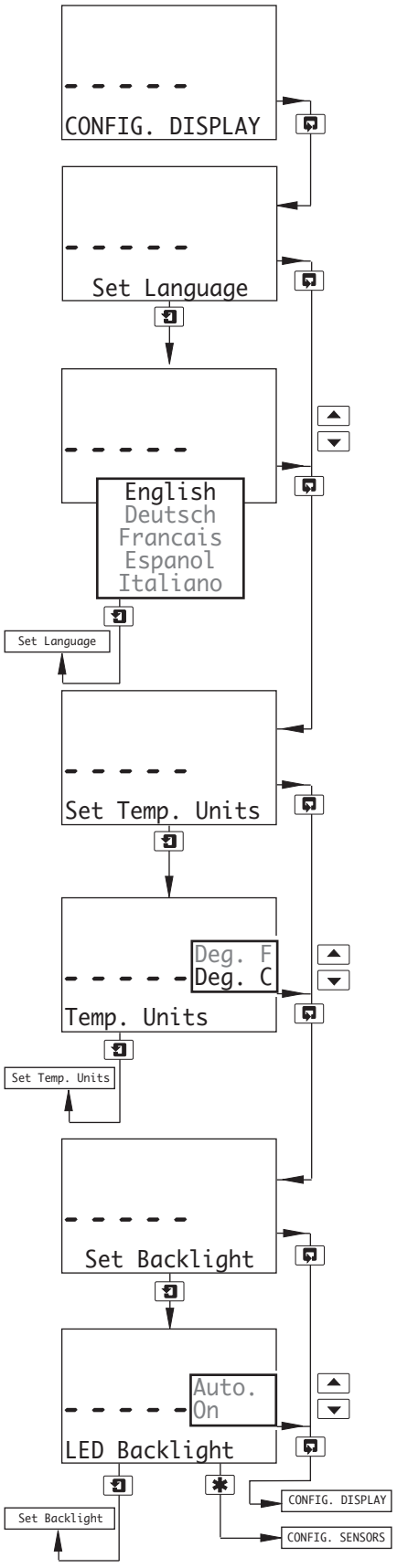


Note. This frame is displayed only if **Alter Sec. Code** is not set to zero – see Section 5.8, page 41.

Enter the required code number (between 0000 and 19999), to gain access to the configuration pages. If an incorrect value is entered, access to the configuration pages is prevented and the display reverts to the *Operating Page* – see Section 2.3, page 6.

See Section 5.2, page 29.

5.2 Configure Display



Set Language

Sets the language to be used on all displays.

Language Page

Use the ▲ and ▼ keys to select the required language.

Set Temperature Units

Temperature Units

Use the ▲ and ▼ keys to select the sample temperature display units.

Set Up Display Backlight

Backlight

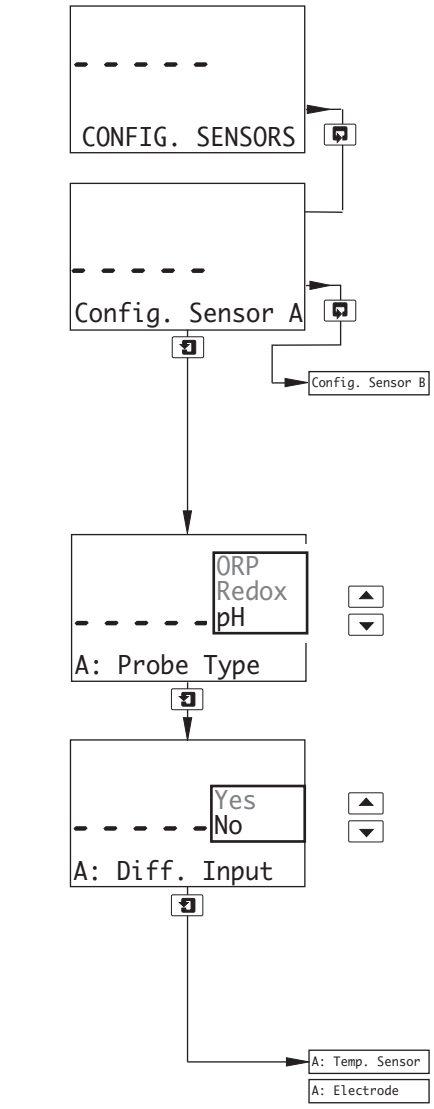
Use the ▲ and ▼ keys to select the required backlight option:

- `Auto.` – Backlight comes on at each button press and switches off one minute after the last button press.
- `On` – Backlight is always on.

Return to main menu.

See Section 5.3, page 30.

5.3 Configure Sensors



Configure Sensor A

Sensor B configuration (dual input analyzers only) is identical to Sensor A configuration.

Probe Type

Select the required probe type.

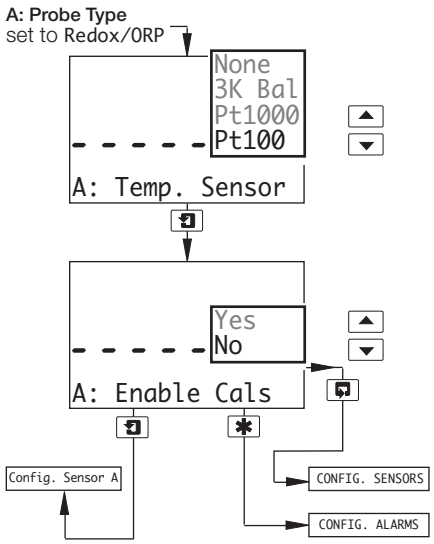
ORP	–	Millivolt display
Redox	–	Millivolt display
pH	–	pH display

Differential Input

Yes	–	Select if electrode system is equipped with a solution earth (ground) rod and sensor diagnostics are required – see Section 5.4, page 33.
No	–	Select if electrode system is not equipped with a solution earth (ground) rod or sensor diagnostics are not required.

Note. Ensure the electrode system is connected correctly for the type of input selected (Standard or Differential) – see Fig. 6.9 (wall-/pipe-mount analyzers) or Fig. 6.11 (panel-mount analyzers).

Probe Type set to **Redox** or **ORP** – continued below.
Probe Type set to **pH** – continued on next page.



Temperature Sensor

Select the type of temperature sensor used: Pt100, Pt1000, Balco 3K or None.

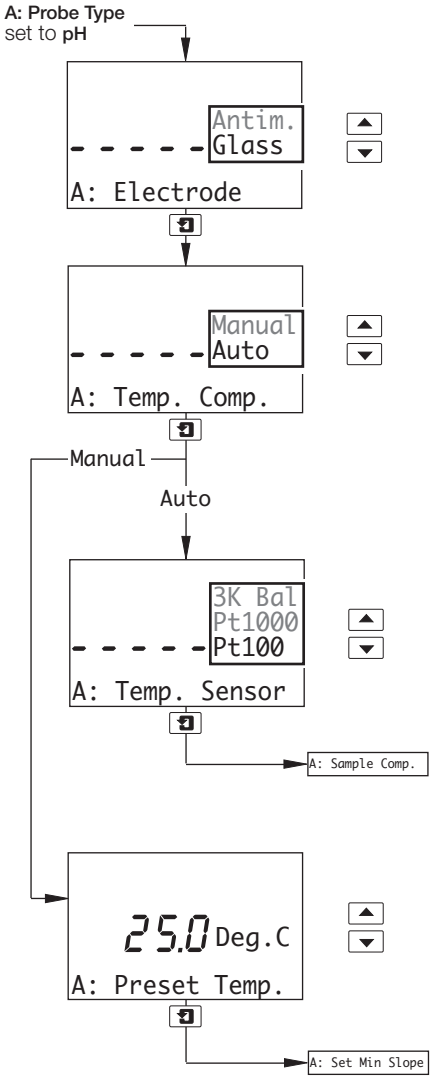
Enable Calibration

Select **Yes** to enable sensor calibration.

Select **No** to disable sensor calibration and all associated frames.

Return to main menu.

See Section 5.4, page 33.



pH Electrode Type

Select the type of pH electrode used, Glass or Antimony.

Temperature Compensation

Select **Auto** to enable the analyzer to compensate automatically for fluctuations in sample temperature.

Temperature Sensor (Automatic Temperature Compensation only)

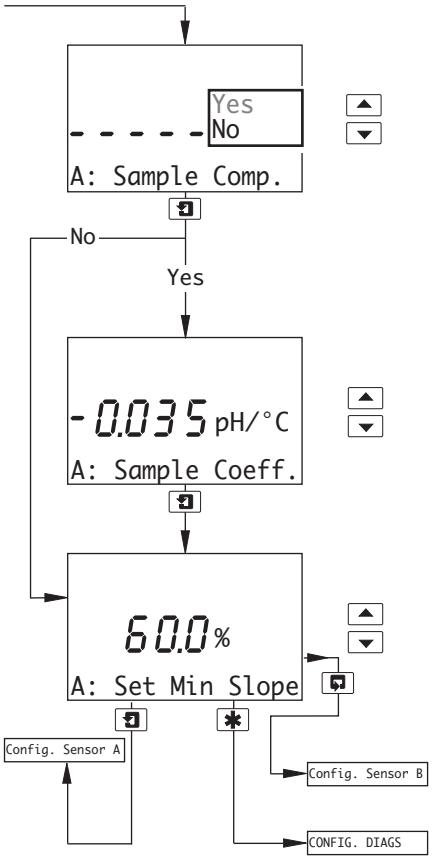
Select the type of temperature sensor used: Pt100, Pt1000 or Balco 3K.

continued on next page.

Preset Temperature (Manual Temperature Compensation only)

Enter the temperature of the sample within the range –10.0 to 120.0 °C.

continued on next page.



Solution Temperature Compensation

Select **Yes** to enable compensation for solution temperature effects referenced to 25 ºC.

Sample Coefficient

If **Sample Comp.** is set to **Yes**, enter the temperature coefficient of the sample, in pH/ºC, within the range 0.020 to –0.050 (in –0.001 increments). For ammonia and sodium hydroxide dosed boilers the value is typically –0.035 (this depends on the individual boiler chemistry). The exact value for a particular sample needs to be determined by laboratory analysis.

pH Calibration Minimum Slope Value

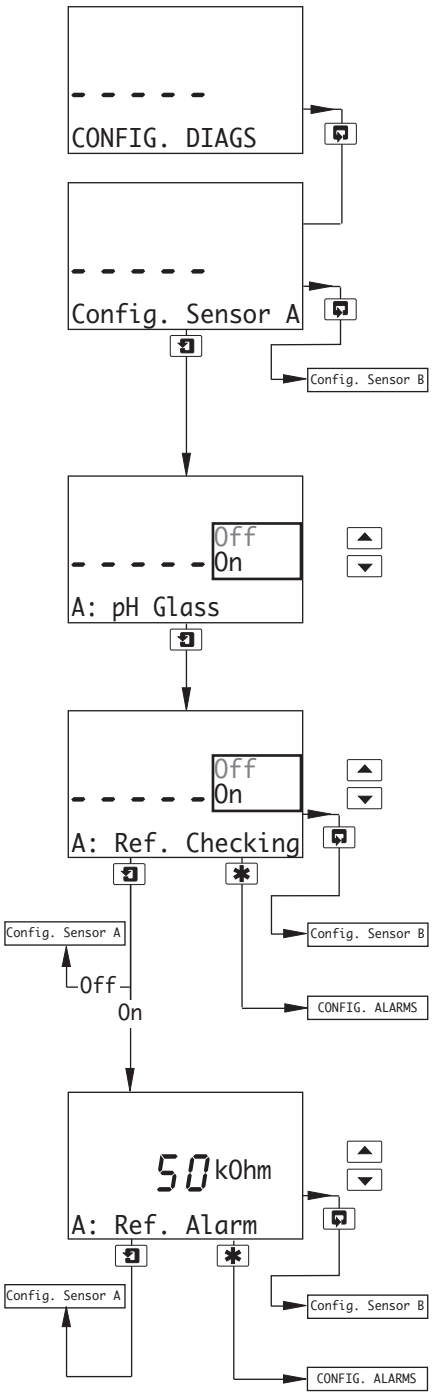
Set the required pH calibration minimum slope value, in %, within the range 60.0 to 90.0 (in 0.1 increments). The calibration fail limit is set automatically to 20 % below the minimum slope setting – see Table 4.1.

Sensor B (dual input analyzers only) configuration is identical to Sensor A configuration.

see Section 5.4, page 33

5.4 Configure Diagnostics

Note. The Configure Diagnostics function is applicable only if **Diff. Input** for Sensor A and/or Sensor B is set to **Yes** – see Section 5.3, page 30.



Configure Sensor A

Sensor B configuration (dual input analyzers only) is identical to Sensor A configuration.

pH Glass Check

Set to **On** to enable the impedance of the glass electrode circuit to be monitored in order to provide low glass impedance and out-of-sample/broken cable warnings.

Note. This frame is displayed only if **A: Probe Type** is set to **pH *and* A: Electrode** is set to **Glass** – see Section 5.3, page 30.

Reference Electrode Check

Set to **On** to enable the condition of the reference electrode to be monitored in order to provide:

- an indication of when sensor cleaning or replacement is required
- out-of-sample/broken cable warnings

Sensor B (dual input analyzers only) configuration is identical to Sensor A configuration.

See section 5.5, page 34.

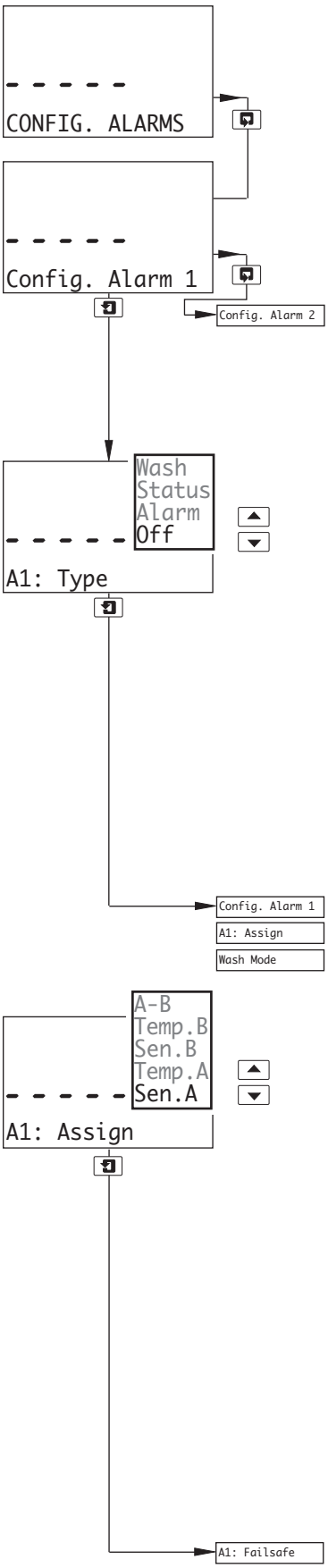
Reference Alarm

Set the impedance value above which the reference alarm is activated.

Sensor B (dual input analyzers only) configuration is identical to Sensor A configuration.

See section 5.5, page 34.

5.5 Configure Alarms



Configure Alarm 1

Alarms 2 and 3 configuration (and Alarms 4 and 5 if option board fitted ***and*** analog features enabled – see Section 7.3, page 57) is identical to Alarm 1 configuration.

Alarm 3 can also be configured as a Wash alarm if **A3: Type** is set to **Wash** – see following frame.

Alarm 1 Type

Select the type of alarm required:

`Off` – The alarm is disabled, the alarm LED is off and the relay is de-energized at all times.

`Alarm` – The analyzer is configured using the **Assign** frame (following) to generate an alarm in response to a specified high or low pH, Redox (ORP) or process temperature sensor reading.

`Status` – An alarm is generated if either a power failure or a condition that causes any of the error messages in Table 8.1 (page 62) to be displayed occurs.

`Wash` – Alarm 3 is configured to control the wash sequence.

Note. The **Wash** alarm type can be assigned only to Alarm 3 and is displayed only when the lower display line shows **A3: Type**.

A1: Type set to **Off** or **Status**.
A1: Type set to **Alarm** – continued below.
A3: Type set to **Wash** – see Section 5.5.1, page 36.

Alarm 1 Assign

Select the alarm assignment required:

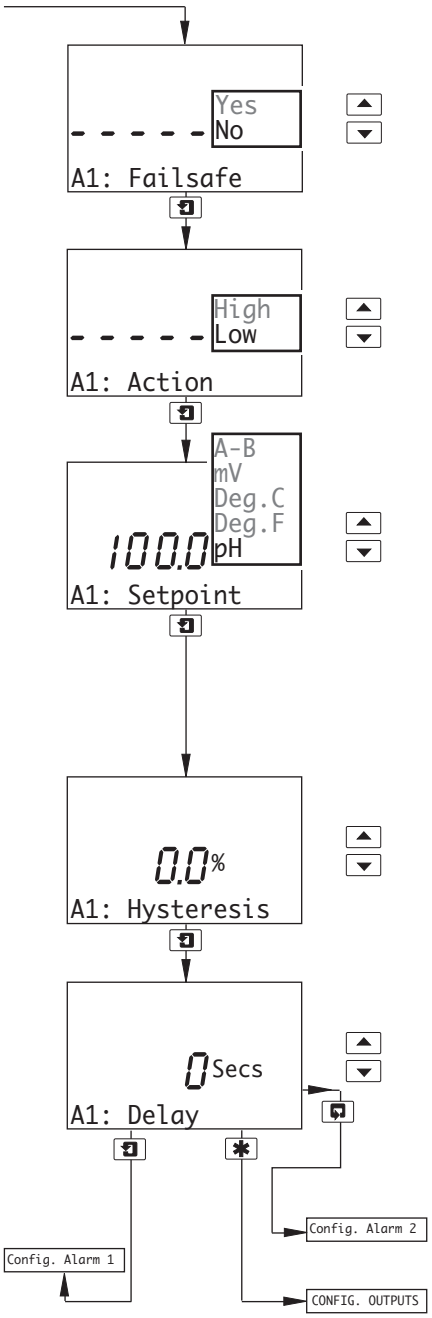
`Sen.A` `Sen.B` – The analyzer activates an alarm if the pH or Redox (ORP) value of the process fluid measured by the selected sensor exceeds or drops below the value set in the **Alarm 1 Set Point** parameter, depending on the type of **Alarm 1 Action** selected – see next page.

`Temp.A` `Temp.B` – The analyzer activates an alarm if the temperature of the process fluid measured by the selected sensor exceeds or drops below the value set in the **Alarm 1 Set Point** parameter, depending on the type of **Alarm h1 Action** selected – see next page.

`A-B` – The analyzer activates an alarm if the difference between the Sensor A and Sensor B readings exceeds or drops below the value set in the **Alarm 1 Set Point** parameter, depending on the type of **Alarm 1 Action** selected – see next page.

Note. The **Sen.B**, **Temp.B** and **A-B** alarm assignment types are applicable only to dual input analyzers and **A-B** is displayed only when **Probe Type** for each sensor is set to **pH** – see Section 5.3, page 30.

Continued on next page.



Alarm 1 Failsafe

Select **Yes** to enable failsafe action, otherwise select **No**.

See also Fig. 5.2 to Fig. 5.6 (page 37).

Alarm 1 Action

Select the alarm action required, **High** or **Low**.

See also Fig. 5.2 to Fig. 5.6 (page 37).

Alarm 1 Set Point

The Alarm 1 Set Point can be set within the following ranges:

pH	–	–2.00 to 16.00 pH
mV	–	–1200 to 1200 mV
Deg.C	–	–10.0 to 150.0
Deg.F	–	–14.0 to 302.0
A-B	–	0.00 to 14.00 pH

Set to the value required.

Alarm 1 Hysteresis

A differential set point can be defined between 0 and 5 % of the alarm set point value. Set the required hysteresis in 0.1 % increments.

See also Fig. 5.2 to Fig. 5.6 (page 37).

Alarm 1 Delay

If an alarm condition occurs, the activation of the relays and LEDs can be delayed for a specified time period. If the alarm clears within the period, the alarm is not activated.

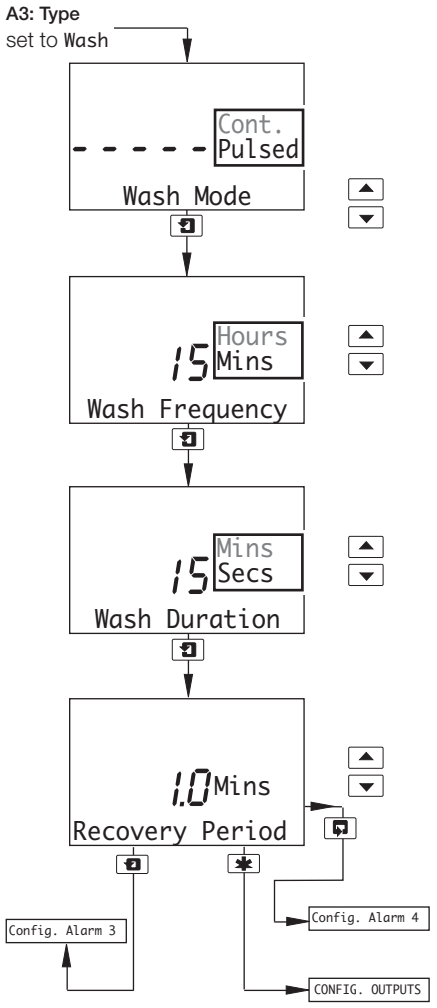
Set the required delay, in the range 0 to 60 seconds in 1 second increments.

See also Fig. 5.2 to Fig. 5.6 (page 37).

Alarms 2 and 3 configuration (and Alarms 4 and 5 if option board fitted and analog features enabled – see Section 7.3, page 57) is identical to Alarm 1 configuration.

See Section 5.6, page 38.

5.5.1 Wash Cycle Configuration (Applicable Only to Alarm 3)



Wash Mode

Select the wash mode required.

`Cont.` – (continuous) the relay remains energized for the wash duration
`Pulsed` – the relay is switched on and off every second for the duration of the wash, – see Fig. 5.1.

Wash Frequency

Set the wash frequency required.

Wash frequency is set in 15 minute increments between 15 and 45 minutes, then in 1 hour increments between 1 and 24 hours.

Wash Duration

Set the wash duration required.

Wash duration is set in 15 second increments between 15 and 45 seconds, then in 1 minute increments between 1 and 10 minutes.

Recovery Period

Set the recovery period required, between 0.5 and 5.0 minutes in 0.5 minute increments.

Option board fitted ***and*** analog features enabled (see Section 7.3, page 57) – Alarm 4 configuration is identical to Alarm 1.

Option board not fitted ***or*** option board fitted ***and*** analog features disabled (see Section 7.3, page 57) – see Section 5.6, page 38.

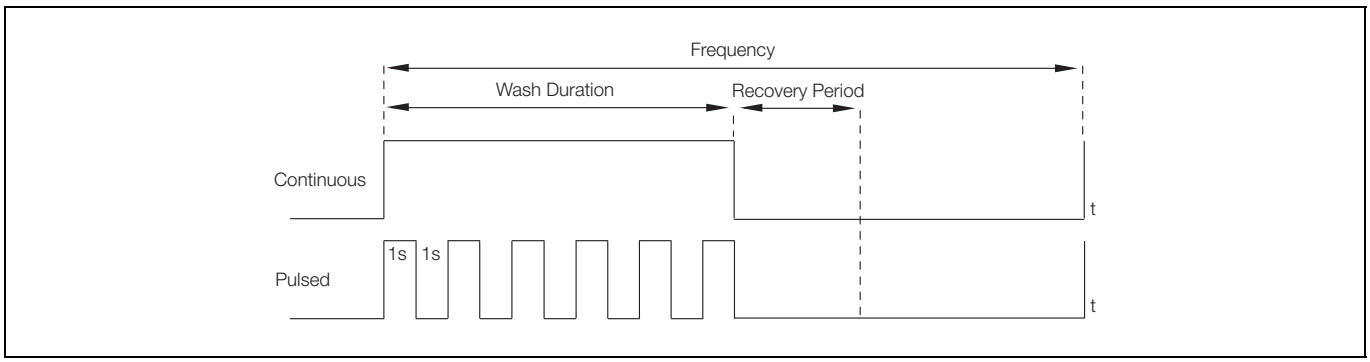


Fig. 5.1 Pulsed and Continuous Wash Cycles

Note. The following examples illustrate **High Alarm Actions**, i.e. the alarm is activated when the process variable exceeds the defined set point. **Low Alarm Actions** are the same, except the alarm is activated when the process variable drops below the defined set point.

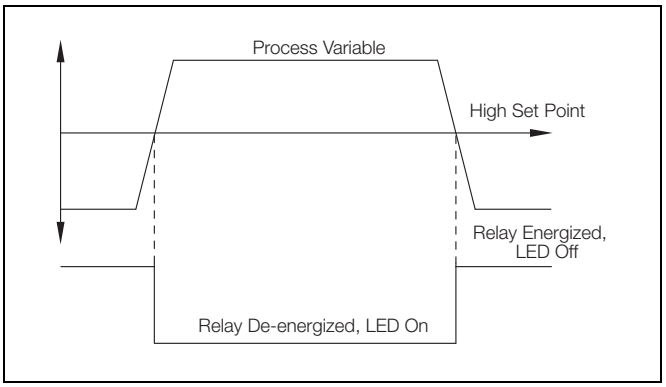


Fig. 5.2 High Failsafe Alarm without Hysteresis and Delay

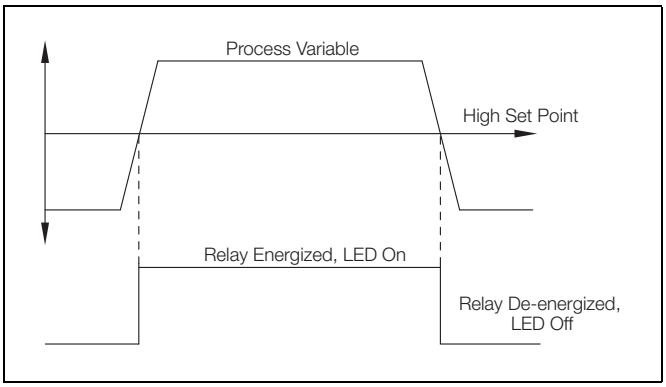


Fig. 5.5 High Non-Failsafe Alarm without Delay and Hysteresis

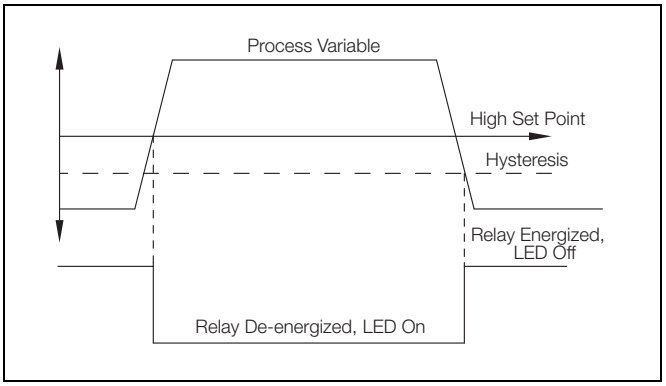


Fig. 5.3 High Failsafe Alarm with Hysteresis but no Delay

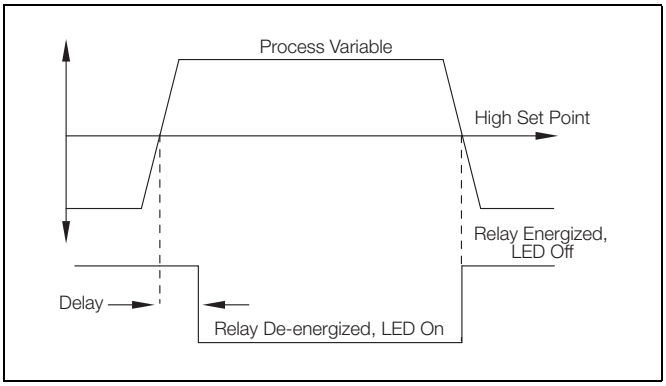


Fig. 5.6 High Failsafe Alarm with Delay but no Hysteresis

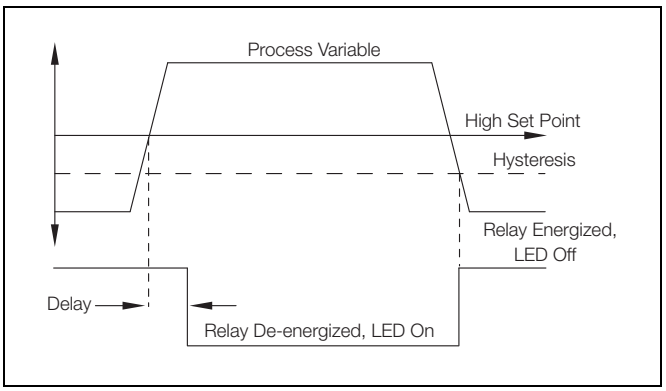
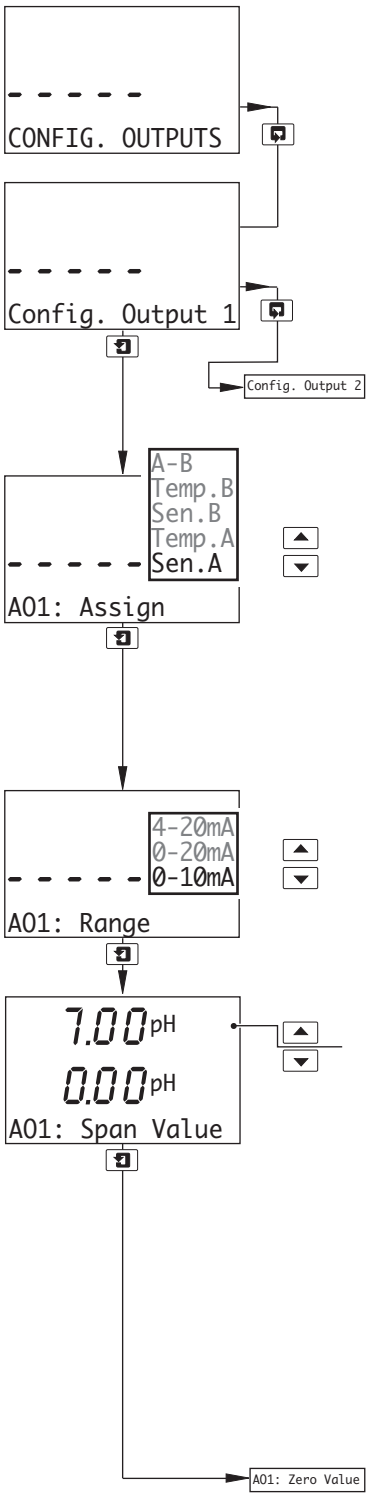


Fig. 5.4 High Failsafe Alarm with Hysteresis and Delay

5.6 Configure Outputs



Configure Output 1

Output 2 configuration (and Outputs 3 and 4 if option board fitted ***and*** analog features enabled – see Section 7.3, page 57) is identical to Output 1 configuration.

Assign

Select the sensor and analog output required:

Sen.A Sen.B	–	pH/Redox (ORP)/mV for the selected sensor.
Temp.A Temp.B	–	Temperature for the selected sensor.
A-B	–	Difference between the Sensor A and Sensor B readings.

Note. **Sen.B**, **Temp.B** and **A-B** are applicable only to dual input analyzers.

Range

Select the analog output current range for the selected output.

Span Value

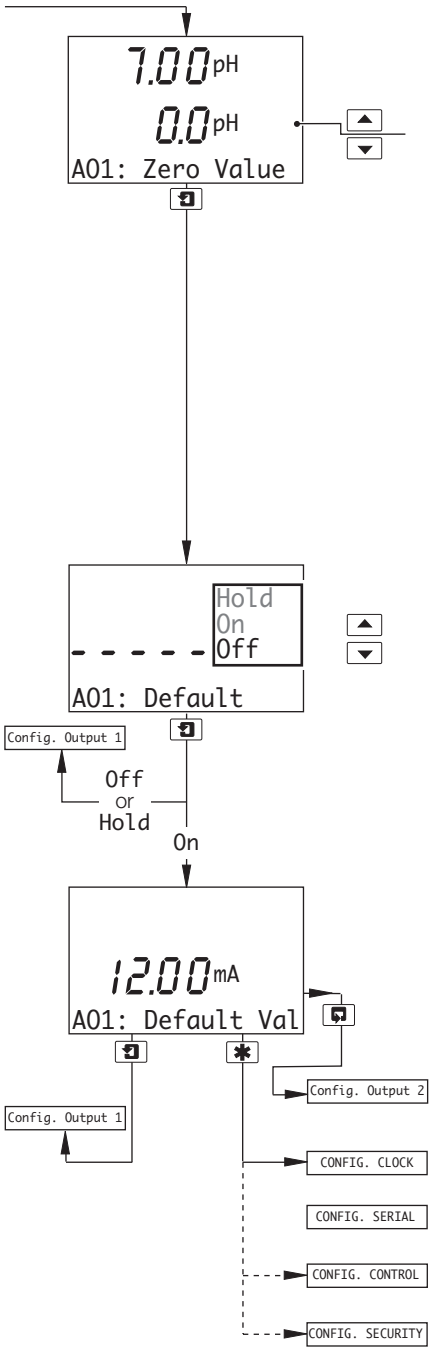
pH (or **mV** or **Deg.C** or **Deg.F** or **A-B**) and **Adjust** are shown alternately on the upper display line. Use the ▲ and ▼ keys to adjust the displayed reading to the required span value.

Note. The minimum and maximum span values are determined by the **Zero Value** setting (see next page) plus the minimum differential, e.g. to set **Span Value** to 0.00 pH, first set **Zero Value** to –2.00 pH.

pH	–	0.00 to 16.00 pH (minimum differential, 2.00 pH)
Redox/ORP	–	–1100 to 1200 mV (minimum differential, 100 mV)
Temperature	–	Deg. C 0.0 to 150.0 (minimum differential, 10 °C) Deg. F 32.0 to 302.0 (minimum differential,18 °F)
A-B	–	0.00 to 14.00 pH (minimum differential, 2.00 pH)

Note. **A-B** is applicable only to dual input analyzers.

Continued on next page.



Zero Value

pH (or **mV** or **Deg.C** or **Deg.F** or **A-B**) and **Adjust** are shown alternately on the center display line. Use the ▲ and ▼ keys to adjust the displayed reading to the required zero value:

Note. The zero value setting plus the minimum differential determines the minimum and maximum values for the span setting, e.g. to set a span value of –1100 mV, first set the zero value to –1200 mV.

pH	–	–2.00 to 14.00 pH (minimum differential, 2.00 pH)
ORP/Redox	–	–1200 to 1100 mV (minimum differential, 100 mV)
Temperature	–	Deg. C –10.0 to 140.0 (minimum differential, 10 °C) Deg. F 14.0 to 284.0 (minimum differential, 18 °F)
A-B	–	–2.00 to 12.00 pH (minimum differential, 2.00 pH)

Note. **A-B** is applicable only to dual input analyzers.

Default Output

Select the system reaction to failure:

Hold	–	Hold the analog output at the value prior to the failure.
On	–	Stop on failure. This drives the analog output to the level set in the **Default Val** frame below.
Off	–	Ignore failure and continue operation.

Default Value

The level to which the analog output is driven if a failure occurs.

Set the value between 0.00 and 22.00 mA

Output 2 configuration (and Outputs 3 and 4 if option board fitted ***and*** analog features enabled – see Section 7.3, page 57) is identical to Output 1 configuration.

Option board fitted ***and*** analog features enabled (see Section 7.3, page 57) – see Section 5.7, page 40.

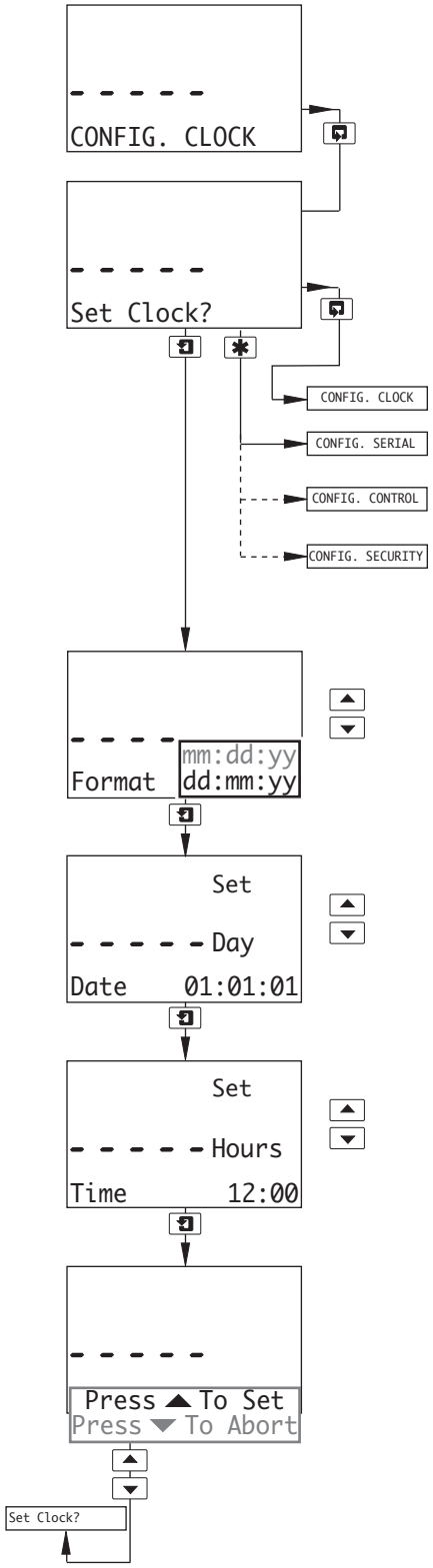
Option board fitted ***and*** Serial Communications feature enabled (see Section 7.3, page 57) – see Supplementary Manual *Profibus® Datalink Description (IM/AX4/PBS)*.

Single input analyzer ***and*** option board not fitted – see *PID Control Supplement (IM/AX4PID)*.

Dual input analyzer ***and*** option board not fitted – see Section 5.8, page 41.

5.7 Configure Clock

Note. The Configure Clock function is available only if the option board is fitted ***and*** analog features enabled – see Section 7.3, page 57.



Set Clock

Set the system clock.

Return to main menu.

Option board fitted ***and*** Serial Communications feature enabled (see Section 7.3, page 57) – see Supplementary Manual *Profibus® Datalink Description (IM/AX4/PBS)*.
Single input analyzer ***and*** option board not fitted – see *PID Control Supplement (IM/AX4PID)*.
Dual input analyzer ***and*** option board not fitted – see Section 5.8, page 41.

Date Format

Select the required date format.

Date

Set the date in the format selected above.

Press [↵] to move between the day, month and year fields.

Use the [▲] and [▼] keys to adjust each field.

Time

Set the time in the format hh:mm.

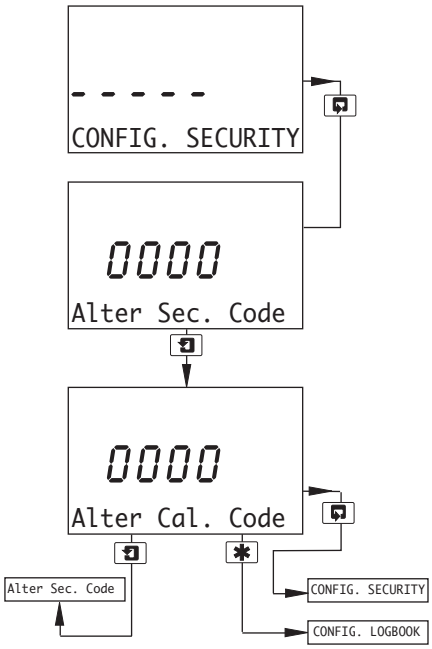
Press [↵] to move between hours and minute fields.

Use the [▲] and [▼] keys to adjust each field.

Press ▲ to Set and **Press ▼ to Abort** are shown alternately on the lower display line.

Press the appropriate key to set the clock or abort the changes.

5.8 Configure Security



Alter Security Code

Set the security code to a value between 0000 and 19999.

Alter Calibration Code

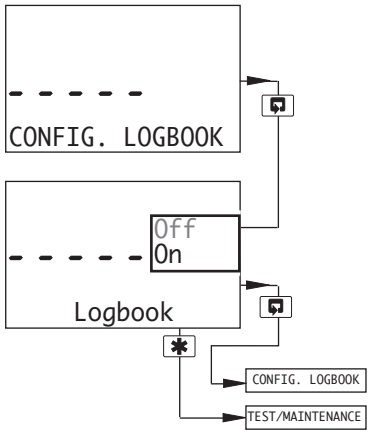
Set the sensor calibration access code to a value between 0000 and 19999.

Return to main menu.

Option board fitted ***and*** analog features enabled (see Section 7.3, page 57) – see Section 5.9, page 41.

5.9 Configure Logbook

Note. The Configure Logbook function is available only if the option board is fitted ***and*** analog features enabled – see Section 7.3, page 57.



Configure Logbook

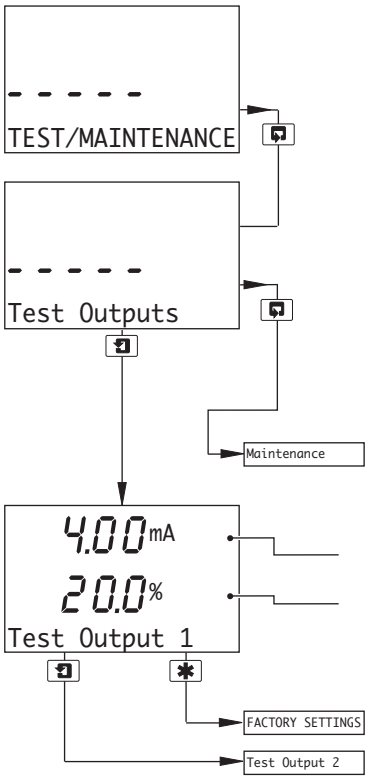
Use the ▲ and ▼ keys to set the logbook **On** or **Off**.

If **Off** is selected, all data entries in the logbook are cleared.

Return to main menu.

See Section 5.10, page 42.

5.10 Test Outputs and Maintenance



Test Outputs

Displays the output test details for the analog outputs.

Note. Outputs 3 and 4 are available only if the option board is fitted and analog features enabled – see Section 7.3, page 57.

Test Output 1 frame only is shown; the format of frames for the remaining outputs is identical.

See below.

Test Output 1

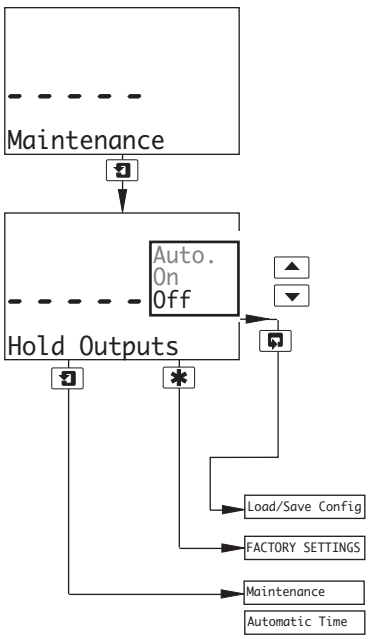
The theoretical output current value.

Output current as a percentage of the full range current.

Use the ▲ and ▼ keys to adjust the displayed theoretical output current value to give the output required.

See Section 7.3, page 57.

Test remaining outputs.



Maintenance

Hold Outputs

Enables the relay action and analog outputs to be maintained.

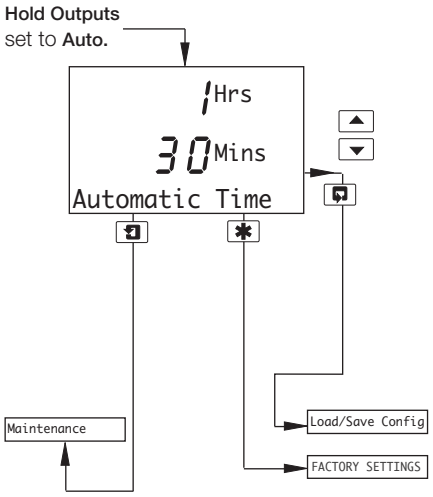
Auto.	–	Changes in relay action and analog outputs are inhibited during sensor calibration.
On	–	Changes in relay action and analog outputs are inhibited.
Off	–	Changes in relay action and analog outputs are not inhibited.

Note. The LEDs flash while the analyzer is in 'Hold' mode.

Continued on next page.

See Section 7.3, page 57.

Hold Outputs set to **Off** or **On** – return to main menu.
Hold Outputs set to **Auto.** – continued on next page.



Automatic Time

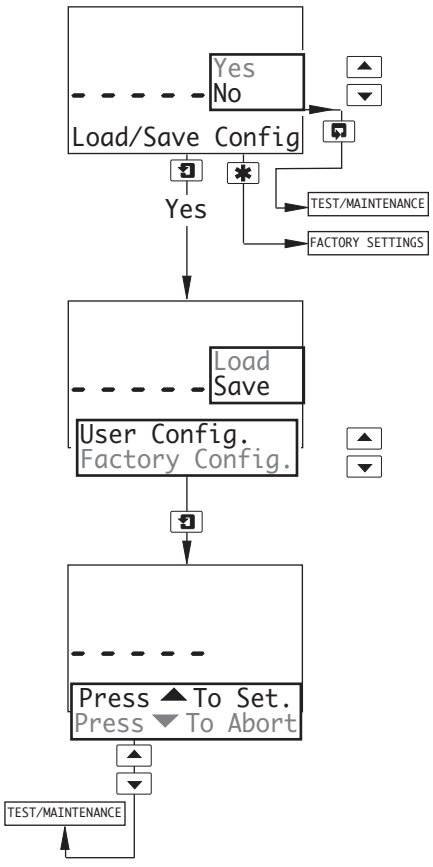
If required, set a time period between 1 and 6 hours, in 30 minute increments, for which the outputs are held when **Hold Outputs** is set to **Auto**.

At the default setting of **Off**, changes in relay action and analog outputs are inhibited during sensor calibration and released automatically at the end of the procedure.

If a time is set, changes in relay action and analog outputs are inhibited during sensor calibration, but if the calibration is not completed within the set time, the calibration is aborted, the display returns to the *Operating Page* and **CAL. ABORTED** is displayed.

Continued below.

See Section 7.3, page 57.



Load/Save Configuration

Select whether a configuration is to be loaded or saved.

Note. If **No** is selected, pressing the [↵] key has no effect.

Return to main menu.

See Section 7.3, page 57.

Load User/Factory Configuration

Note. Applicable only if **Load/Save Config** is set to **Yes**.

`Factory Config.`	–	resets all the parameters in the **Configuration Pages** to the Company Standard.
`Save User Config.`	–	saves the current configuration into memory.
`Load User Config.`	–	reads the saved user configuration into memory.

User Config. and **Factory Config.** are displayed alternately if a User Configuration has been saved previously. Use the [▲] and [▼] keys to make the required selection.

Press ▲ to Set and **Press ▼ to Abort** are shown alternately on the lower display line.

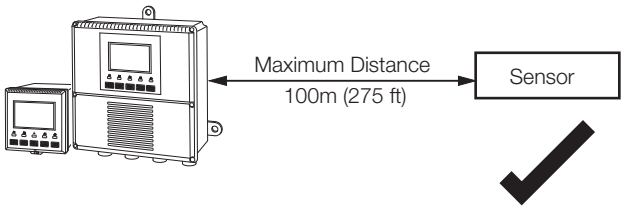
Press the appropriate key to load/save the configuration or abort the changes.

6 Installation

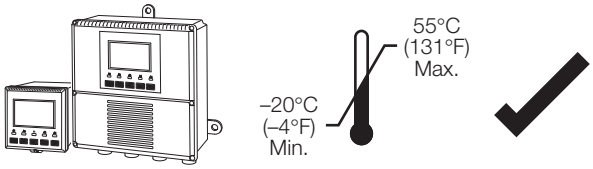
6.1 Siting Requirements

Note.

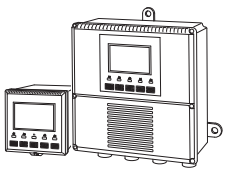
- Mount in a location free from excessive vibration, and where the temperature and humidity specification will not be exceeded.
- Mount away from harmful vapors and/or dripping fluids and ensure that it is suitably protected from direct sunlight, rain, snow and hail.
- Where possible, mount the analyzer at eye level to allow an unrestricted view of the front panel displays and controls.



A – Maximum Distance Between Analyzer and Sensor



B – Within Temperature Limits



C – Within Environmental Limits

* Refer to Specification, page 64

Fig. 6.1 Siting Requirements

6.2 Mounting

6.2.1 Wall-/Pipe-mount Analyzers

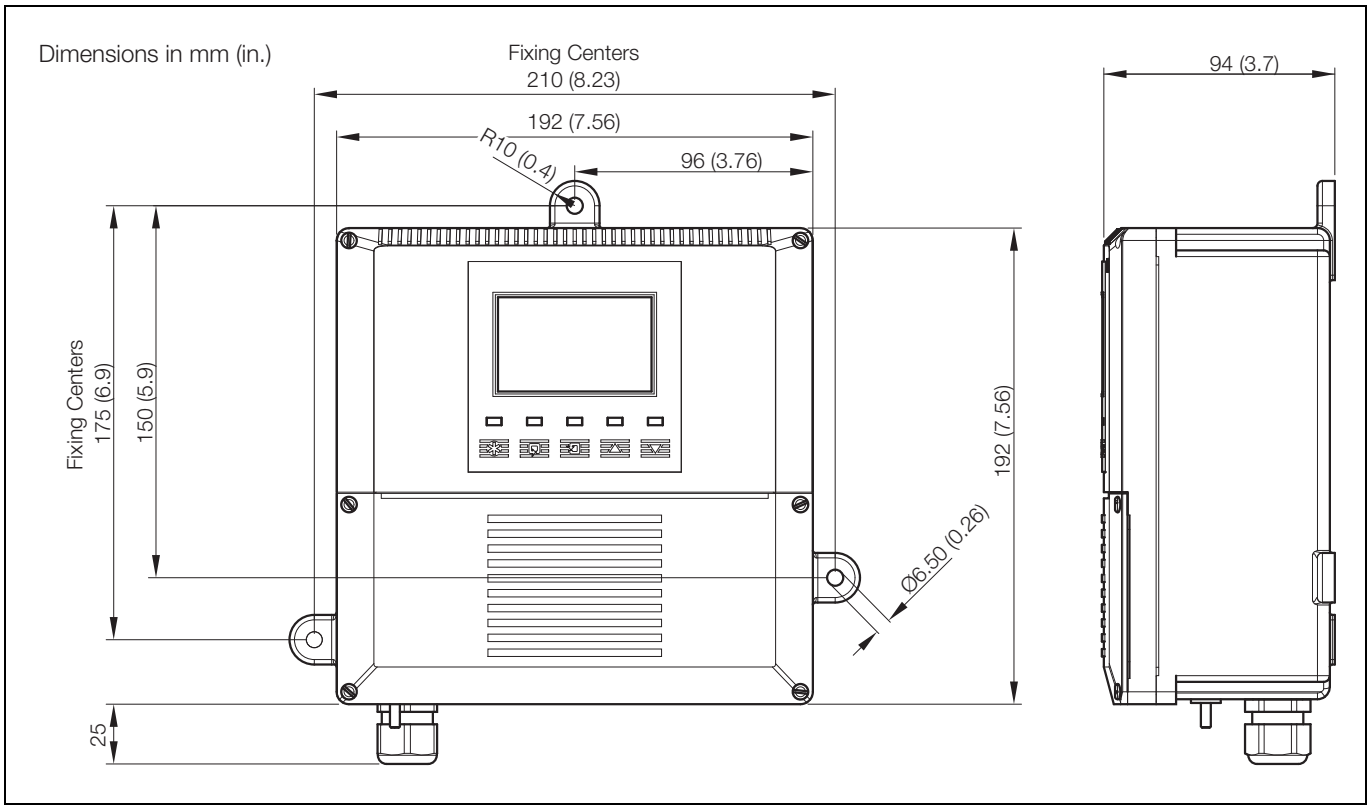


Fig. 6.2 Overall Dimensions

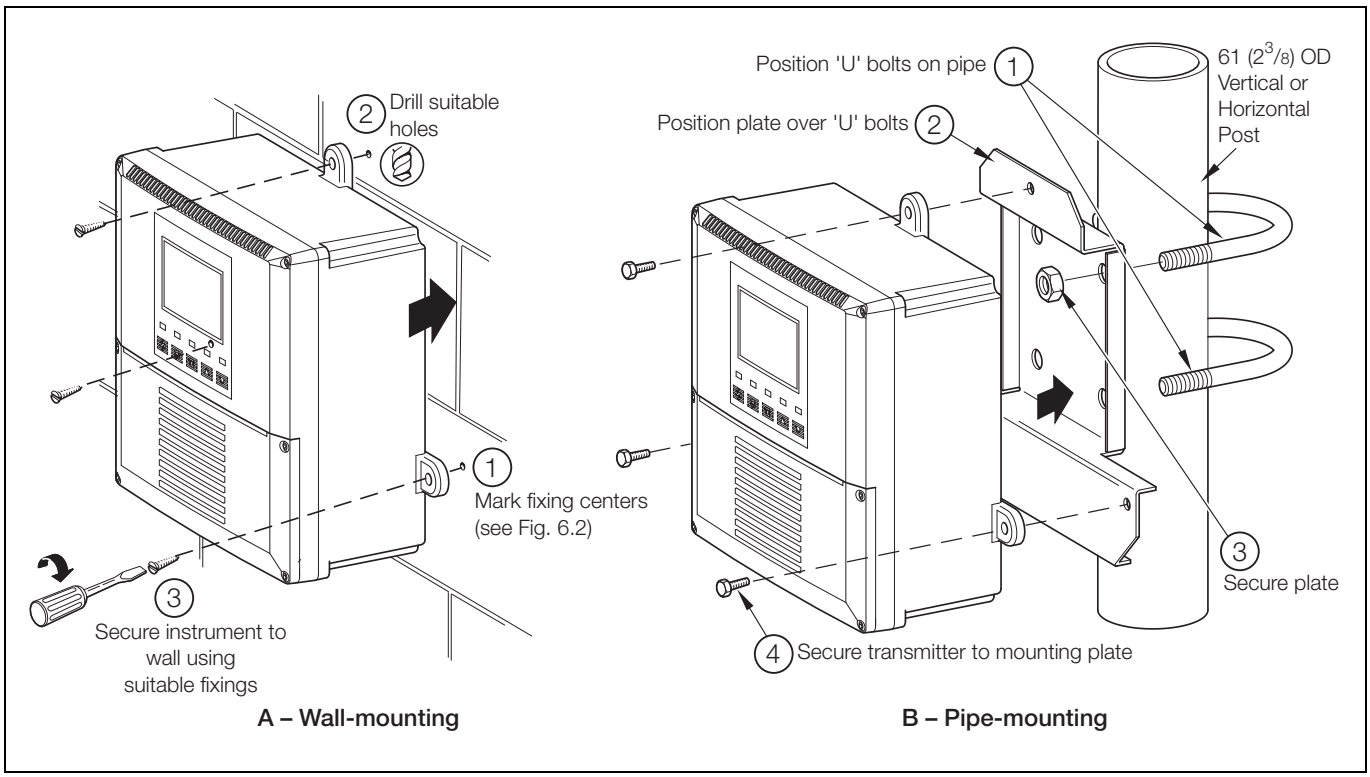


Fig. 6.3 Wall-/Pipe-mounting

6.2.2 Panel-mount Analyzers

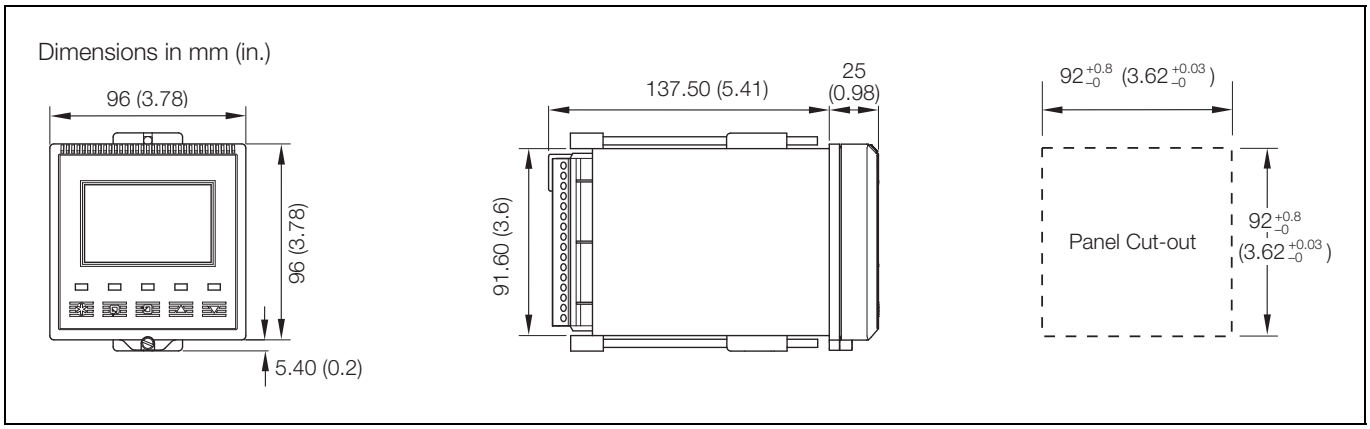


Fig. 6.4 Overall Dimensions

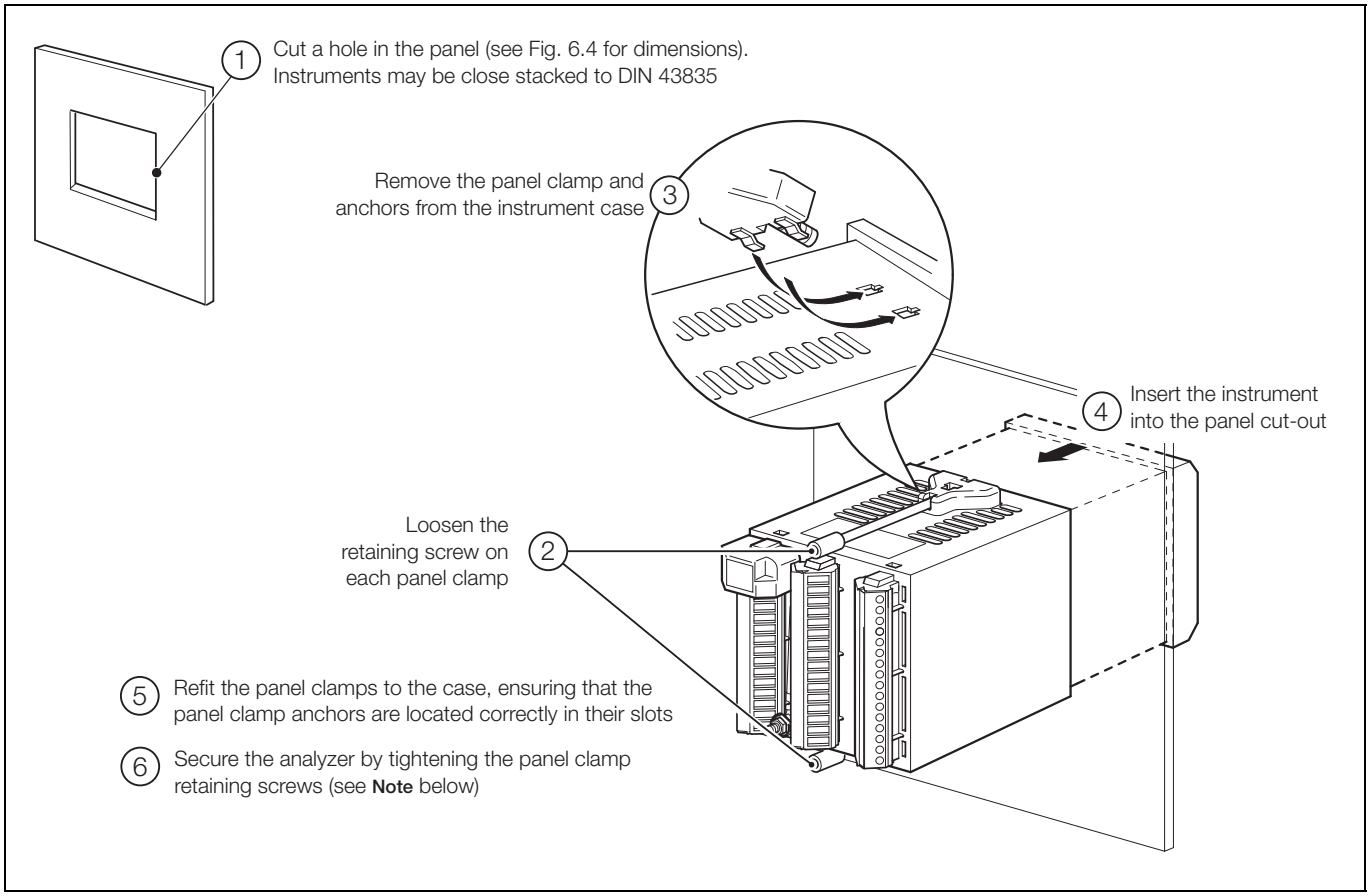


Fig. 6.5 Panel-mounting

Note. The clamp must fit flat on the analyzer casing. The clamp uses a torque limiter, so it is not possible to over-tighten the securing screws.

6.3 Connections, General

Warning.

- The instrument is not fitted with a switch therefore a disconnecting device such as a switch or circuit breaker conforming to local safety standards must be fitted to the final installation. It must be fitted in close proximity to the instrument within easy reach of the operator and must be marked clearly as the disconnection device for the instrument.
- Remove all power from supply, relay and any powered control circuits and high common mode voltages before accessing or making any connections.
- The power supply earth (ground) **must** be connected to reduce the effects of RFI interference and ensure the correct operation of the power supply interference filter.
- The power supply earth (ground) **must** be connected to the earth (ground) stud on the analyzer case – see Fig. 6.8 (wall-/pipe-mount analyzers) or Fig. 6.10 (panel-mount analyzers).
- Use cable appropriate for the load currents. The terminals accept cables from 20 to 14 AWG (0.5 to 2.5mm^2) UL Category AVLV2.
- The instrument conforms to Mains Power Input Insulation Category III. All other inputs and outputs conform to Category II.
- All connections to secondary circuits must have basic insulation.
- After installation, there must be no access to live parts, e.g. terminals.
- Terminals for external circuits are for use only with equipment with no accessible live parts.
- The relay contacts are voltage-free and must be appropriately connected in series with the power supply and the alarm/control device which they are to actuate. Ensure that the contact rating is not exceeded. Refer also to Section 6.3.1 for relay contact protection details when the relays are to be used for switching loads.
- Do not exceed the maximum load specification for the selected analog output range.

  The analog output is isolated, therefore the –ve terminal must be connected to earth (ground) if connecting to the isolated input of another device.
- 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, EN61010-1).

USA and Canada Only

- The supplied cable glands are provided for the connection of signal input and ethernet communication wiring ONLY.
- The supplied cable glands and use of cable / flexible cord for connection of the mains power source to the mains input and relay contact output terminals is not permitted in the USA or Canada.
- For connection to mains (mains input and relay contact outputs), use only suitably rated field wiring insulated copper conductors rated min. 300 V, 14 AWG 90C. Route wires through suitably flexible conduits and fittings.

Note.

- An earthing (grounding) – stud terminal is fitted to the analyzer case for bus-bar earth (ground) connection – see Fig. 6.8 (wall-/pipe-mount analyzers) or Fig. 6.10 (panel-mount analyzers).
- Always route signal output/sensor cell cable leads and mains-carrying/relay cables separately, ideally in earthed (grounded) metal conduit. Use twisted pair output leads or screened cable with the screen connected to the case earth (ground) stud.

  Ensure that the cables enter the analyzer through the glands nearest the appropriate screw terminals and are short and direct. Do not tuck excess cable into the terminal compartment.
- Ensure that the IP65 rating is not compromised when using cable glands, conduit fittings and blanking plugs/bungs (M20 holes). The M20 glands accept cable of between 5 and 9mm (0.2 and 0.35 in.) diameter.

6.3.1 Relay Contact Protection and Interference Suppression

If the relays are used to switch loads on and off, the relay contacts can become eroded due to arcing. Arcing also generates radio frequency interference (RFI) which can result in analyzer malfunctions and incorrect readings. To minimize the effects of RFI, arc suppression components are required; resistor/capacitor networks for AC applications or diodes for DC applications. These components must be connected across the load – see Fig. 6.6.

For AC applications the value of the resistor/capacitor network depends on the load current and inductance that is switched. Initially, fit a 100R/0.022 µF RC suppressor unit (part no. B9303) as shown in Fig. 6.6A. If the analyzer malfunctions (locks up, display goes blank, resets etc.) the value of the RC network is too low for suppression and an alternative value must be used. If the correct value cannot be obtained, contact the manufacturer of the switched device for details on the RC unit required.

For DC applications fit a diode as shown in Fig. 6.6B. For general applications use an IN5406 type (600 V peak inverse voltage at 3 A).

Note. For reliable switching the minimum voltage must be greater than 12V and the minimum current greater than 100mA.

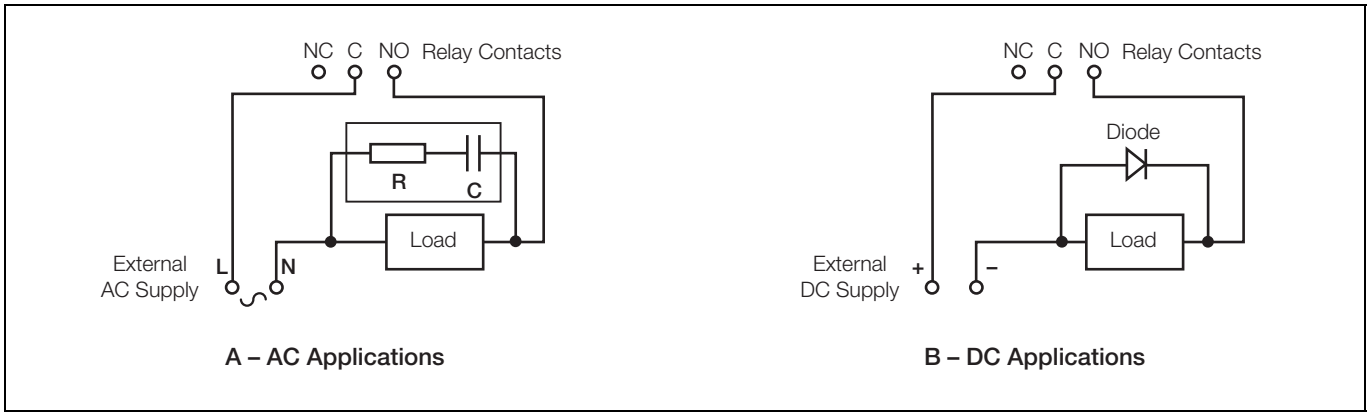


Fig. 6.6 Relay Contact Protection

6.3.2 Cable Entry Knockouts, Wall-/Pipe-mount Analyzer

The analyzer is supplied with 7 cable glands, one fitted and six to be fitted, as required, by the user – see Fig. 6.7.

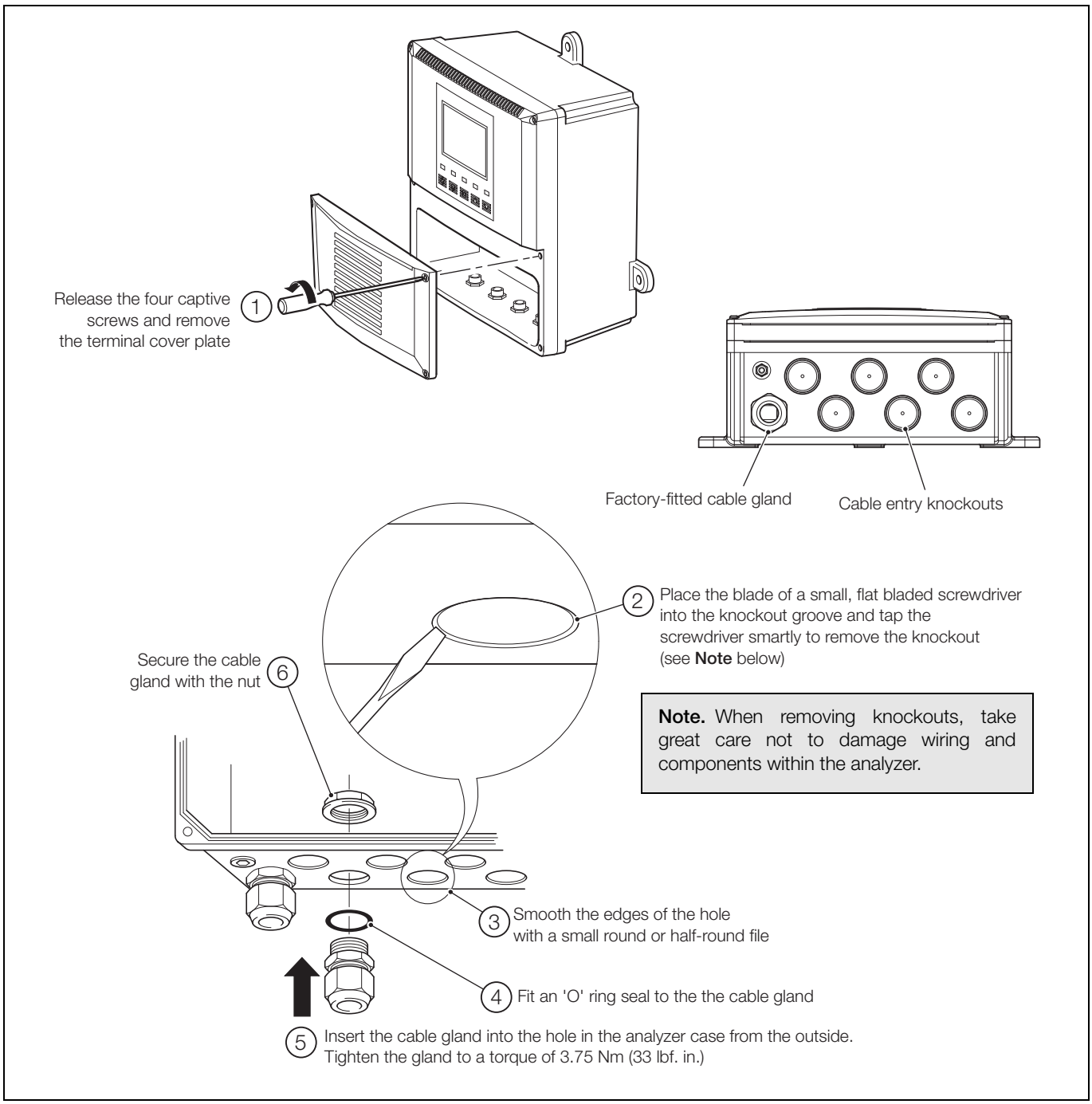


Fig. 6.7 Cable Entry Knockouts, Wall-/Pipe-mount Analyzer

Note. The cable glands must be tightened to a torque of 3.75 Nm (33 lbf. in.)

6.4 Wall-/Pipe-mount Analyzer Connections

6.4.1 Access to Terminals

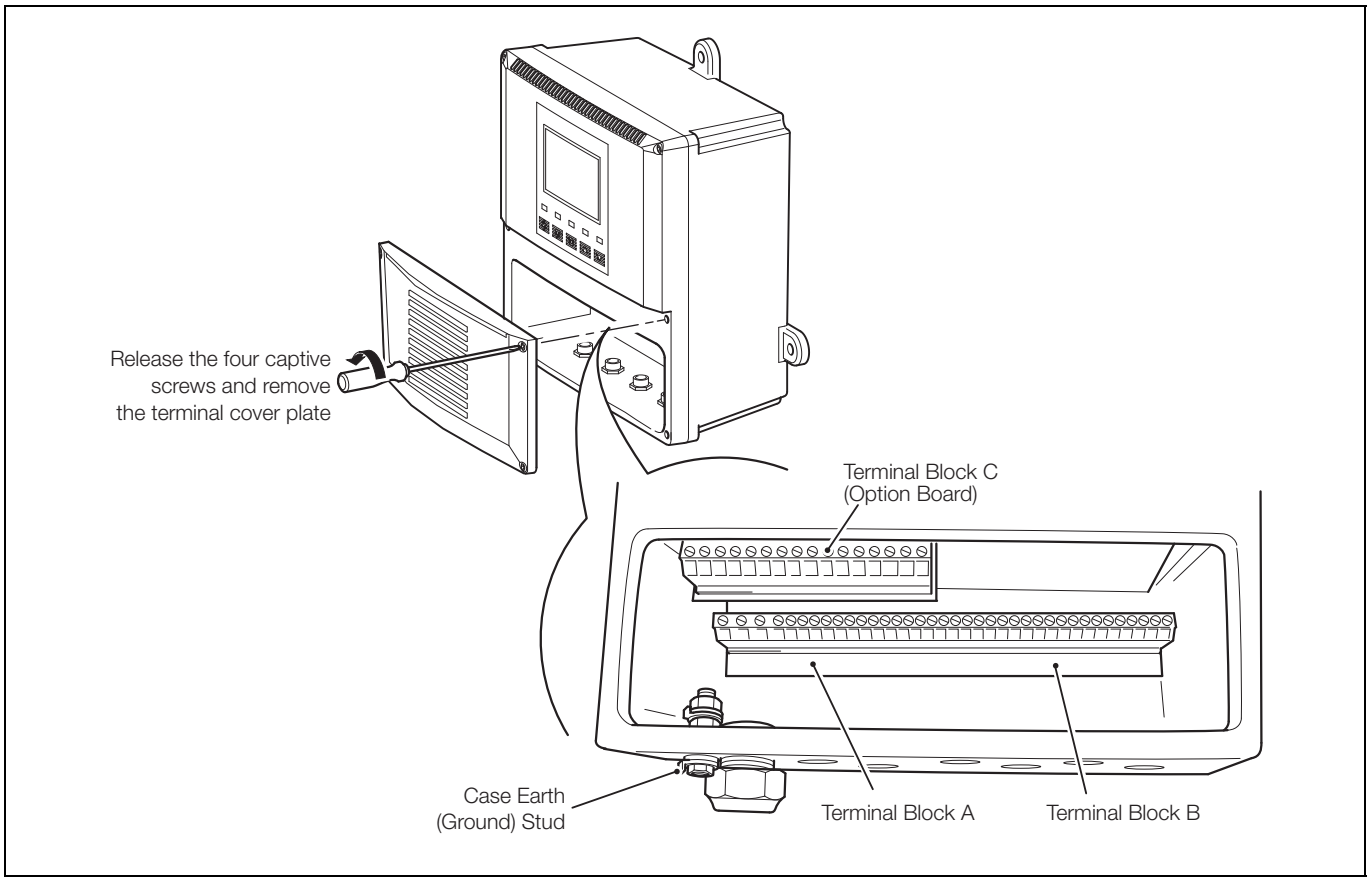


Fig. 6.8 Access to Terminals, Wall-/Pipe-mount Analyzer

Note. When refitting the terminal cover plate, tighten the captive screws to a torque of 0.40 Nm (3.5 lbf. in.)

6.4.2 Connections

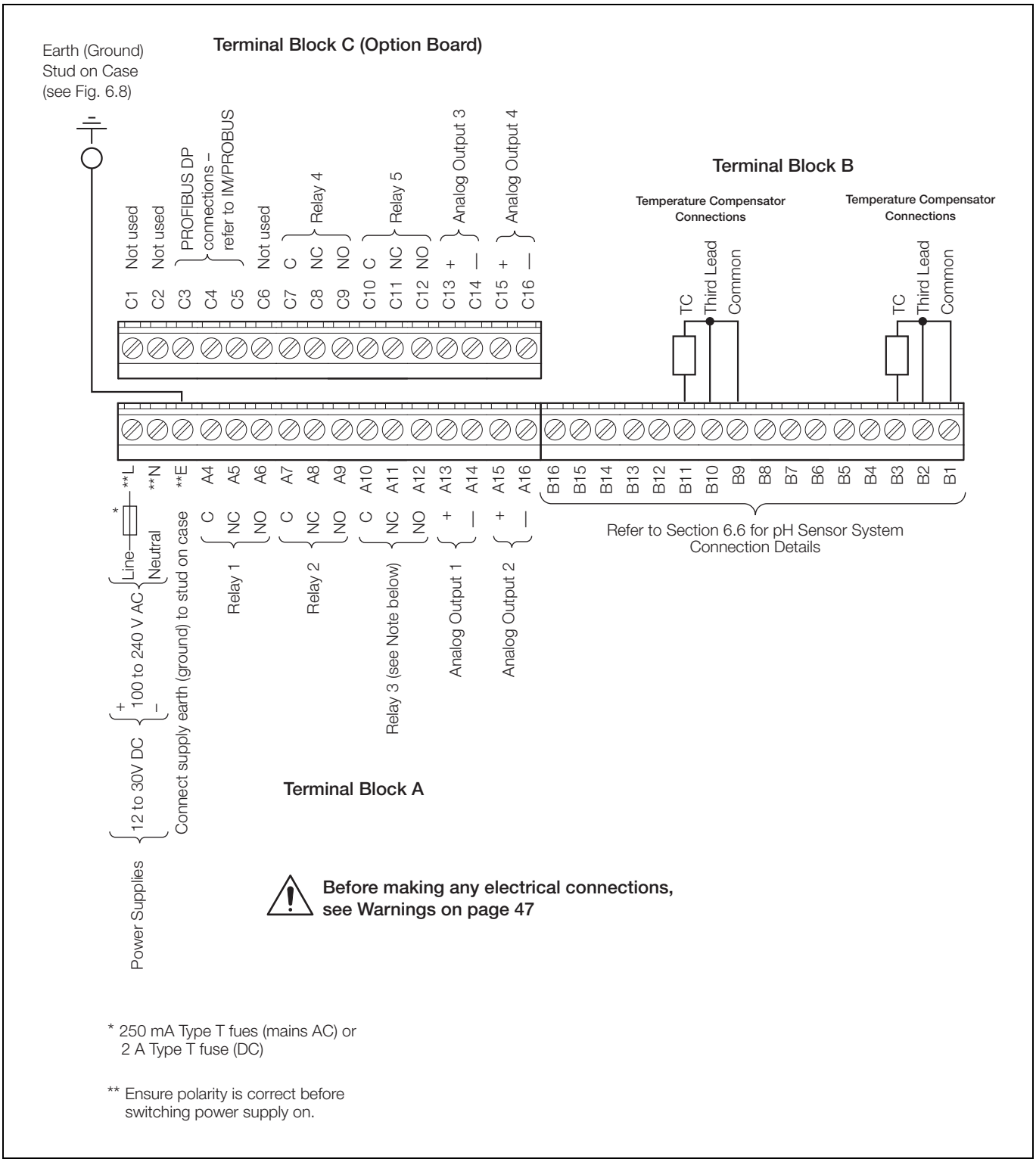


Fig. 6.9 Connections, Wall-/Pipe-mount Analyzer

Note.

- Relay 3 can be configured to control the wash facility – see Section 5.4, page 33.
- Tighten the terminal screws to a torque of 0.60 Nm (5.3 lbf. in.).

6.5 Panel-mount Analyzer Connections

6.5.1 Access to Terminals

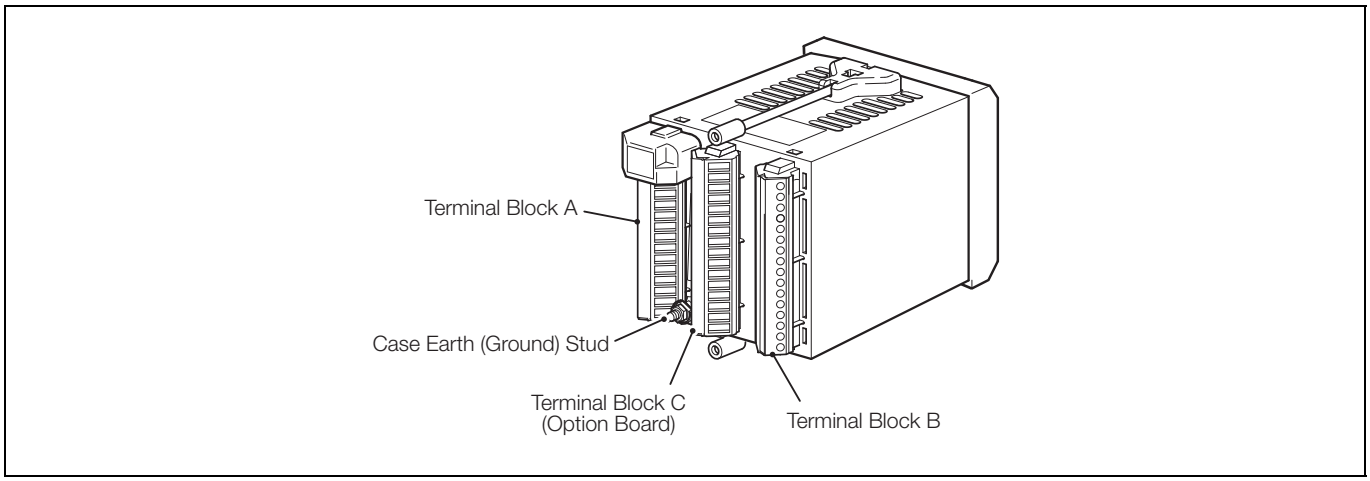


Fig. 6.10 Access to Terminals, Panel-mount Analyzers

6.5.2 Connections

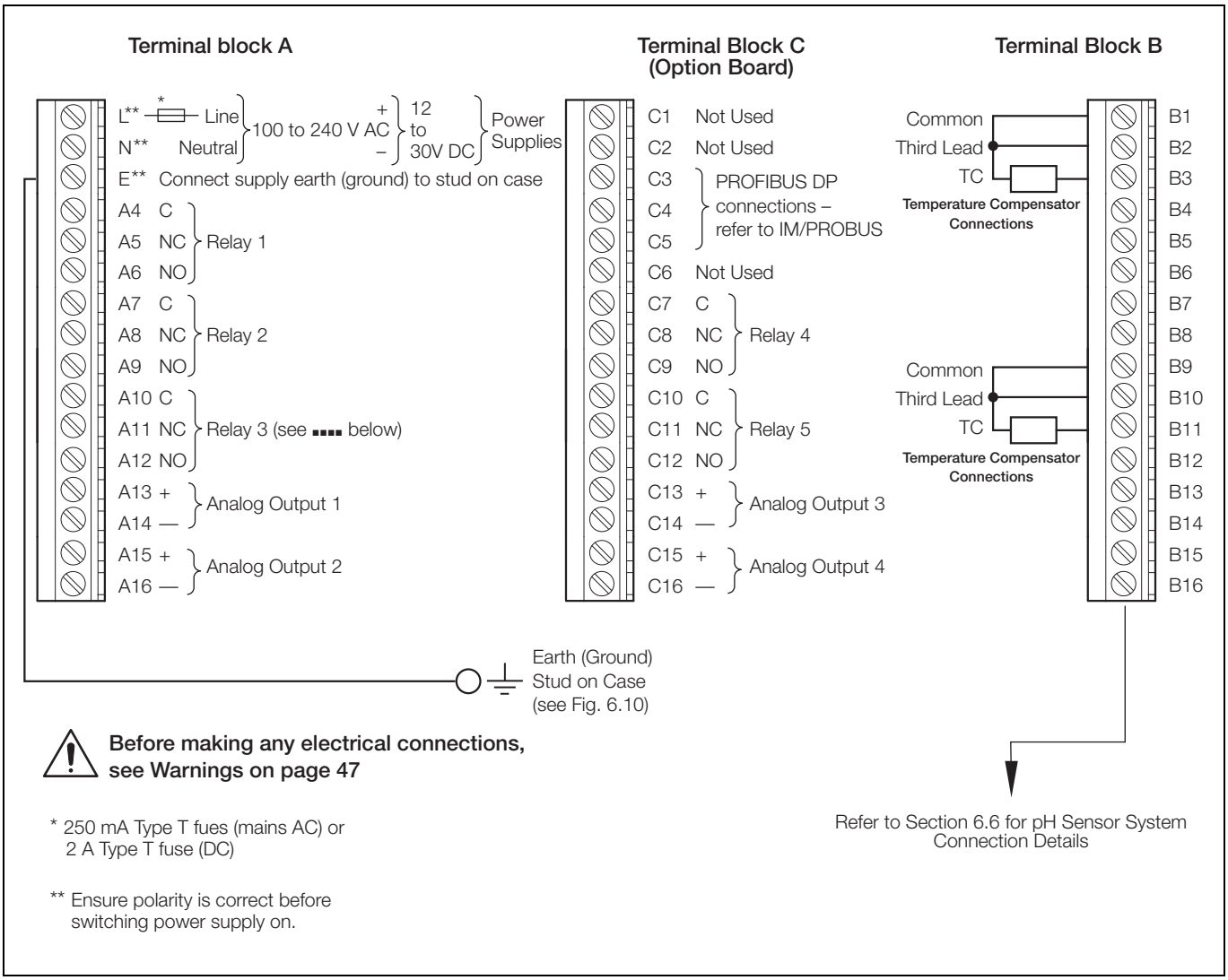


Fig. 6.11 Connections, Panel-mount Analyzers

Note.

- Relay 3 can be configured to control the wash facility – see Section 5.4, page 33.
- Tighten the terminal screws to a torque of 0.60 Nm (5.3 lbf. in.).

6.6 pH Sensor Systems Connections

6.6.1 Standard ph Systems Connection – 2867, AP100, AP300, 7650/60, TB5, Non-ABB

When connecting one of these pH systems to the AX400 transmitter, ensure the differential input switch for the relevant sensor is **OFF**.

Terminal Block B		Function	2867	AP100	AP300
Sensor B	Sensor A		Color	Color	Color
B1	B9	Temperature Compensator (if fitted) Common – **see also Note 1below**	Not Used	Red	White
B2	B10	Temperature Compensator (if fitted) 3rd Lead	Not Used	Red	Grey
B3	B11	Temperature Compensator (if fitted)	Not Used	White	Red
B4	B12	Not Used	Not Used	Not Used	Not Used
B5	B13	Not Used	Not Used	Not Used	Not Used
B6	B14	Reference Electrode	Black	Black	Black
B7	B15	Screen/Shield (if fitted)	Not Used	Not Used	Not Used
B8	B16	Glass/Metal Electrode	Clear	Clear	Blue

Table 6.1 Standard ph Systems Connection – 2867, AP100, AP300

Terminal Block B		Function	*7650/60	TB5	Non-ABB
Sensor B	Sensor A		Color	Color	
B1	B9	Temperature Compensator (if fitted) Common – **see also Note 1below**	Red	White	Connect as per function – refer to (non-ABB) sensor system manual for cable colors
B2	B10	Temperature Compensator (if fitted) 3rd Lead	Red	Link to White	
B3	B11	Temperature Compensator (if fitted)	White	Red	
B4	B12	Not Used	Not Used	Not Used	
B5	B13	Not Used	Not Used	Not Used	
B6	B14	Reference Electrode	Black	Black	
B7	B15	Screen/Shield (if fitted)	Yellow	Not Used	
B8	B16	Glass/Metal Electrode	Clear	Blue	

*See Note 2

Table 6.2 Standard ph Systems Connection – 7650/60, TB5, Non-ABB

Note.

1. If the sensor is fitted with a 2-wire PT100, Pt1000 or 3K Balco temperature compensator, link terminals B9 and B10 (and B1 and B2 if dual input analyzer).
2. Discard large green wire as not required with this transmitter.
3. Redox systems are not temperature compensated so do not have temperature sensors. To remove temperature error messages, set **Temperature Sensor** to **NONE**. If a temperature sensor is used for a separate temperature display, set **Temperature Sensor** to the correct type – see Section 5.3, page 30.

6.6.2 Differential ph Systems Connections – Capable of Providing Sensor Diagnostics (AP200, TBX5)

When connecting one of these pH systems to the AX400 transmitter, ensure the differential input switch for the relevant sensor is **ON**. See Section 5.4, page 33 for sensor diagnostics configuration. If diagnostics are not required leave them switched off.

Terminal Block B		Function	AP200	*TBX5
Sensor B	Sensor A		Color	Color
B1	B9	Temperature Compensator (if fitted) Common – **see also Note 1below**	Grey	White
B2	B10	Temperature Compensator (if fitted) 3rd Lead	White	Link to White
B3	B11	Temperature Compensator (if fitted)	Green	Red
B4	B12	Reference	Blue	Black
B5	B13	Not Used	Not Used	Not Used
B6	B14	Solution Earth (Ground Rod)	Green/Yellow	Green
B7	B15	Screen/Shield (if fitted)	Red	Yellow
B8	B16	Glass/Metal Electrode	Clear	Blue

Table 6.3 Differential ph Systems Connection – AP200, TBX5

*In normal operation do not connect the **heavy green wire**. If noisy readings are obtained, connect the wire to the earth stud.

Note.

1. If the sensor is fitted with a 2-wire PT100, Pt1000 or 3K Balco temperature compensator, link terminals B9 and B10 (and B1 and B2 if dual input analyzer.).
2. Redox systems are not temperature compensated so do not have temperature sensors. To remove temperature error messages, set **Temperature Sensor** to **NONE**. If a temperature sensor is used for a separate temperature display, set **Temperature Sensor** to the correct type – see Section 5.3, page 30.

7 Calibration

Note.

- The analyzer is calibrated by the Company prior to dispatch and the Factory Settings pages are protected by an access code.
- Routine recalibration is not necessary – high stability components are used in the analyzer's input circuitry and, once calibrated, the Analog-to-Digital converter chip self-compensates for zero and span drift. It is therefore unlikely that the calibration will change over time.
- Do Not attempt recalibration without first contacting ABB.
- Do Not attempt recalibration unless the input board has been replaced or the Factory Calibration tampered with.
- Prior to attempting recalibration, test the analyzer's accuracy using suitably calibrated test equipment – see Section 7.1, page 56 and see Section 7.2, page 56.

7.1 Equipment Required

1. Millivolt source (pH or Redox input simulator): –1000 to 1000 mV.
2. Decade resistance box (Pt100/Pt1000 temperature input simulator): 0 to 10 kΩ (in increments of 0.01 Ω), accuracy ±0.1 %.
3. Digital milliammeter (current output measurement): 0 to 20 mA.

Note. Resistance boxes have an inherent residual resistance that may range from a few mΩ up to 1 Ω. This value must be taken into account when simulating input levels, as should the overall tolerance of the resistors within the boxes.

7.2 Preparation

1. Switch off the supply and disconnect the conductivity cell(s), temperature compensator(s) and current output(s) from the analyzer's terminal blocks.
2. Sensor A – Fig. 7.1:
   a. Link terminals B9 and B10.
   b. Connect the millivolt source to terminals B14 (–ve) and B16 (+ve) to simulate the pH or Redox input. Connect the millivolt source earth to the Case Earth (Ground) Stud – see Fig. 6.8 (wall-/pipe-mount analyzer) or Fig. 6.10 (panel-mount analyzer).
   c. Connect the 0 to 10 kΩ decade resistance box to terminals B9 and B11 to simulate the Pt100/Pt1000/Balco 3K.

   Sensor B (dual input analyzers only) – Fig. 7.1:
   a. Link terminals B1 and B2.
   b. Connect the millivolt source to terminals B6 (–ve) and B8 (+ve) to simulate the pH or Redox input. Connect the millivolt source earth to the Case Earth (Ground) Stud – see Fig. 6.8 or (wall-/pipe-mount analyzer) or Fig. 6.10 (panel-mount analyzer).
   c. Connect the 0 to 10 kΩ decade resistance box to terminals B1 and B3 to simulate the Pt100/Pt1000/Balco 3K.
3. Connect the milliammeter to the analog output terminals.
4. Switch on the supply and allow ten minutes for the circuits to stabilize.
5. Select the **FACTORY SETTINGS** page and carry out Section 7.3.

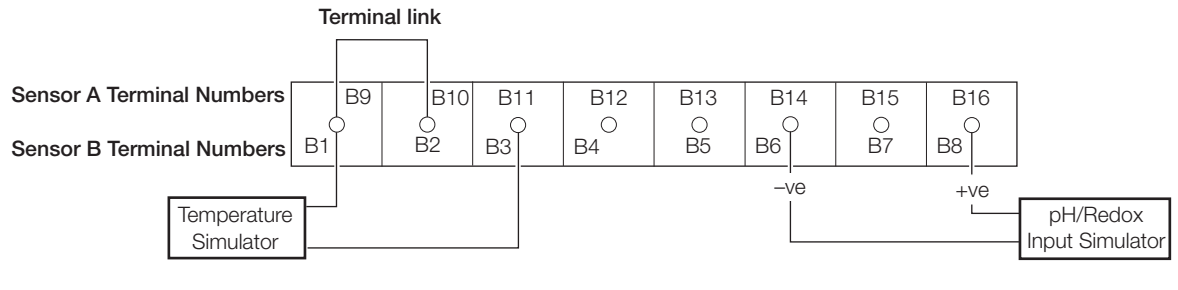


Fig. 7.1 Analyzer Terminal Links and Decade Resistance Box Connections

7.3 Factory Settings

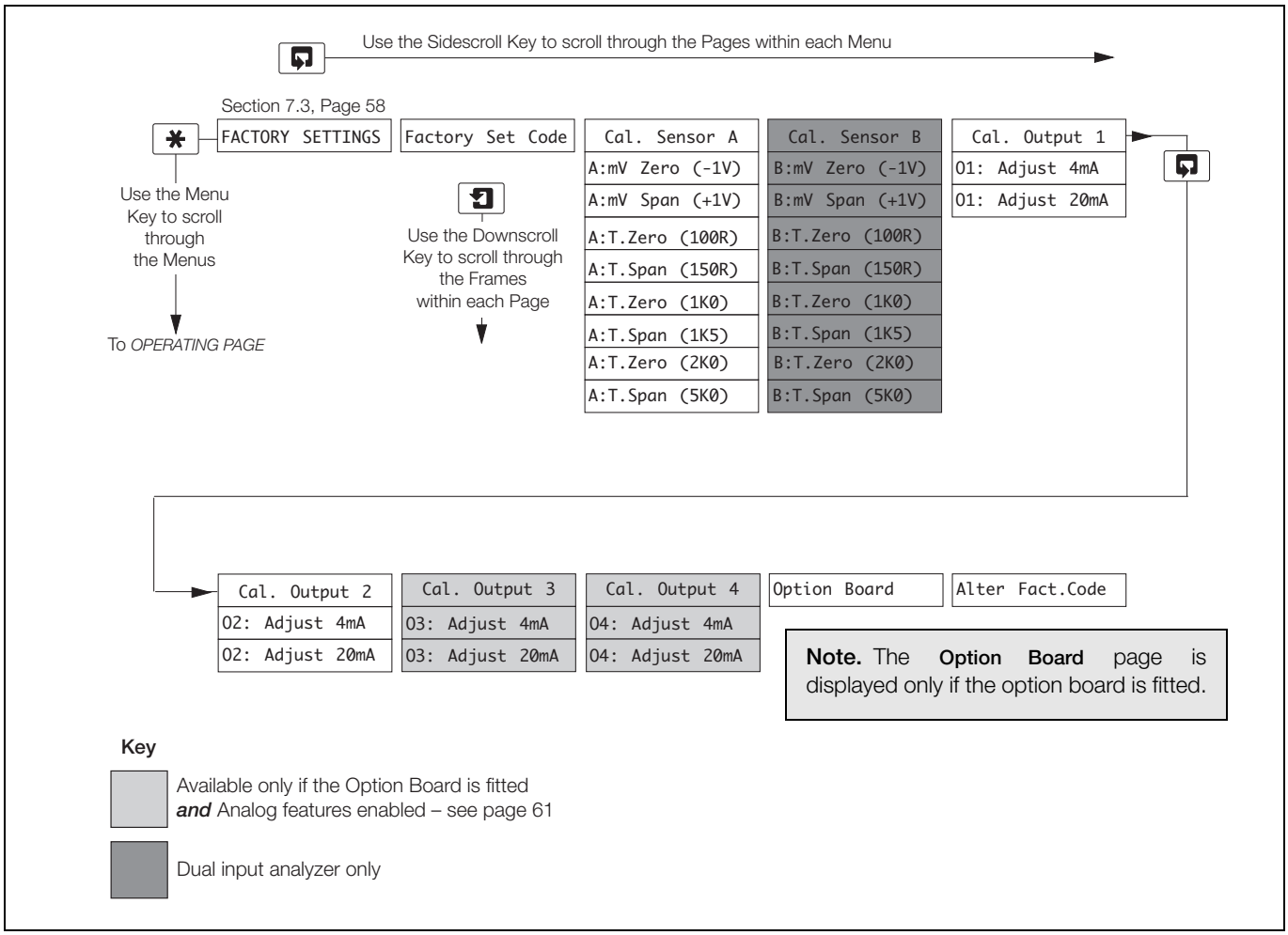
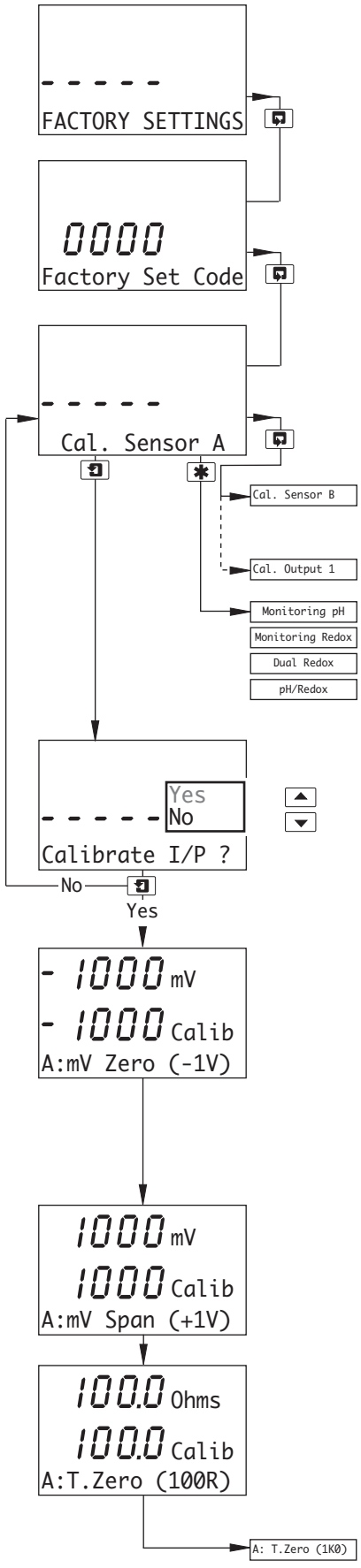


Fig. 7.2 Overall Factory Settings Chart



Factory Settings Access Code

Enter the required code number (between 0000 and 19999) to gain access to the factory settings. If an incorrect value is entered, access to subsequent frames is prevented and the display reverts to the top of the page.

Calibrate Sensor A

Note. The values in the display lines for sensor calibration are shown only as examples – the actual values obtained will differ.

Sensor B calibration (dual input analyzers only) is identical to Sensor A calibration.

Single input analyzers only – see page 61.

Operating Page – see Section 2.3, page 6.

Calibrate Input for Sensor A ?

If calibration is required select **Yes** otherwise select **No**.

Note. To abort calibration, press the ◱ key again at any time before calibration is complete – see next page.

Millivolt Zero

Set the millivolt source to –1000 mV.

The display advances automatically to the next step once a stable and valid value is recorded.

Note. The upper 6-segment display shows the measured input voltage. Once the signal is within range the lower 6-segment display shows the same value and **Calib** is displayed to indicate that calibration is in progress.

Millivolt Span

Set the millivolt source to +1000 mV.

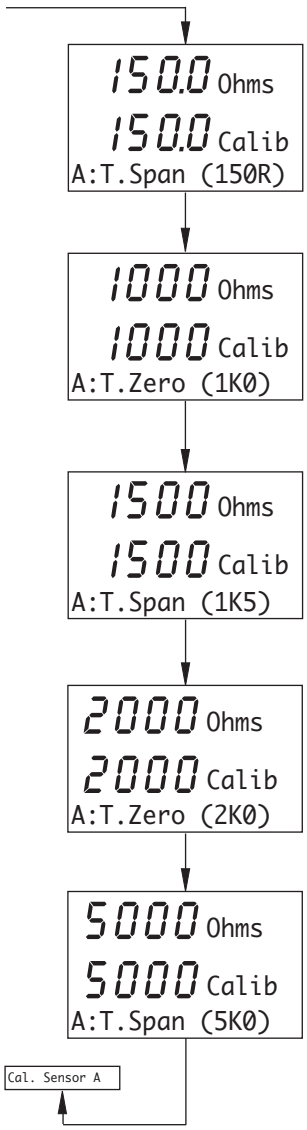
The display advances automatically to the next step once a stable and valid value is recorded.

Temperature Zero (100R)

Set the temperature simulator to 100 Ω

The display advances automatically to the next step once a stable and valid value is recorded.

Continued on next page.



Temperature Span (150R)

Set the temperature simulator to 150 Ω

The display advances automatically to the next step once a stable and valid value is recorded.

Temperature Zero (1k0)

Set the temperature simulator to 1000 Ω

The display advances automatically to the next step once a stable and valid value is recorded.

Temperature Span (1k5)

Set the temperature simulator to 1500 Ω

The display advances automatically to the next step once a stable and valid value is recorded.

Temperature Zero (2k0)

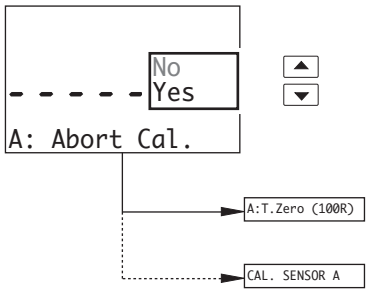
Set the temperature simulator to 2000 Ω

The display advances automatically to the next step once a stable and valid value is recorded.

Temperature Span (5k0)

Set the temperature simulator to 5000 Ω

The display returns automatically to **Cal. Sensor A** once a stable and valid value is recorded.



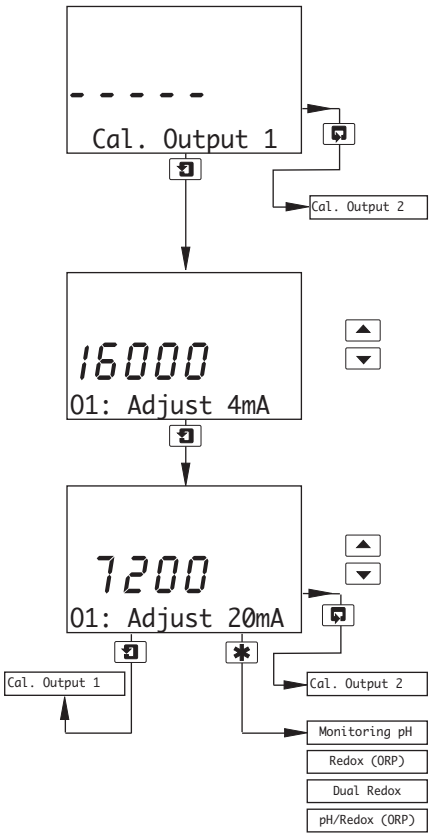
Abort Calibration

Select Yes or No

Yes selected:

- **before** completion of **A:mV Span (+1V)** frame – calibration advances to **A:T.Zero (100R)** and continues.
- **after** completion of **A:mV Span (+1V)** frame – the display returns to the **Calibrate Sensor A** page.

No selected – calibration continues from the point at which the key was pressed.



Calibrate Output 1

Note. When adjusting the 4 and 20 mA outputs, the display reading is unimportant and is used only to indicate that the output is changing when the ▲ and ▼ keys are pressed.

See below.

Adjust 4mA

Use the ▲ and ▼ keys to set the milliammeter reading to 4 mA.

Note. The analog output range selected in **Configure Outputs** (Section 5.6) does not affect the reading.

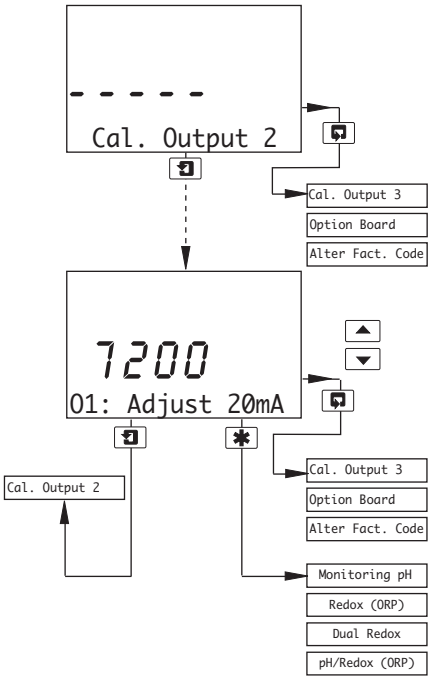
Adjust 20mA

Use the ▲ and ▼ keys to set the milliammeter reading to 20 mA.

Note. The analog output range selected in **Configure Outputs** (Section 5.6) does not affect the reading.

See below.

Operating Page – see Section 2.3, page 6.



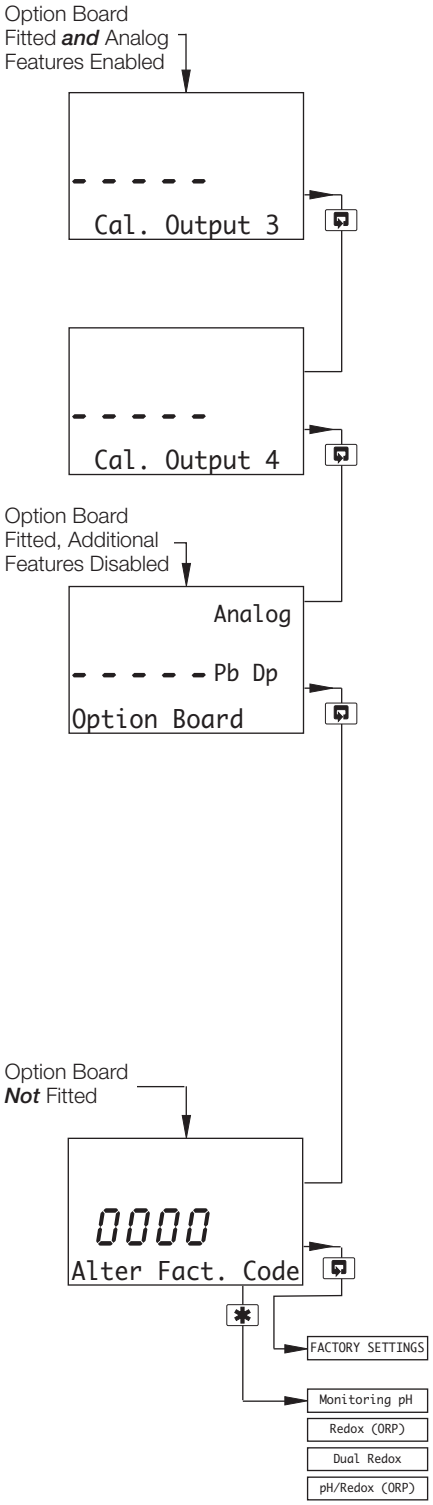
Calibrate Output 2

Note. Output 2 calibration is identical to Output 1 calibration.

Option board fitted ***and*** analog features enabled – continued on next page.
Option board fitted, additional features disabled – continued on next page.
Option board not fitted – continued on next page.

Option board fitted ***and*** analog features enabled – continued on next page.
Option board fitted, additional features disabled – continued on next page.
Option board not fitted – continued on next page.

Operating Page – see Section 2.3, page 6.



Calibrate Output 3

Note.

- Output 3 (and Output 4) calibration is applicable only if the Option board is fitted ***and*** analog features enabled – see below.
- Output 3 calibration is identical to Output 2 calibration.

Calibrate Output 4

Note. Output 4 calibration is identical to Output 3 calibration.

Configure Option Board

Note.

- This frame is displayed only if an option board is fitted.
- The software detects if an option board is fitted but cannot detect the additional features available.
- If an option board is fitted, the correct selection must be made below to enable use of the available features. If an incorrect selection is made, the software menus and frames associated with that option are displayed in the Operating and Configuration pages but the features do not work.

Use the ▲ and ▼ keys to enable the features for the type of option(s) fitted:

`Analog`	–	Analog features enabled (comprising two additional analog outputs, two additional alarm relays, clock and logbook facility).
`Pb Dp`	–	Profibus-DP digital communications features enabled.
`Analog + Pb Dp`	–	Both analog and Profibus-DP features enabled.

Alter Factory Code

Set the factory settings access code to a value between 0000 and 19999.

Return to main menu.

Operating Page – see Section 2.3, page 6.

8 Simple Fault Finding

8.1 Error Messages

If erroneous or unexpected results are obtained, the fault may be indicated in the *Operating Page* by an error message – see Table 8.1. However, some faults may cause problems with analyzer calibration or give discrepancies when compared with independent laboratory measurements.

Error Message	Possible Cause
A: FAULTY Pt100 A: FAULTY Pt1000 A: FAULTY BALCO	Temperature compensator/associated connections for Sensor A are either open circuit or short circuit.
B: FAULTY Pt100 B: FAULTY Pt1000 B: FAULTY BALCO	Temperature compensator/associated connections for Sensor B are either open circuit or short circuit.
A: CAL LOW SLOPE B: CAL LOW SLOPE	Although the calibration has not failed, the electrode pair associated with the sensor indicated is becoming fatigued and replacement is recommended.
A: PH CAL FAILED B: PH CAL FAILED	The calibration of the sensor indicated has failed. Check buffer values and repeat buffering. If the fault persists, replace the electrodes.
WASH INHIBITED	**Wash Function** is set to **Off**. Set **Wash Function** to **On** – see Section 2.3.3, page 8.
A: OUT OF SAMPLE A: BROKEN CABLE (alternating display) B: OUT OF SAMPLE B: BROKEN CABLE (alternating display)	1. The sensor indicated is not fully immersed in sample. 2.The cable associated with the sensor indicated may be damaged.
A: BROKEN CABLE B: BROKEN CABLE	The cable associated with the sensor indicated may be damaged.
A: LOW GLASS IMP. A: BROKEN CABLE (alternating display) B: LOW GLASS IMP. B: BROKEN CABLE (alternating display)	1. The glass electrode associated with the sensor indicated may be broken. 2.The cable associated with the sensor indicated may be damaged. 3.The connections associated with the sensor indicated may be faulty.
A: CHECK REF. B: CHECK REF.	The reference electrode associated with the sensor indicated may need cleaning or the sensor may need replacing.

Table 8.1 Error Messages

8.2 Calibration Fail Message or No Response to pH/Redox Changes

The majority of problems are associated with the electrodes and cabling. Replace the electrodes as an initial check – refer to the appropriate instruction manual. It is also important that all program parameters have been entered correctly and have not been altered inadvertently – see Section 7, page 56.

If the above checks do not resolve the fault:

1. Check that the analyzer responds to a millivolt input. Connect a pH simulator, such as Model 2410, to the transmitter input; +ve to glass and –ve to reference – see Section 6.4, page 50 or 6.5. Select the **CONFIG. SENSORS** page and set the **Probe Type** to **Redox** or **ORP**. Check that the analyzer displays the correct values as set on the simulator.

   Note. A normal laboratory mV source is not suitable for use as a pH simulator.

   Failure to respond to the input indicates a fault with the analyzer which must be returned to the Company for repair. Correct response, but with incorrect readings, usually indicates a calibration problem. Recalibrate the analyzer as detailed in Section 7.

2. Use the pH simulator to carry out an impedance check on the analyzer, i.e. glass to reference, glass to earth and reference to earth – refer to simulator manual.

   If the analyzer fails this test, check for moisture within the transmitter and in particular the terminal compartment. It is vital that all evidence of moisture is removed with the use of a hot air drier.

3. Reconnect the electrode cable and connect the simulator to the electrode end of the cable. Repeat the procedures 1) and 2) above. If the analyzer fails test 2), check for moisture around the connections and check that the insulation on the inner co-axial conductor is clean and that the graphite layer has been removed.

8.3 Checking the Temperature Input

Check the analyzer responds to a temperature input. Disconnect the Pt100/Pt1000/Balco 3K leads and connect a suitable resistance box directly to the analyzer inputs – see Section 6.4, page 50 (wall-/pipe-mount analyzer) or see Section 6.5, page 52 (panel-mount analyzer). Check the analyzer displays the correct values as set on the resistance box – see Table 8.2.

Incorrect readings usually indicate an electrical calibration problem. Re-calibrate the analyzer as detailed in Section 7.

Temperature		Input Resistance (Ω)		
°C	°F	Pt100	Pt1000	Balco 3K
0	32	100.00	1000.0	2663
10	50	103.90	1039.0	2798
20	68	107.79	1077.9	2933
25	77	109.73	1097.3	3000
30	86	111.67	1116.7	3068
40	104	115.54	1155.4	3203
50	122	119.40	1194.0	3338
60	140	123.24	1232.4	3473
70	158	127.07	1270.7	3608
80	176	130.89	1308.9	3743
90	194	134.70	1347.0	3878
100	212	138.50	1385.0	4013
130.5	267	150.00	1500.0	4424

Table 8.2 Temperature Readings for Resistance Inputs

9 Specification

pH/Redox (ORP) – AX460 and AX466

Inputs

One or two* pH or mV inputs and solution earth

One or two* temperature sensors

Enables connection to glass or enamel pH and reference sensors and Redox (ORP) sensors

*AX466 only

Input resistance

Glass >1 x 10^{13} Ω

Reference 1 x 10^{13} Ω

Range

–2 to 16 ph or –1200 to +1200 mV

Minimum span

Any 2 ph span or 100 mV

Resolution

0.01 pH

Accuracy

0.01 pH

Temperature compensation modes

Automatic or manual Nernstian compensation

Range –10 to 200 °C (14 to 392 °F)

Process solution compensation with configurable coefficient

Range –10 to 200 °C (14 to 392 °F)

adjustable –0.05 to +0.02 %/°C (–0.02 to +0.009 %/°F)

Temperature sensor

Programmable Pt100, Pt1000 or Balco 3 kΩ

Calibration Ranges

Check value (zero point)

0 to 14 pH

Slope

Between 40 and 105 % (low limit user-configurable)

Electrode Calibration Modes

Calibration with auto-stability checking

Automatic 1 or 2 point calibration selectable from:

ABB

DIN

Merck

NIST

US Tech

2 x user-defined buffer tables for manual entry,

2-point calibration or single-point process calibration

Conductivity – AX416 Only

Range

Programmable 0 to 0.5 to 0 to 10,000 µS/cm (with various cell constants)

Minimum span

10 x cell constant

Maximum span

10,000 x cell constant

Units of measure

µS/cm, µS/m, mS/cm, mS/m, MΩ-cm and TDS

Accuracy

Better than ±0.01 % of span (0 to 100 µS/cm)

Better than ±1 % of reading (10,1000 µS/cm)

Operating temperature range

–10 to 200 °C (14 to 392 °F)

Temperature compensation

–10 to 200 °C (14 to 392 °F)

Temperature coefficient

Programmable 0 to 5 %/°C and fixed temperature compensation curves (programmable) for acids, neutral salts and ammonia

Temperature sensor

Programmable Pt100 or Pt1000

Reference Temperature

25 °C (77 °F)

Display

Type

Dual 5-digit, 7-segment backlit LCD

Information

16-character, single line dot-matrix

Energy-saving function

Backlit LCD configurable as ON or Auto-Off after 60 s

Logbook*

Electronic record of major process events and calibration data

Real-time clock*

Records time for logbook and auto-manual functions

*Available if option board is fitted

Relay Outputs – On/Off

Number of relays

Three supplied as standard or five with option board fitted

Number of set points

Three supplied as standard or five with option board fitted

Set point adjustment

Configurable as normal or failsafe high/low or diagnostic alert

Hysteresis of reading

Programmable 0 to 5 % in 0.1 % increments

Delay

Programmable 0 to 60 s in 1 s intervals

Relay contacts

Single-pole changeover

Rating 5 A, 115/230 V AC, 5 A DC

Insulation

2 kV RMS contacts to earth/ground

Analog Outputs

Number of current outputs (fully isolated)

Two supplied as standard or four with option board fitted

Output ranges

0 to 10 mA, 0 to 20 mA or 4 to 20 mA

Analog output programmable to any value between 0 and 22 mA to indicate system failure

Accuracy

±0.25 % FSD, ±0.5 % of reading (whichever is the greater)

Resolution

0.1 % at 10mA, 0.05 % at 20 mA

Maximum load resistance

750 Ω at 20 mA

Configuration

Can be assigned to either measured variable or either sample temperature

Digital Communications

Communications

Profibus-DP (with option board fitted)

Control Function – AX460 Only

Controller Type

P, PI, PID (configurable)

Control Outputs

Output

Can be assigned a maximum of two relays, two analog outputs, or one of each

Analog

Current output control (0 to 100 %)

Time proportioning cycle time

1.0 to 300.0 s, programmable in increments of 0.1 s

Pulse frequency

1 to 120 pulses per minute, programmable in increments of 1 pulse per minute

Controller action

Reverse, direct or bi-directional (programmable)

Proportional band

0.1 to 999.9 %, programmable in increments of 0.1 %

Integral action time (Integral reset)

1 to 7200 s, programmable in increments of 1 s (0 = Off)

Derivative

0.1 to 999.9s programmable in increments of 0.1s, available only for single set point control

Auto/Manual

User-programmable

Access to Functions

Direct keypad access

Measurement, maintenance, configuration, diagnostics and service functions

Performed without external equipment or internal jumpers

Sensor Cleaning Function

Configurable cleaning action relay contact

Continuous

Pulse in 1 s on and off times

Frequency

5 minutes to 24 hours, programmable in 15 minute increments up to 1 hour then in 1 hour increments for 1 to 24 hours

Duration

15 s to 10 minutes, programmable in 15 s increments up to 1 minute then in 1 minute increments up to 10 minutes

Recovery period

30 s to 5 minutes, programmable in 30 s increments

Mechanical Data

Wall-/Pipe-mount versions

IP65 (not evaluated under UL certification)

Dimensions 192 mm high x 230 mm wide x 94 mm deep
(7.56 in. high x 9.06 in. wide x 3.7 in. deep)

Weight 1 kg (2.2 lb)

Panel-mount versions

IP65 (front only)

Dimensions 96mm x 96mm x 162mm deep
(3.78 in. x 3.78 in. x 6.38 in. deep)

Weight 0.6kg (1.32 lb)

Cable Entry Types

Standard	5 or 7 x M20 cable glands
North American	7 x knockouts suitable for 1/2 in. Hubble gland

Power Supply

Voltage requirements

100 to 240 V AC 50/60 Hz
(90 V Min. to 264 V Max. AC)

12 to 30 V DC

Power consumption

10 W

Insulation

Mains to earth (line to ground) 2 kV RMS

Environmental Data

Operating temperature limits

–20 to 55 °C (–4 to 131 °F)

Storage temperature limits

–25 to 75 °C (–13 to 167 °F)

Operating humidity limits

Up to 95 %RH non condensing

EMC

Emissions and immunity

Meets requirements of:

EN61326 (for an industrial environment)

EN50081-2

EN50082-2

Approvals, Certification and Safety

Safety approval

UL

CE Mark

Covers EMC & LV Directives (including latest version EN 61010)

General safety

EN61010-1

Overvoltage Class II on inputs and outputs

Pollution category 2

Languages

Languages configurable:

English

French

German

Italian

Spanish

DS/AX4PH–EN Rev. K

Appendix A – Buffer Solutions

The pH value of buffer solutions is influenced considerably by temperature variations. Thus, when significant temperature fluctuations occur, it is general practice to correct automatically the measured, prevailing pH to the value that would apply if the solution temperature were 25 ºC (77 ºF), the internationally accepted standard.

Tables A1 to A5 include the pH values for ABB, DIN, Merck, NIST, and US Technical buffer solutions. Standards are for 4, 7 and 9 pH values, from 0 to 95 ºC (32 to 203 ºF).

Temp		ABB Buffers		
ºC	ºF	4.01 pH	7 pH	9.18 pH
0	32	4.000	7.110	9.475
5	41	3.998		9.409
10	50	3.997	7.060	9.347
15	59	3.998		9.288
20	68	4.001	7.010	9.233
25	77	4.005	7.000	9.182
30	86	4.011	6.980	9.134
35	95	4.018		9.091
40	104	4.027	6.970	9.051
45	113	4.038		9.015
50	122	4.050	6.970	8.983
55	131	4.064		8.956
60	140	4.080	6.970	8.932
65	149	4.097		8.913
70	158	4.116	6.990	8.898
75	167	4.137		8.888
80	176	4.159	7.030	8.882
85	185	4.183		8.880
90	194	4.208	7.080	8.884
95	203	4.235		8.892

Table A.1 ABB Buffer Solutions

Temp		DIN 19266 Buffers			
ºC	ºF	1.68 pH	4.01 pH	6.86 pH	9.18 pH
0	32	1.666	4.003	6.984	9.464
5	41	1.668	3.999	6.951	9.395
10	50	1.670	3.998	6.923	9.332
15	59	1.672	3.999	6.900	9.276
20	68	1.675	4.002	6.881	9.225
25	77	1.679	4.008	6.865	9.180
30	86	1.683	4.015	6.853	9.139
35	95	1.688	4.024	6.844	9.102
40	104	1.694	4.035	6.838	9.068
45	113	1.700	4.047	6.834	9.038
50	122	1.707	4.060	6.833	9.011
55	131	1.715	4.075	6.834	8.985
60	140	1.723	4.091	6.836	8.962
65	149				
70	158	1.743	4.126	6.845	8.921
75	167				
80	176	1.766	4.164	6.859	8.885
85	185				
90	194	1.792	4.205	6.877	8.850
95	203	1.806	4.227	6.886	8.833

Table A.2 DIN Buffer Solutions

Temp		Merck Buffers			
ºC	ºF	4 pH	7 pH	9 pH	10 pH
0	32	4.05	7.13	9.24	10.26
5	41	4.04	7.07	9.16	10.17
10	50	4.02	7.05	9.11	10.11
15	59	4.01	7.02	9.05	10.05
20	68	4.00	7.00	9.00	10.00
25	77	4.01	6.98	8.95	8.95
30	86	4.01	6.98	8.91	9.89
35	95	4.01	6.96	8.88	9.84
40	104	4.01	6.95	8.85	9.82
45	113	4.01	6.95	8.82	
50	122	4.00	6.95	8.79	9.74
55	131	4.00	6.95	8.76	
60	140	4.00	6.96	8.73	9.67
65	149	4.00	6.96	8.72	
70	158	4.00	6.96	8.70	9.62
75	167	4.00	6.96	8.68	
80	176	4.00	6.97	8.66	9.55
85	185	4.00	6.98	8.65	
90	194	4.00	7.00	8.64	9.49
95	203	4.00	7.02	8.64	8.833

Table A.3 Merck Buffer Solutions

Temp		NIST Buffers		
ºC	ºF	4.01 pH	6.86 pH	9.18 pH
0	32	4.003	6.982	9.460
5	41	3.998	6.949	9.392
10	50	3.996	6.921	9.331
15	59	3.996	6.898	9.276
20	68	3.999	6.878	9.227
25	77	4.004	6.863	9.183
30	86	4.011	6.851	9.143
35	95	4.020	6.842	9.107
40	104	4.030	6.836	9.074
45	113	4.042	6.832	9.044
50	122	4.055	6.831	9.017
55	131	4.070		
60	140	4.085		
65	149			
70	158	4.120		
75	167			
80	176	4.160		
85	185			
90	194	4.190		
95	203	4.210		

Table A.4 NIST Buffer Solutions

Temp		US Technical Buffers		
ºC	ºF	4.01 pH	7 pH	10.01 pH
0	32	4.000	7.118	10.317
5	41	3.998	7.087	10.245
10	50	3.997	7.059	10.179
15	59	3.998	7.036	10.118
20	68	4.001	7.016	10.062
25	77	4.005	7.000	10.012
30	86	4.011	6.987	9.966
35	95	4.018	6.977	9.925
40	104	4.027	6.970	9.889
45	113	4.038	6.965	9.857
50	122	4.050	6.964	9.828
55	131	4.064	6.965	
60	140	4.080	6.968	
65	149	4.097	6.974	
70	158	4.116	6.982	
75	167	4.137	6.992	
80	176	4.159	7.004	
85	185	4.183	7.018	
90	194	4.208	7.034	
95	203	4.235	7.052	

Table A.5 US Technical Buffer Solutions

Acknowledgments

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IM/AX4PH Rev. P 12.2018