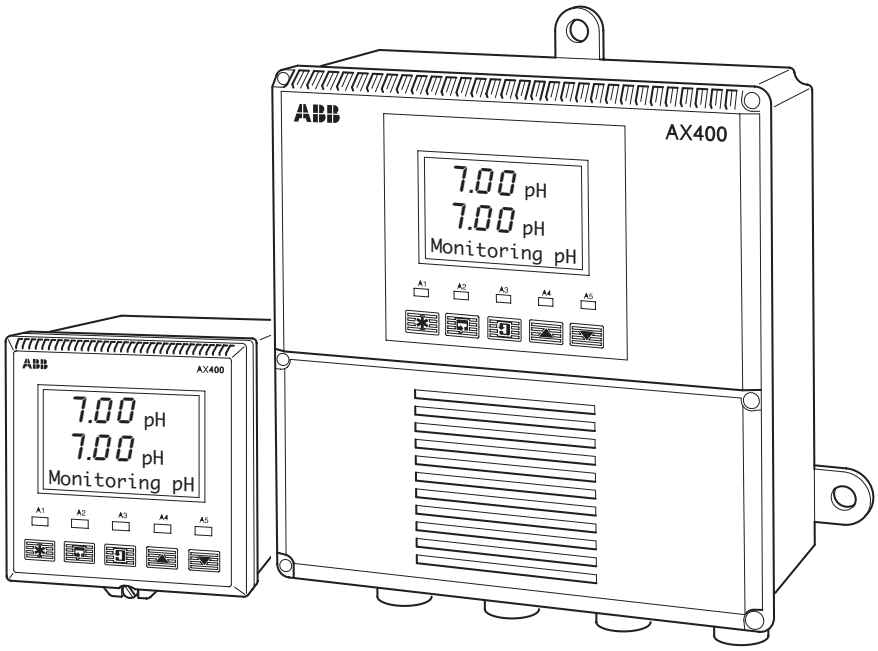
AX400 Series

User Guide

Models AX460 and AX466 Single and Dual Input pH/Redox (ORP) Analyzers



ABB

The Company

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

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

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

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

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

BS EN ISO 9001:1994

Cert. No. Q05907

EN 29001 (ISO 9001)

Lenno, Italy – Cert. No. 9/90A

Stonehouse, U.K.

Use of Instructions

Warning.
An instruction that draws attention to the risk of injury or death.

Note.
Clarification of an instruction or additional information.

Caution.
An instruction that draws attention to the risk of damage to the product, process or surroundings.

Information.
Further reference for more detailed information or technical details.

Although **Warning** hazards are related to personal injury, and **Caution** hazards are associated with equipment or property damage, it must be understood that operation of damaged equipment could, under certain operational conditions, result in degraded process system performance leading to personal injury or death. Therefore, comply fully with all **Warning** and **Caution** notices.

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 Marketing Communications Department.

Health and Safety

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

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

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

CONTENTS

1 INTRODUCTION

1.1 System Description

The AX400 Series 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 impedence input $>10^{13}\Omega$) or differential pH input (dual, high impedence 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 impedence 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 AX400 Series Analyzer Options

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

Analyzer Model Number	Description of Analyzer	Sensor A	Sensor B
AX410	Single Input Conductivity (0 to 10,000 µS/cm)	Conductivity	Not Applicable
AX411	Dual Input Conductivity (0 to 10,000 µS/cm)	Conductivity	Conductivity
AX416	Dual Input Conductivity and pH/Redox(ORP)	Conductivity	pH/Redox(ORP)
AX450	Single Input Conductivity (USP)	Conductivity	Not Applicable
AX455	Dual Input Conductivity (USP)	Conductivity	Conductivity
AX460	Single Input pH/Redox(ORP)	pH/Redox(ORP)	Not Applicable
AX466	Dual Input pH/Redox(ORP)	pH/Redox(ORP)	pH/Redox(ORP)

Table 1.1 AX400 Series Analyzer Options

2 OPERATION

2.1 Powering Up the Analyzer

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

1) Ensure the input sensor(s) is/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** (see Section 2.3) is displayed as the pH or Redox (ORP) monitoring operation starts.

2.2 Displays and Controls – Fig. 2.1

The display comprises two rows of 4½ digit, 7-segment digital displays, which 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 the programming information.

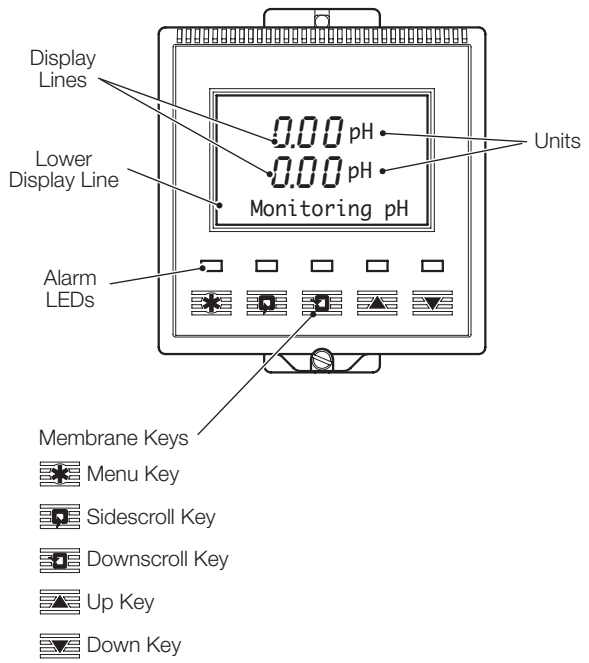
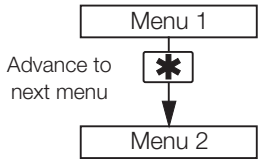
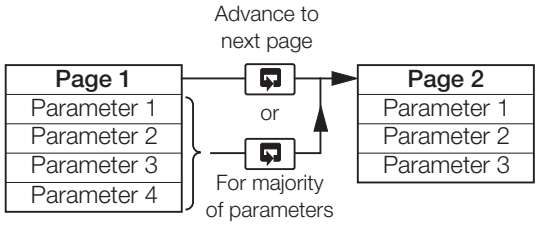


Fig. 2.1 Location of Controls and Displays

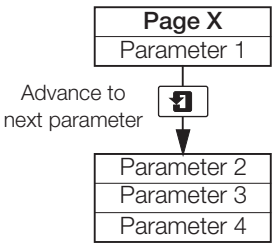
2.2.1 Key Functions



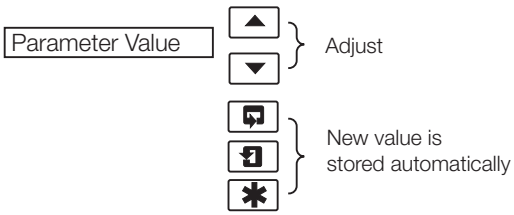
A – Moving Between Menus



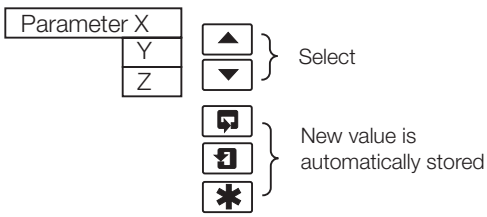
B – Advancing to Next Page



C – Moving Between Parameters



D – Adjusting and Storing a Parameter Value



E – Selecting and Storing a Parameter Choice

Fig. 2.2 Membrane Key Functions

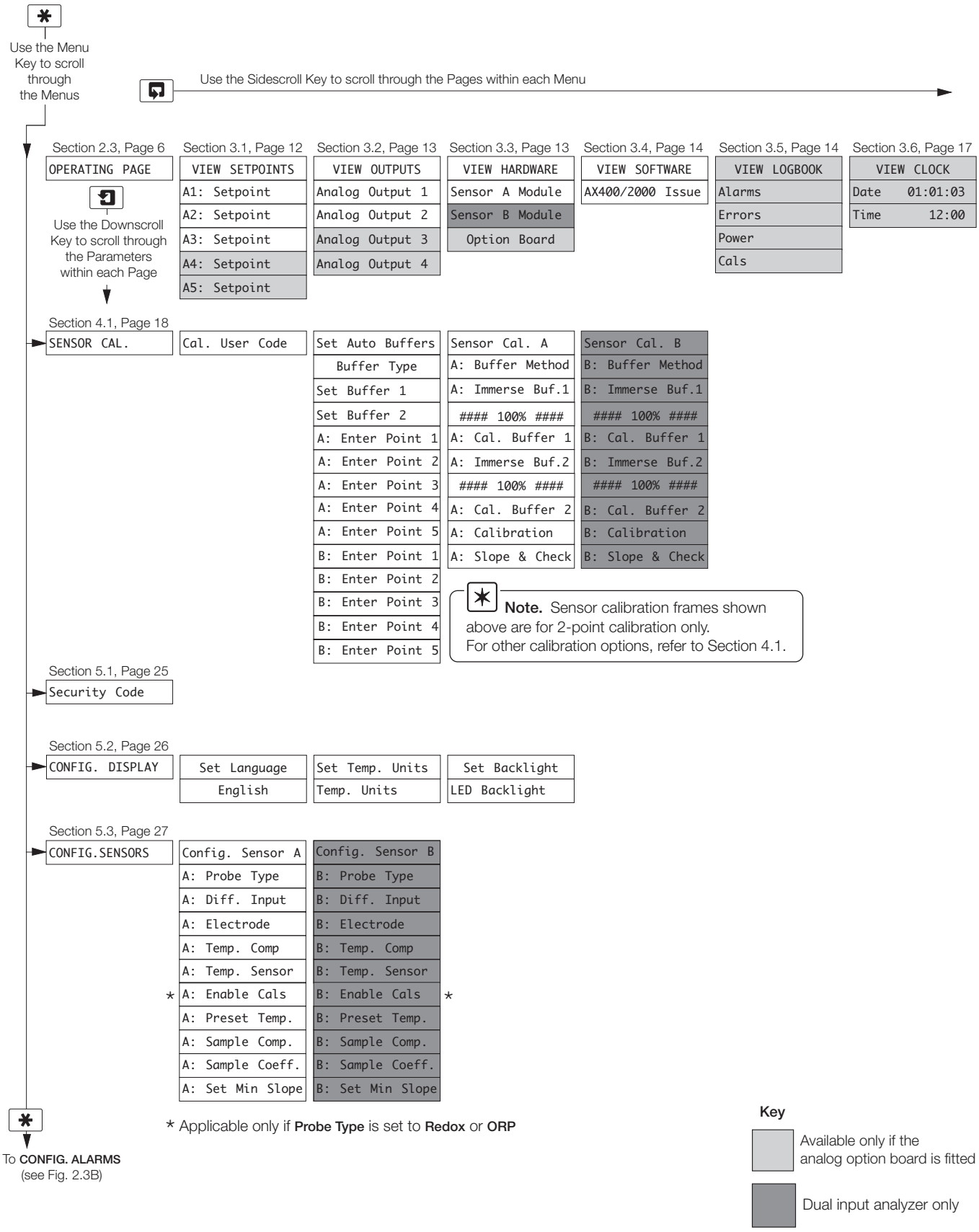


Fig. 2.3A Overall Programming Chart

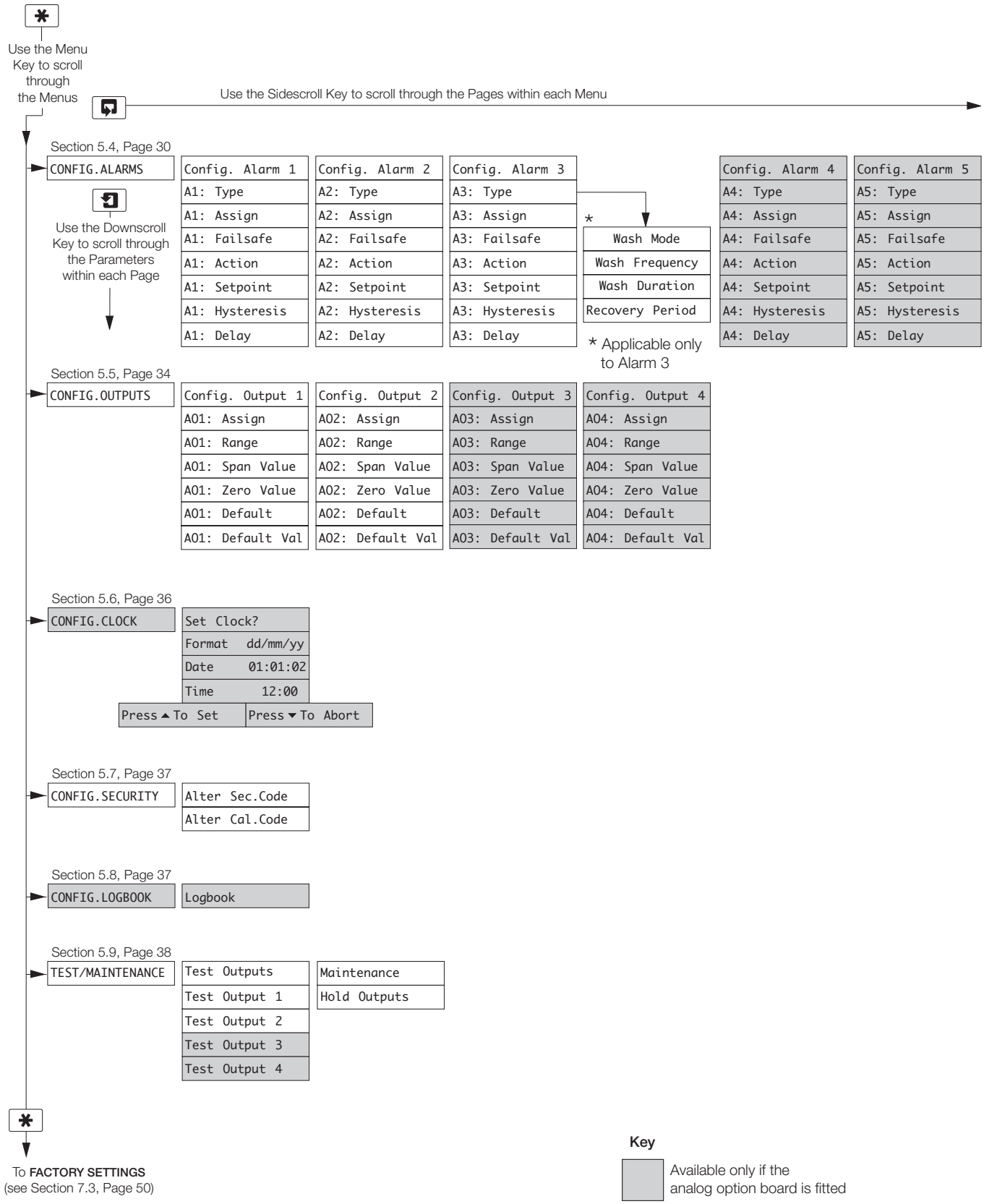
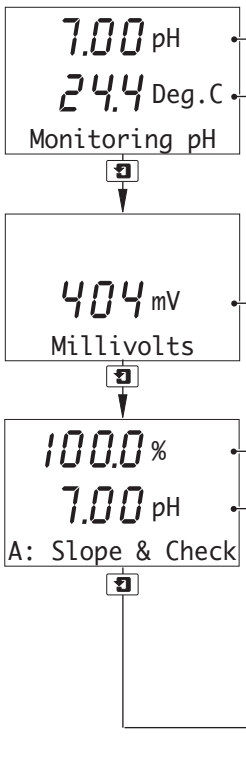


Fig. 2.3B Overall Programming Chart

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** 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 (zero point).

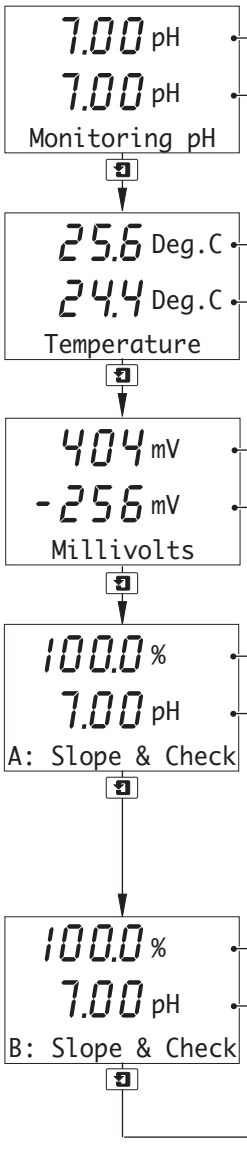
Displayed as an additional indication of pH electrode system condition; 7pH is the optimum value for glass electrodes and 0pH for Antimony electrodes.

Wash Function — Alarm 3 set to **Wash** (**A3: Type**, Section 5.4) – see Section 2.3.3.

Monitoring pH — Alarm 3 not set to **Wash**.

…2.3 Operating 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.

Sensor A % Slope and pH Check 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 (zero point).
Displayed as an additional indication of pH electrode system condition; 7pH being the optimum value for glass electrodes and 0pH for Antimony electrodes.

Sensor B % Slope and pH Check Value
% slope value.

pH check value (zero point).

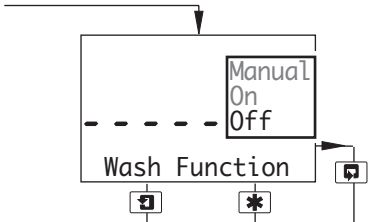
} See Sensor A above.

Wash Function — Alarm 3 set to **Wash** (**A3: Type**, Section 5.4) – see Section 2.3.3.
Monitoring pH — Alarm 3 not set to **Wash**.

…2.3 Operating Page

2.3.3 Wash Function

Note. Applicable only if Alarm 3 (**A3: Type**) is set to **Wash** in the **CONFIG. ALARMS** page – see Section 5.4.



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.

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

VIEW SETPOINTS – See Section 3.1.

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

SENSOR CAL. – See Section 4.1.

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

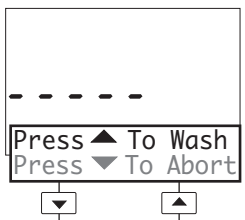
SENSOR CAL. – Sensor calibration enabled (Section 5.3) – see Section 4.1.

Security Code – **Alter Sec. Code** not set to zero (Section 5.7) – see Section 5.1.

CONFIG. DISPLAY – **Alter Sec. Code** set to zero (Section 5.7) – see Section 5.2.

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

MONITORING PH – **Wash Function** not set to **Manual**.



Press to Wash (Manual Wash only)

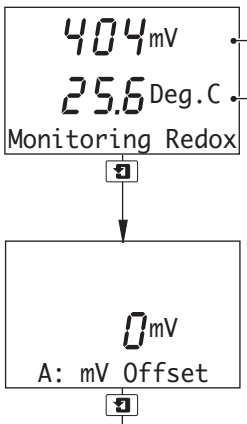
Press ▲ to Wash and **Press ▼ to Abort** are shown alternately on the lower display line.

WASH IN PROGRESS – 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 resets to the one that was set before **Manual** was selected.

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

…2.3 Operating Page

2.3.4 Single Input Redox (ORP)



Measured Values
Millivolts.

Temperature.

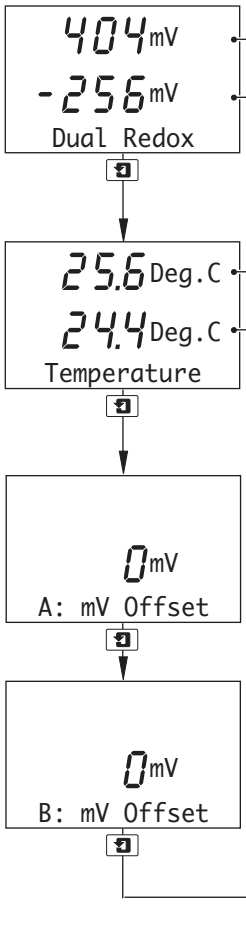
Note. If **Probe Type** is set to **ORP** in the **CONFIG. SENSORS** page (see Section 5.3), the lower display line shows `Monitoring ORP`.

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

`Wash Function` Alarm 3 set to **Wash** (**A3: Type**, Section 5.4) – see Section 2.3.3.
`Dual Redox` Alarm 3 not set to **Wash**.

…2.3 Operating Page

2.3.5 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** in the **CONFIG. SENSORS** page (see 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** in the **CONFIG. SENSORS** page – see Section 5.3.

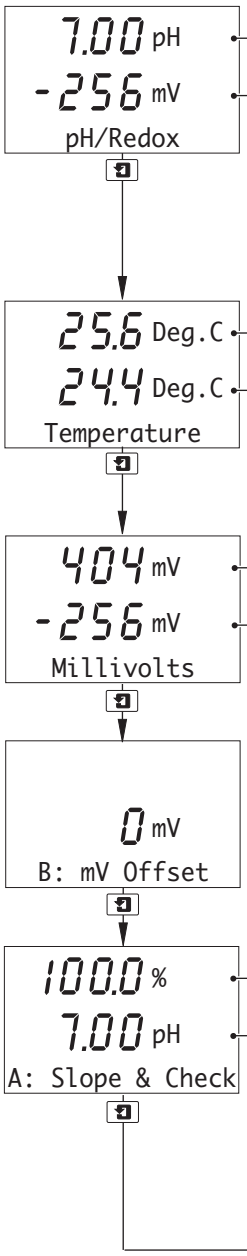
Sensor A Offset
Displays the offset value for Sensor A set in **A: Adjust Offset** – see Section 4.1.3.

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

`Wash Function` Alarm 3 set to **Wash** (**A3: Type**, Section 5.4) – see Section 2.3.3.
`Dual Redox` Alarm 3 not set to **Wash**.

…2.3 Operating Page

2.3.6 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** in the **CONFIG. SENSORS** page – see Section 5.3. 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/pH.

Measured Temperature
Sensor A.

Sensor B.

Note. The measured temperature is displayed only if **Temp. Sensor** is not set to **None** in the **CONFIG. SENSORS** page – see Section 5.3.

Measured Millivolts
Sensor A.

Sensor B.

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

Sensor A % Slope and pH Check 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.

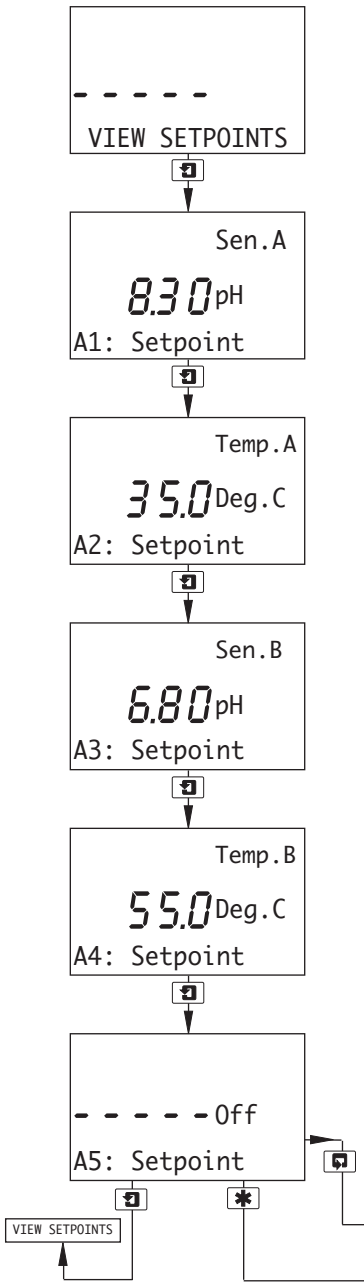
pH check value (zero value).
Displayed as an additional indication of pH electrode system condition; 7pH is the optimum value for glass electrodes and 0pH for Antimony electrodes.

Wash Function — Alarm 3 set to **Wash** (**A3: Type**, Section 5.4) – see Section 2.3.3.
pH/Redox — Alarm 3 not set to **Wash**.

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 in the **CONFIG. SENSORS** page – see Section 5.3. 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.

Set point values and relay/LED actions are programmable – see Section 5.4.

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 is available only if the optional analog output board is fitted.

Alarm 5 Set Point

Note. Alarm 5 is available only if the optional analog output board is fitted.

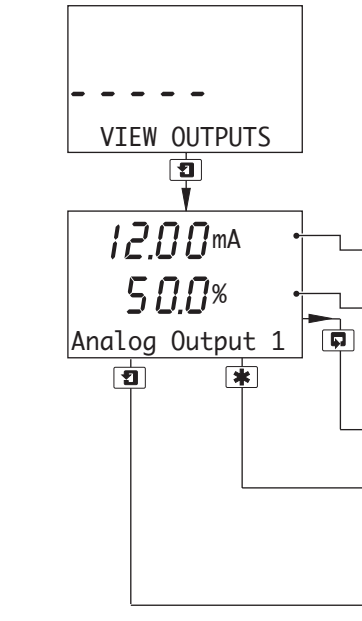
VIEW OUTPUTS – Return to main menu.

SENSOR CAL. – Sensor calibration enabled (Section 5.3) – see Section 4.1.

Security Code – **Alter Sec. Code** not set to zero (Section 5.7) – see Section 5.1.

CONFIG. DISPLAY – **Alter Sec. Code** set to zero (Section 5.7) – see Section 5.2.

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 are available only if the optional analog output board is fitted.

Live current output value being retransmitted.

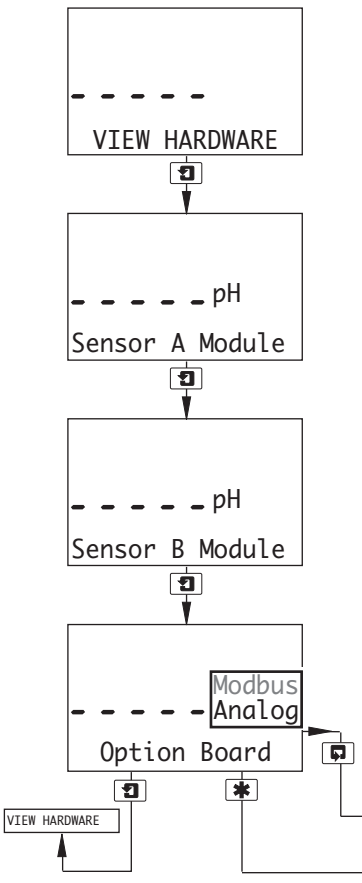
Current output shown as a percentage of full scale for the output range set in **CONFIG. OUPUTS** – see Section 5.6.

VIEW HARDWARE – See Section 3.3.

SENSOR CAL. – Sensor calibration enabled (Section 5.3) – see Section 4.1.
Security Code – **Alter Sec. Code** not set to zero (Section 5.7) – see Section 5.1.
CONFIG. DISPLAY – **Alter Sec. Code** set to zero (Section 5.7) – see Section 5.2.

Analog Output 2 – **Analog Output 2** – repeat for output 2 (and outputs 3 and 4 if optional analog output board fitted).

3.3 View Hardware



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

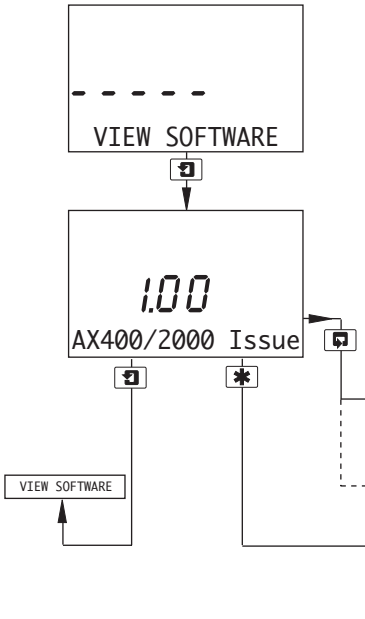
Sensor B Module – Dual input analyzers only
Shows the type of input board fitted to the analyzer for the Sensor B input.

Option Board
Shows the type of option board fitted to the analyzer (if applicable).

VIEW SOFTWARE – See Section 3.4.

SENSOR CAL. – Sensor calibration enabled (Section 5.3) – see Section 4.1.
Security Code – **Alter Sec. Code** not set to zero (Section 5.7) – see Section 5.1.
CONFIG. DISPLAY – **Alter Sec. Code** set to zero (Section 5.7) – see Section 5.2.

3.4 View Software



Issue
Shows the version number of the operating software.

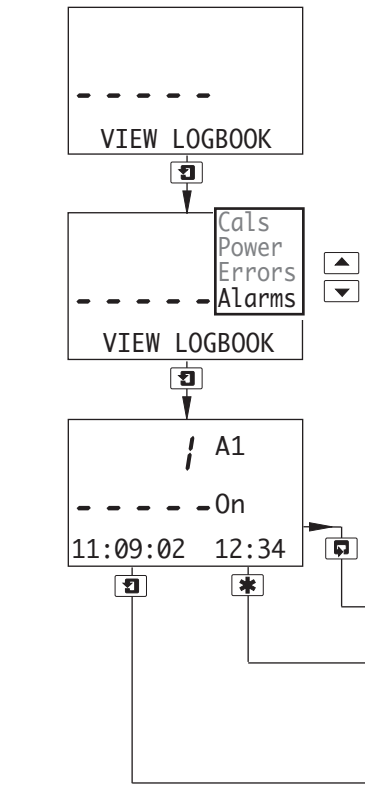
VIEW LOGBOOK — Optional analog output board fitted ***and*** **Logbook** set to **On** in the **CONFIG. LOGBOOK** page (Section 5.8) – see Section 3.5.

Monitoring pH — **Operating Page** (optional analog output board not fitted) – see Section 2.3.

SENSOR CAL. — Sensor calibration enabled (Section 5.3) – see Section 4.1.
Security Code — **Alter Sec. Code** not set to zero (Section 5.7) – see Section 5.1.
CONFIG. DISPLAY — **Alter Sec. Code** set to zero (Section 5.7) – see Section 5.2.

3.5 View Logbook

Note. The **VIEW LOGBOOK** function is available only if the optional analog output board is fitted ***and*** **Logbook** is set to **On** in the **CONFIG. LOGBOOK** page – see Section 5.8.



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.

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 and time of the occurrence.

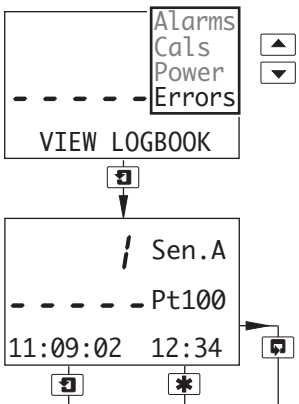
VIEW CLOCK — Optional analog input board fitted – see Section 3.6.

SENSOR CAL. — Sensor calibration enabled (Section 5.3) – see Section 4.1.
Security Code — **Alter Sec. Code** not set to zero (Section 5.7) – see Section 5.1.
CONFIG. DISPLAY — **Alter Sec. Code** set to zero (Section 5.7) – see Section 5.2.

2 A1 — Advance to entries 2 to 10.

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

...3.5 Logbook

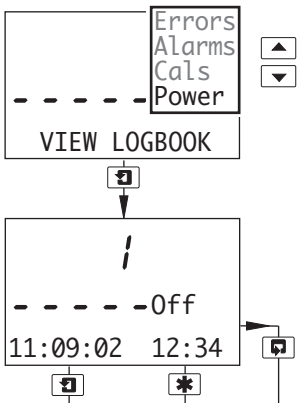


View Logbook
Use the ▲ and ▼ keys to access the **Errors** logbook.

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 and time of the occurrence.

VIEW CLOCK	Optional analog input board fitted – see Section 3.6.
SENSOR CAL.	Sensor calibration enabled (Section 5.3) – see Section 4.1.
Security Code	**Alter Sec. Code** not set to zero (Section 5.7) – see Section 5.1.
CONFIG. DISPLAY	**Alter Sec. Code** set to zero (Section 5.7) – see Section 5.2.
2 Sen.A	Advance to entries 2 to 5.

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



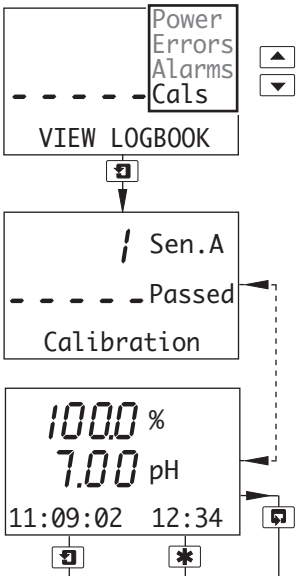
View Logbook
Use the ▲ and ▼ keys to access the **Power** logbook.

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 and time of the occurrence.

VIEW CLOCK	Optional analog input board fitted – see Section 3.6.
SENSOR CAL.	Sensor calibration enabled (Section 5.3) – see Section 4.1.
Security Code	**Alter Sec. Code** not set to zero (Section 5.7) – see Section 5.1.
CONFIG. DISPLAY	**Alter Sec. Code** set to zero (Section 5.7) – see Section 5.2.
2	Advance to entry 2.

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

…3.5 Logbook



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

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 and time of the occurrence.

VIEW CLOCK — Optional analog input board fitted – see Section 3.6.

SENSOR CAL. — Sensor calibration enabled (Section 5.3) – see Section 4.1.

Security Code — **Alter Sec. Code** not set to zero (Section 5.7) – see Section 5.1.

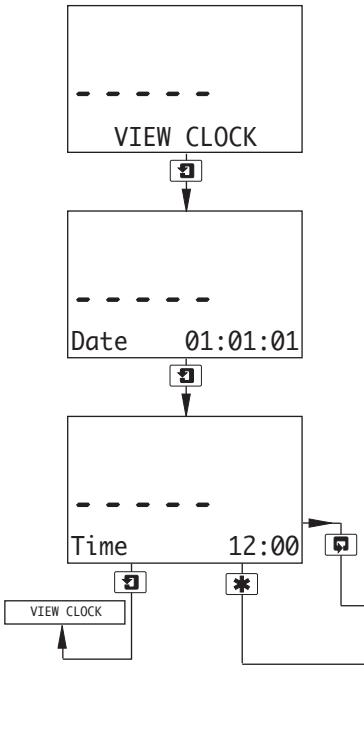
CONFIG. DISPLAY — **Alter Sec. Code** set to zero (Section 5.7) – see Section 5.2.

2 Sen.A — 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 optional analog output board is fitted.



Date
Shows the current date.

Time
Shows the current time.

Monitoring pH — **Operating Page** – see Section 2.3

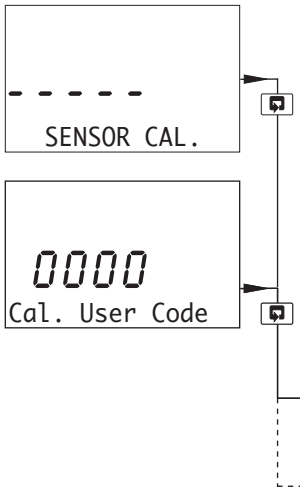
SENSOR CAL. — Sensor calibration enabled (Section 5.3) – see Section 4.1.

Security Code — **Alter Sec. Code** not set to zero (Section 5.7) – see Section 5.1.

CONFIG. DISPLAY — **Alter Sec. Code** set to zero (Section 5.7) – see Section 5.2.

4 SETUP

4.1 Sensor Calibration



Sensor Calibration

Note. When **Probe Type** for either sensor (Sensor A only if single-input) is set to **Redox** or **ORP**, this section is applicable only if **Enable Cals.** for that sensor is set to **Yes** – see Section 5.3.

Sensor Calibration Security Code

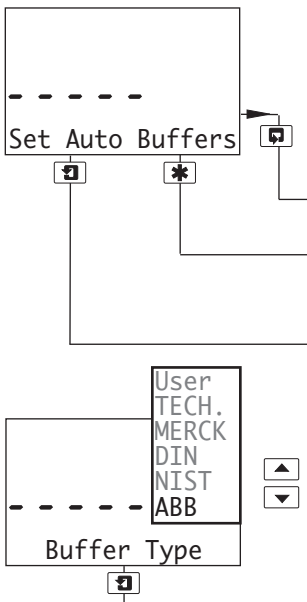
Enter the required code number (between 0000 and 19999), to gain access to the sensor calibration procedure. If an incorrect value is entered, access to subsequent calibration pages is prevented and the display reverts to the **SENSOR CAL.** page.

Note. Applicable only if **Alter Cal. Code** is not set to zero – see Section 5.7.

Set Auto Buffers — **Probe Type** set to **pH** (for ***either*** sensor if dual input analyzer) – continued below.

Sensor Cal. A — **Probe Type** set to **Redox** or **ORP** (for ***both*** sensors if dual input analyzer) – continued on page 21.

4.1.1 Set Buffer Type (pH Only)



Set Auto Buffers

Sensor Cal. A — Continued on Page 21.

SECURITY CODE — **Alter Sec. Code** not set to zero (Section 5.7) – see Section 5.1.

CONFIG. DISPLAY — **Alter Sec. Code** set to zero (Section 5.7) – see Section 5.2.

Buffer Type — Continued below.

Buffer Type

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

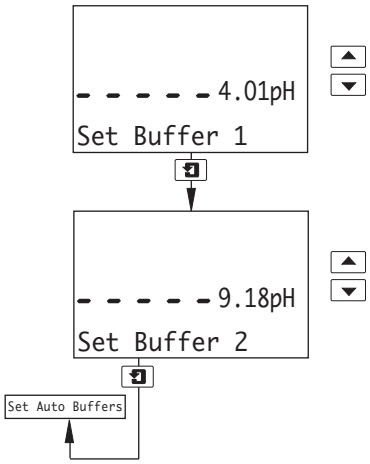
- `ABB` – ABB supplied buffer solution.
- `NIST` – NIST buffer solution.
- `DIN` – DIN 19266 buffer solution.
- `MERCK` – MERCK buffer solution
- `TECH` – US Technical buffer solution
- `User` – Buffer solution with a user defined pH value – see Section 4.1.2.

Set Buffer 1 — **Buffer Type** not set to **User** – continued on next page.

A: Enter Point 1 — **Buffer Type** set to **User** – see Section 4.1.2.

…4.1 Sensor Calibration

…4.1.1 Set Buffer Type (pH Only)



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

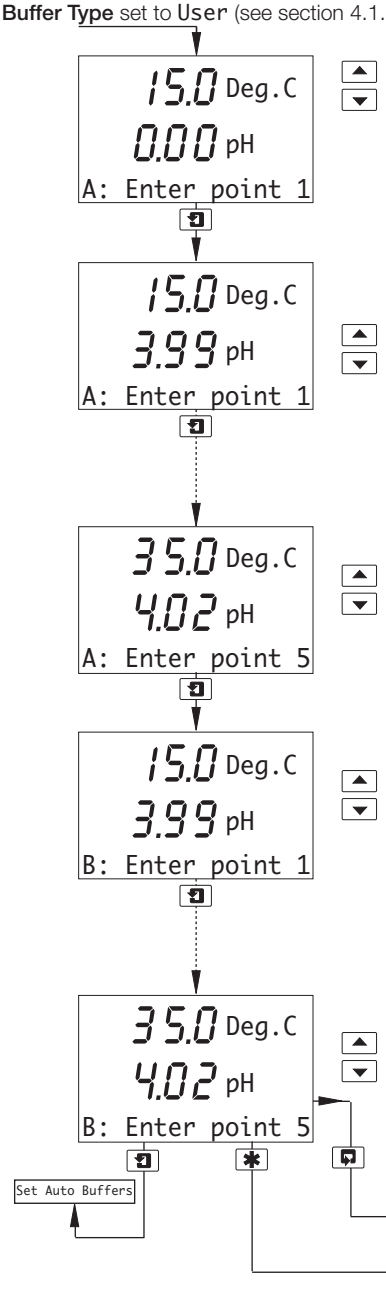
Set Buffer 2
Set the pH value of the buffer 2 solution.

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

…4.1 Sensor Calibration

4.1.2 Set Up User Defined Buffers (pH Only)

Buffer Type set to User (see section 4.1.1)



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 0.01pH) 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°C 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.

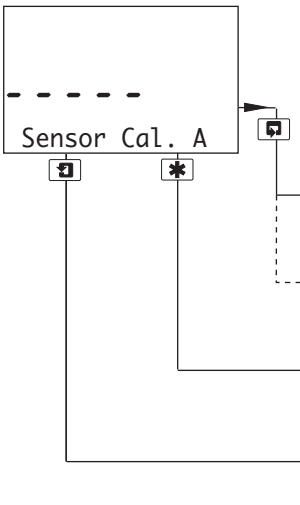
Sensor Cal. A — See Section 4.1.3.

SECURITY CODE — **Alter Sec. Code** not set to zero (Section 5.7) – see Section 5.1.

CONFIG. DISPLAY — **Alter Sec. Code** set to zero (Section 5.7) – see Section 5.2.

…4.1 Sensor Calibration

4.1.3 Adjust Offset (Redox/ORP Only)



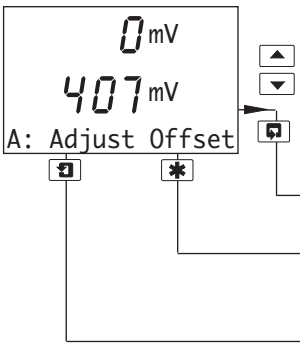
Calibrate Sensor A

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** (see Section 5.3) – return to top of page.

Alter Sec. Code not set to zero (Section 5.7) – see Section 5.1.
Alter Sec. Code set to zero (Section 5.7) – see Section 5.2.

Probe Type set to **Redox** or **ORP** – continued below.
Probe Type set to **pH** – see Section 4.1.4.



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.

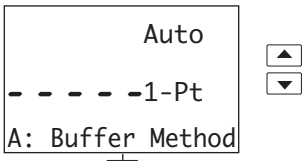
Return to main menu.

Alter Sec. Code not set to zero (Section 5.7) – see Section 5.1.
Alter Sec. Code set to zero (Section 5.7) – see Section 5.2.

Return to top of page.

…4.1 Sensor Calibration

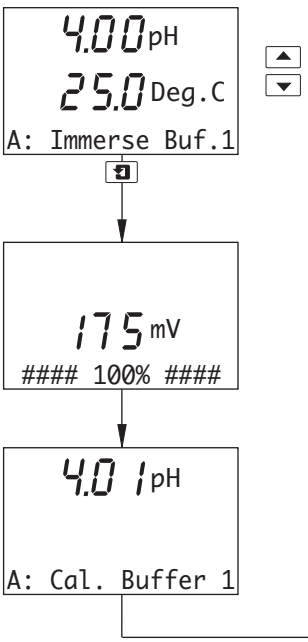
4.1.4 Automatic and Manual, Single- and Two-Point Calibration (pH Only)



Sensor A: Buffer Method (pH probes only)
Select the type of calibration required:

Auto 1-Pt	–	Automatic, single-point calibration
Auto 2-Pt	–	Automatic, two-point calibration
Man 1-Pt	–	Manual, single-point calibration
Man 2-Pt	–	Manual, two-point calibration
Grab	–	Adjust the display to match the measured pH value of a sample.

A: Immerse Buf 1 Anything other than **Grab** selected – continued below.
A: Adjust Value **Grab** selected, see **Adjust Value** on page 24.



Calibrate Buffer (Single-Point Calibration) or Calibrate Buffer 1 (Two-Point Calibration)
Immerse sensor A in the buffer solution.

If a **Manual** calibration has been selected, set the upper display to the temperature-corrected pH value of the chosen solution (see the datasheet provided with the solution).

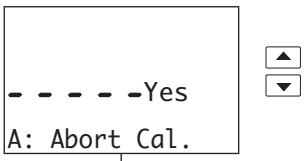
Press the ↵ key to initiate calibration.

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

The center display line shows the sensor e.m.f.
As calibration procedes, a progress indicator appears in the lower display line. When a stable e.m.f. is detected, 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 parameter.

A: Immerse Buf.2 Two-point calibration selected – continued on next page.
A: Calibration Single-point calibration selected – continued on next page.



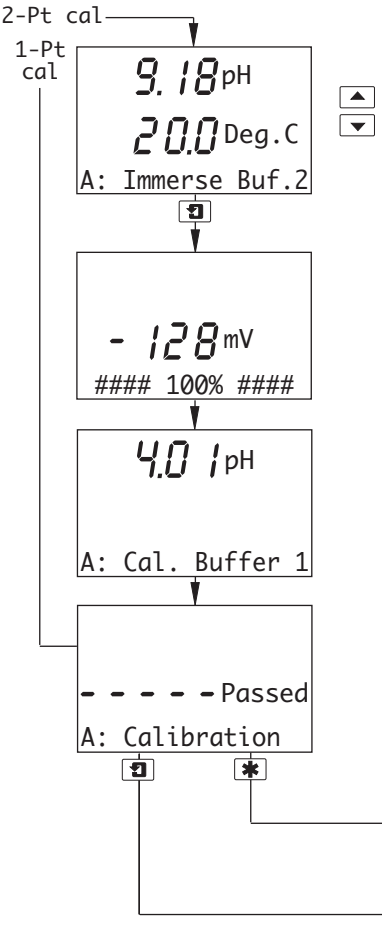
Abort Calibration

Select Yes or No.

A: SENSOR CAL. **Yes** selected – the display returns to the top of the **Calibration Page**.
A: Immerse Buf.2 **No** selected – calibration continues.

…4.1 Sensor Calibration

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



Calibrate Buffer 2 (Two-Point Calibration only)
Immerse Sensor A in the second buffer solution and continue as for Buffer 1.

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

The center display line shows the sensor e.m.f.
As calibration procedes, a progress indicator appears in the lower display line. When a stable e.m.f. is detected, 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 parameter.

Calibration Message
See Table 4.1 for details of calibration messages.

SECURITY CODE **Alter Sec. Code** not set to zero (Section 5.7) – see Section 5.1.
CONFIG. DISPLAY **Alter Sec. Code** set to zero (Section 5.7) – see Section 5.2.

A: Slope & Check Provides indication of electrode condition – continued below.

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; 7pH is the optimum value for glass electrodes and 0pH for Antimony electrodes.

SECURITY CODE **Alter Sec. Code** not set to zero (Section 5.7) – see Section 5.1.
CONFIG. DISPLAY **Alter Sec. Code** set to zero (Section 5.7) – see Section 5.2.

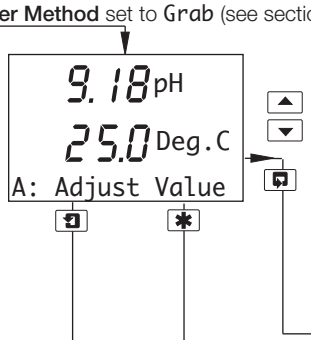
Calibration Message	Min.	Max.	Explanation	Action
PASSED	40 to 70%	105%	The new calibration coefficients are accepted	None
CAL LOW SLOPE	60 to 90%	60 to 90%	The new calibration coefficients are accepted	The electrode pair are becoming fatigued – replacement is recommended
PH CAL FAILED	0%	40 to 70%	The new calibration coefficients are ignored and the last known good calibration coefficients are used	Check buffer values and repeat buffering. If the fault persists, replace the electrodes

Table 4.1 Calibration Messages

…4.1 Sensor Calibration

4.1.5 Grab Calibration (pH Only)

A: Buffer Method set to Grab (see section 4.1.4)



Adjust Value (Grab only)

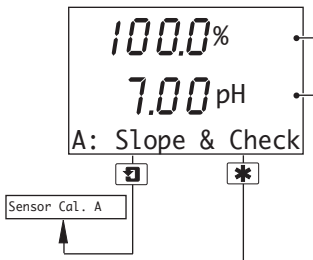
ph and **Adjust** are shown alternately on the upper display line. The displayed pH value is the reading sampled by the analyzer as this frame opened and is held until the display advances to the next frame. Use the ▲ and ▼ keys to adjust the displayed value as necessary to match the pH value of the measured grab sample.

CONFIG. SENSORS — Return to main menu.

SECURITY CODE — **Alter Sec. Code** not set to zero (Section 5.7) – see Section 5.1.

CONFIG. DISPLAY — **Alter Sec. Code** set to zero (Section 5.7) – see Section 5.2.

A: Slope & Check — Continued below.



Slope Value

% slope value.

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

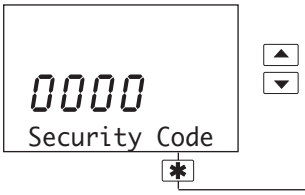
✶ **Note.** The pH check value is reset to the previous, valid check value if a single- or two-point calibration is carried out after a grab calibration.

SECURITY CODE — **Alter Sec. Code** not set to zero (Section 5.7) – see Section 5.1.

CONFIG. DISPLAY — **Alter Sec. Code** set to zero (Section 5.7) – see Section 5.2.

5 PROGRAMMING

5.1 Security Code

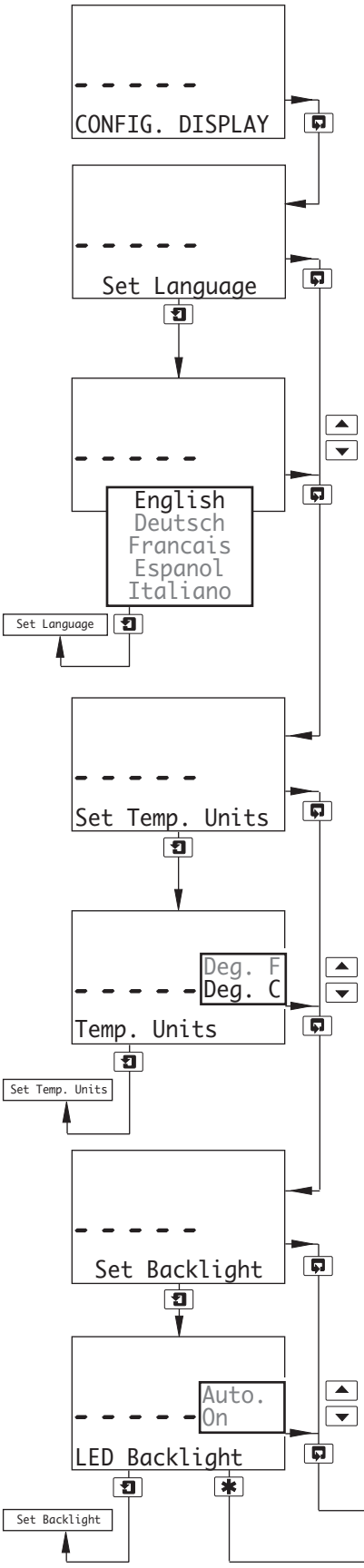


Enter the required code number (between 0000 and 19999), to gain access to the secure parameters. If an incorrect value is entered, access to subsequent programming pages is prevented and the display reverts to the **Operating Page** – see Section 2.3.

Note. This item is displayed only if **Alter Sec. Code** is not set to zero – see Section 5.7.

CONFIG. DISPLAY See Section 5.2.

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

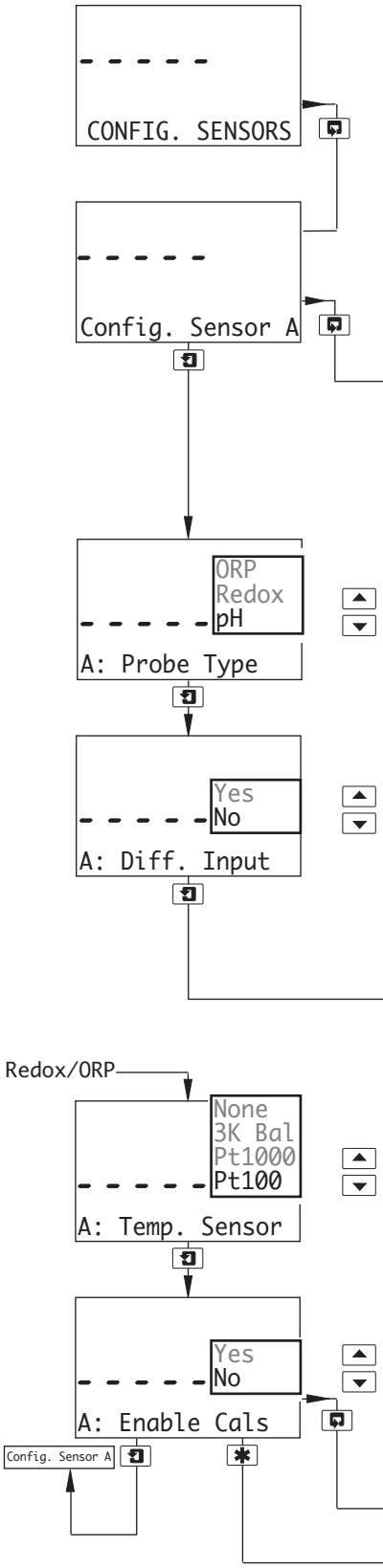
Backlight
Use the ▲ and ▼ keys to select the required backlight option:

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

`CONFIG. DISPLAY` Return to main menu.

`CONFIG. SENSORS` See Section 5.3.

5.3 Configure Sensors



Configure Sensor A

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

A: Probe Type

Select the required probe type.

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

A: Differential Input

- Yes – Select if electrode system is equipped with a solution earth (ground) rod.
- No – Select if electrode system is not equipped with a solution earth (ground) rod.

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) .

A: Temp. Sensor — **Probe Type** set to **Redox** or **ORP** – continued below.

A: Electrode — **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

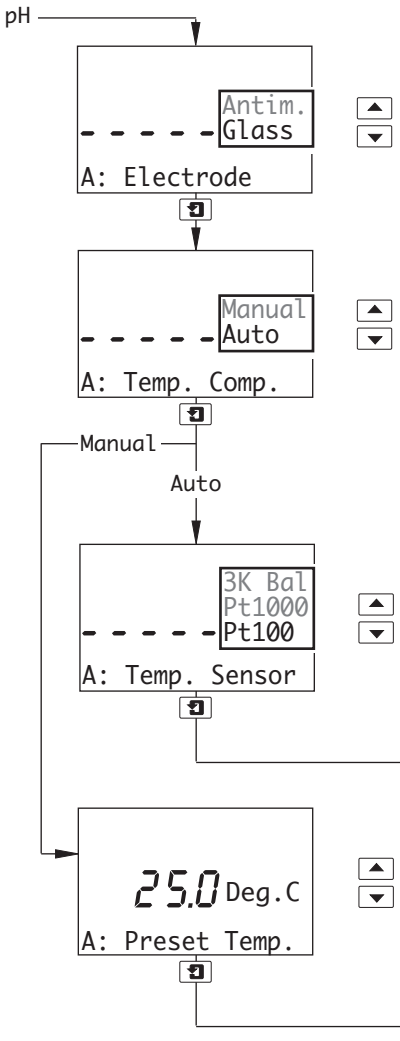
Select **Yes** to enable sensor calibration.

Select **No** to disable sensor calibration and all asociated menus.

CONFIG. SENSORS — Return to main menu.

CONFIG. ALARMS — See Section 5.4.

…5.3 Configure Sensors



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.

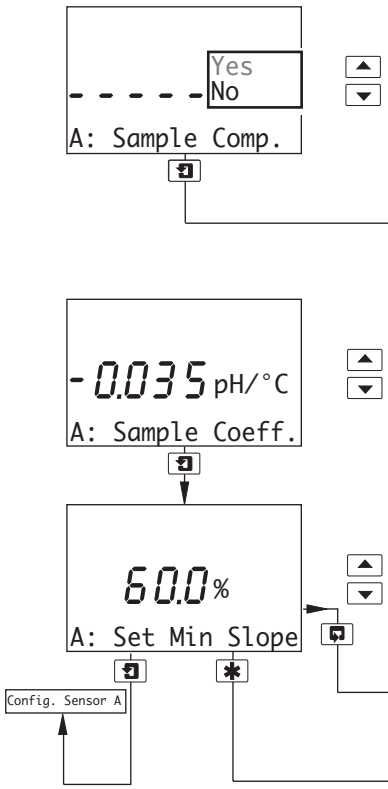
Temperature Sensor (Automatic Temperature Compensation only)
Select the type of temperature sensor used: Pt100, Pt1000 or Balco 3K.

A: Sample Comp. 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.

A: Set Min Slope continued on next page.

...5.3 Configure Sensors



Sample Compensation
Select **Yes** to enable boiling water compensation.

A: Sample Coeff. **Yes** selected – see below.
A: Set Min Slope **No** selected – see below.

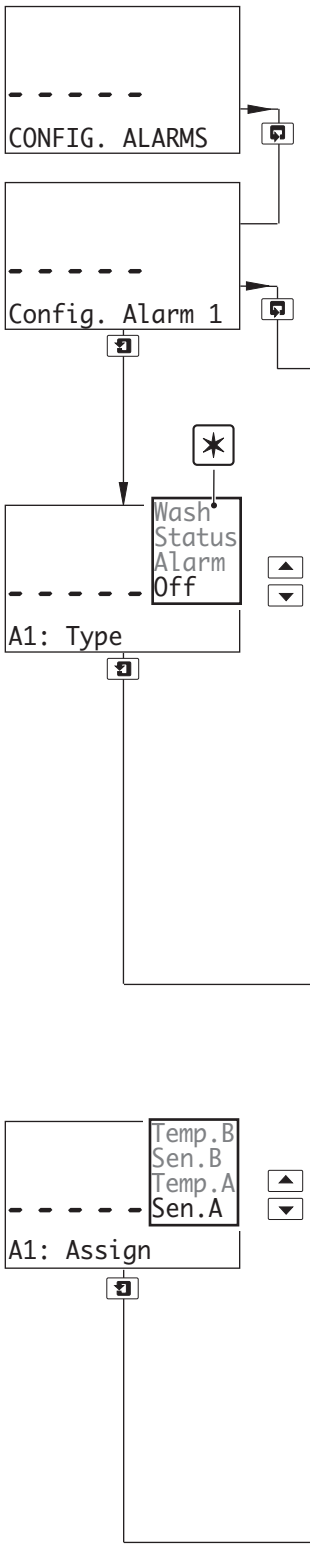
Sample Coefficient
If sample compensation is enabled, enter the temperature coefficient of the sample, in pH/°C, within the range 0.020 to –0.050 (in –0.001 increments). For boiling water applications, enter –0.035.

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.

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

Config. Alarms See Section 5.4.

5.4 Configure Alarms



Configure Alarm 1

Config. Alarm 2 — Configuration of Alarms 2 to 5 is identical to Alarm 1 configuration. Alarm 3 can also be configured as a Wash alarm if **A3: Type** is set to **Wash**.

Note. Alarms 4 and 5 are available only if optional analog output board is fitted.

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** parameter (following) to generate an alarm in response to a specified high or low ph, Redox (ORP) or process temperature sensor reading.
- `Status` – The analyzer alerts the operator to either a power failure or a condition that causes any of the error messages in Table 8.1 to be displayed.
- `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`.

Config. Alarm 1 — **A1: Type** set to **Off** or **Status**.
A1: Assign — **A1: Type** set to **Alarm** – continued below.
Wash Mode — **A3: Type** set to **Wash** – see Section 5.4.1.

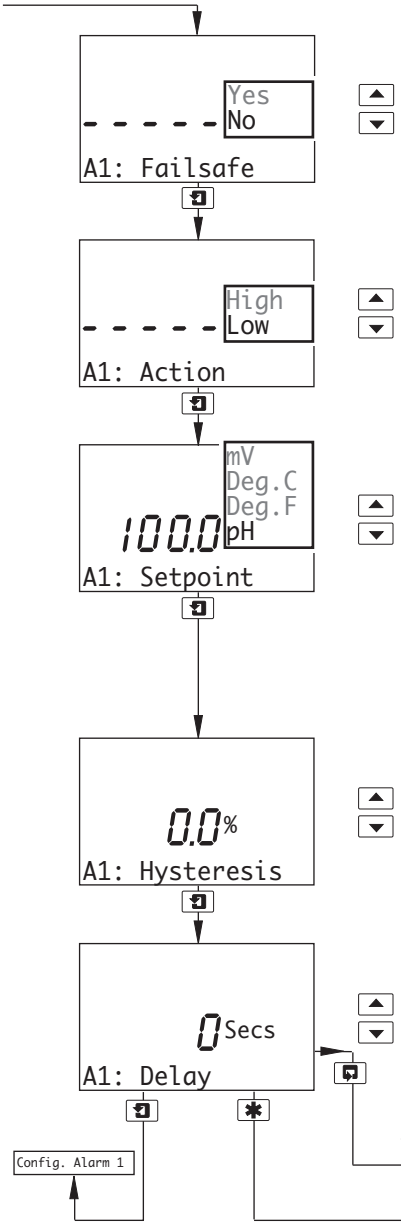
Alarm 1 Assign

The alarm can be assigned to one of two alarm conditions for a specified sensor:

- `Sen.A` / `Sen.B` – The analyzer alerts the operator 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 (see next page), depending on the type of **Alarm 1 Action** opposite – see next page.
- `Temp.A` / `Temp.B` – The analyzer alerts the operator 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 (see next page), depending on the type of **Alarm 1 Action** selected – see next page.

A1: Failsafe — Continued on next page.

...5.4 Configure Alarms



Alarm 1 Failsafe
Select **Yes** to enable failsafe action, otherwise select **No**.
See also Figs. 5.2 to 5.6.

Alarm 1 Action
Select the alarm action required, **High** or **Low**.
See also Figs. 5.2 to 5.6.

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

pH	–	–2.00 to 16.00 pH
mV	–	–2000 to 2000 mV
Deg. C	–	–10.0 to 150.0
Deg. F	–	–14.0 to 302.0

Set to the required value.

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 Figs. 5.2 to 5.6.

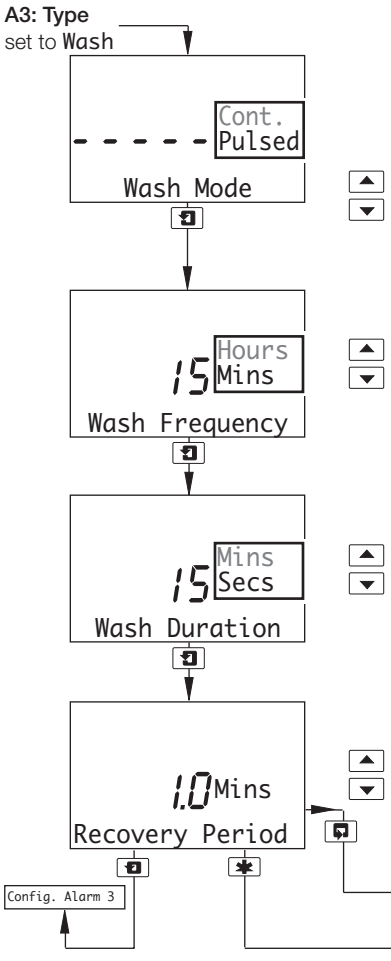
Alarm 1 Delay
When an alarm condition occurs, the activation of the relays and LEDs can be delayed for a specified time period. If the alarm clears within the period, the alarm is not activated. Set the required delay, in the range 0 to 60 seconds in 1 second increments.
See also Figs. 5.2 to 5.6.

Config. Alarm 2 Configure Alarm 2.

CONFIG. OUTPUTS See Section 5.5.

…5.4 Configure Alarms

5.4.1 Wash Cycle Configuration (applicable only to Alarm 3)



Wash Mode
The wash can be configured as continuous or pulsed. If **Cont.** is selected, the relay remains energized for the wash duration. If **Pulsed** is selected, the relay is switched on and off every second for the duration of the wash – see Fig. 5.1.

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

Recovery Period
The recovery period is set in 0.5 minute intervals between 0.5 and 5.0 minutes.

Config. Alarm 4 Configure Alarm 4.

CONFIG. OUTPUTS See Section 5.5.

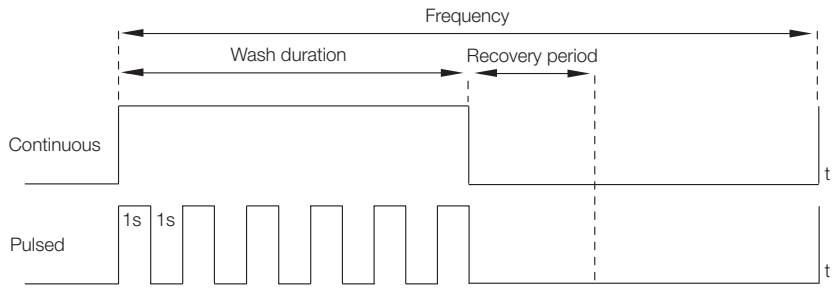


Fig. 5.1 Pulsed and Continuous Wash Cycles

...5.4 Configure Alarms

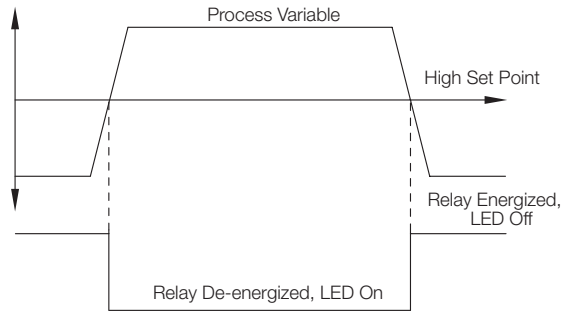


Fig. 5.2 High Failsafe Alarm without Hysteresis and Delay

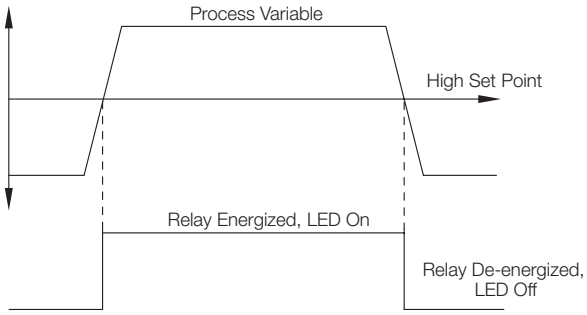


Fig. 5.5 High Non–Failsafe Alarm without Delay and Hysteresis

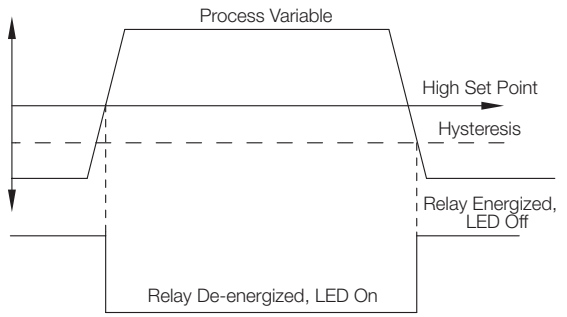


Fig. 5.3 High Failsafe Alarm with Hysteresis but no Delay

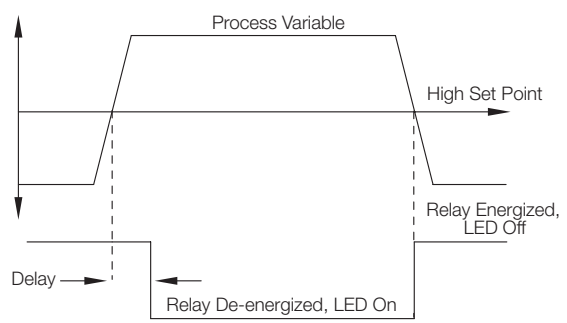


Fig. 5.6 High Failsafe Alarm with Delay but no Hysteresis

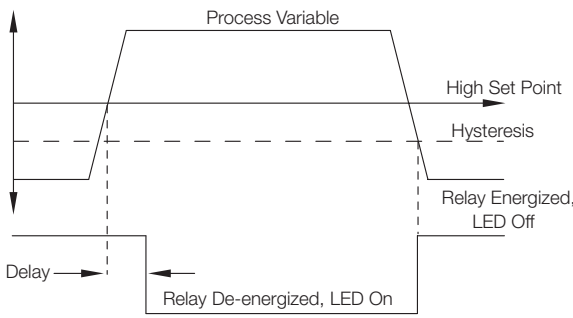
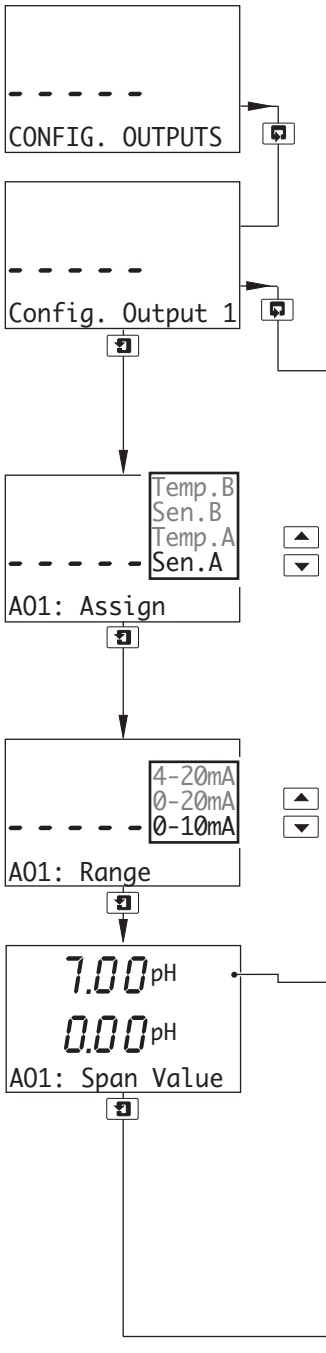


Fig. 5.4 High Failsafe Alarm with Hysteresis and Delay

5.5 Configure Outputs



Configure Output 1

Config. Output 2 — Output 2 configuration (and Outputs 3 and 4 if optional analog output board is fitted) 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.

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

Range

Select the analog output current range for the selected output.

Span Value

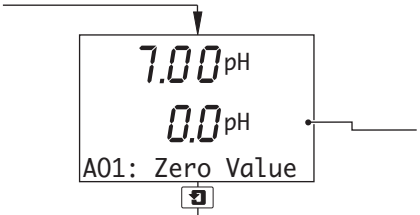
ph (or **mV** or **Deg.C** or **Deg.F**) and **Adjust** are shown alternately on the upper display line. Use the ▲ and ▼ keys to adjust the displayed reading to the required span value.

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 a Span Value of 0.00 pH, first set the Zero Value to –2.00pH.

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

A01: Zero Value — Continued on next page.

...5.5 Configure Outputs

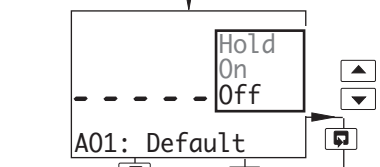


Zero Value

ph (or **mV** or **Deg.C** or **Deg.F**) 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 –1100mV, first set the zero value to –1200mV.

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



Default Output

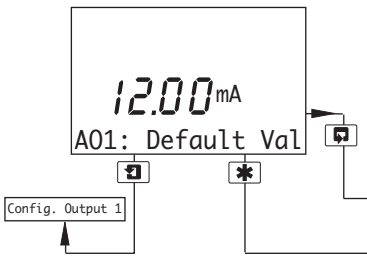
Select the system reaction to failure:

- `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.

`Config. Output 2` Output 2 configuration.

`CONFIG. CLOCK` Optional analog output board fitted – see Section 5.6.
`CONFIG. SECURITY` Optional analog output board not fitted – see Section 5.7.

`Config. Output 2` **Default Output** set to **Hold** or **Off**.
`A01: Default Val` **Default Output** set to **On** – continued below.



Default Value

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

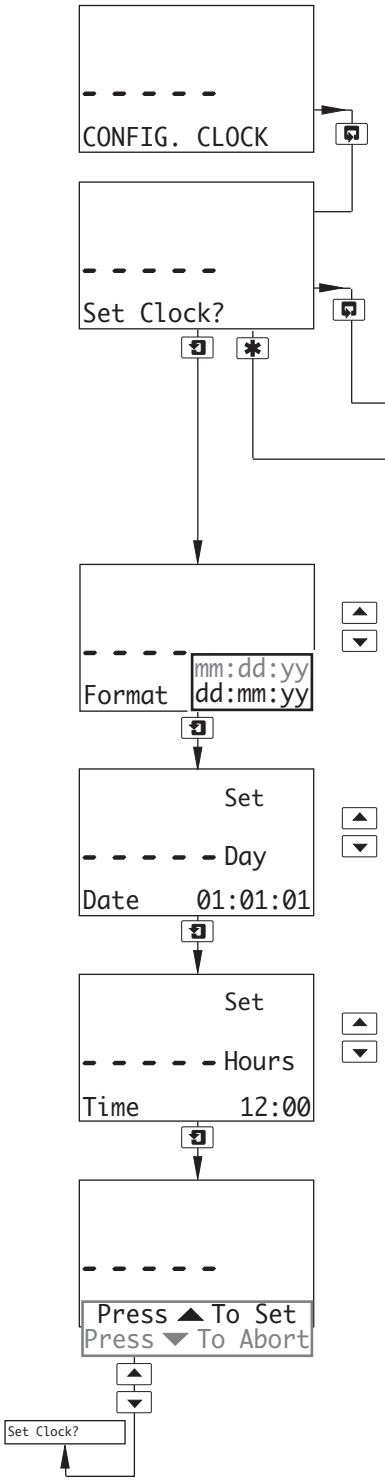
Set the value between 0.00 and 22.00mA

`Config. Output 2` Output 2 configuration.

`CONFIG. CLOCK` Optional analog output board fitted – see Section 5.6.
`CONFIG. SECURITY` Optional analog output board not fitted – see Section 5.7.

5.6 Configure Clock

Note. The **Config. Clock** function is available only if the optional analog output board is fitted.



Set Clock
Set the system clock.

CONFIG. CLOCK — Return to main menu.

CONFIG. COMMS — Modbus option board fitted – see Supplementary Manual *IM/AX400–MOD*.
CONFIG. SECURITY — Modbus option board not fitted – see Section 5.7.

Format
Select the required clock format.

Date
Set the date in the form dd:mm:yy.

Press ◙ to move between the day, month and year fields.
Use the ▲ and ▼ keys to adjust each field.

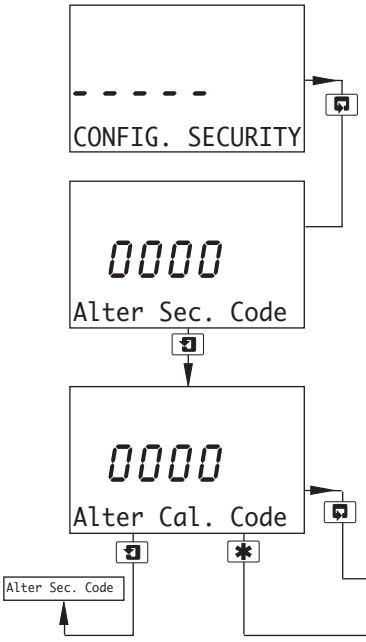
Time
Set the time in the form hh:mm.

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.

5.7 Configure Security



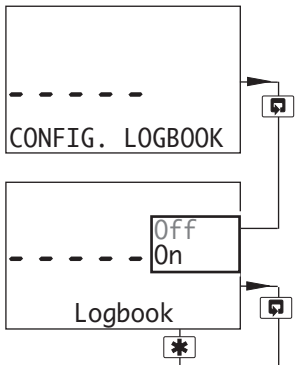
Alter Security Code
Set the security code to a value between 0000 and 19999.

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

CONFIG. SECURITY Return to main menu.

CONFIG. LOGBOOK See Section 5.8.

5.8 Configure Logbook

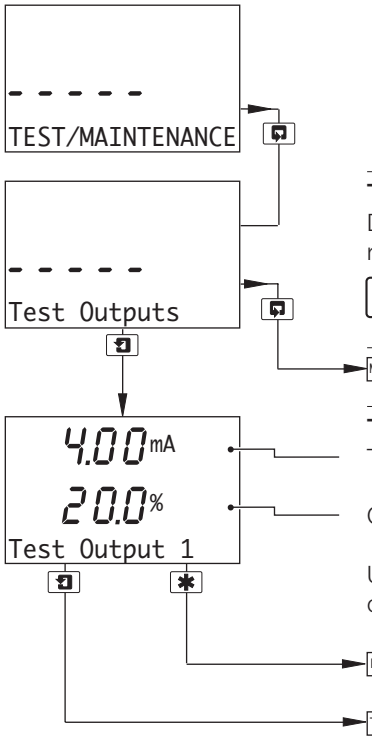


Configure Logbook
Use the ▲ and ▼ keys to to set the logbook **On** or **Off**.
If **Off** is selected, all data entries in the logbook are cleared.

CONFIG. LOGBOOK Return to main menu.

TEST/MAINTENANCE See Section 5.9.

5.9 Test Outputs and Maintenance



Test Outputs
Displays the output test details for the four channels. Test Output 1 only is shown; the remaining outputs are identical.

Note. Outputs 3 and 4 are available only if the optional analog output board is fitted.

Maintenance — See below.

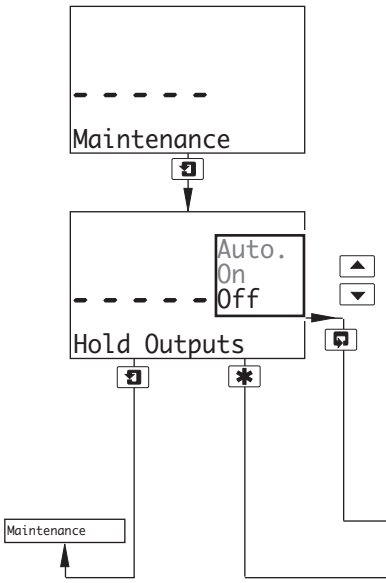
Test Output 1
The theoretical output current value.

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.

FACTORY SETTINGS — See Section 7.3.

Test Output 2 — Test remaining outputs.



Maintenance

Hold Outputs
Enables the relay action and analog outputs to be maintained.

- `Auto.` – Hold is released automatically after six hours.
- `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.

TEST/MAINTENANCE — Return to main menu.

CONFIG. SENSORS — See Section 7.3.

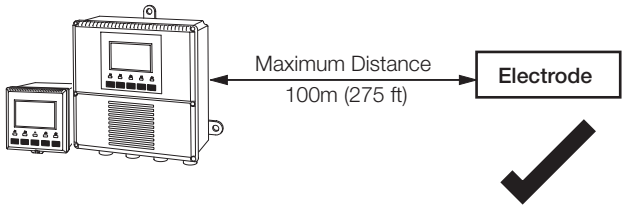
6 INSTALLATION

6.1 Siting Requirements

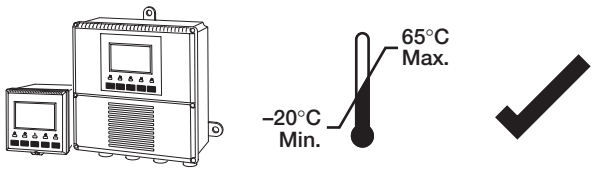
Caution.

- Mount in a location free from excessive vibration.
- Mount away from harmful vapours and/or dripping fluids.

Information. It is preferable to mount the analyzer at eye level, allowing an unrestricted view of the front panel displays and controls.



A – Maximum Distance Between Analyzer and Electrode



B – Within Temperature Limits

C – Within Environmental Limits

Fig. 6.1 Siting Requirements

6.2 Mounting

6.2.1 Wall-/Pipe-mount Analyzers – Figs. 6.2 and 6.3

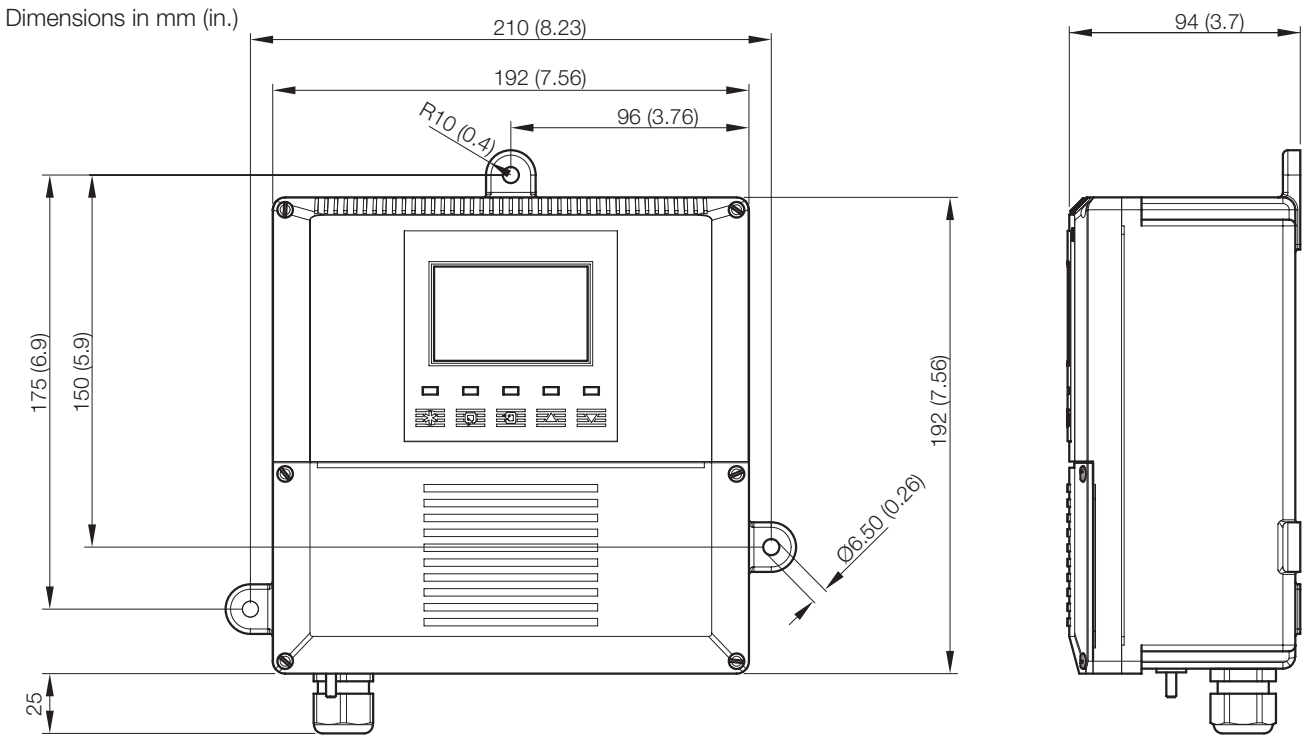
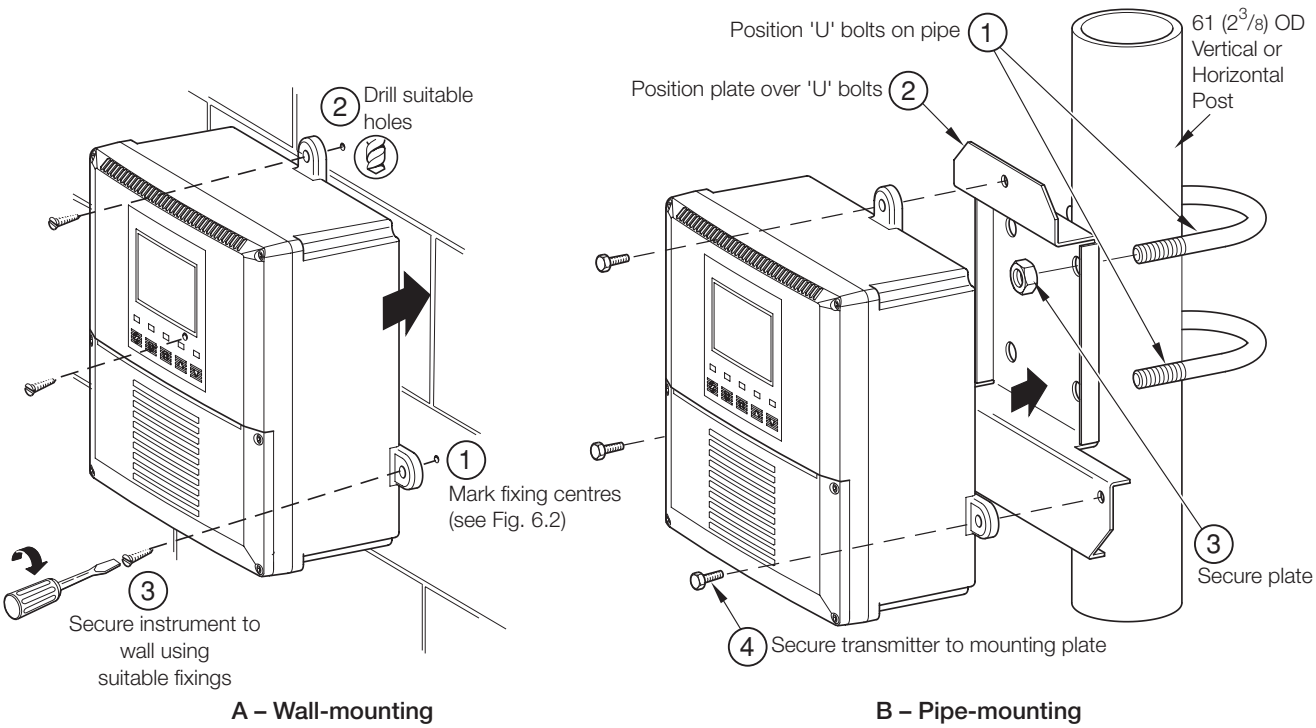


Fig. 6.2 Overall Dimensions



A – Wall-mounting

B – Pipe-mounting

Fig. 6.3 Wall-/Pipe-mounting

…6.2 Mounting

6.2.2 Panel-mount Analyzers – Figs. 6.4 and 6.5

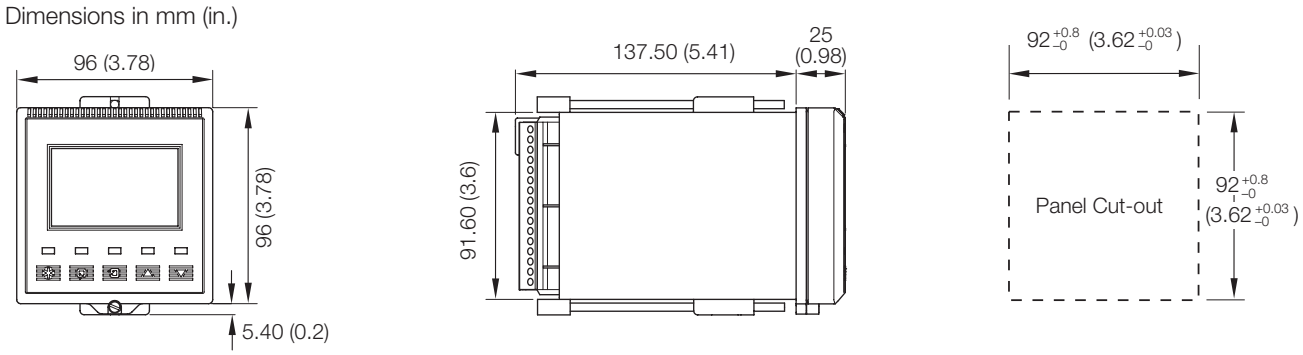


Fig. 6.4 Overall Dimensions

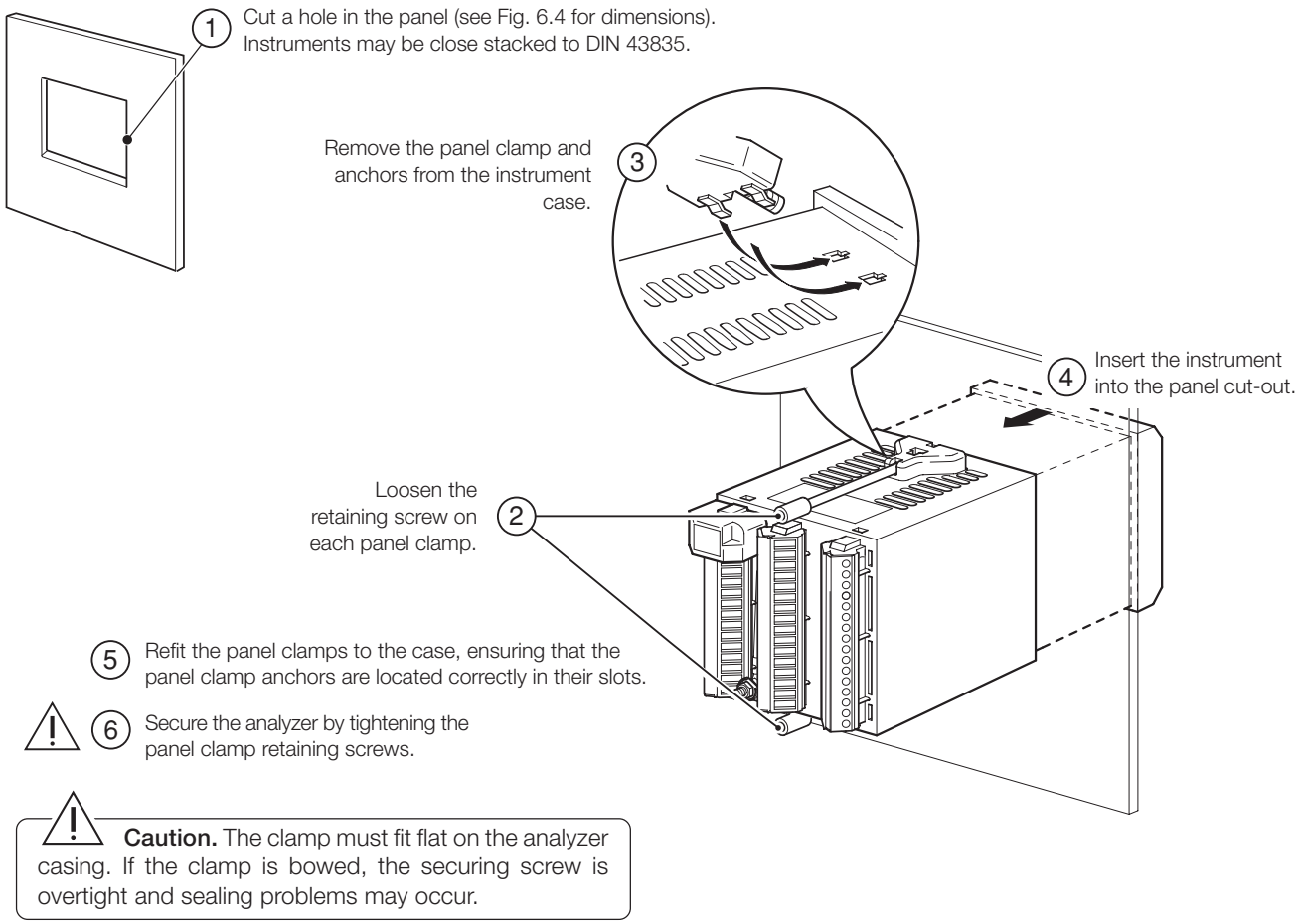


Fig. 6.5 Panel-mounting

6.3 Connections, General

Warning. The power supply earth (ground) **must** be connected to ensure safety to personnel, reduction of the effects of RFI interference and correct operation of the power supply interference filter.

Information.

- **Earthing (grounding)** – a case earth (ground) stud 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).
- **Cable routing** – always route signal output/pH electrode cable leads and mains-carrying/relay cables separately, ideally in earthed 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.
- **Cable glands & conduit fittings** – ensure that the NEMA4X/IP66 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.
- **Relays** – 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.
- **Analog output** – Do not exceed the maximum load specification for the selected analog output range.

  Since the analog output is isolated, the –ve terminal **must** be connected to earth (ground) if connecting to the isolated input of another device.

…6.3 Connections, General

6.3.1 Relay Contact Protection and Interference Suppression – Fig. 6.6

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 a.c. applications or diodes for d.c. applications. These components can be connected either across the load or directly across the relay contacts. The RFI components must be fitted to the relay terminal block along with the supply and load wires – 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/0.022µF 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 (600V peak inverse voltage at 3A – part no. B7363).

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

A – AC Applications

B – DC Applications

Fig. 6.6 Relay Contact Protection

…6.3 Connections, General

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

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

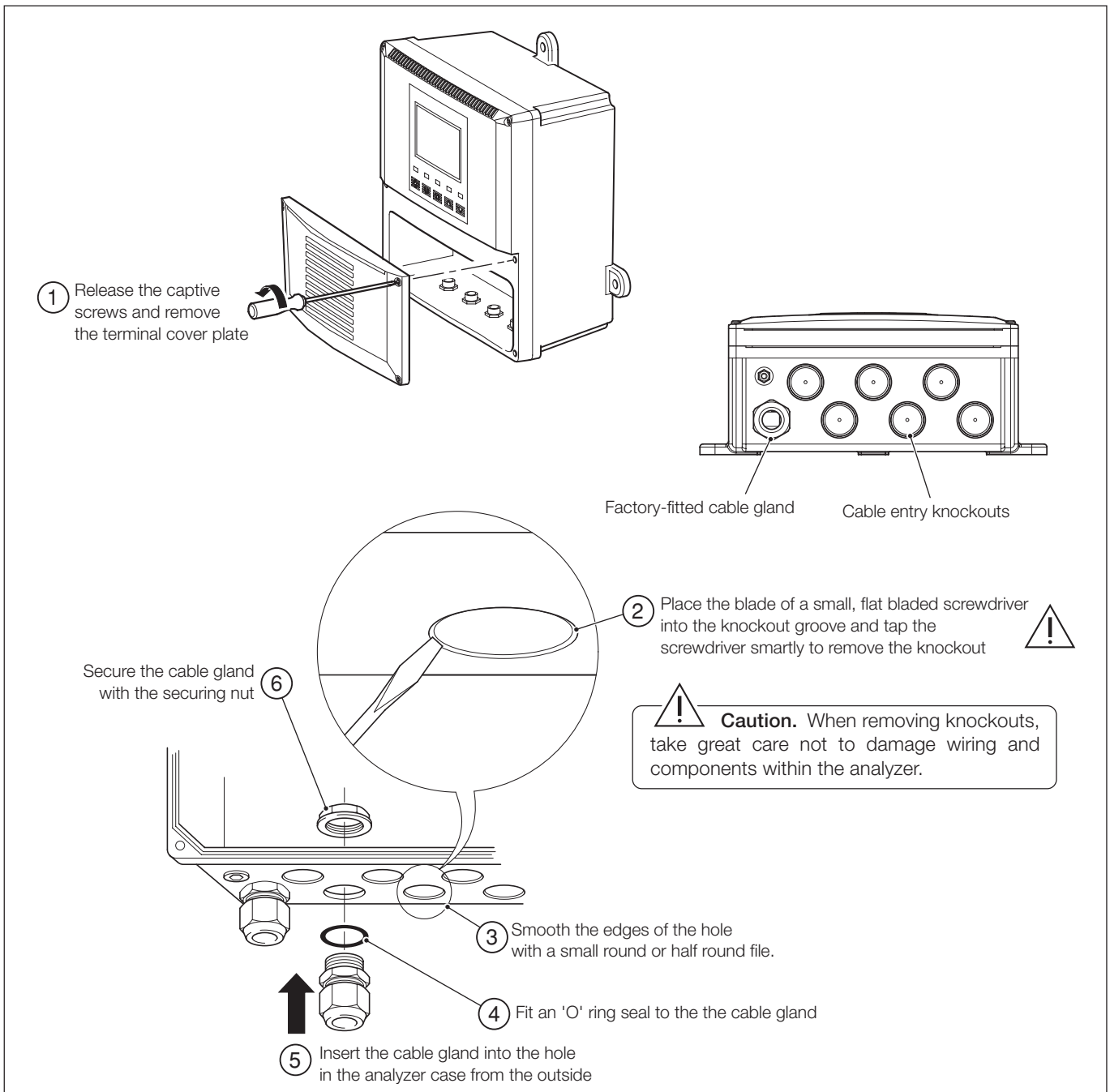


Fig. 6.7 Cable Entry Knockouts, Wall-/Pipe-mount Analyzer

Warning. Before making any connections, ensure that the power supply, any high voltage-operated control circuits and high common mode voltages are switched off.

6.4 Wall-/Pipe-mount Analyzer Connections

6.4.1 Access to Terminals – Fig. 6.8

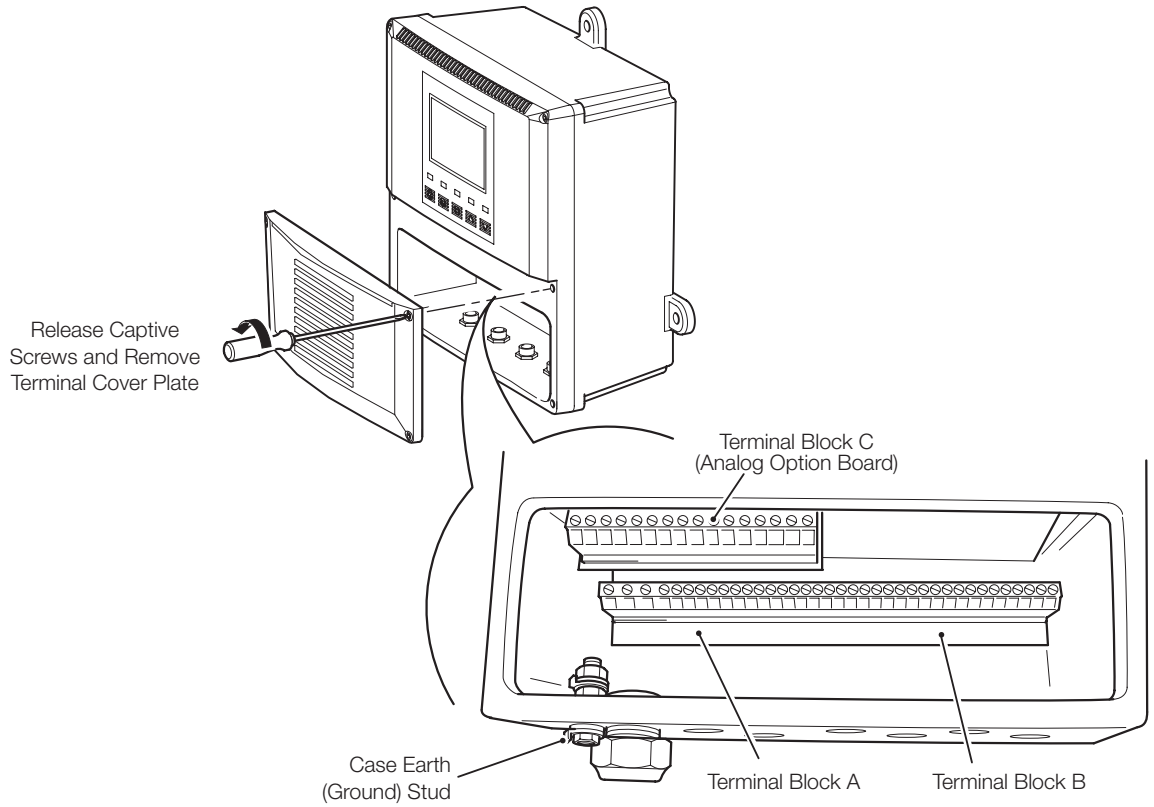
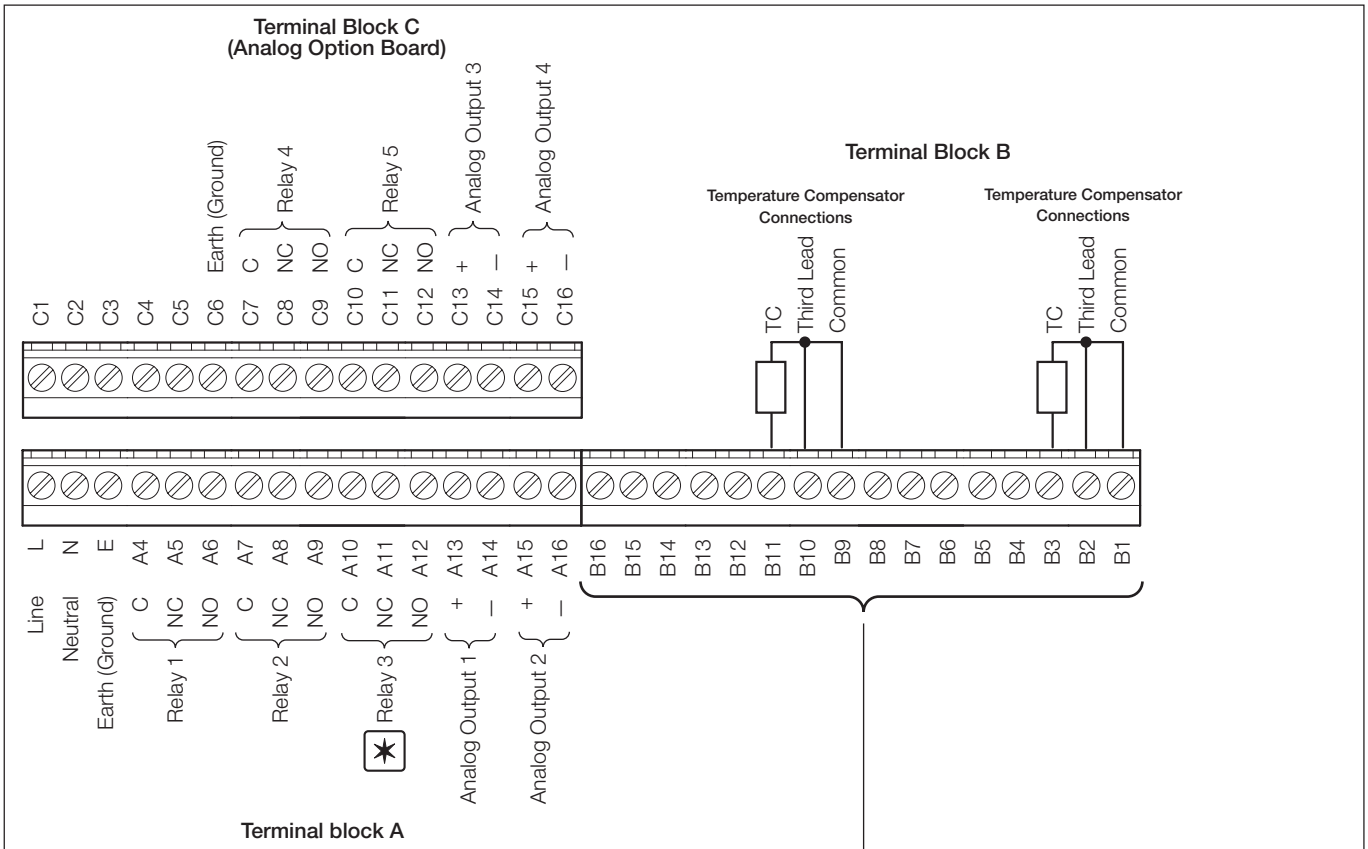


Fig. 6.8 Access to Terminals, Wall-/Pipe-mount Analyzer

…6.4 Wall-/Pipe-mount Analyzer Connections

6.4.2 Connections – Fig. 6.9



Terminal Block B		pH/Redox (ORP) without solution earth (standard input)	pH/Redox (ORP) with solution earth (differential input)
Sensor B	Sensor A		
1	9	TC Common*, Link 1 & 2/9 & 10**	TC Common*, Link 1 & 2/9 & 10**
2	10	TC Third Lead*	TC Third Lead*
3	11	TC	TC
4	12	N/A	Reference Electrode
5	13	Not Used	Not Used
6	14	Reference Electrode	Solution Earth***
7	15	Screen*	Screen*
8	16	Glass/Metal Electrode	Glass/Metal Electrode

* If fitted
** When a 2-wire Pt100, Pt1000 or 'Balco 3K' temperature compensator is fitted.
*** Solution Earth also referred to as Ground Rod.
TC = Temperature Compensator.

✶ **Note.** Relay 3 can be configured to control the wash facility – see Section 5.4.

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

Warning. Before making any connections, ensure that the power supply, any high voltage-operated control circuits and high common mode voltages are switched off.

6.5 Panel-mount Analyzer Connections

6.5.1 Access to Terminals – Fig. 6.10

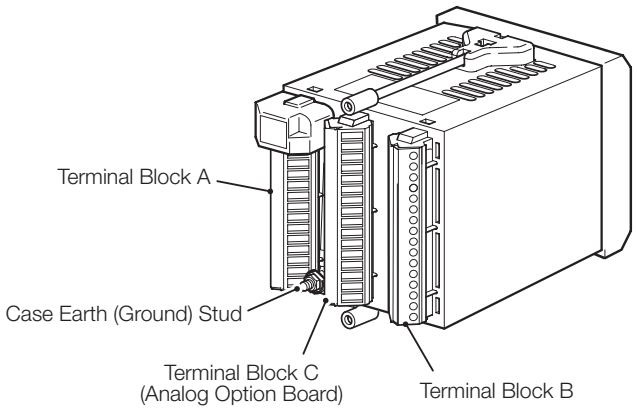
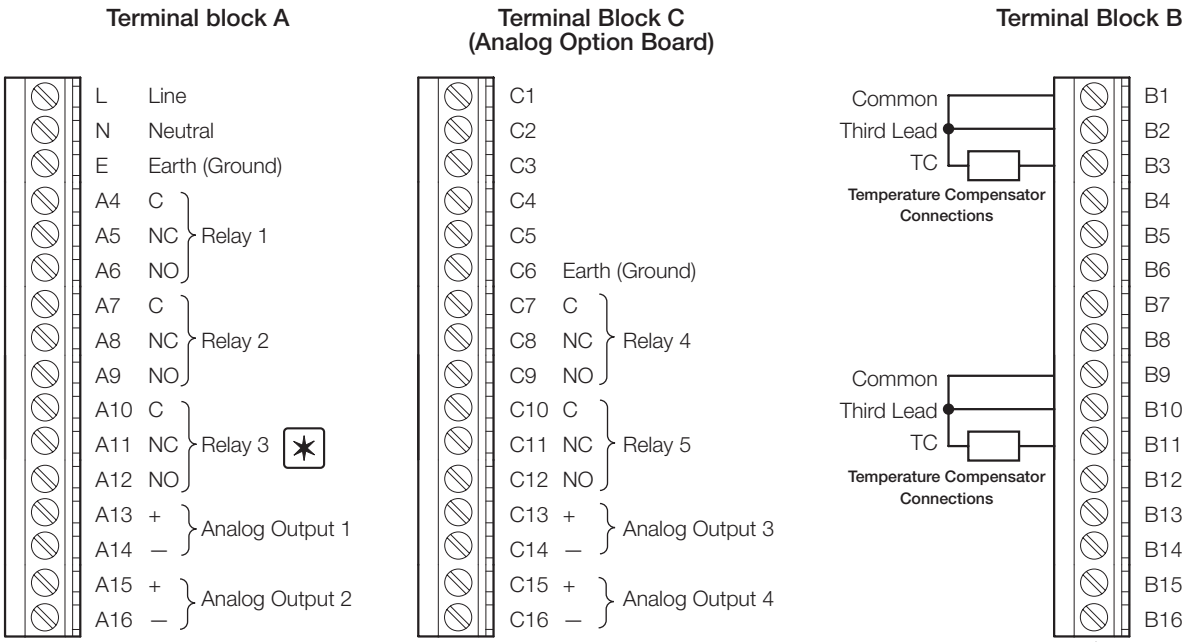


Fig. 6.10 Access to Terminals, Panel-mount Analyzers

…6.5 Panel-mount Analyzer Connections

6.5.2 Connections – Fig. 6.11



Terminal Block B		pH/Redox (ORP) without solution earth (standard input)	pH/Redox (ORP) with solution earth (differential input)
Sensor B*	Sensor A		
1	9	TC Common*, Link 1 & 2/9 & 10**	TC Common*, Link 1 & 2/9 & 10**
2	10	TC Third Lead*	TC Third Lead*
3	11	TC	TC
4	12	N/A	Reference Electrode
5	13	Not Used	Not Used
6	14	Reference Electrode	Solution Earth***
7	15	Screen*	Screen*
8	16	Glass/Metal Electrode	Glass/Metal Electrode

* If fitted
** When a 2-wire Pt100, Pt1000 or 'Balco 3K' temperature compensator is fitted.
*** Solution Earth also referred to as Ground Rod.
TC = Temperature Compensator.

✶ **Note.** Relay 3 can be configured to control the wash facility – see Section 5.4.

Fig. 6.11 Connections, Panel-mount Analyzers

7 CALIBRATION

Notes.

- The analyzer is calibrated by the Company prior to dispatch and 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. It is not advisable to attempt recalibration unless the input board has been replaced or the calibration tampered with.
- Prior to attempting recalibration, test the analyzer's accuracy using suitably calibrated test equipment – see Sections 7.2 and 7.3.

7.1 Equipment Required

a) Millivolt source (pH or Redox input simulator): –1000 to 1000 mV.

b) Decade resistance box (Pt100/Pt1000 temperature input simulator): 0 to 1kΩ (in increments of 0.01Ω), accuracy ±0.1%.

c) Digital milliammeter (current output measurement): 0 to 20mA.

Note. Resistance boxes have an inherent residual resistance which may range from a few mΩ up to 1Ω. 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

a) Switch off the supply and disconnect the electrode system, temperature compensator(s) and current output(s) from the analyzer's terminal blocks.

b) Sensor A:
   1) Link terminals B9 and B10.
   2) Connect the millivolt source to terminals B16 (+ve) and B14 (–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).
   4) Connect the 0 to 10kΩ decade resistance box to terminals B11 and B9 to simulate the Pt100/Pt1000/Balco 3K.

   Sensor B:
   1) Link terminals B1 and B2.
   2) Connect the millivolt source to terminals B8 (+ve) and B6 (–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).
   4) Connect the 0 to 10kΩ decade resistance box to terminals B3 and B1 to simulate the Pt100/Pt1000/Balco 3K.

c) Connect the milliammeter to the analog output terminals.

d) Switch on the supply and allow ten minutes for the circuits to stabilize.

d) Select the **FACTORY SETTINGS** page and carry out Section 7.3.

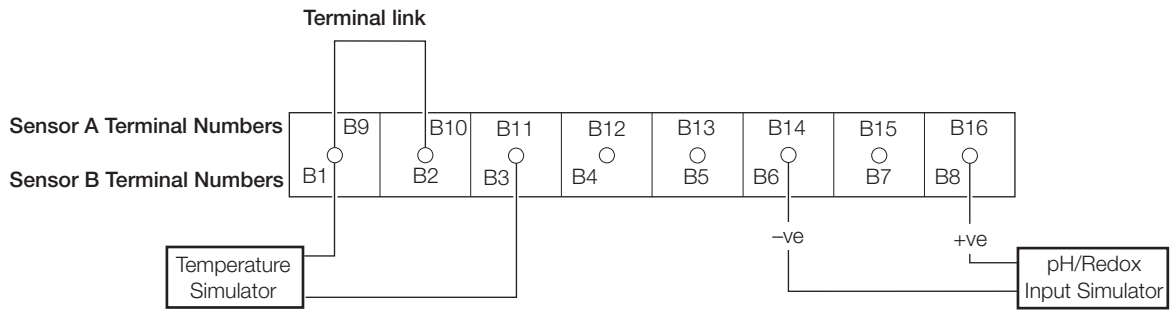


Fig. 7.1 Analyzer Terminal Links and Decade Resistance Box Connections

7.3 Factory Settings

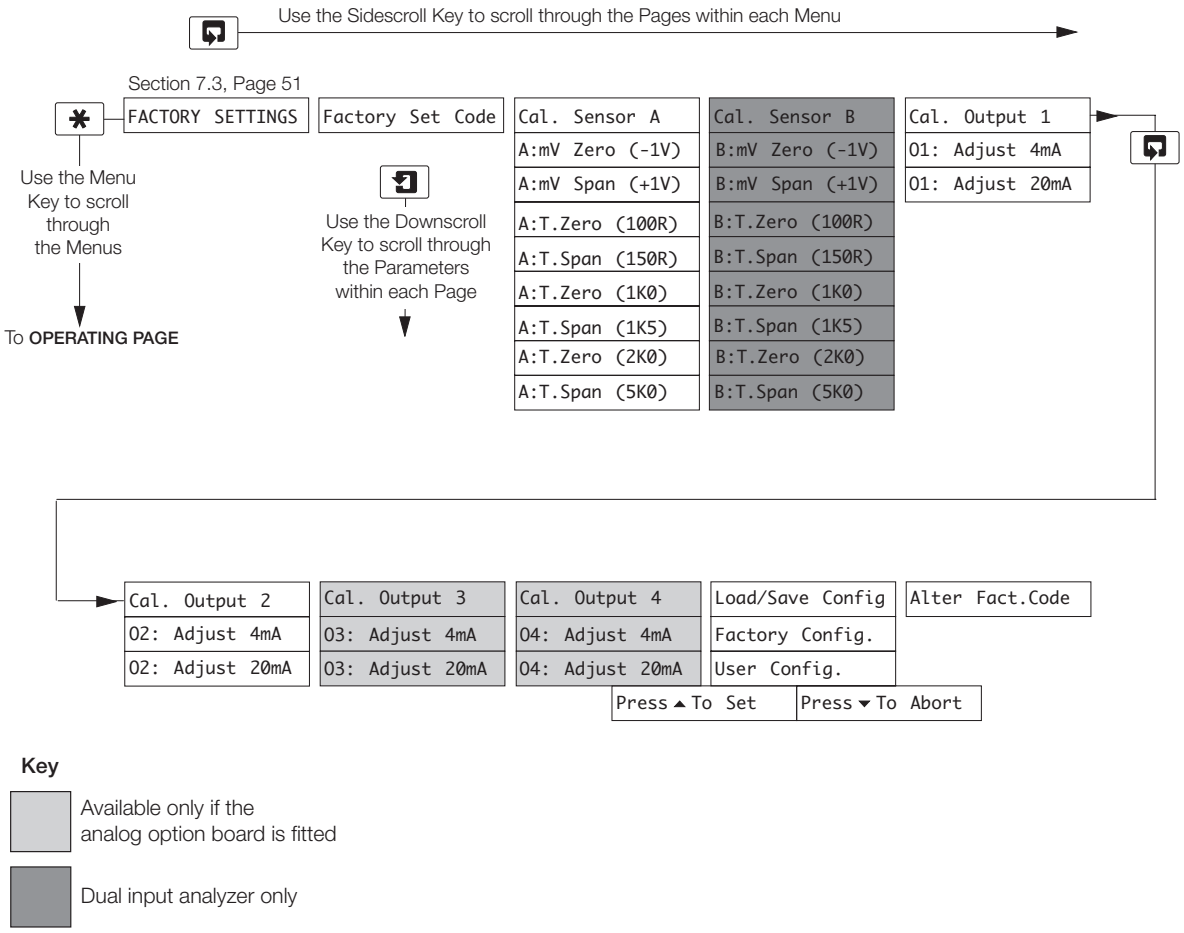
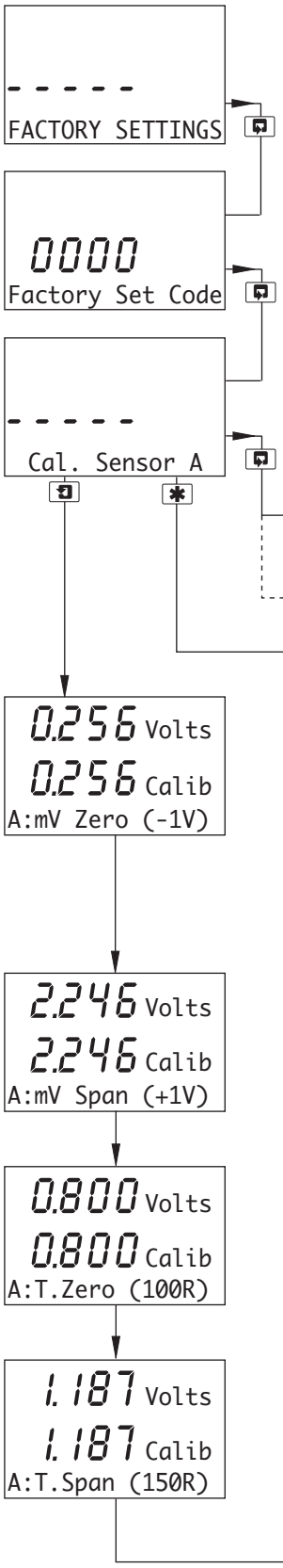


Fig. 7.2 Overall Factory Settings Chart

...7.3 Factory Settings



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 parameters is prevented and the display reverts to the top of the **Factory Settings 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.

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

Cal. Output 1 — See page 53.

Monitoring pH — Return to **Operating Page** – see Section 2.3.

Millivolt Zero
Set the millivolt source to –1000mV.

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 +1000mV

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

Temperature Zero (100R)
Set the temperature simulator to 100Ω

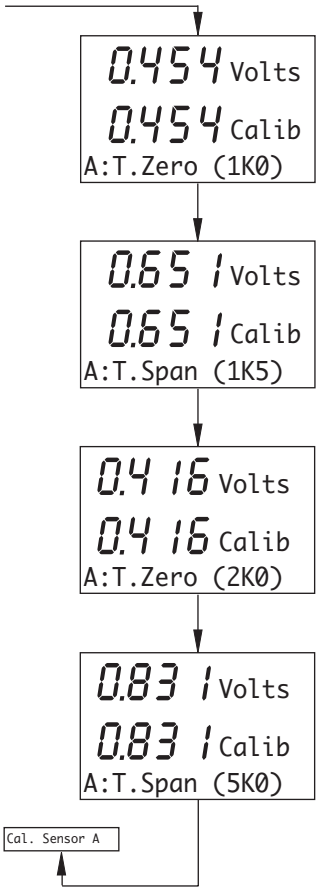
The display advances automatically to the next step once a stable and valid value is recorded.

Temperature Span (150R)
Set the temperature simulator to 150Ω

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

A: T.Zero (1K0) — Continued on next page.

...7.3 Factory Settings



Temperature Zero (1k0)
Set the temperature simulator to 1000Ω

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

Temperature Span (1k5)
Set the temperature simulator to 1500Ω

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

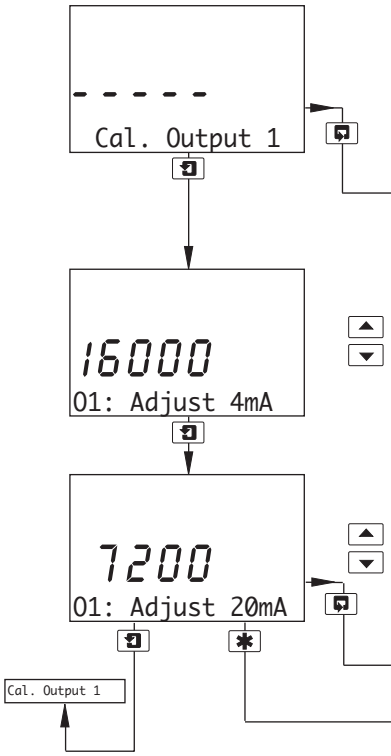
Temperature Zero (2k0)
Set the temperature simulator to 2000Ω

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

Temperature Span (5k0)
Set the temperature simulator to 5000Ω

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

...7.3 Factory Settings



Calibrate Output 1

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

Cal. Output 2 See below.

Adjust 4mA

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

Note. The analog output range selected in **Configure Outputs** (see Section 5.5) does not affect the reading.

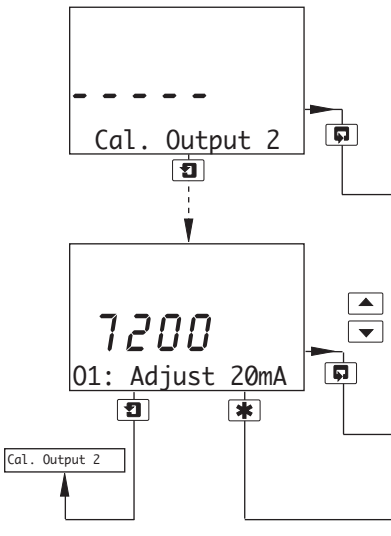
Adjust 20mA

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

Note. The analog output range selected in **Configure Outputs** (see Section 5.5) does not affect the reading.

Cal. Output 2 See below.

Monitoring pH **Operating Page** – see Section 2.3.



Calibrate Output 2

Note. Output 2 calibration (and Outputs 3 and 4 if optional analog output board is fitted) is identical to Output 1 calibration.

Cal. Output 3 Optional analog output board fitted.

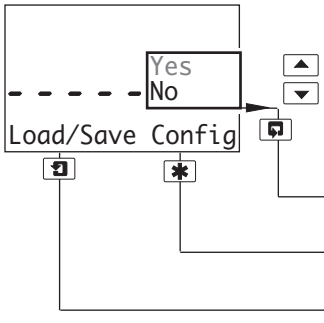
Load/Save Config Optional analog output board not fitted – continued on next page.

Cal. Output 3 Optional analog output board fitted.

Load/Save Config Optional analog output board not fitted – continued on next page.

Monitoring pH **Operating Page** – see Section 2.3.

…7.3 Factory Settings



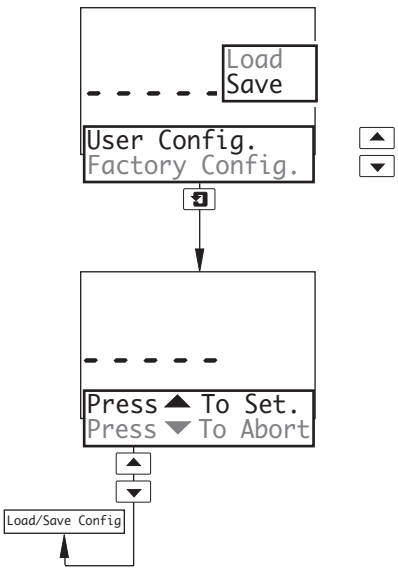
Load/Save Configuration
Select whether a configuration is to be loaded or saved.

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

Alter Fact. Code — See below.

Monitoring pH — **Operating Page** – see Section 2.3.

User Config. — **Yes** selected – continued below.



Load User/Factory Configuration

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

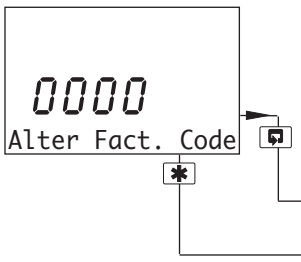
`Factory Config.` – resets all the parameters in the **Configuration Pages** to the Company Standard.
`Save User Config.` – saves the current configuration into memory.
`Load User Config.` – reads a saved user configuration into memory.

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.

Note. **User Config.** is displayed only if a User Configuration has been saved previously.

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

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



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

FACTORY SETTINGS — Return to main menu.

Monitoring pH — **Operating Page** – see Section 2.3.

8 SIMPLE FAULT FINDING

8.1 Error Messages

If erroneous or unexpected results are obtained the fault may be indicated 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** in the **Operating Page**. Set **Wash Function** to **On** – see Section 2.3.3.

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.

If the above checks do not resolve the fault:

a) 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 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.

b) 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.

c) Reconnect the electrode cable and connect the simulator to the electrode end of the cable. Repeat the procedures a) and b) above. If the analyzer fails test b), 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 (wall-/pipe-mount analyzer) or Section 6.5 (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 7.3.

Temperature		Input Resistance (Ω)		
°C	°F	Pt100	Pt1000	Balco 3K
0	32	100.00	1000.00	2663.00
10	50	103.90	1039.00	2798.00
20	68	107.79	1077.90	2933.00
25	77	109.73	1097.30	3000.00
30	86	111.67	1116.70	3068.00
40	104	115.54	1155.40	3203.00
50	122	119.40	1194.00	3338.00
60	140	123.24	1232.40	3473.00
70	158	127.07	1270.70	3608.00
80	176	130.89	1308.90	3743.00
90	194	134.70	1347.00	3878.00
100	212	138.50	1385.00	4013.00
130.5	266.9	150.00	1500.00	4582.50

Table 8.2 Temperature Readings for Resistance Inputs

APPENDIX A

A1 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°C, the internationally accepted standard.

The following tables include the pH values for US Tech, NIST, DIN, Merck, and ABB buffer solutions. Standards are for 4, 7 and 9pH values, from 0 to 100°C.

Temp		ABB Buffers		
°C	°F	4.01pH	7pH	9.18pH
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 A1 ABB Buffer Solutions

Temp		DIN 19266			
°C	°F	1.68pH	4.01pH	6.86pH	9.18pH
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 A2 DIN Buffer Solutions

…A1 Buffer Solutions

Temp		Merck			
°C	°F	4pH	7pH	9pH	10pH
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**	**9.94**
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 A3 MERCK Buffer Solutions

Temp		NIST		
°C	°F	4.01pH	6.86pH	9.18pH
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 A4 NIST Buffer Solutions

…A1 Buffer Solutions

Temp		Technical Buffers (US)		
°C	°F	4.01pH	7pH	10.01pH
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 A5 US Tech Buffer Solutions

SPECIFICATION

pH/Redox (ORP)

Inputs

1 or 2* pH or mV inputs (*AX466 only) and solution earth

1 or 2* temperature sensors (*AX466 only)

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

Input resistance

Glass >1 x $10^{13}\Omega$

Reference 1 x $10^{13}\Omega$

Range

–2 to 16pH or –1200 to +1200mV

Minimum span

Any 2pH span or 100mV

Resolution

0.01pH

Accuracy

0.01pH

Temperature compensation modes

Automatic or manual Nernstian compensation

Range –10 to 150°C (14 to 302°F)

Process solution compensation with configurable coefficient

Range 0 to 100°C (32 to 212°F)

Temperature sensor

Programmable Pt100, Pt1000 & Balco 3KΩ

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 60s

Logbook (with option board)

Electronic record of major process events and calibration data

Real-time clock (with option board)

Records time for logbook and auto-cleaning functions

Control Function – AX460 Only

Controller Type

P, PI, PID (Configurable)

Control Outputs

Analog

Current output control (0 to 100%)

Time proportioning cycle time

5 to 60s, programmable in 1s steps displayed with doP or roP

Pulse frequency

1 to 120 pulses per minute

Controller action

Reverse, direct or bi-directional (programmable)

Proportional band

0.1 to 1000%, programmable in 0.1% increments

Integral action time (Reset)

1 to 7200s in 1s steps, 0 = Off

Derivative

0.1 to 1000s in 0.1s increments

Auto/Manual

User-programmable

Sensor cleaning function

Configurable cleaning action relay contact

Continuous

Pulse in 1s on and off times

Frequency

5 minutes to 24 hours, fully configurable

Duration

15s to 10 minutes, fully configurable

Recovery period

30s to 5 minutes, fully 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
manual entry or 2-point calibration
one-point process calibration

Calibration Ranges

Zero point

0 to 14pH

Slope

Between 40 and 105% (low limit user configurable)

Outputs and Set Points

Number of set points

3 if relay control, 5 with option card

Number of relays

4 standard, 2 standard and 2 control

Retransmission outputs

2 (4 optional) fully-isolated standard

Environmental Data

Operating temperature limits

–20 to 65°C (–4 to 149°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

Analog Retransmission

Number of signals

Two, fully-isolated outputs supplied as standard

Four, fully-isolated outputs when ordered with option card

Output current

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

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

Accuracy

±0.25% FSD, ±5% of reading

Resolution

0.1% at 10mA 0.05% at 20mA

Maximum load resistance

750Ω at 20mA

Configuration

Can be assigned to either measured variable or either sample temperature

Serial communications

Modbus serial data interface

Relay Outputs – On/Off

Number of relays

Three, supplied as standard

Five, when ordered with option card

Set point adjustment

Fully 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 60s in 1s intervals

Relay contacts

Single-pole changeover

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

Insulation

2kV RMS contacts to earth/ground

Access to Functions

Direct keypad access

Measurement, maintenance, configuration, diagnostics or service functions

Performed without external equipment or internal jumpers

Power supply

Voltage requirements

85 to 265V AC 50/60 Hz

24V AC or 12 to 30V DC (optional)

Power consumption

<10VA

Insulation

Mains to earth (line to ground) 2kV RMS

Safety

General safety

EN61010-1

Overvoltage Class II on inputs and outputs

Pollution category 2

Cable Entry Types

Standard

5 or 7* x M20 cable glands

N. American

7 x knockouts suitable for 1/2 in. Hubble gland

Hazardous area approvals

CENELEC ATEX IIG EEx n IIC T4 Pending

FM non-incendive Class I Div. 2 Groups A to D Pending

CSA non-incendive Class I Div. 2 Groups A to D Pending

Mechanical Data

Panel-mount versions

IP66/NEMA4X

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

Weight 1kg (2.2 lb)

Panel-mount versions

IP66/NEMA4X (front only)

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

Weight 0.6kg (13.2 lb)

Languages

Languages configurable

English

French

German

Italian

Spanish

NOTES

PRODUCTS & CUSTOMER SUPPORT

Products

Automation Systems

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

Drives and Motors

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

Controllers & Recorders

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

Flexible Automation

- *Industrial Robots and Robot Systems*

Flow Measurement

- *Electromagnetic Magnetic Flowmeters*
- *Mass Flow Meters*
- *Turbine Flowmeters*
- *Wedge Flow Elements*

Marine Systems & Turbochargers

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

Process Analytics

- *Process Gas Analysis*
- *Systems Integration*

Transmitters

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

Valves, Actuators and Positioners

- *Control Valves*
- *Actuators*
- *Positioners*

Water, Gas & Industrial Analytics Instrumentation

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

Customer Support

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

United Kingdom

ABB Limited
Tel: +44 (0)1453 826661
Fax: +44 (0)1453 827856

United States of America

ABB Inc.
Tel: +1 (0) 755 883 4366
Fax: +1 (0) 755 883 4373

Client Warranty

Prior to installation, the equipment referred to in this manual must be stored in a clean, dry environment, in accordance with the Company's published specification. Periodic checks must be made on the equipment's condition.

In the event of a failure under warranty, the following documentation must be provided as substantiation:

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

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