Operating Instructions

IM/4600–DO_9

Dissolved Oxygen Analyzers

4600 Series

ABB

The Company

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

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

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

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

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

EN ISO 9001:2000

Cert. No. Q 05907

EN 29001 (ISO 9001)

Lenno, Italy – Cert. No. 9/90A

Stonehouse, U.K.

0255

Electrical Safety

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

Symbols

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

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

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

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

Health and Safety

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

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

The 4640 and 4645 Dissolved Oxygen (D.O.) transmitters and associated sensors have been designed for continuous monitoring and control in a wide range of applications including, aeration in sewage treatment and river/effluent monitoring. The sensor can be standardized to the instrument using the built-in calibration facility.

The 4640/42 model is a wall- or pipe-mounted instrument and the 4645/47 model is a panel-mounted, DIN sized instrument. Both instruments have a single programmable D.O. input channel, and a single temperature input channel. The sample temperature is sensed by a Pt100 resistance thermometer.

Models 4642 and 4647 incorporate a water wash facility for system cleaning. During the water wash cycle, the Alarm 1 status and the retransmission value are held in their pre-cycle condition.

Instrument operation and programming is via four tactile membrane switches located on the front panel. Programmed functions are protected from unauthorized alteration by a five-digit security code.

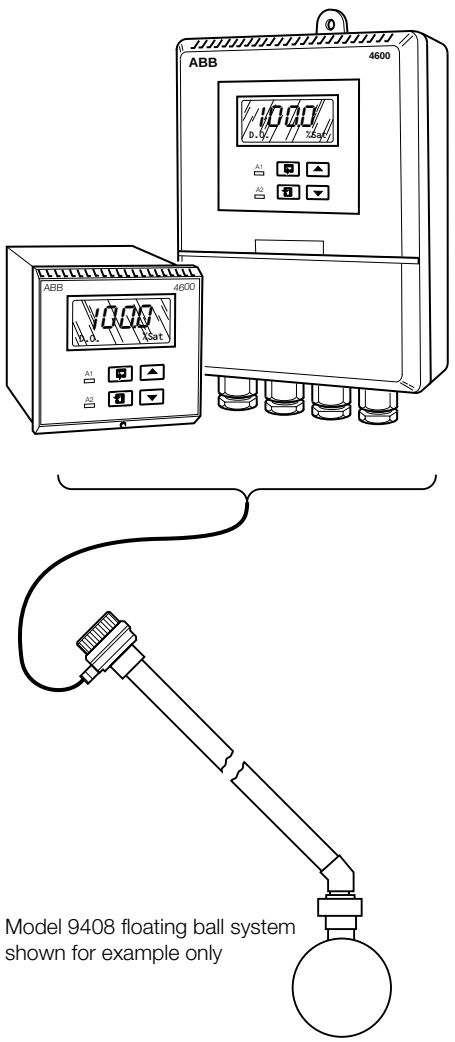


Fig. 1.1 System Schematic

2 PREPARATION

2.1 Checking the Code Number

2.1.1 Wall-/Pipe-mounted Instruments – Fig. 2.1

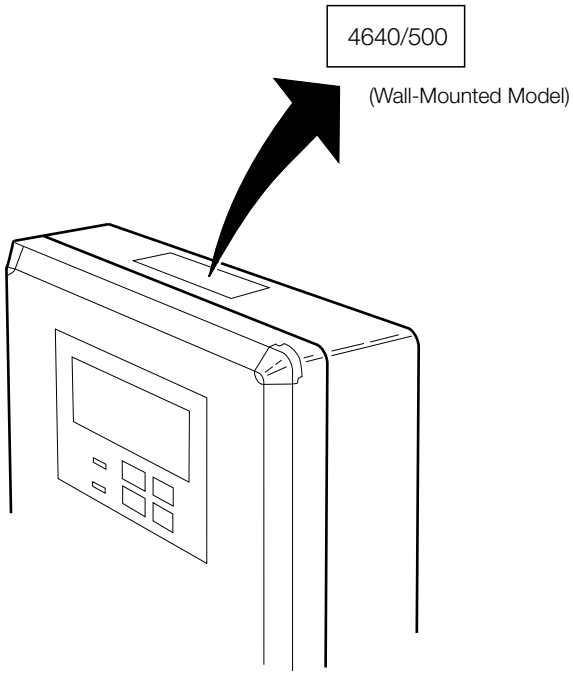


Fig. 2.1 Checking the Code Number (Model 4640)

2.1.2 Panel-mounted Instruments – Fig. 2.2

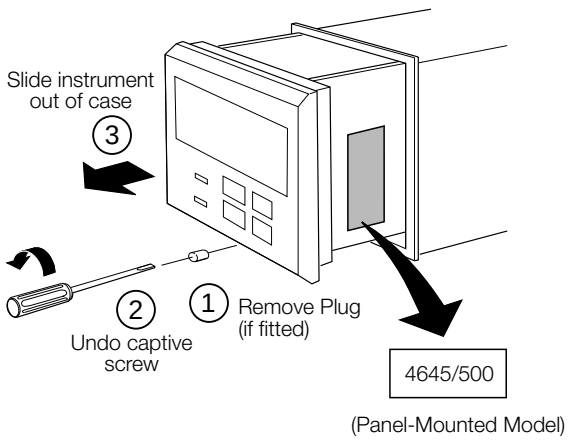


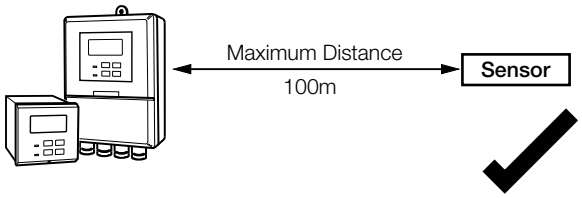
Fig. 2.2 Checking the Code Number (Model 4645)

3 MECHANICAL INSTALLATION

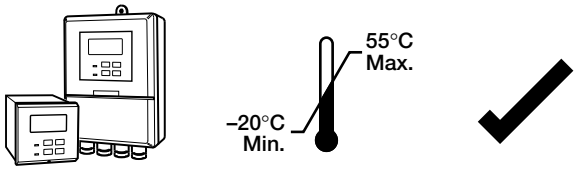
3.1 Siting Requirements

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 instrument at eye level, allowing an unrestricted view of the front panel displays and controls.



A – Maximum Distance of Instrument to Sensor



B – Within Temperature Limits

C – Within Environmental Limits

Fig. 3.1 Siting Requirements

3.2 Mounting

3.2.1 Wall-/Pipe-mounted Instruments – Figs. 3.2 and 3.3

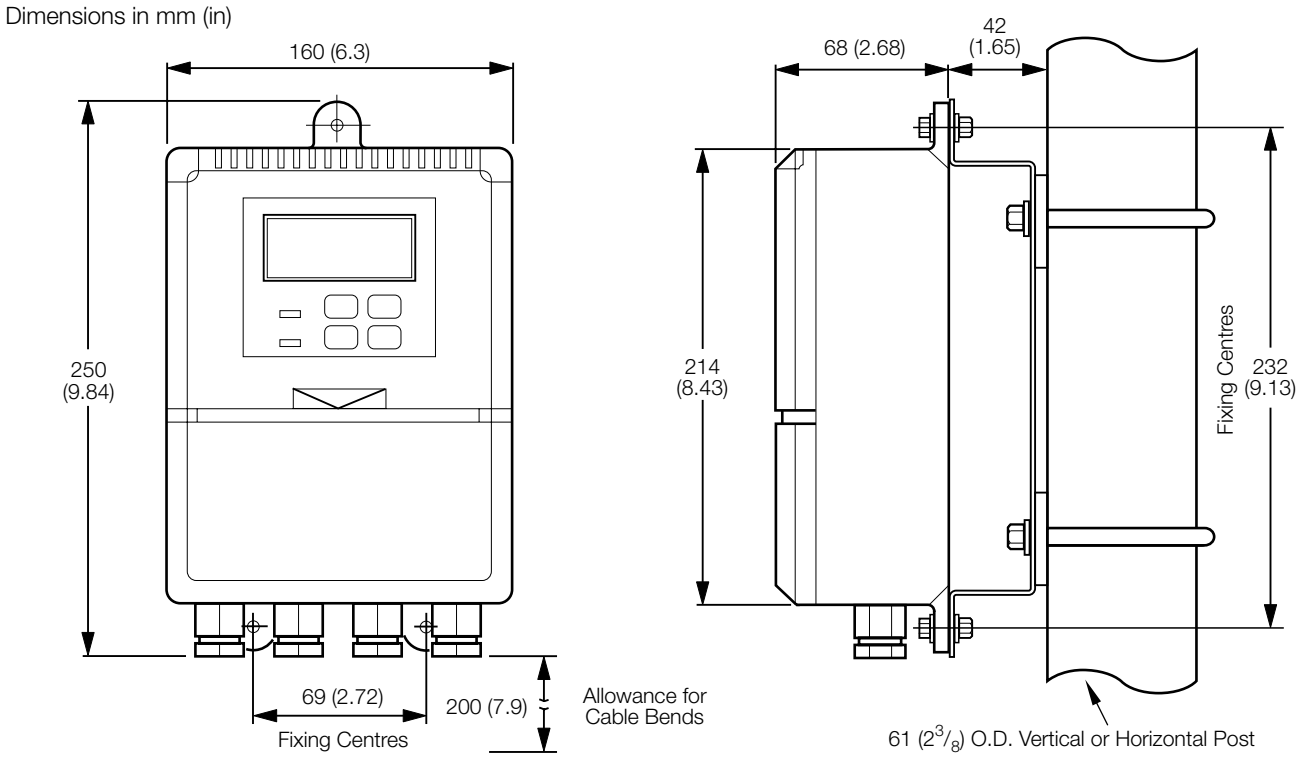
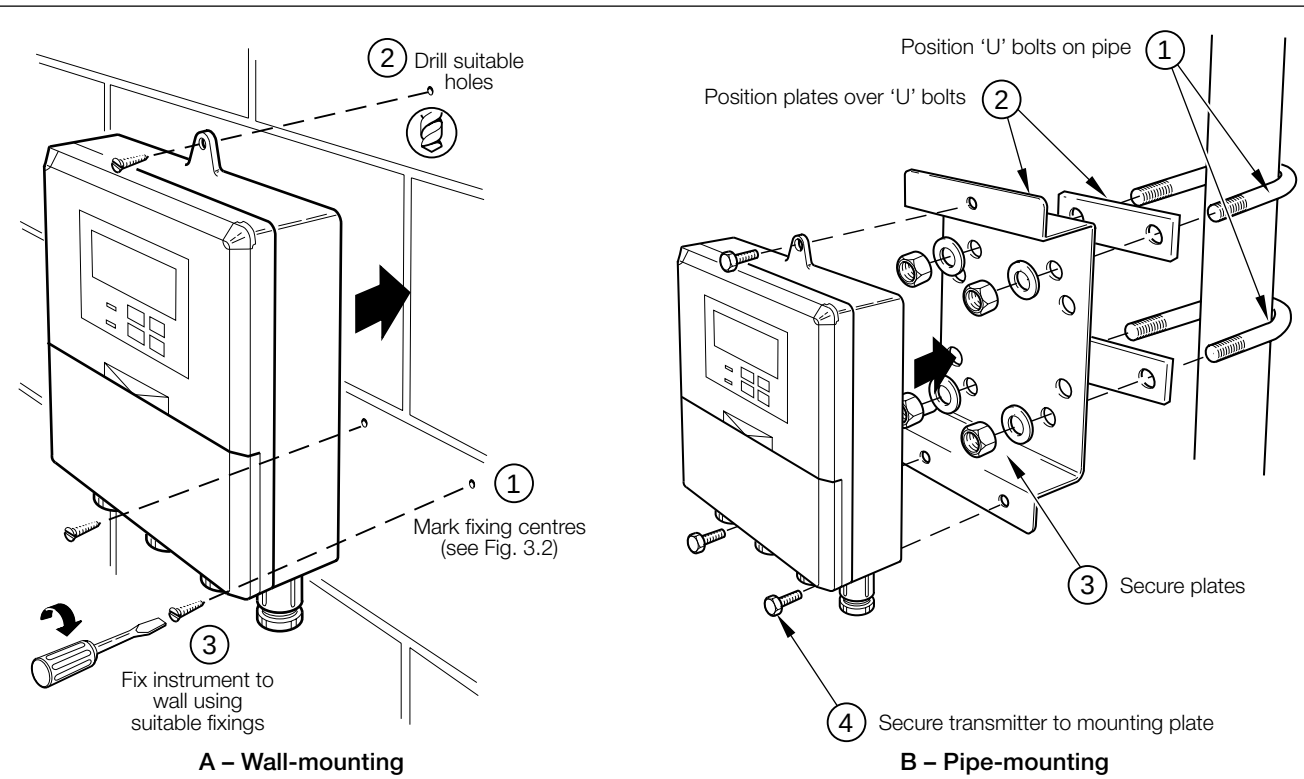


Fig. 3.2 Overall Dimensions



A – Wall-mounting **B – Pipe-mounting**

Fig. 3.3 Wall-/Pipe-mounting

…3.2 Mounting

3.2.2 Panel-mounted Instruments – Figs. 3.4 and 3.5

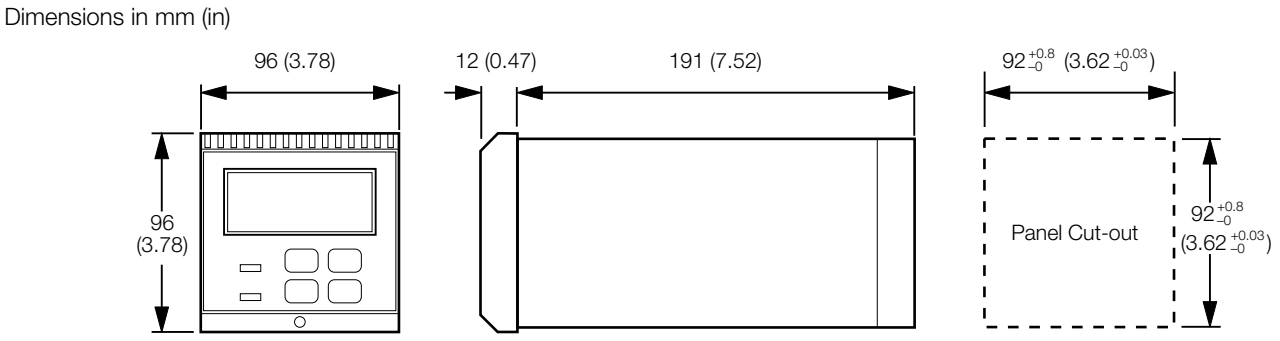
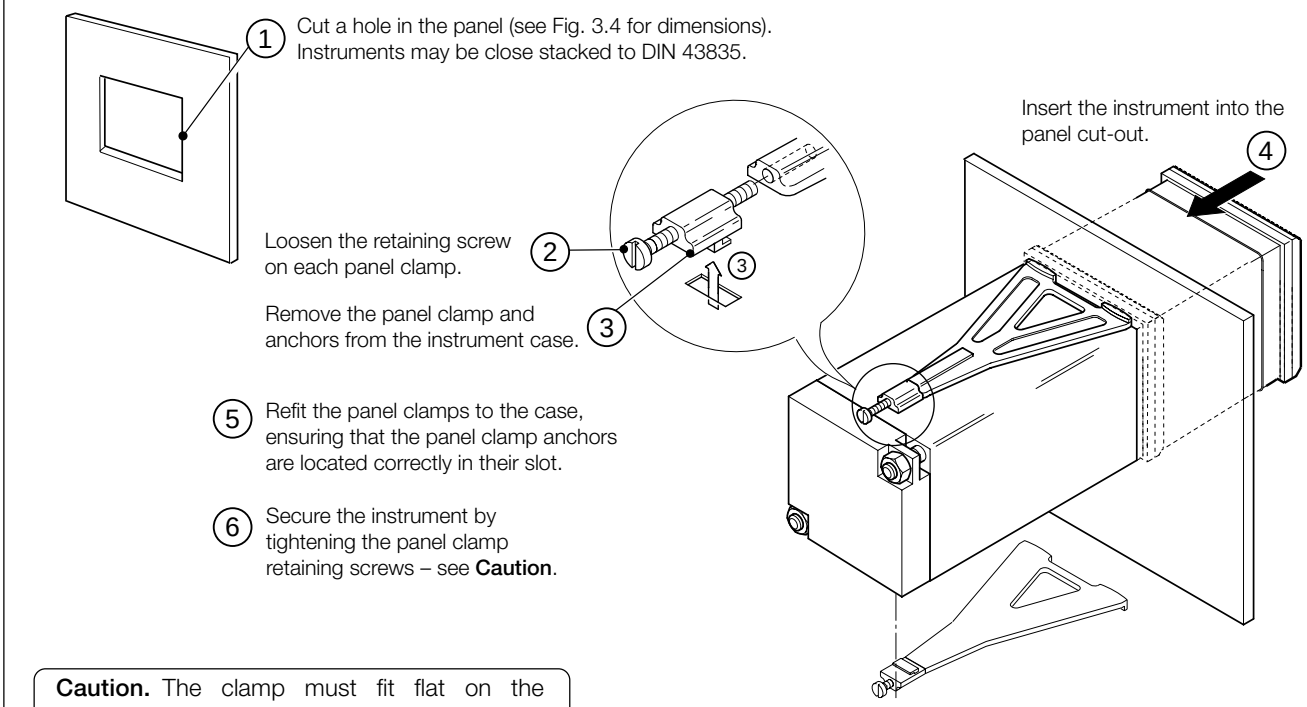


Fig. 3.4 Overall Dimensions



Caution. The clamp must fit flat on the instrument casing. If the clamp is bowed, the securing screw is overtight and sealing problems may occur.

Fig. 3.5 Panel Mounting

4 ELECTRICAL CONNECTIONS

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

4.1 Access to Terminals

4.1.1 Wall-/Pipe-mounted Instruments – Fig. 4.1

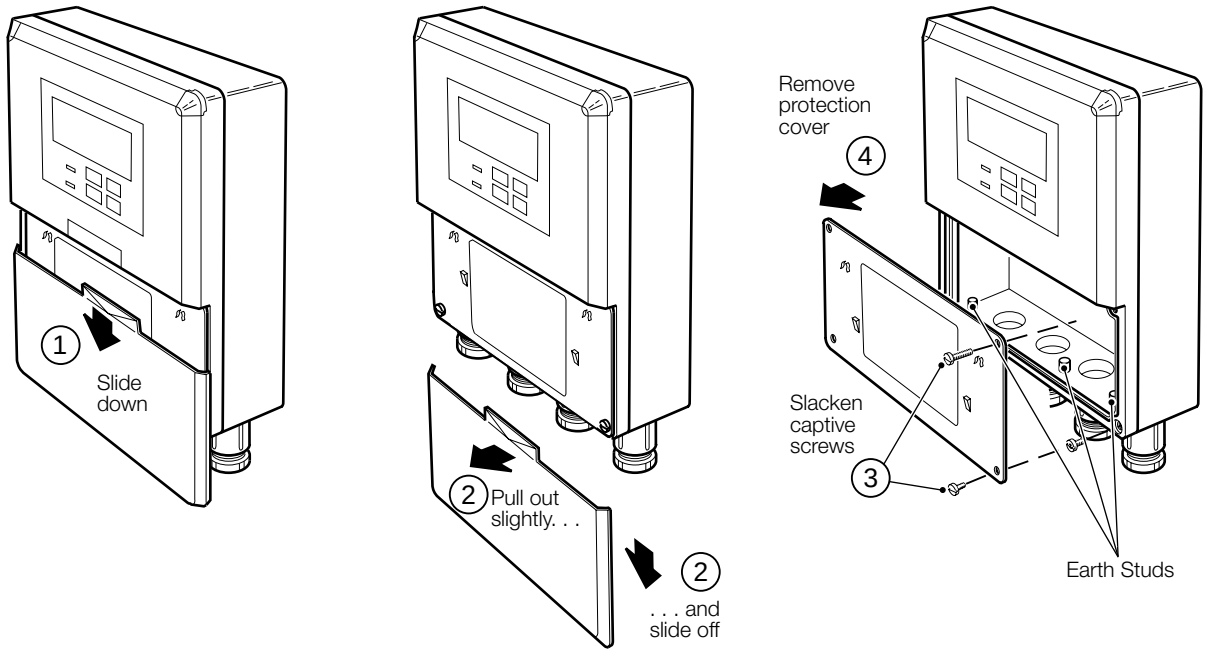


Fig. 4.1 Access to Terminals – Wall-/Pipe-mounted Instruments

4.1.2 Panel-mounted Instruments – Fig. 4.2

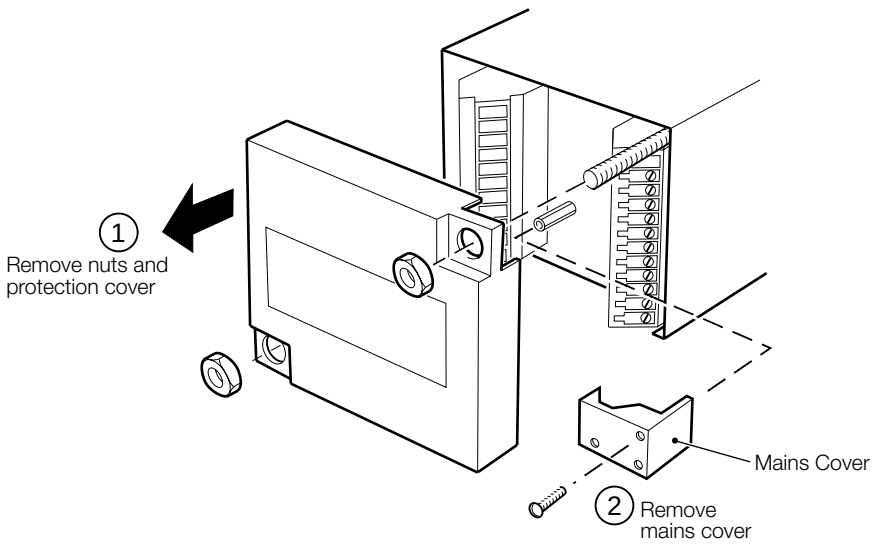


Fig. 4.2 Access to Terminals – Panel Mounted Instruments

4.2 Connections, General

Information.

- **Earthing (grounding) –** stud terminal(s) is fitted to the transmitter case for bus-bar earth (ground) connection – see Fig. 4.1 or 4.5.

- **Cable routing** – always route signal output/conductivity cell cable leads and mains-carrying/relay cables separately, ideally in earthed metal conduit. Employ twisted-pair output leads or use screened cable with the screen connected to the case earth stud.

  Ensure that the cables enter the transmitter 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 a moisture-tight fit when using cable glands, conduit fittings and blanking plugs/bungs (M20 holes). The M16 glands ready-fitted to wall-mounted instruments accept cable of between 4 and 7mm 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 4.2.1 (below) for relay contact protection details when the relays are to be used for switching loads.

- **Retransmission output** – Do not exceed the maximum load specification for the selected current retransmission range – see Section 10, **SPECIFICATION**.

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

4.2.1 Relay Contact Protection and Interference Suppression – Fig. 4.3

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 instrument malfunctions and incorrect readings. To minimise 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. On 4600 Series instruments the RFI components must be fitted to the relay terminal block along with the supply and load wires – see Fig 4.3.

For **a.c. 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. 4.3A. If the instrument malfunctions (incorrect readings) or resets (display shows 88888) the value of the RC network is too low for suppression 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 **d.c. applications** fit a diode as shown in Fig. 4.3B. 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

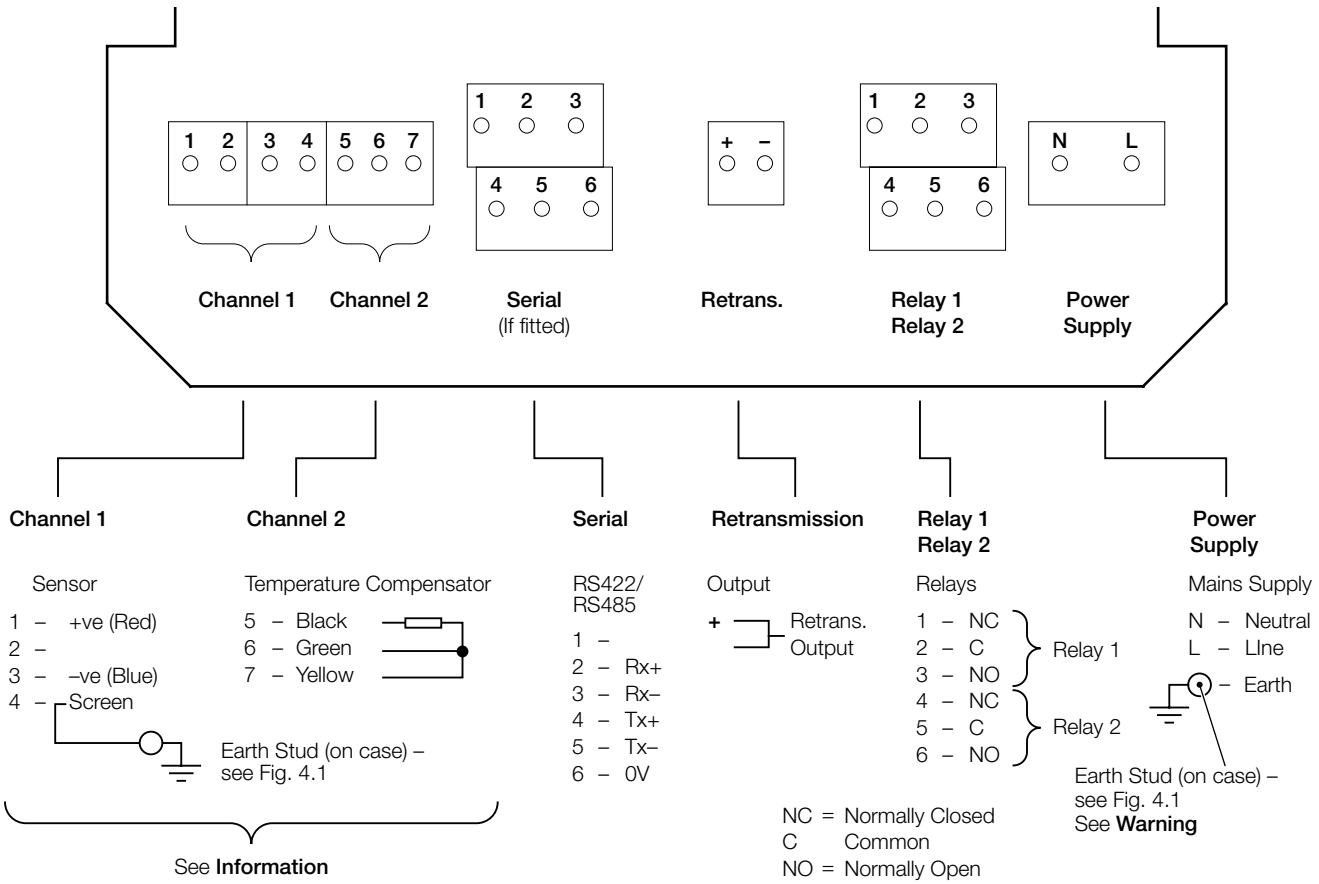
A – A.C. Applications **B – D.C. Applications**

Fig. 4.3 Relay Contact Protection

4.3 Wall-/Pipe-mounted Instrument Connections – Fig. 4.4

Note. Refer to Fig. 4.1 for Access to Terminals.

Caution. Slacken terminal screws fully before making connections.



Information.
- The colours relate to the 6-core screened extension cable from the system junction box.
- Screen – connect to earth stud – see Fig. 4.1.
- White – cut back to insulation

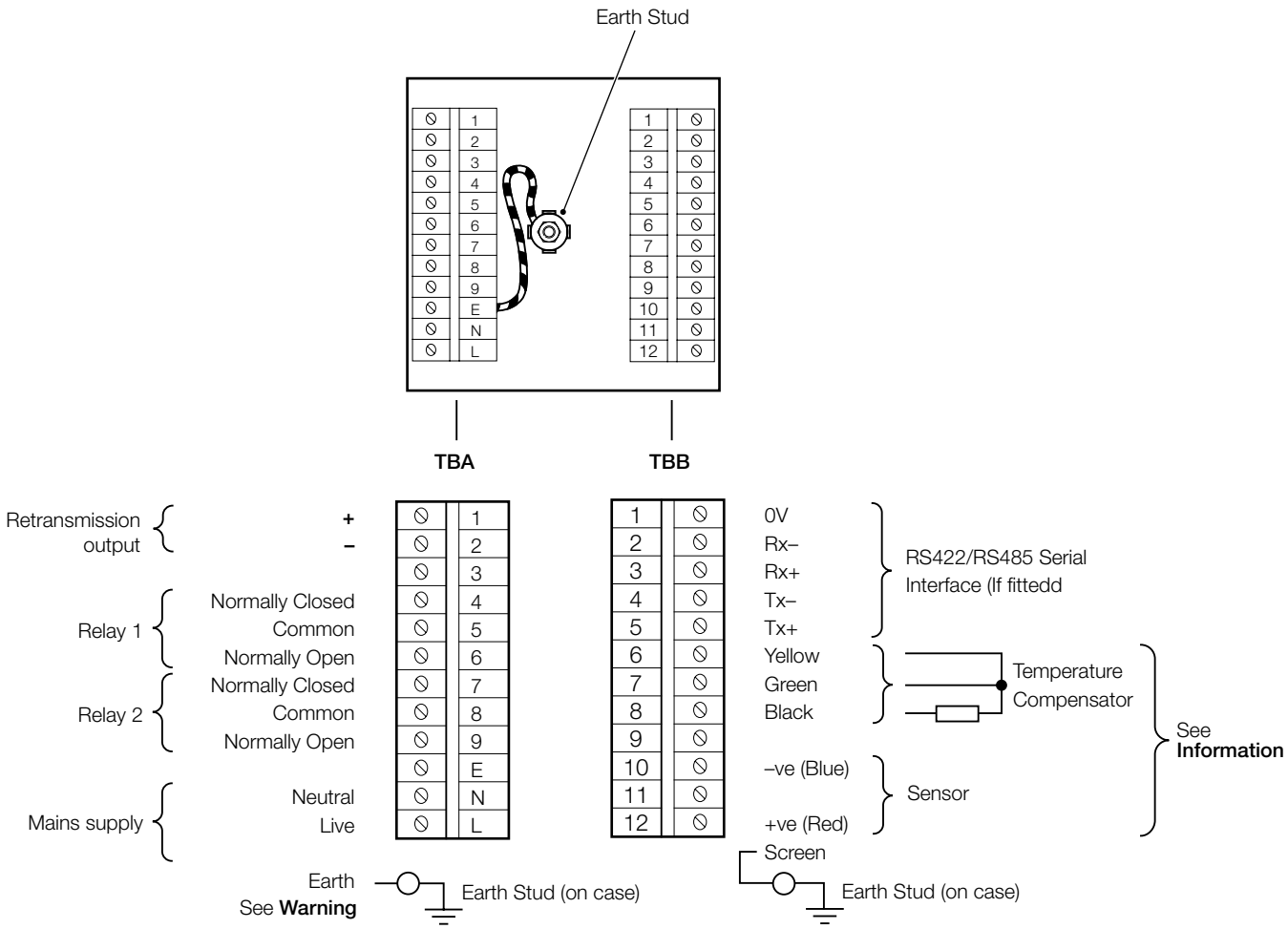
Warning. The power supply earth (ground) **must** be connected to ensure safety to personnel, reduction of the effects of RFI interference and correct operation of the power supply interference filter.

Fig. 4.4 Wall-/Pipe-mounted Instrument Connections

4.4 Panel-mounted Instrument Connections – Fig. 4.5

Note. Refer to Fig. 4.1 for Access to Terminals.

Caution. Slacken terminal screws fully before making connections.



Information.
- The colours relate to the 6-core screened extension cable from the system junction box.
- Screen – connect to earth stud – see Fig. 4.1.
- White – cut back to insulation

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. Connect the earth lead directly to the case earth stud and **not** to the 'E' terminal.

Fig. 4.5 Panel-mounted Instrument Connections

4.5 Selecting the Mains Voltage

4.5.1 Wall-/Pipe-mounted Instruments – Fig. 4.6

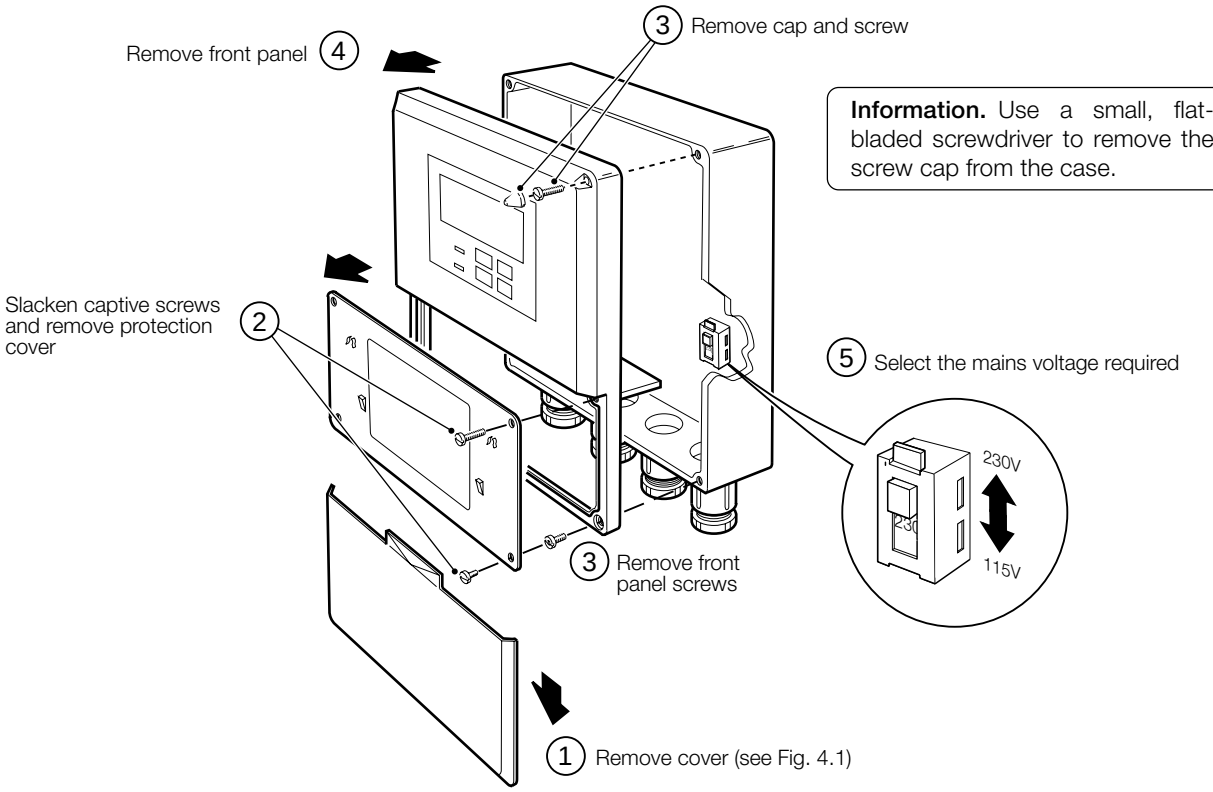


Fig. 4.6 Selecting the Mains Voltage – Wall-/Pipe-mounted Instruments

4.5.2 Panel-mounted Instruments – Fig. 4.7

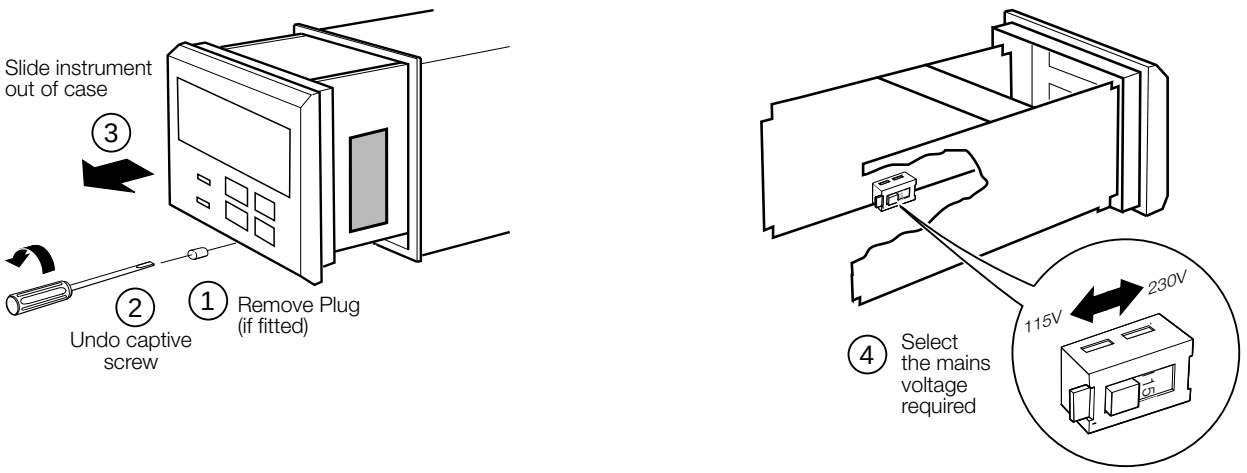


Fig. 4.7 Selecting the Mains Voltage – Panel-mounted Instruments

5 CONTROLS AND DISPLAYS

5.1 Displays – Fig. 5.1

The display comprises a 5-digit, 7-segment digital upper display line and a 16-character dot-matrix lower display line. The upper display line shows actual values of D.O., temperature, alarm set points or programmable parameters. The lower display line shows the associated units or programming information.

5.2 Switch Familiarisation – Figs. 5.1 and 5.2

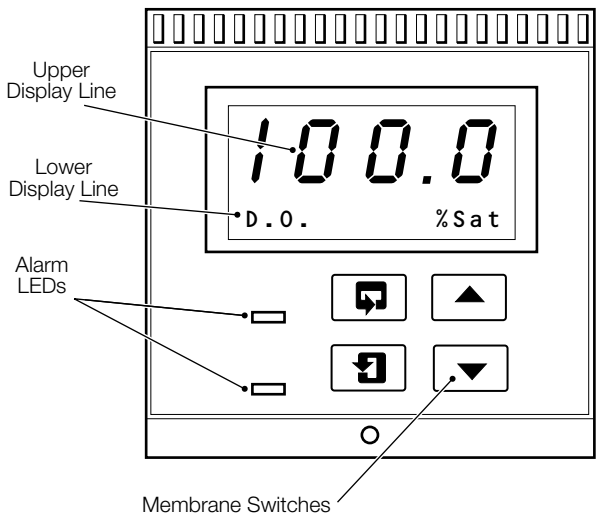
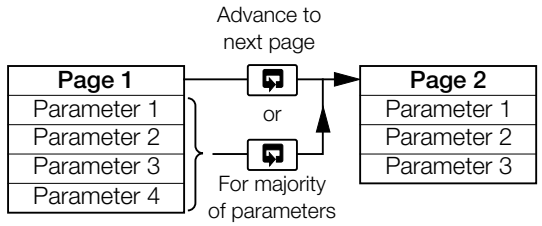
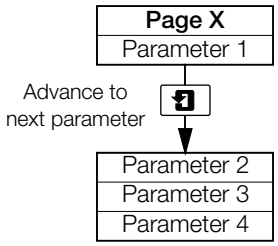


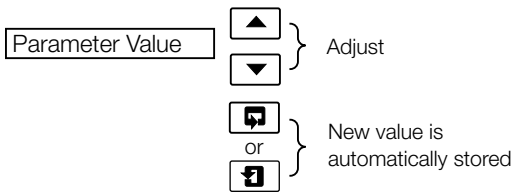
Fig. 5.1 Location of Controls and Displays



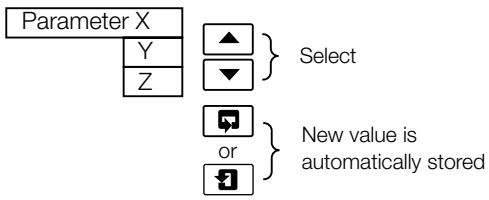
A – Advancing to Next Page



B – Moving Between Parameters



C – Adjusting and Storing a Parameter Value



D – Selecting and Storing a Parameter Choice

Fig. 5.2 Functions of the Membrane Switches

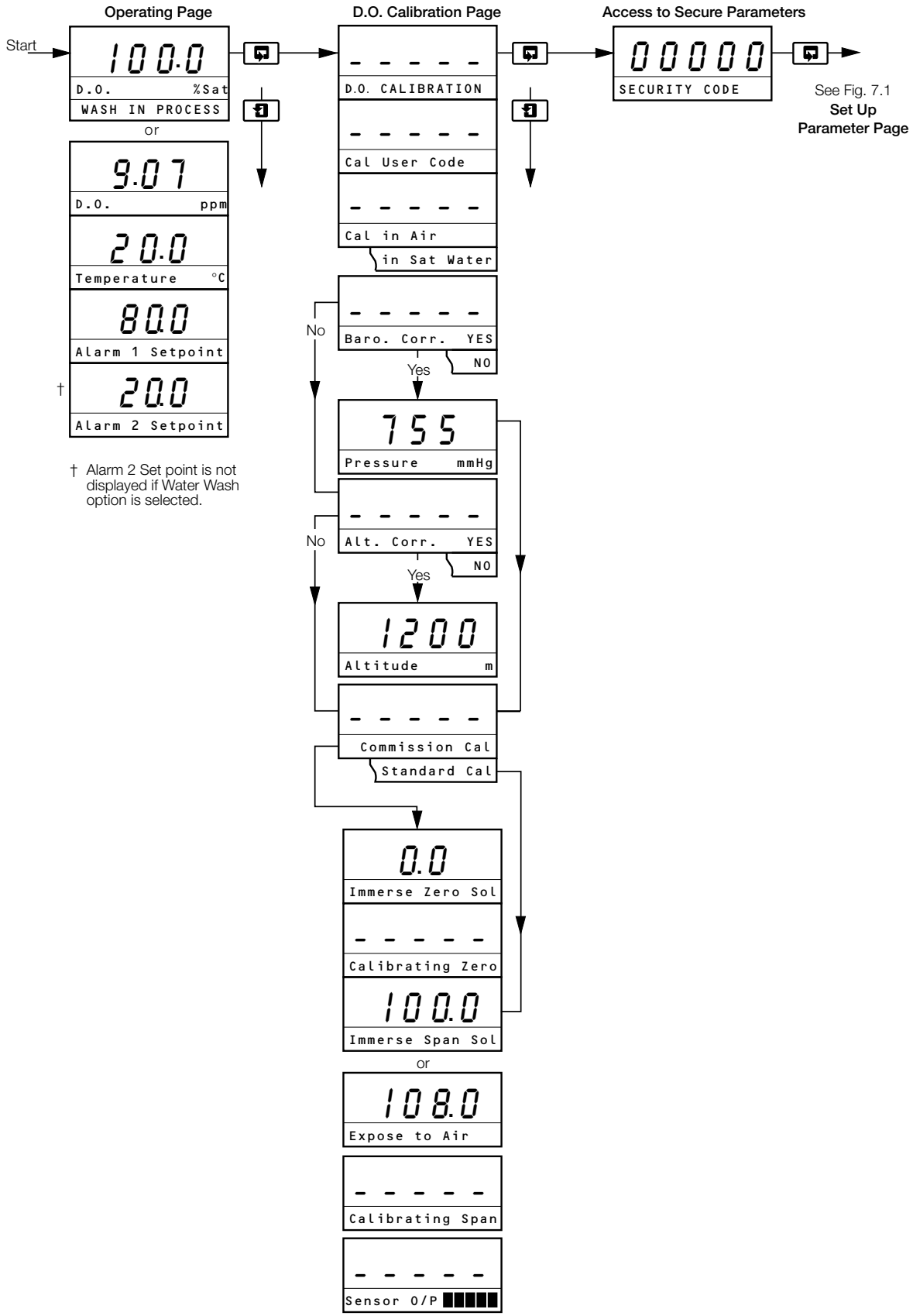


Fig. 6.1 Overall Programming Chart – Operating Parameters

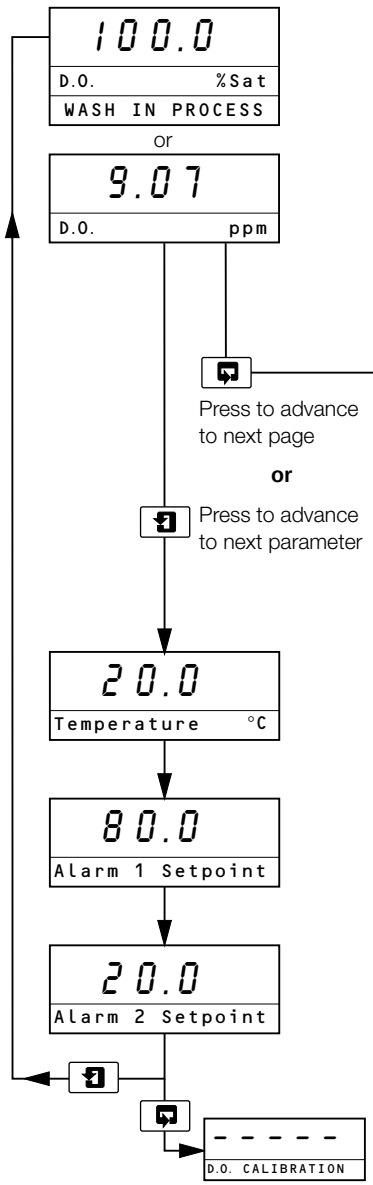
6.1 Instrument Start-up

Ensure all electrical connections have been made correctly and switch on the power supply. If the instrument is being commissioned for the first time its parameters must be programmed, as detailed in Section 7, before carrying out a D.O. Calibration.

6.2 Operation General

Operation comprises an **Operating Page** and a **D.O. Calibration Page**. The **Operating Page** is a general use page in which parameters are viewed only and cannot be altered. To alter or program a parameter refer to the programming pages in Section 7. The **D.O. Calibration Page** allows the sensor to be standardized to the instrument. A 5-digit calibration code is used to prevent unauthorized access to the D.O. calibration page. The value is preset at 00000 to allow access during commissioning but should be altered to a unique value, known only to authorized operators, in the **Set Up Outputs Page** – see Section 7.4.

6.3 Operating Page



Measured Dissolved Oxygen
The measured dissolved oxygen is displayed in either % saturation (**%Sat**) or parts per million (**ppm**) units. The display units can be altered in the **Set Up Parameters Page** – See Section 7.3.

Note. Dissolved oxygen concentrations are often reported in mg/l units, which are identical to p.p.m. units.

If the Water Wash cycle is selected (models 4642 or 4647), an alternative message **WASH IN PROCESS** is displayed. The Alarm status and the retransmission value are held in their pre-cycle condition for the duration of the wash cycle.

– see Fig. 6.1 on page 12.

These two switches are used to advance to all subsequent parameters and pages.

Sample Temperature:
is displayed in either °C or °F. The display units are programmable – see Section 7.3, **Set Up Parameters Page**.

Alarm 1 Set Point
The set point value and relay/l.e.d. action are programmable – see Section 7.4, **Set Up Outputs Page**.

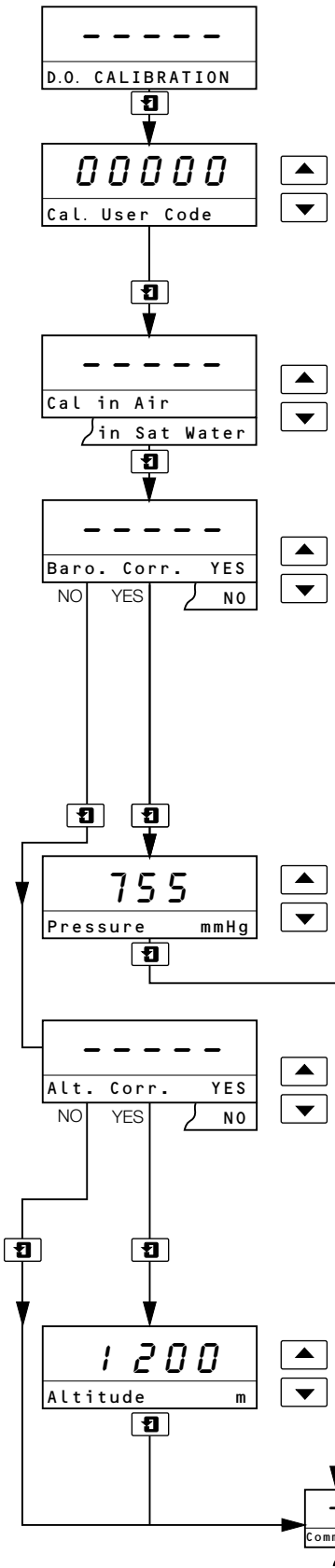
Alarm 2 Set Point
The set point value and relay/l.e.d. action are programmable – see Section 7.4, **Set Up Outputs Page**.

Advance to **D.O. Calibration Page** on page 14.

6.4 D.O. Calibration Page

D.O. Calibration involves standardizing the instrument and the sensor using sample solutions/air.

A 5% sodium sulphite solution is required for zero calibration, whilst full scale calibration can be carried-out either in air or air saturated water – see Appendix A3.



Advance to next parameter.

Calibration Access
Enter the required calibration code number, between 00000 and 19999. If an incorrect value is entered, access to D.O. calibration is prevented and the display returns to the top of the **D.O. Calibration Page**.

Advance to next parameter.

Air or Air Saturated Water Selection
Select the appropriate medium to be used for span calibration.

Advance to next parameter.

Automatic Barometric Correction
If the local barometric pressure is known select **YES** to enable automatic barometric correction.

If the local barometric pressure is not known **NO** should be selected; the instrument will then operate using the standard sea-level value of barometric pressure, i.e. 760mmHg, unless Automatic Altitude Correction (see below) is subsequently selected.

Select **YES** or **NO** for barometric correction.

Advance to next parameter.

Barometric Pressure
Set the local barometric pressure in mmHg.

Advance to next parameter.

Automatic Altitude Correction
If the local barometric pressure is not known but the instrument is installed at a known altitude significantly above sea-level, e.g. more than 50m, **YES** should be selected. The instrument will then operate using the standard value of barometric pressure for the altitude set below.

Select **YES** or **NO** for altitude correction.

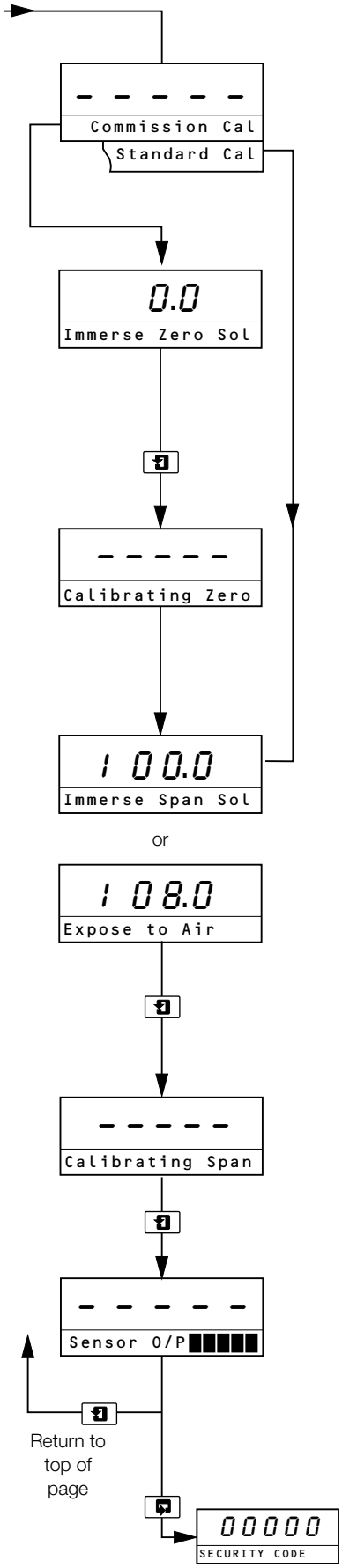
Advance to next parameter.

Altitude
Set the local altitude in metres above sea level.

Advance to next parameter.

Continued on next page.

...6.4 D.O. Calibration Page



Calibration Type
Commissioning calibration – Enables a zero calibration to be carried out, using 5% sodium sulphite. Recommended when commissioning the system or when a replacement capsule is fitted.

Standard calibration – Eliminates the need for a zero calibration. Calibration is carried out in Air Saturated Water or Air. Recommended for routine maintenance.

Zero Calibration
Immerse the sensor capsule in the 5% sodium sulphite solution.

Note. The upper display line displays, in the units selected in the **Set Up Parameter Page**, the value to which the instrument reading will be set following successful Zero Calibration.

Advance to initiate calibration.

The auto-calibration mode has a built-in three minute delay for Zero Calibration to allow time for the sensor response to be essentially complete. If the sensor output has not reached the required level after this time has elapsed, the instrument displays `Calibration Fail`. If the magnitude of the sensor output is satisfactory the instrument waits for it to become stable, then automatically advances to the next parameter. If satisfactory stability is not achieved within approximately 10 minutes the instrument displays `Calibration Fail`.

Span Calibration
Thoroughly rinse the sensor with demineralized water and carefully dry the capsule with a soft tissue.

If `Cal In Air` was selected above, expose the sensor to air.
If `Cal In Sat Water` was selected above, immerse the sensor capsule in the air saturated water.

Note. The upper display line displays the value to which the instrument reading will be set following successful Span Calibration. If barometric or altitude correction is selected, the value displayed includes these corrections.

Advance to initiate calibration.

The auto-calibration mode has a built-in two minute delay for span calibration, otherwise the functioning is identical to that described for Zero Calibration above.

Sensor Output
Provides an indication of the sensor performance in the form of a 5 bar display. When 5 bars are displayed, the sensor has maximum life remaining.
When 2 bars are displayed and flashing, the sensor is exhausted.
A replacement sensor should be ordered when three bars are displayed.

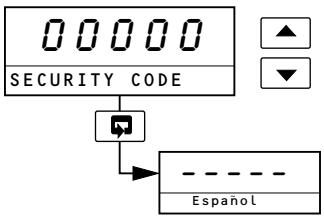
If a calibration is carried out when 2 bars are displayed, the calibration is ignored and the values obtained from the previous calibration are used.

Advance to **Access to Secure Parameters** on page 16.

7 PROGRAMMING

7.1 Access to Secure Parameters

A 5-digit security code is used to prevent tampering with the secure parameters.



Security Code

Enter the required code number, between 00000 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**.

Advance to **Language Page**.

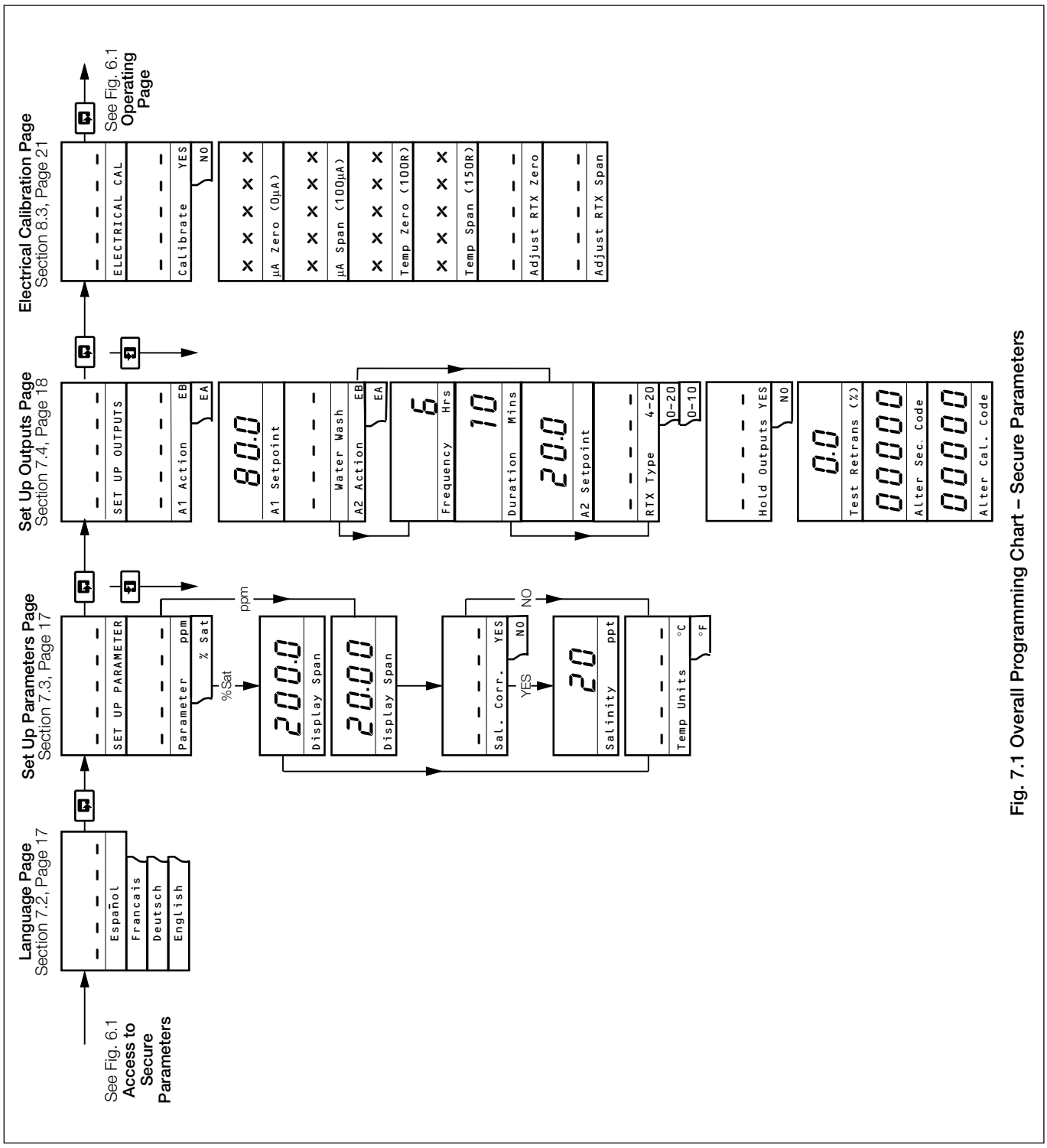
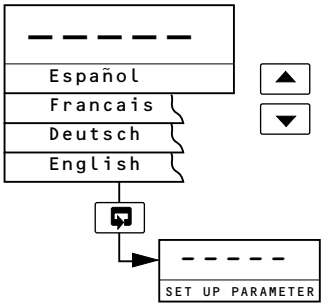


Fig. 7.1 Overall Programming Chart – Secure Parameters

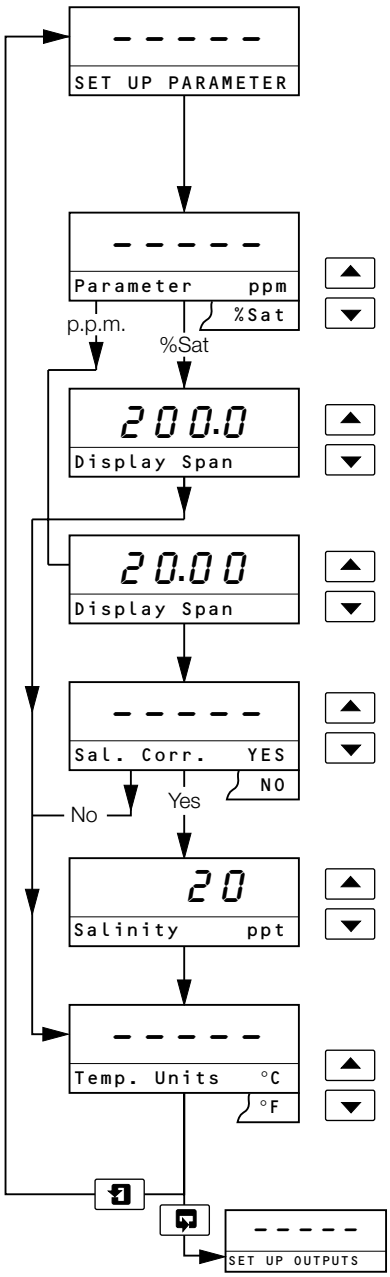
7.2 Language Page



Language Page
Select the language to be displayed on all subsequent pages.

Advance to **Set Up Parameters Page**.

7.3 Set Up Parameters Page



– press to advance to next parameter
or
– press to advance to next page.

These two switches are used to advance to all subsequent parameters and pages. If a parameter is changed it is automatically stored on operation of either switch.

D.O. Units
Select the required units, either **%Sat** or **ppm**.

Display Span:
is the full scale setting displayed in the units selected above, i.e. %Sat or ppm.

Select the full scale value required between either 20 to 200%Sat or 2 to 20 ppm.

Salinity Correction:
is required when monitoring the dissolved oxygen concentration (ppm) in sea water or estuarine waters – see **Appendix A2**.

Select **YES** or **NO**.

Salinity:
in parts per thousand (ppt) must be determined by the user – see **Appendix A2**.

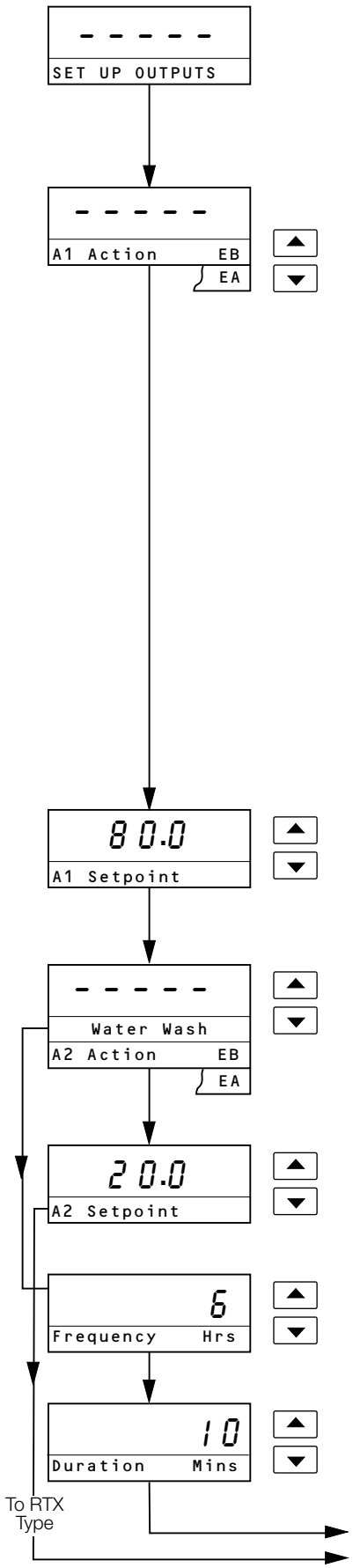
Select the appropriate value, determined above, between 0 and 40ppt.

Temperature Units
can be displayed as either degrees Celsius or Fahrenheit.

Select either **°C** or **°F**.

Advance to **Set Up Outputs Page**.

7.4 Set Up Outputs Page



[ ] – press to advance to next parameter

or

[ ] – press to advance to next page.

These two switches are used to advance to all subsequent parameters and pages. If a parameter is changed it is automatically stored on operation of either switch.

Alarm 1 Action

For '**Fail-safe**' alarm operation the relay's alarm state must be the same as the power-down state, i.e. the relay is de-energised.

For **high alarm** operation the relay must be **E**nergised **B**elow the alarm set point (EB).

For **low alarm** operation the relay must be **E**nergised **A**bove the alarm set point (EA).

The alarm l.e.d.s are illuminated in the alarm condition.

Select the required alarm 1 action from the following table:

Alarm Action	L.E.D. Action for Input Above Set Point	L.E.D. Action for Input Below Set Point	Relay Action for Input Above Set Point	Relay Action for Input Below Set Point
EB	ON	OFF	De-energized	Energized
EA	OFF	ON	Energized	De-energized

The set point band is defined as the actual value of the set point plus or minus the hysteresis value. The hysteresis value is ± 1% of the Alarm 1 set point. Alarm action occurs if the input value is above or below the set point band. If the input moves within the set point band the last alarm action is maintained.

Alarm 1 Set Point

The alarm 1 set point can be set to any value within the input range being displayed. The set point value is subject to hysteresis as detailed above.

Set the alarm set point to the required value.

Water Wash (4642/4647 only) /Alarm 2 Action

To select the Water Wash cycle press the [▲] switch until `Water Wash` is displayed.

To select Alarm 2 Action, press the [▲] switch until `A2 Action` is displayed, then repeat as for **Alarm 1 Action** above.

Alarm 2 Set Point

Repeat as for **Alarm 1 Set Point** above (this frame is omitted when Water Wash is selected – models 4642/4647 only).

Wash Frequency

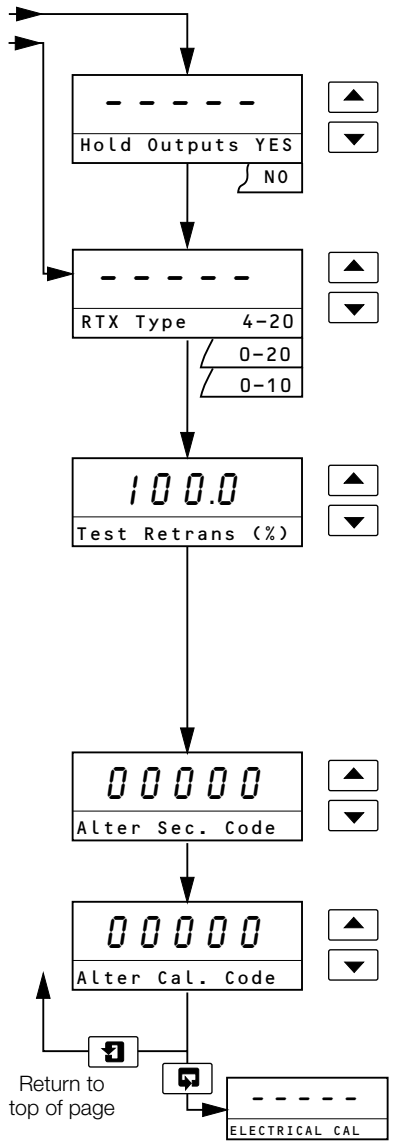
Water wash frequency can be set in 15 minute increments between 15 and 60 minutes, then in 1 hour increments between 1 and 24 hours.

Wash Duration

Water wash duration can be set in 15 second increments between 15 and 60 seconds, then in 1 minute increments between 1 and 10 minutes.

Continued on next page.

...7.4 Set Up Outputs Page



Hold Outputs
The retransmission and alarm outputs can be held to prevent inadvertent operation during D.O. calibration – see Section 6.4.

Select YES to hold the outputs or **NO** to maintain normal output operation.

Retransmission Output Assignment
The retransmission output is assigned to the D.O. range.

Select the retransmission output current range required (4 to 20mA, 0 to 20mA or 0 to 10mA).

Test Retransmission Output
The instrument automatically transmits a test signal of 0, 25, 50, 75 or 100% of the retransmission range selected above. The % test signal selected is shown on the upper display.

Example – for a selected range of 0 to 20mA and 50% retransmission test signal, 10mA is transmitted.

Select the required retransmission test signal.

Alter Security Code
Set the security code to a value between 00000 and 19999.

Alter D.O. Calibration Code
Set the security code to a value between 00000 and 19999.

Advance to **Electrical Calibration Page**.

8 ELECTRICAL CALIBRATION

Note. The instrument is calibrated by the company prior to despatch and an electrical calibration should only be carried out if its accuracy is suspect and suitably calibrated test equipment is available.

8.1 Equipment Required

a) Current source 0 to +100μA (sensor simulator).

b) Decade resistance box (temperature input simulator): 0 to 1kΩ (in increments of 0.01Ω).

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

Note. Resistance boxes have an inherent residual resistance ranging 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.

8.2 Preparation

a) Switch off the supply and disconnect the sensor, temperature compensator and current output from the instrument's terminal blocks – see Fig. 4.4 (page 8) or Fig. 4.5 (page 9).

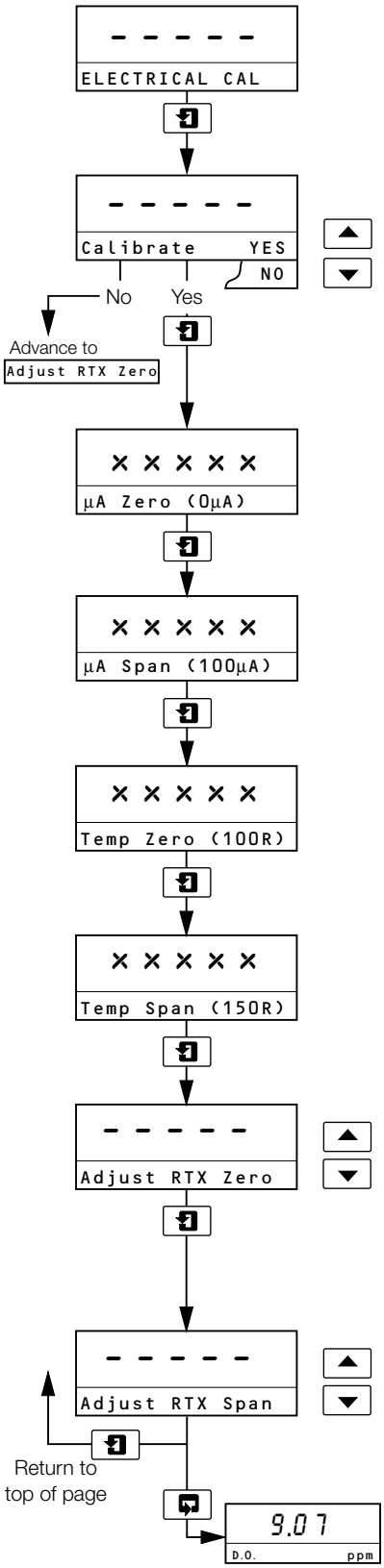
b) Connect the current source, decade box and milliammeter to the appropriate terminals.

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

d) Select the **ELECTRICAL CAL** page and proceed as in Section 8.3, on the following page.

8.3 Electrical Calibration Page

In this section the actual values denoted by '✕ ✕ ✕ ✕ ✕' are unimportant and are used to determine display reading stability, when carrying out the electrical calibration procedure.



Electrical Calibration
Select **YES** to access the electrical calibration sequence. Select **NO** to advance to Adjust Retransmission Zero – see below.

Caution. Do not select **YES** unless it is intended to calibrate the instrument.

Advance to next parameter.

Zero Calibration
Set the current source to 0.0µA and allow the instrument display to stabilize.

Advance to next parameter.

Span (full scale) Calibration
Set the current source to 100µA and allow the instrument display to stabilize.

Advance to next parameter.

Calibrate Temperature Zero
Set the temperature simulator resistance box to 100Ω and allow the instrument display to stabilize.

Advance to next parameter.

Calibrate Temperature Span
Set the temperature simulator resistance box to 150Ω and allow the instrument display to stabilize.

Advance to next parameter.

Adjust Retransmission Zero
Set the milliammeter reading to 4mA.

Note. The retransmission range selected in the **Set Up Outputs Page** does not affect the reading.

Advance to next parameter.

Adjust Retransmission Span
Set the milliammeter reading to 20mA.

Note. The retransmission range selected in the **Set Up Outputs Page** does not affect the reading.

Return to **Operating Page**.

9 SIMPLE FAULT FINDING

9.1 Error Messages

If erroneous or unexpected results are obtained the fault may be indicated by an error message – see Table 9.1. However some faults may cause problems with instrument calibration or give discrepancies when compared with independent laboratory measurements.

Error Message	Possible Cause
FAULTY PT100	Temperature compensator/ associated connections are either open/short circuit.
FAULTY MODULE	D.O. sensor input module is probably faulty.
LAST CAL. FAILED	Message only displayed on power-up. The last D.O. calibration, carried out before power-down, failed.*
NV MEMORY ERROR	The contents of the non-volatile memory have not been read correctly during power up.**

* This message applies the the last D.O. calibration carried out prior to power-down and is not an indication of incorrect electrical calibration.

** To rectify the fault, switch off, wait 10 seconds and switch on again. If the fault persists contact the Company.

Table 9.1 Error Messages

9.2 Calibration Fail Message or no Response to D.O. Changes

The majority of problems are associated with the D.O. sensor. Replace the sensor as an initial check – refer to the appropriate instruction manual. It is also important that all program parameters have been set correctly and have not been altered inadvertently – see Section 7.

If the above checks do not resolve the fault:

a) Carry out an electrical calibration as detailed in Section 8 and check that the instrument responds correctly to the current input.

Failure to respond to the input usually indicates a fault with the transmitter, which must be returned to the Company for repair.

b) If the response in a) is correct, select the **Operating Page** and set the current source to a value which gives an on-scale D.O. reading on the transmitter. Make a note of the current source setting and the D.O. reading. Reconnect the sensor cable and connect the current source to the sensor end of the cable. Set the same current value on the source and check that the transmitter displays the noted reading in this configuration.

If check a) is correct but check b) fails, check the cable connections and condition. If the response for both checks is correct, replace the sensor.

10 SPECIFICATION

Display

Measured value

5-digit x 7-segment back-lit LCD

Information

16-character, single line, dot matrix, back-lit LCD

Ranges

Programmable 0 to 200% saturation, 0 to 20mg/l

Resolution

0.1% saturation, 0.01% ppm

Accuracy

±1% saturation, 0.1% ppm

Temperature compensation

0° to 40°C (32° to 104°F) automatic via Pt100 resistance

Salinity correction

Automatic over the range 0 to 40% parts per thousand

Environmental Data

Operating temperature limits

–20° to 55°C (–4° to 130°F)

Storage temperature limits

–25° to 70°C (–13° to 158°F)

Operating humidity limits

Up to 95%RH non-condensing

Power Supply

Voltage requirements

100 to 130V or

200 to 260V 50/60Hz

Power Consumption

<10VA

Error due to power supply variations

Less than 2% for +6% –20% variation from nominal supply voltage

Insulation

Mains to earth (line to ground) 2kV RMS

Outputs and Set Points

No. of Relays

Two – one used for water wash on models 4642 and 4647

Set point adjustment

Programmable

Set point differential

±1% of span

Relay contact

Single pole changeover

Rating		250V AC 3A AC	250V DC max. 3A DC max.
Loading:	(non-inductive)	750VA	30W max.
	(inductive)	750VA	3W max.

Insulation

2kV RMS contacts to earth (ground)

No. of set points

Two

Set point adjustment

Programmable

Set point hysteresis

±1% fixed

Local set point annunciation

Red LED

…10 SPECIFICATION

Retransmission

No. of retransmission signals

One fully isolated, supplied as standard
Second retransmission output optional

Output current

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

Accuracy

±0.25% FSD or ±0.5% reading

Resolution

0.1% at 10mA, 0.05% at 20mA

Minimum range

0 to 3 ppm or 30% saturation

Maximum range

0 to 20 ppm or 200% saturation

Maximum load resistance

750Ω (20mA max.)

Serial communication

RS485 (optional extra)

Mechanical Data

Models 4640 & 4642

Wall-mounting

Protection	IP66/NEMA4X
Dimensions	160mm (6.30 in.) wide x 214mm (8.43 in.) high x 68mm (2.68 in.) deep
Weight	2kg (4½ lb)

Models 4645 & 4647

Panel-mounting (¼ DIN)

Protection	IP66/NEMA4X front
Dimensions	96mm (3.78 in.) wide x 96mm (3.78 in.) high x 191mm (7.52 in.) deep
Weight	1.5kg (3¼ lb)
Panel cut-out:	$92\ ^{+0.8}_{-0.0}$ mm x $92\ ^{+0.8}_{-0.0}$ mm ($3.62\ ^{+0.03}_{-0.0}$ in. x $3.62\ ^{+0.03}_{-0.0}$ in.)

SS/4640 Issue 8

APPENDICES

A1 Oxygen Solubility in Pure Water

Table A1 gives values for the solubility of oxygen in pure water at various temperatures. The solubility values are given in mg/l (ppm) and relate to pure water in equilibrium with water vapor-saturated normal air at the standard atmospheric pressure of 760 mmHg.

Note. The instrument automatically compensates for solubility in pure water variations due to temperature, using the values stated in Table A1.

Temperature °C	Solubility in Pure Water (ppm)
0	14.59
1	14.19
2	13.81
3	13.44
4	13.08
5	12.75
6	12.42
7	12.12
8	11.82
9	11.54
10	11.27
11	11.01
12	10.75
13	10.52
14	10.28
15	10.07
16	9.85
17	9.64
18	9.44
19	9.25
20	9.07
21	8.90
22	8.73
23	8.55
24	8.40
25	8.24
26	8.08
27	7.94
28	7.80
29	7.66
30	7.54
31	7.41
32	7.28
33	7.15
34	7.04
35	6.93
36	6.82
37	6.71
38	6.61
39	6.51
40	6.41

This table is abstracted from Table IVb of 'International Oceanographic Tables' volume 2, National Institute of Oceanography of Great Britain and UNESCO, 1973 (0 to 35°C) and from R. Weiss, Deep Sea Res., 1970 17, 721 (36 to 40°C).

Table A1 Oxygen Solubility in Pure Water

A2 Correction for Salinity

Automatic correction for the effect of salinity on oxygen solubility is available for the measurement of dissolved oxygen concentrations in saline water, provided the salinity value of the water is known and is constant. Correction is applied by entering the known value of salinity, in parts per thousand, at the appropriate place in the **Set Up Parameter Page** after the instrument has been calibrated.

Automatic salinity correction is based upon data given in 'International Oceanographic Tables', Volume 2 (National Institute of Oceanography of Great Britain and UNESCO, 1973) and is applicable only to sea or estuarine waters. For waters containing significant amounts of dissolved salts other than sodium chloride, it may be necessary to determine appropriate oxygen solubility values experimentally, e.g. by saturating aliquots of the water with air at various temperatures, spanning the required measurement range, and determining the resulting dissolved oxygen concentrations titrimetrically. The instrument should then be used to measure both % saturation and temperature. The required oxygen concentration can be calculated from:

$$\text{concentration} = S_x \left[\frac{\%\ \text{Saturation}}{100} \right] \text{ppm}$$

where S_x = experimentally determined oxygen solubility, mg/l(ppm), at measurement temperature.

A3 D.O. Calibration

Note. Both the oxygen and the temperature sensors must be exposed to the calibration medium.

A3.1 Zero Calibration

A 5% sodium sulphite solution is required which should be prepared well in advance by dissolving 5.0g of anhydrous sodium sulphite in 100ml of demineralized water. It should be stored in a tightly closed bottle. Ideally, this bottle should have a sufficiently wide neck to allow direct insertion of the oxygen and temperature sensors. Do not store the solution for more than one week.

When the oxygen sensor is dipped into the solution, ensure that no air bubbles are trapped on, or close to, the membrane and that the sensor is supported so that the membrane cannot be damaged by contact with the bottom of the bottle.

When the sensors are withdrawn, all traces of sodium sulphite must be removed by rinsing them thoroughly with demineralized water.

A3.2 Span Calibration

Either air or air-saturated water may be used. Air calibration is more convenient and is likely, in practice, to be at least as accurate as calibration in air-saturated water.

A3.2.1 Air Calibration

The air should be saturated with water vapour. This is conveniently achieved by suspending the sensors inside a bottle containing a few drops of water. Alternatively, the sensors can be suspended close (within a few centimetres) to the surface of a body of water.

The operation of the oxygen sensor is such that the output in air is slightly higher than in air-saturated water at the same temperature. This difference is reproducible, allowing calibration in air by adjusting the instrument reading to 108% saturation (or the equivalent concentration) rather than 100%. This adjustment is made automatically in the calibration procedure.

A3.2.2 Air-saturated Water Calibration

This should be prepared, as described below, well in advance. Using an aeration stone, or a sintered glass diffuser, aerate approximately 1 litre of demineralized water, either continuously, for at least five minutes, with a small pump, or intermittently, for at least 15 minutes, with hand bellows. These techniques are adequate for many applications, provided the ambient temperature is constant but, to obtain an accurate 100% saturation solution, the water should be maintained at constant temperature and stirred gently, without forced aeration, using a magnetic stirrer set to provide continuous agitation without breaking the liquid surface. This process should be continued for at least two hours to attain complete equilibrium. For calibration, the sensors should be suspended in the air-saturated water, which should be stirred continuously so that the flow velocity at the membrane of the oxygen sensor is at least 30cm/s.

NOTES

…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 Flowmeters*
- *Mass Flow Meters*
- *Turbine Flowmeters*
- *Flow Elements*

Marine Systems & Turbochargers

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

Process Analytics

- *Process Gas Analysis*
- *Systems Integration*

Transmitters

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

Valves, Actuators and Positioners

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

Water, Gas & Industrial Analytics 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 829671

United States of America

ABB Inc.
Tel: +1 775 850 4800
Fax: +1 775 850 4808

Client Warranty

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

Periodic checks must be made on the equipment's condition. In the event of a failure under warranty, the following documentation must be provided as substantiation:

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

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

www.abb.com

Printed in UK (04.04)

IM/4600–DO Issue 9

ABB Limited
Oldends Lane, Stonehouse
Gloucestershire, GL10 3TA
UK

Tel: +44 (0)1453 826661
Fax: +44 (0)1453 829671

ABB Inc.
Analytical Instruments
9716 S. Virginia St., Ste. E
Reno, Nevada 89521
USA
Tel: +1 775 850 4800
Fax: +1 775 850 4808