User Guide

IM/4600/GP_2

Oxygen Transmitters for use with ZGP2 Probes

4681 and 4686

ABB

ABB

The Company

EN ISO 9001:2000

Cert. No. Q 05907

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.

EN 29001 (ISO 9001)

Lenno, Italy – Cert. No. 9/90A

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.

Stonehouse, U.K.

0255

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.

Electrical Safety

This instrument complies with the requirements of CEI/IEC 61010-1:2001-2 '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 Models 4681 and 4686 Oxygen Transmitters are designed for continuous monitoring of Oxygen content in applications using 'in situ' ZGP2 probes.

Operation and programming of each Transmitter is via four tactile membrane switches and a digital display located on the front of the instrument. Two LEDs on the front panel provide local alarm indication.

In operation, each instrument can display measured % oxygen, cell mV, or cell temperature. Set up of alarm, retransmission and calibation parameters is achieved in programming mode, where key parameters are protected by a five-digit security code.

Measured $\%O_2$ values can be retransmitted to remote equipment using the retransmission output facility. The range of values retransmitted can be set anywhere within the instrument's display range of 0 to 25% O_2, subject to limits detailed in Section 7.7.

Remote alarm indication is provided by two relay outputs. Relays are programmed to activate when the oxygen level moves either above or below a pre-defined set point. The second alarm relay can also be used as a 'general alarm' which activates in the event of an instrument or system fault.

An optional external reference air unit is used to provide reference air supply for the ZGP2 probe. If this unit is not specified, reference air must be supplied to the probe from an alternative source.

For full installation and operation details of the ZGP2 probe refer to the Operating Instructions, *IM/ZGP2*.

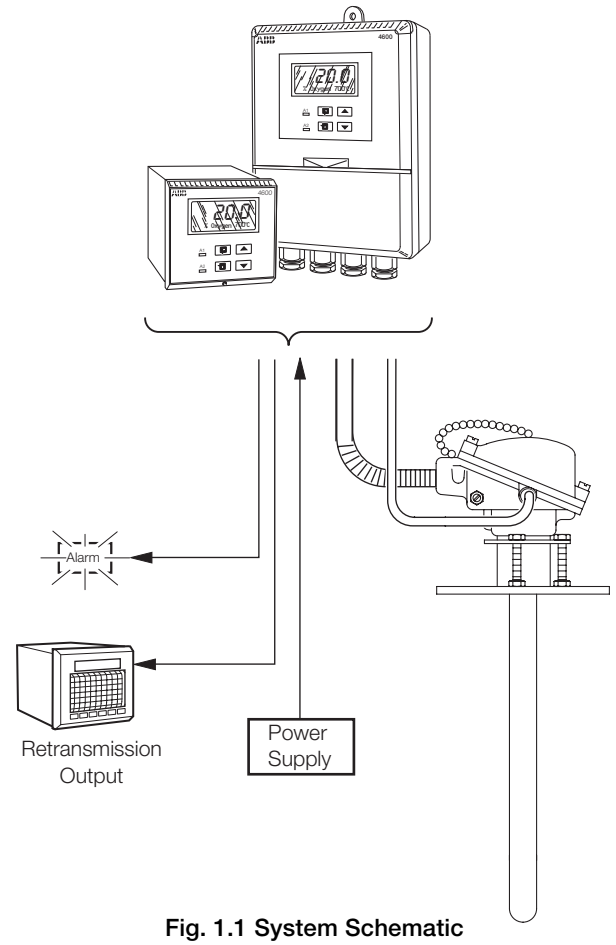


Fig. 1.1 System Schematic

2 PREPARATION

2.1 Checking the Code Number

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

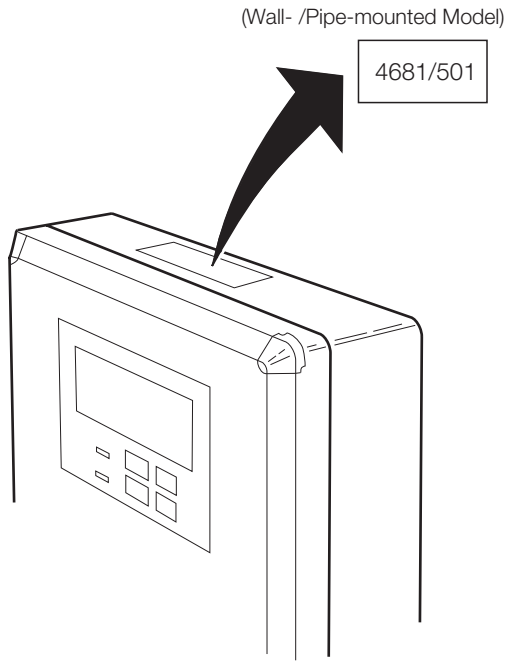


Fig. 2.1 Checking the Code Number (Model 4681)

2.1.2 Panel-mounted Instruments – Fig. 2.2

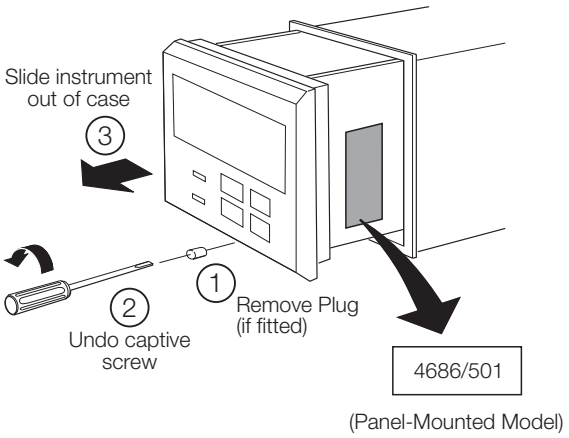


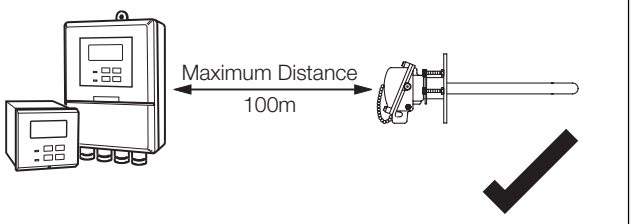
Fig. 2.2 Checking the Code Number (Model 4686)

3 MECHANICAL INSTALLATION

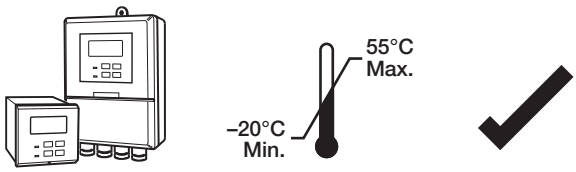
3.1 Siting Requirements

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 Probe



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

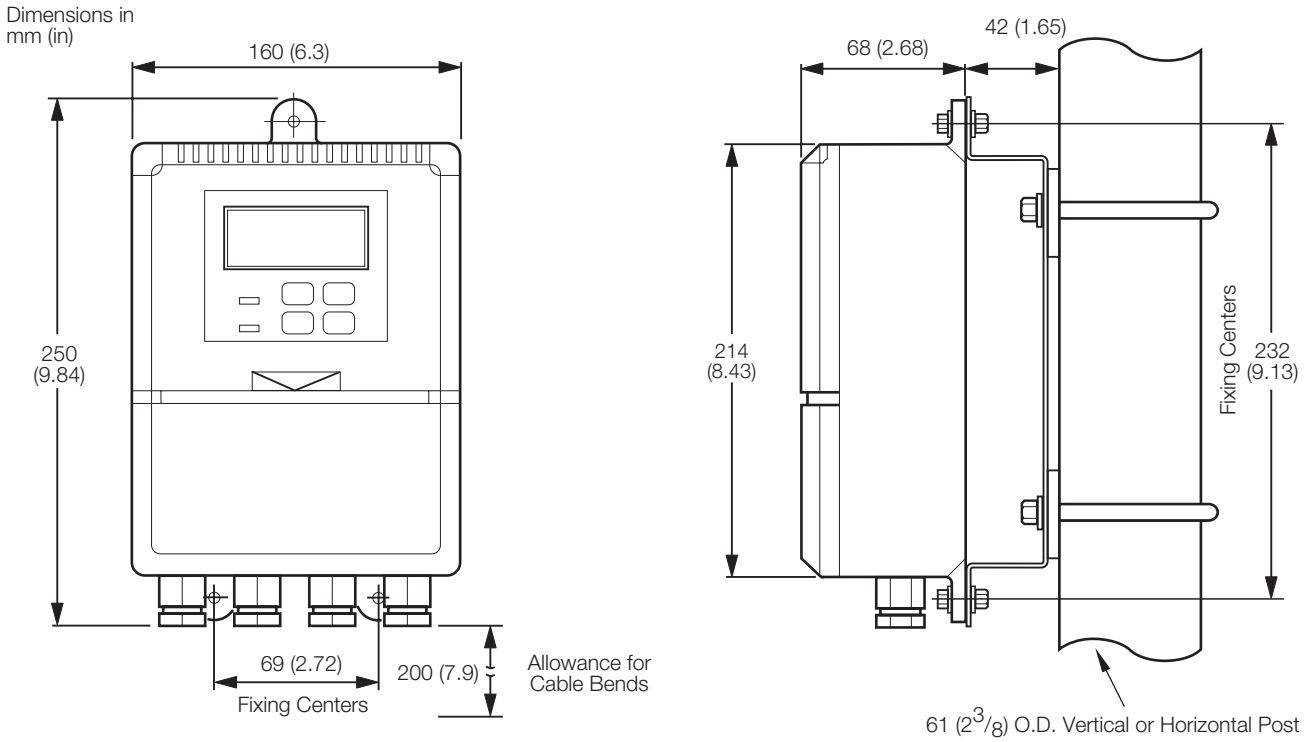
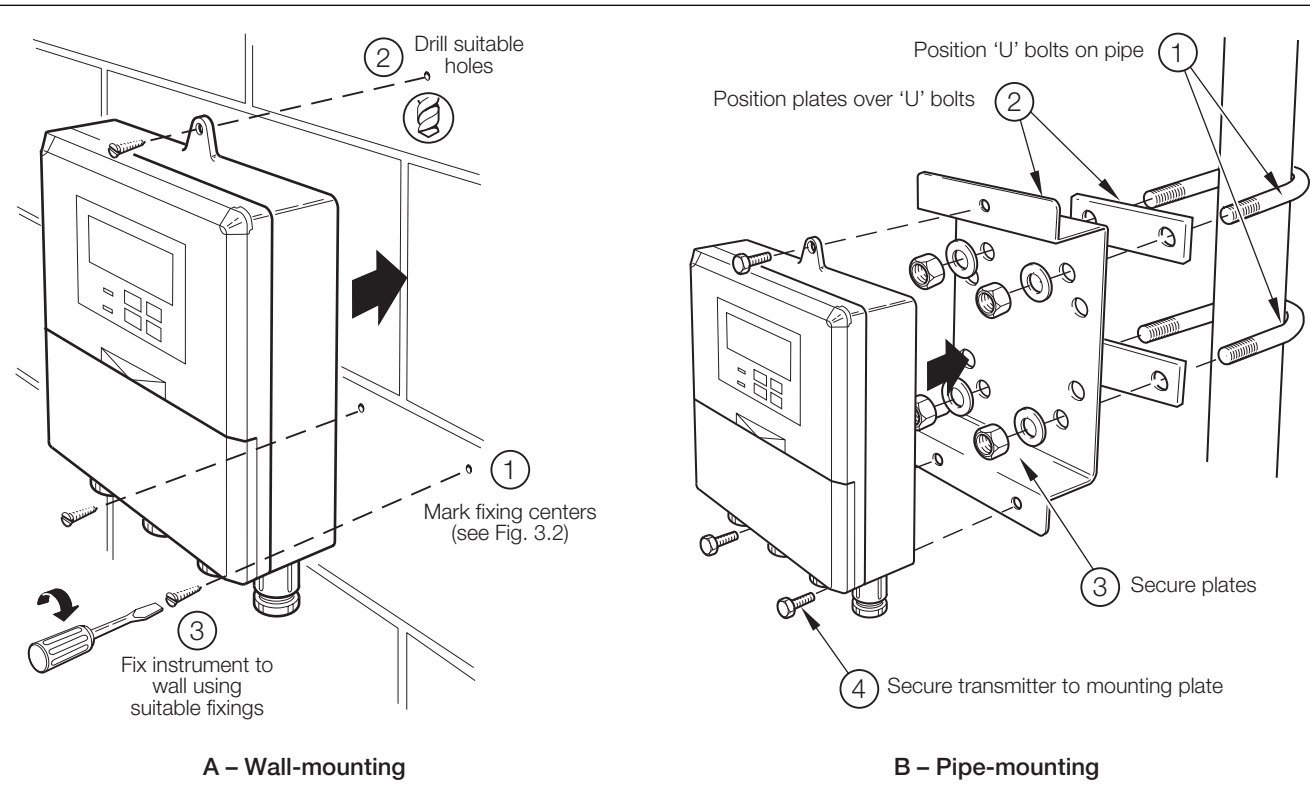


Fig. 3.2 Overall Dimensions



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

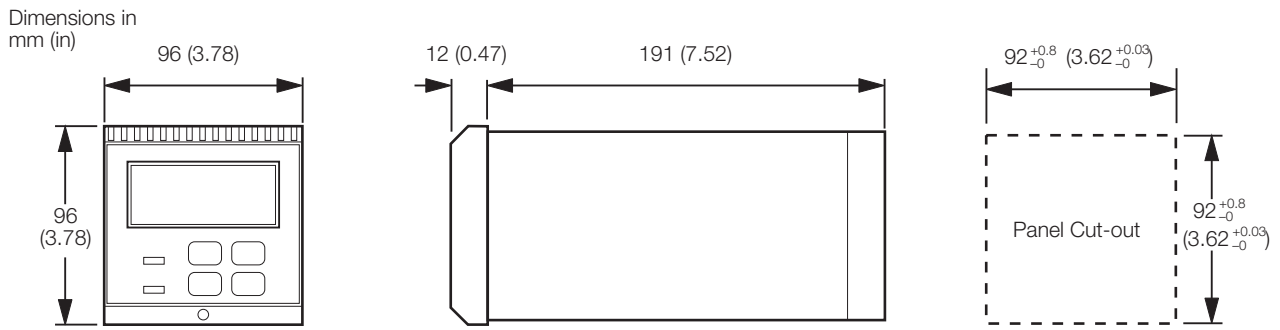
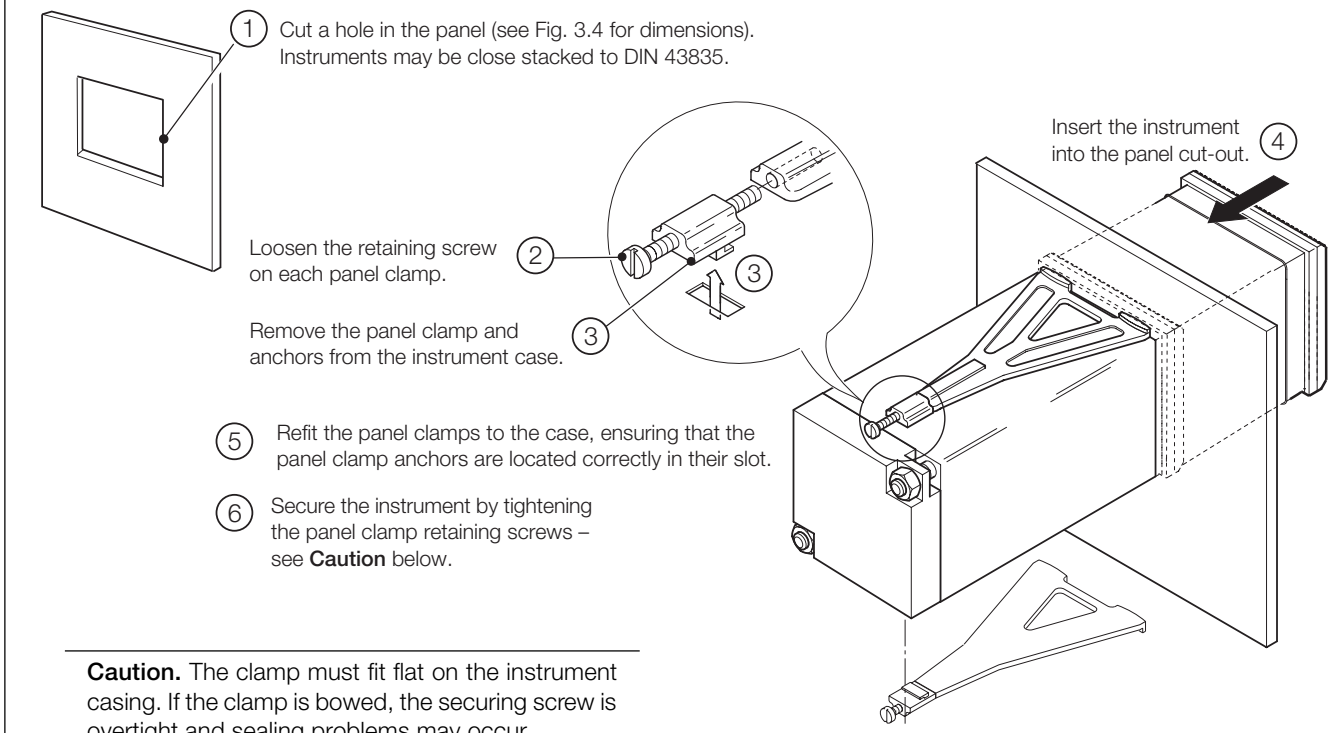


Fig. 3.4 Overall Dimensions



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

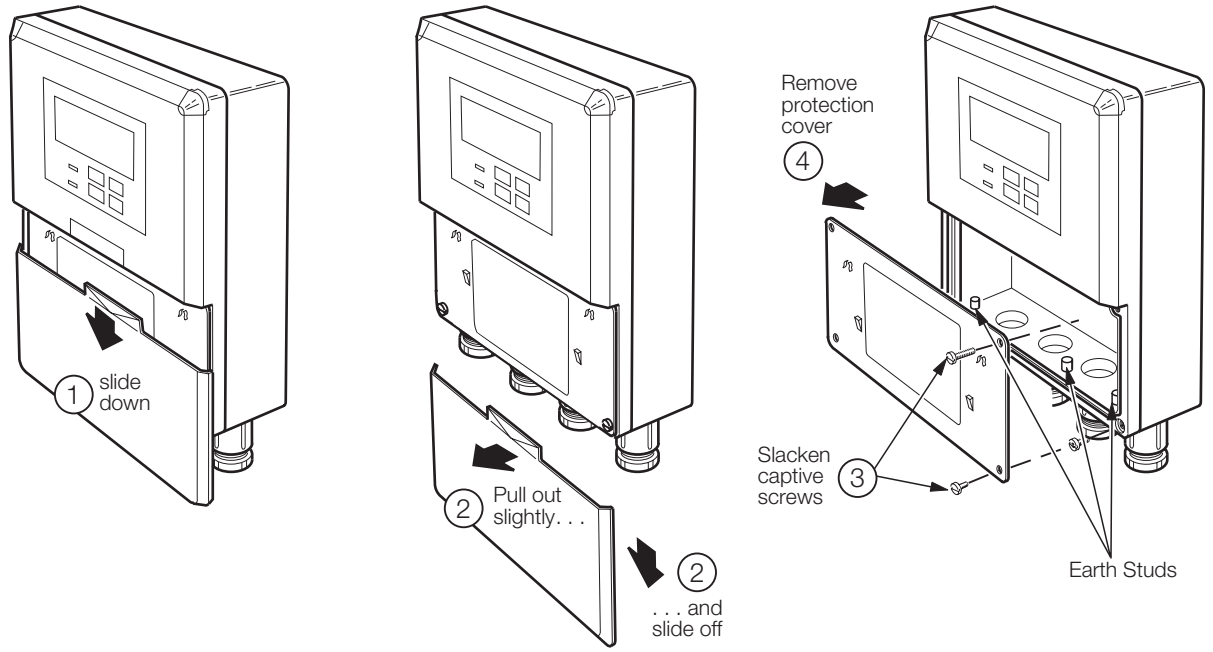


Fig. 4.1 Access to Terminals – Wall-/Pipe-mounted Instruments

4.1.2 Panel-mounted Instruments – Fig. 4.2

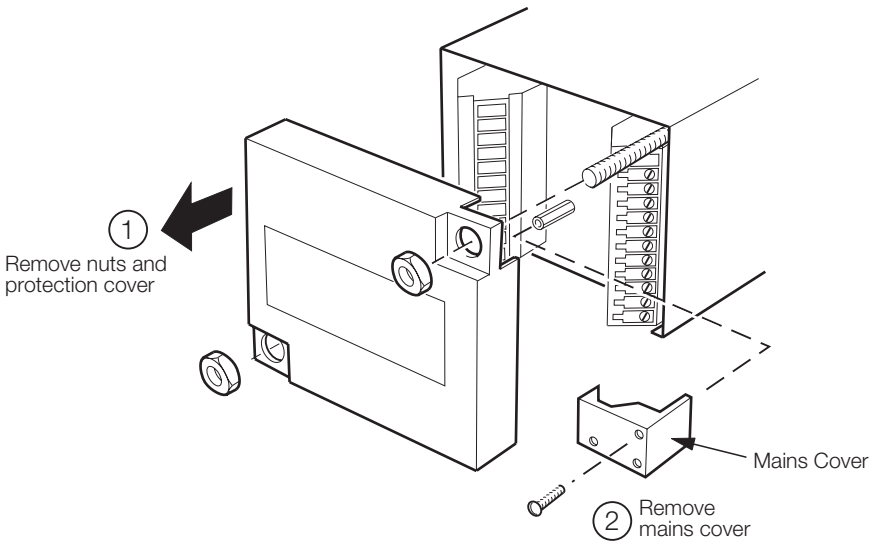


Fig. 4.2 Access to Terminals – Panel Mounted Instruments

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/O_2 probe 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.

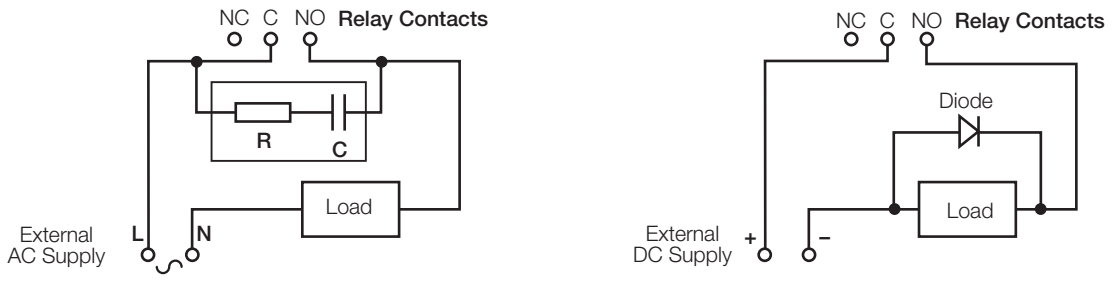
4.2.1 Relay Contact Protection and Interference Suppression – Fig. 4.3

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 AC applications or diodes for DC 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 **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. 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 **DC 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.



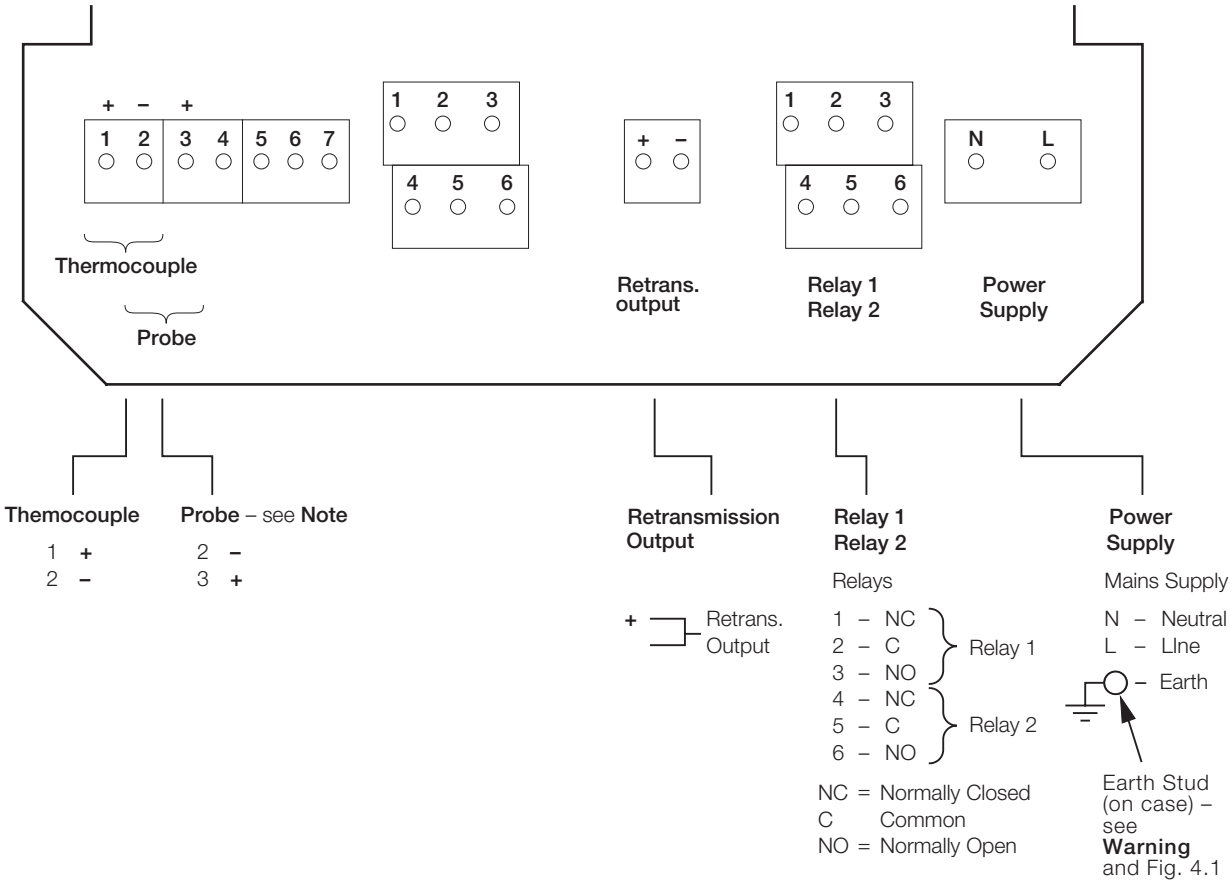
A – AC Applications B – DC Applications

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.



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 terminal.

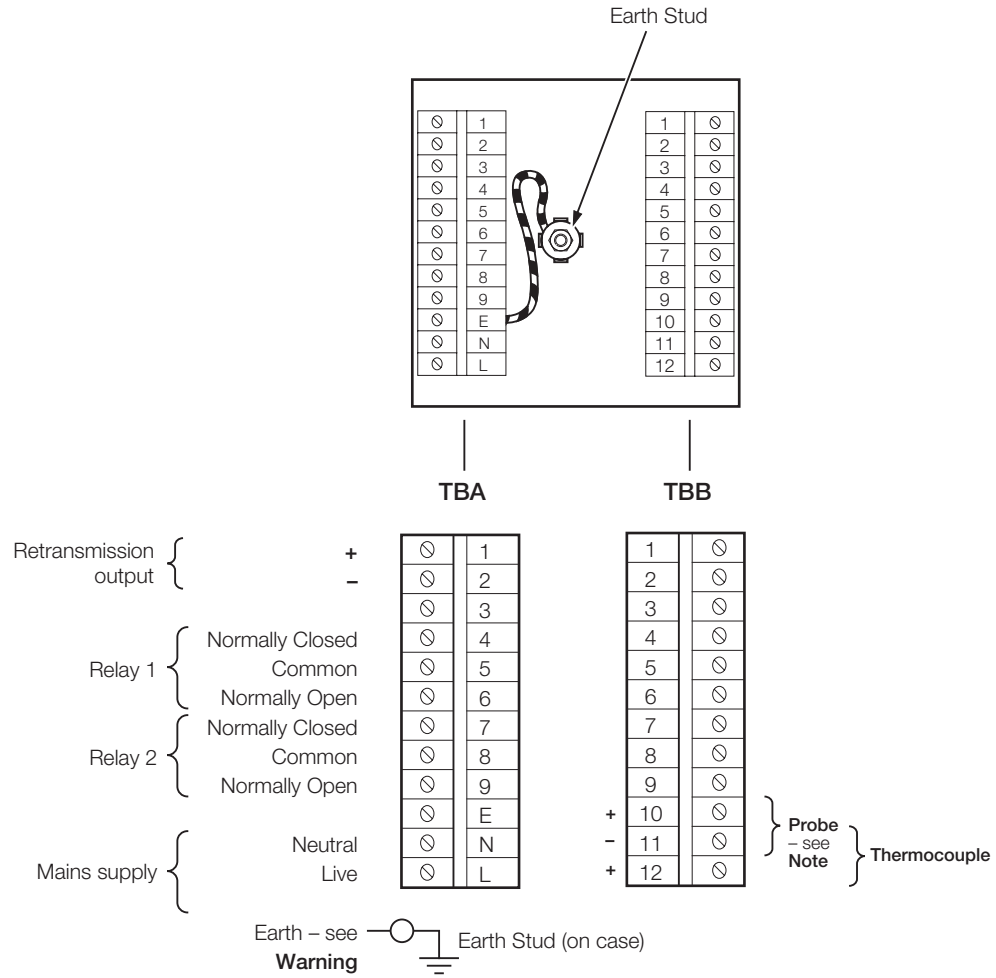
Note. Cut the probe cable braid back to the outer sheath.

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.



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.

Note. Cut the probe cable braid back to the outer sheath.

Fig. 4.5 Panel-mounted Instrument Connections

4.5 Selecting the Mains Voltage

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

Information. Use a small, flat-bladed screwdriver to remove the screw cap from the case.

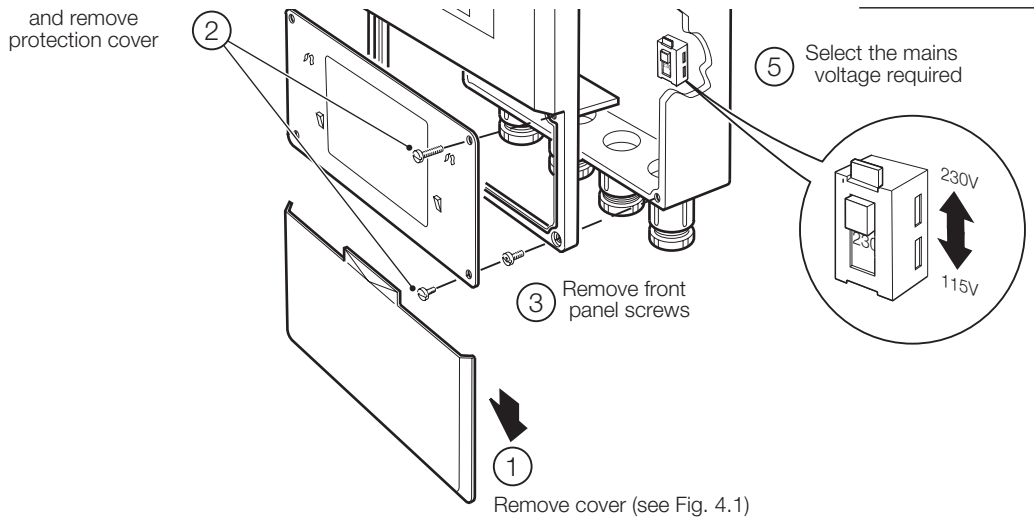


Fig. 4.6 Selecting the Mains Voltage – Wall-/Pipe-mounted Instruments

4.5.2 Panel-mounted Instruments – Fig. 4.7

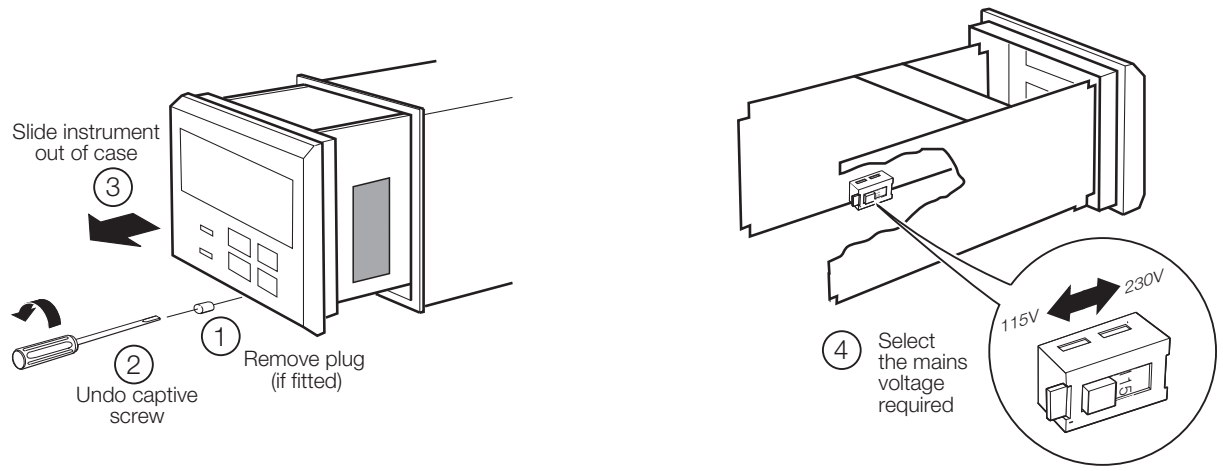


Fig. 4.7 Selecting the Mains Voltage – Panel-mounted Instruments

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. In operation, the upper display line shows actual values of % oxygen, temperature, cell millivolts or alarm set points. In programming mode it is used to display programmable parameters. The lower display line shows the associated units and/or other programming information.

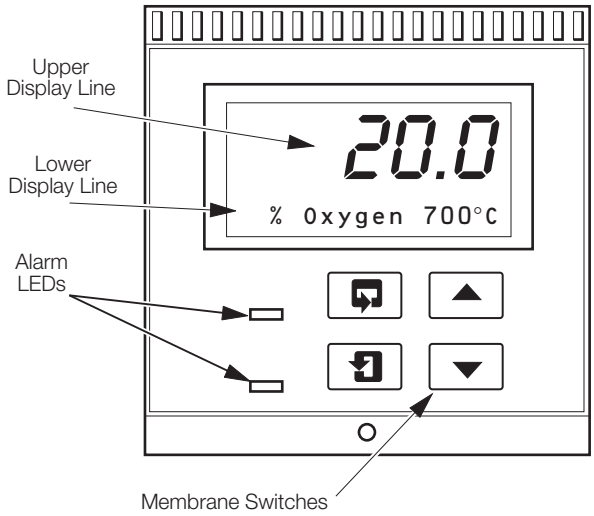
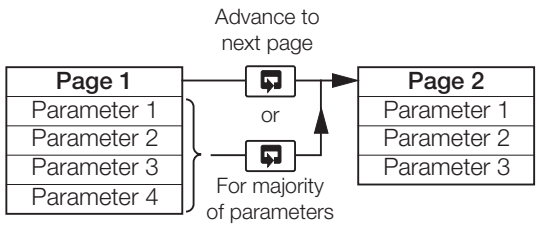
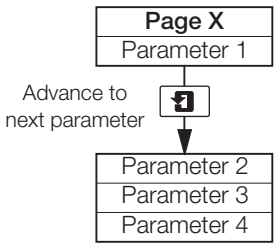


Fig. 5.1 Location of Controls and Displays

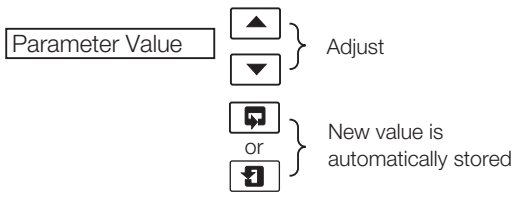
5.2 Switch Functions – Fig. 5.2



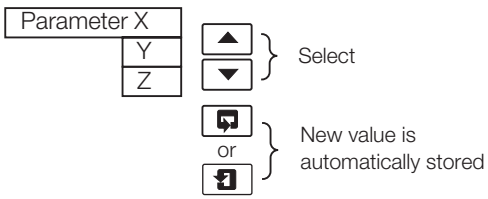
A – Advancing to Next Page



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

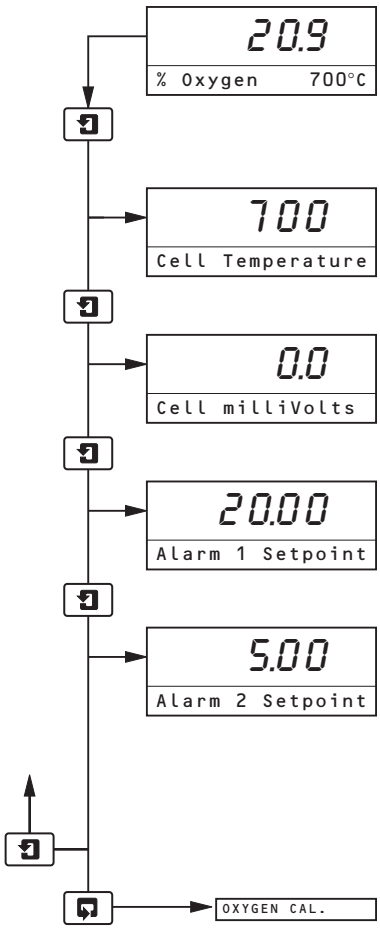
6 OPERATION

6.1 Instrument Start-up

Ensure all electrical connections have been made correctly and apply power to the instrument.

6.2 Operating Page

The operating page is a general use page in which continuously updated measured values and preset parameters can be viewed but not altered. To adjust or set a parameter refer to the programming pages in Section 7.



% Oxygen

The upper display indicates the measured oxygen value. If over or under temperature is monitored, the upper display shows '------' and an error message is displayed on the lower dot matrix display – see Section 6.3.
The lower display indicates the measured cell temperature in °C.

Cell Temperature (°C)

The upper display indicates the measured cell temperature in °C.

Cell Millivolts

The upper display indicates the measured cell millivolts.

Alarm 1 Set Point

The upper display indicates the alarm 1 set point, displayed as % oxygen. The set point value and the relay/LED action is programmed in the **Set Up Outputs Page** – see Section 7.7.

Alarm 2 Set Point

Note. This frame is not displayed if the **Alarm 2 Action** parameter has been set to `General Alarm` – see Section 7.7.

The upper display indicates the Alarm 2 set point, displayed as % oxygen.

Press [⏎] to return to the top of the **Operating Page.**

Press [⏎] to advance to the beginning of the **Oxygen Calibration Sequence.**

Note. If Alarm 2 has been programmed as a general system/instrument alarm, the associated front panel LED is illuminated when the alarm is active and Relay 2 has de-energized.

6.3 Operating Page Error Messages

If an error is detected, the appropriate error message (see table below) will replace the `% Oxygen` frame in the **Operating Page**.

Error Message	Possible Cause
`NV MEMORY ERROR`	The contents of the non-volatile memory have not been read correctly during power up. To rectify the fault, switch off, wait 10 seconds and switch on again. If the fault persists contact the Company.
`CELL UNDER TEMP`	The probe has not reached a sufficient temperature to obtain suitable readings (<600°C).
`CALIBRATION FAIL`	The last single- or two-point calibration failed.
`T/C OPEN CIRCUIT`	The thermocouple connections are open circuit or the thermocouple temperature is greater than 1200°C/2192°F (type K thermocouple) or 1500°C/2732°F (type R, S & B thermocouples).

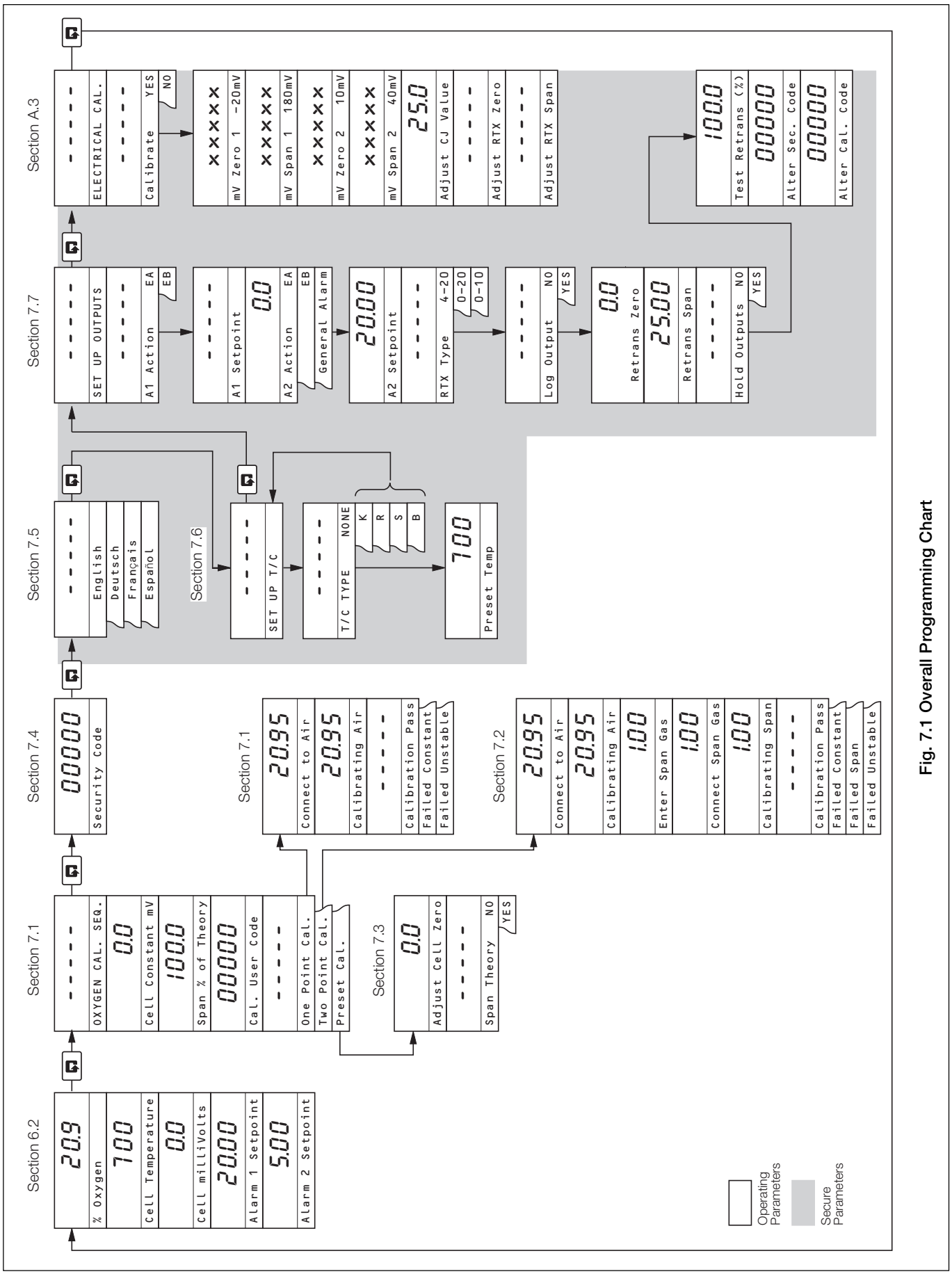
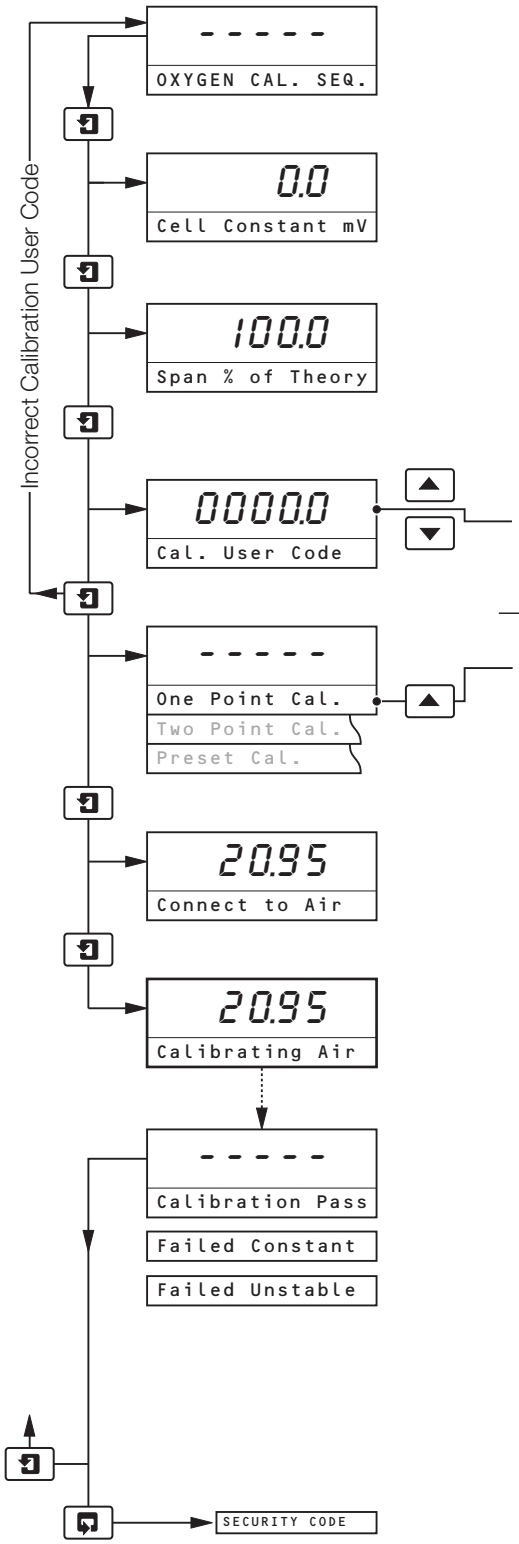


Fig. 7.1 Overall Programming Chart

Note. Before commencing a gas calibration procedure the analyzer and probe must be switched on and allowed to run for at least one hour to allow the system to stabilize thermally.

7.1 Single-point Calibration

The calibration sequence involves standardizing the analyzer and the oxygen probe, using air as the test gas. Until a calibration sequence has been completed successfully, the existing slope remains unaffected.



Oxygen Calibration Sequence

Cell Zero mV
The upper display shows the millivolt offset of the oxygen probe from the last successful calibration.

Span % of Theory
A value between 90 and 110% should be displayed. The display indicates the oxygen probe output slope using parameters derived at the last successful two-point calibration or the preset values.

Calibration User Code
[00000 to 19999]
If an incorrect value is entered, access to the calibration sequence is inhibited and the display returns to the beginning of the **Oxygen Calibration Sequence**.

One Point Calibration
Select one-point calibration sequence.

Connect to Air
Connect the air supply to the probe (refer to the probe's Operating Instructions, *IM/ZGP2*). The upper display indicates the measured % oxygen.

Calibrating Air
The upper display indicates the measured % oxygen. When a stable reading is detected the display advances automatically to the next frame. To abort calibration, press either the [⏎] or [⏎] switch.

Calibration Pass/Fail
On completion a calibration status message is displayed:

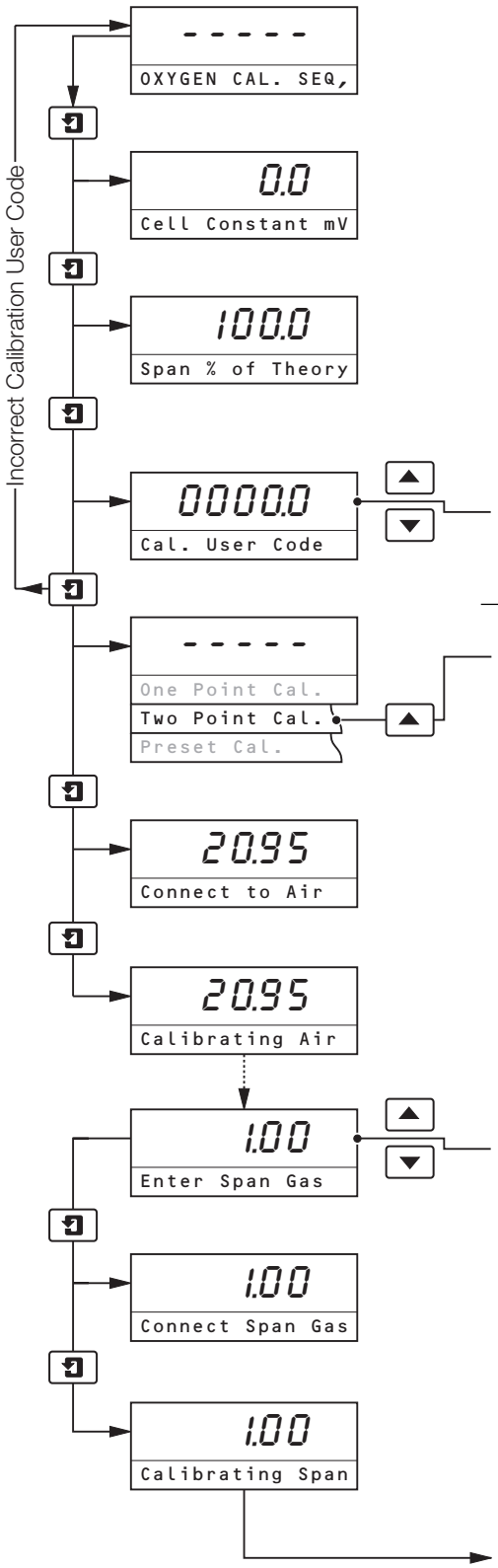
`Calibration Pass`:	Calibration sequence successful
`Failed Constant`:	Cell offset >±10mV (upper display shows cell mV output)
`Failed Unstable`:	Cell output unstable (drifting).

Note. If the sensor calibration is unsuccessful then the **Cell Zero mV** and **Span % of Theory** parameters are unaffected. The instrument continues to operate using parameters stored during the last successful calibration.

Press [⏎] to return to the beginning of the **Oxygen Calibration Sequence.**

Press [⏎] to advance to the **Secure Parameters Page.**

7.2 Two-point Calibration



Oxygen Calibration Sequence

Cell Zero mV
The upper display shows the millivolt offset of the oxygen probe from the last successful calibration.

Span % of Theory
A value between 90 and 110% should be displayed. The display indicates the oxygen probe output slope using parameters derived at the last successful two-point calibration or the preset values.

Calibration User Code
[00000 to 19999]
If an incorrect value is entered, access to the calibration sequence is inhibited and the display returns to the beginning of the **Oxygen Calibration Sequence**.

Two Point Calibration
Select the two-point calibration sequence.

Connect to Air
Connect the air supply to the probe (refer to the probe's Operating Instructions, *IM/ZGP2*). The upper display indicates the test gas value in % oxygen.

Calibrating Air
The upper display indicates measured % oxygen. The display advances automatically to the next frame when a stable reading is detected. To abort calibration, press either the ⏎ or ↩ switch to advance to the next frame.

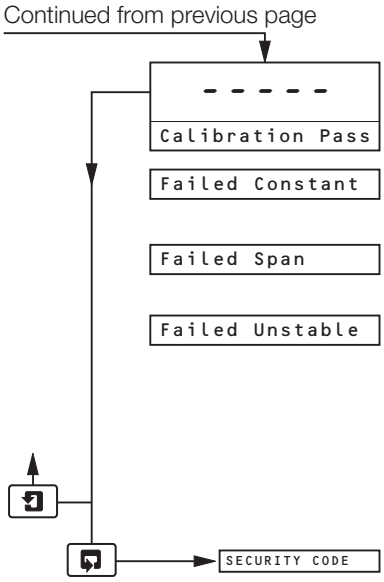
Enter Span Gas
[between 0.10 and 10.00% O_2]
Set the oxygen content of the gas used to calibrate the span.

Connect Span Gas
Connect the span gas to the probe (refer to the probe's Operating Instructions, *IM/ZGP2*). The upper display indicates the test gas value in % oxygen.

Calibrating Span
The upper display indicates measured % oxygen. The display advances automatically to the next frame when a stable reading is detected. To abort calibration, press either the ⏎ or ↩ switch to advance to the next frame.

Continued on next page.

...7.2 Two-point Calibration



Calibration Pass/Fail
On completion a calibration status message is displayed.

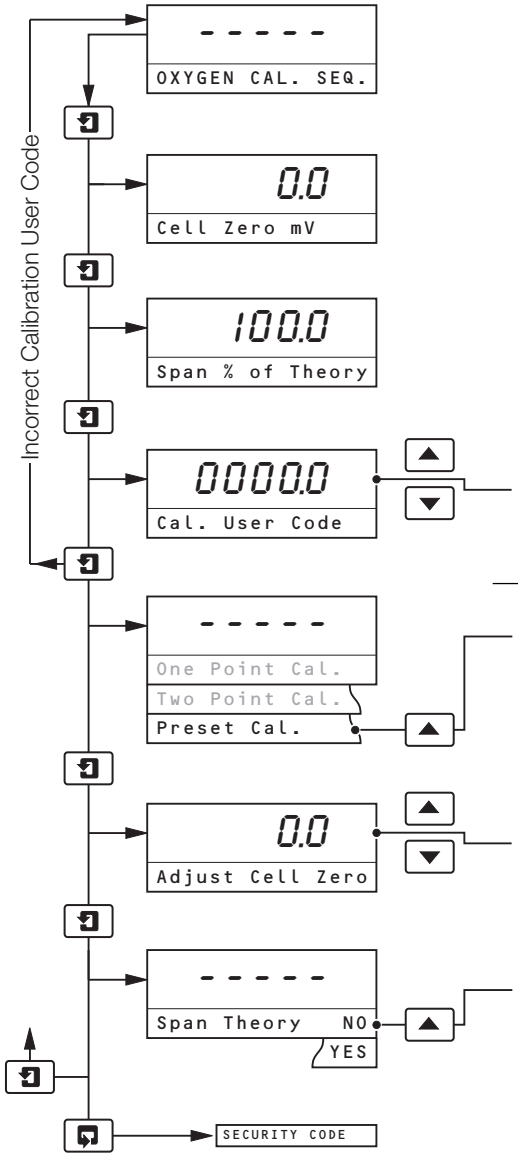
Calibration Pass:	Calibration sequence successful
Failed Constant:	Cell offset >±10mV (upper display shows cell constant)
Failed Span %:	Cell output <90% or >110% of slope (upper display shows measured slope)
Failed Unstable:	Cell output unstable (drifting).

Note. If sensor calibration is unsuccessful then the **Cell Zero mV** and **Span % of Theory** parameters are unaffected. The instrument continues to operate using parameters stored during the last successful calibration.

Press ◱ to return to the beginning of the **Oxygen Calibration Sequence.**

Press ◱ to advance to the **Access to Secure Parameters Page.**

7.3 Preset Calibration



Oxygen Calibration Sequence

Cell Zero mV
The upper display shows the millivolt offset of the oxygen probe from the last successful calibration.

Span % of Theory
A value between 90 and 110% should be displayed. If the value is outside these limits then the oxygen probe must be checked.

Calibration User Code
[00000 to 19999]
If an incorrect value is entered, access to the calibration sequence is inhibited and the display returns to the beginning of the **Oxygen Calibration Sequence**.

Preset Calibration
Select the preset calibration sequence.

Adjust Cell Zero
[0 to ±10mV]
The upper display shows the cell output (in mV) corresponding to a reading of 20.95 $\%O_2$. Adjust the reading to correspond with the probe.

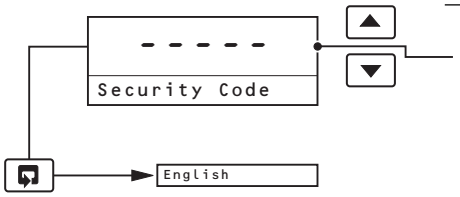
Span Theory
Select **YES** if the **Span % of Theory** parameter is to be reset to 100%. Select **NO** to retain the existing value.

Press ⏎ to return to the beginning of the **Oxygen Calibration Sequence.**

Press ⏎ to advance to the **Access to Secure Parameters Page.**

7.4 Access to Secure Parameters Page

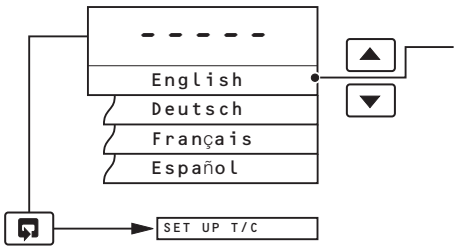
A 5-digit security code is used to prevent tampering with the secure parameters.



Security Code
[00000 to 199999]
If an incorrect value is entered, access to programming pages is inhibited.

Press ↵ to advance to the **Language Selection Page**.

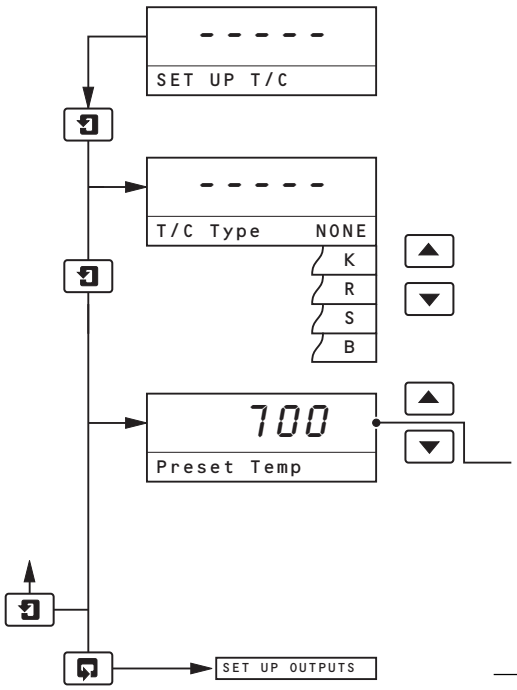
7.5 Language Selection Page



Language Selection
Select the language in which all text is subsequently displayed:
English
German
French
Spanish

Press ↵ to advance to the **Set Up Thermocouple Page**.

7.6 Set Up Thermocouple Page



Set Up Thermocouple
Page header

Thermocouple Type
Set the thermocouple type required: Type **K**, **R**, **S**, **B** or **NONE**. If thermocouple type is set to **NONE**, a preset temperature must be used – see below.

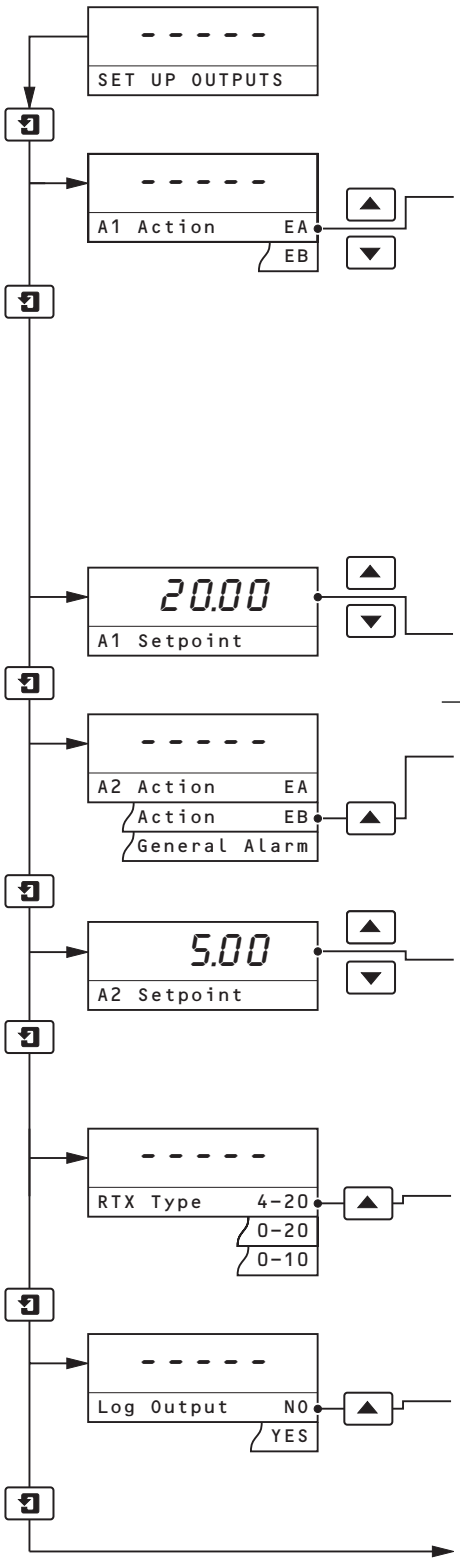
Preset Temperature
If a thermocouple is not used, set the process temperature.
[600 to 1400°C in 1°C steps]

Note. This frame is not displayed unless **Thermocouple Type** is set to **NONE**.

Press ◱ to return to the beginning of the **Oxygen Calibration Sequence.**

Press ◱ to advance to the **Set Up Outputs Page.**

7.7 Set Up Outputs Page



Set Up Outputs
Page header

Alarm A1 Action
Set the required alarm action from the following table:

Alarm Action	LED Action		Relay Action	
	Input Above Set Point	Input Below Set Point	Input Above Set Point	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 fixed at 0.1% of 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 set point can be set to any value within the oxygen range. [0.00% to 25.00%]

Alarm A2 Action
Set the required alarm action from the above table.
If the alarm action is set to `General Alarm`, the relay is de-energized and the associated front panel LED is illuminated when one or more of the following conditions is true: thermocouple open circuit; cell warming up; calibration fail, cell stability check, power failure.

Alarm A2 Set Point
The alarm set point can be set to any value within the oxygen range of 0.3% to 25.0%.

Note. This frame is not displayed if the **Alarm 2 Action** parameter has been set to `General Alarm`.

Retransmission Type
The retransmission output is assigned to the oxygen range.
Select the retransmission output current range required (4 to 20mA, 0 to 20mA or 0 to 10mA).

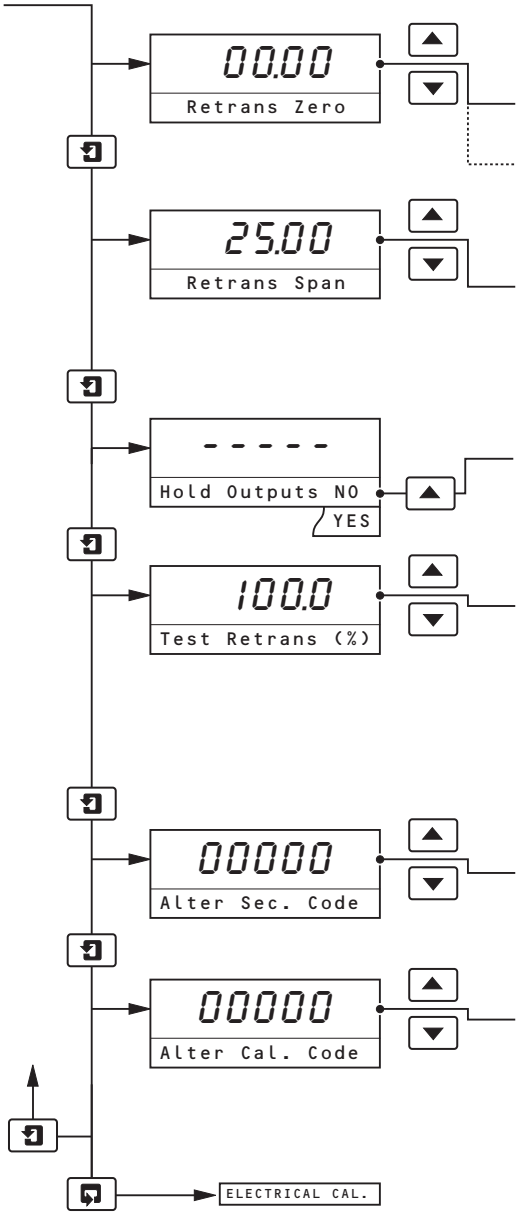
Logarithmic or Linear Output
The retransmission can be assigned to give a logarithmic or linear output.
Select the output required:

`YES` – Logarithmic
`NO` – Linear

Continued on next page.

...7.7 Set Up Outputs Page

Continued from previous page



Retransmission Zero
Set the required retransmission zero value, in % oxygen units.
[0% to 20.00% (linear output)]
or
[0.01% to 0.25% (logarithmic output)].

Retransmission Span
Linear Output – Set the required retransmission span value, in % oxygen units.
[5% to 25.00%]
Logarithmic Output – The retransmission span is preset to two decades above the zero value and cannot be adjusted. For example, if the zero is set to 0.2%, the span is preset to 20.00% .

Hold Outputs
The retransmission and alarm outputs can be held to prevent inadvertent operation during a test gas calibration sequence.

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

Example. When the Retransmission Current Range is set to `0-20` (mA) and the Test Retransmission signal is set to `50%`, the retransmission output value is forced to 10mA.

Alter Security Code
[00000 to 199999]
Set the security code used to gain access to secure parameters – see Section 7.4.

Alter Calibration Code
[00000 and 199999]
Set the code used to gain access to the **Oxygen Calibration Sequence** – see Sections 7.1 to 7.3.

Press ⏎ to return to the top of the **Set Up Outputs Page.**

Press ⏎ to advance to the **Electrical Calibration Page.**

APPENDIX A – ELECTRICAL CALIBRATION

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

A1 Equipment Required

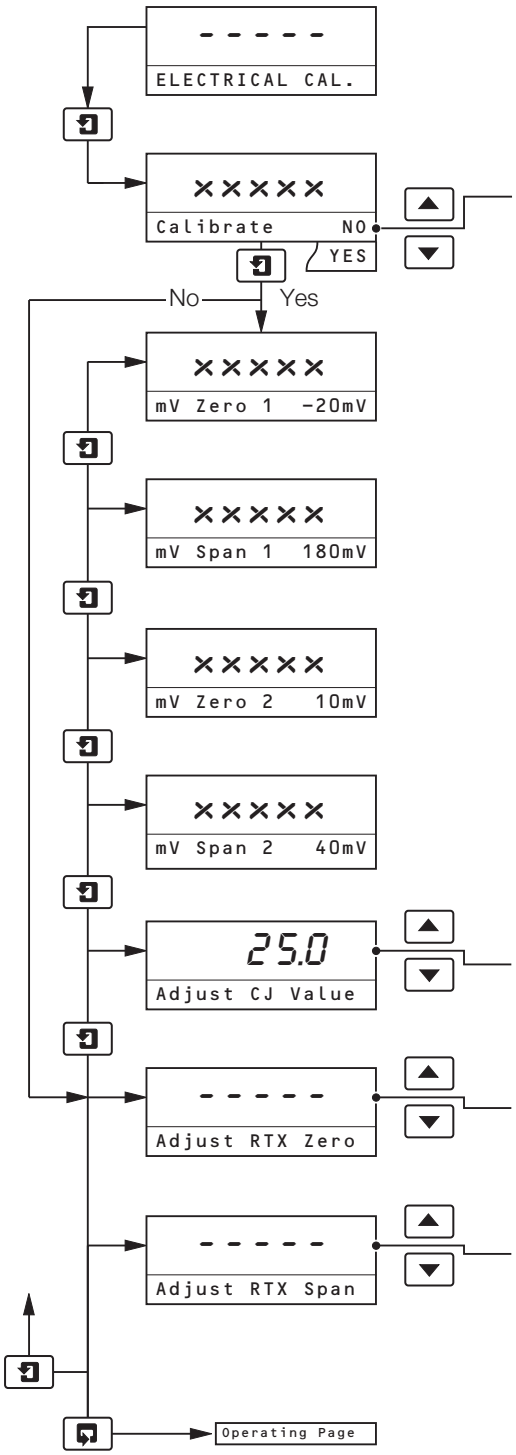
a) Millivolt source (cell input simulator), –20.0 to 180.0mV.
b) Millivolt source (temperature input simulator), 10.0 to 40.0mV.
c) Digital voltmeter (current output), 0 to 20mA.
d) Thermometer, to measure ambient temperature.

A2 Preparation

a) Switch off the mains supply. Disconnect the probe and retransmission output terminations from the instrument – see Fig. 4.4 or 4.5.
b) Connect the millivolt sources and the milliammeter to the appropriate terminals – see Fig. 4.4 or 4.5.
c) Switch on the mains supply to the instrument and allow ten minutes for the circuits to stabilize.
d) Select the **Electrical Calibration Page** and proceed as detailed in Section A3.

A3 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 Page
(To access this page refer to Fig. 7.1).

Calibrate
Select **YES** to access the electrical calibration sequence. Select **NO** to advance to the **Adjust RTX Zero** parameter.

mV Zero 1
Set the Cell simulator millivolt source to –20mV and allow the display to stabilize.

mV Span 1
Set the Cell simulator millivolt source to 180mV and allow the display to stabilize.

mV Zero 2
Set the Temperature simulator millivolt source to 10mV and allow the display to stabilize.

mV Span 2
Set the Temperature simulator millivolt source to 40mV and allow the display to stabilize.

Adjust Cold Junction Value
Measure the ambient temperature and set the display to the measured value, in °C.

Adjust RTX Zero
Adjust the display until the milliammeter reads the minimum retransmission level, i.e. 4mA.

Adjust RTX Span
Adjust the display until the milliammeter reads the maximum retransmission level, i.e. 20mA.

Press ↵ to return to the top of the **Electrical Calibration Page**.

Press ↵ to return to the **Operating Page**.

NOTES

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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.

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