SERVOMEX
ANALYZERS
HIGH-PERFORMANCE GAS ANALYSIS

SERVOTOUGH OxyExact 2200

OPERATOR MANUAL

Part Number: **02210001A**
Revision: **4**
Language: **UK English**

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xendos 2200
Operator Manual

Ref: 02210/001A/4
Order as part no. 02210/001A

Table of Contents

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List of Figures

List of Tables

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1 INTRODUCTION

1.1 Warnings, Cautions and Notes

This manual includes **WARNINGS**, **CAUTIONS** and **NOTES** which provide information relating to the following

WARNINGS

Hazards which could result in personal injury or death.

CAUTIONS

Hazards which could result in equipment or property damage.

NOTES

Alert the user to pertinent facts and conditions.

1.2 Scope of this manual

This manual covers commissioning and operation of Servomex Xendos 2200 series products.

Details of installation, technical specification and spares are held in the relevant installation manual, along with a description of system attributes. Refer to the following documents:

Type 2210 Control Unit; manual part number 02210/005A

Type 2213 Control Unit; manual part number 02213/005A

Type 2222 Transmitter; manual part number 02222/005A

Type 2223 Transmitter; manual part number 02223/005A

Contacts for technical assistance and spares are given at the back of this manual.

A service manual, part number 02200002A, is available for use by qualified personnel.

About this manual

Ref: 02210/001A/4

Order as part no. 02210001A

1.3 Overview of this manual

Section 2 provides details related to the commissioning of a system including power-up.

Section 3 provides an overview of the appearance and use of the user interface and includes simple examples. **This section may be omitted if the user is already familiar with the 2200 user interface.**

Section 4 provides details of password protection. **This section may be omitted if the user has already set up password protection.**

NOTE

The 2200 is supplied with factory configured passwords. These are listed in Section 4. The user may wish to change passwords before placing the system into general operation.

Section 5 provides initial system setup information, ensuring that the control unit is communicating with all transmitters. **This section may be omitted if the system has already been configured.**

NOTE

Section 5 includes the configuration of the date/time parameters.This information may be required if the control unit has been left unpowered for some time.

Section 6 provides transmitter setup information, including details of the software installed in the transmitter. It excludes calibration; see Section 8. **This section may be omitted if all transmitters are already configured.**

Section 7 provides control unit setup information, including details of the software installed in the controller. **This section may be omitted if the control unit is already configured.**

Section 8 provides transmitter calibration information, including autocalibration.

2 COMMISSIONING

It is assumed that the control unit and at least one transmitter unit have been installed in accordance with the requirements of the appropriate installation manual (these are referenced in Section 1.2).

2.1 Warm-up time

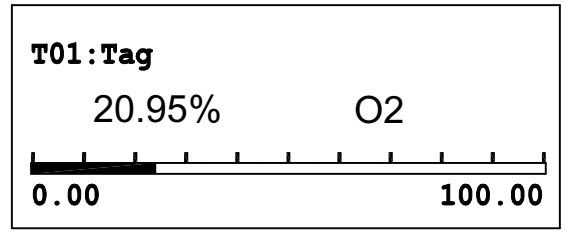
Electrical power is supplied separately to the transmitter unit and the control unit. Either unit may be switched on first.

The control unit will be operational as soon as power is applied.

Transmitters must be allowed to warm up for typically one hour. It is recommended that the transmitter and associated sample conditioning system are flushed with a clean, dry, gas (typically nitrogen) during this period.

Once the automatic start-up sequence has been completed, the control unit display will show one of the options in Table 1.

Table 1 Control unit display options

Display	Description
	A transmitter unit is registered and enabled. See Section 5 to commence setup. If more than one transmitter is connected it will be necessary to **register** additional units; see Section 5.
No Transmitters Registered	It is required to 'register' at least one or more transmitter units to proceed. See Section 5 to **register** transmitters.
A black rectangle obliterates the reading **Transmitter Not Responding**	No response from transmitter unit. Check electrical power to transmitter unit. Check cable continuity.
XXXXXX	A transmitter unit is registered, but is disabled. It must be enabled to proceed. See Section 5 to **enable** a transmitter.

The gas concentration may appear in 'reverse video'; additional messages and icons may also be present.

2.2 Display contrast adjustment

The control unit display contrast may be adjusted if necessary. The adjustment trimpot is accessed through the metal cover on the rear of the hinged door, via a small hole in the side furthest away from the hinge.

2.3 Shutdown procedure

Before disconnecting electrical power, the sample conditioning system and transmitter should be flushed with a clean, dry gas. This will reduce the possibility of condensation and subsequent corrosion of the measuring cell.

Ensure that all sources of electrical power, including those to relay contacts or other inputs/outputs, are disconnected.

After power-off, the analyser parameters will be retained in software indefinitely. However, the real-time clock settings are only retained for typically 14 days. If the clock settings are lost a status alarm will be active at the next power-up.

2.4 2200 Transmitter calibration gas requirements

The 2200 Transmitter requires two calibration gases with known oxygen concentrations.

2.4.1 Low calibration gas

For most applications this is nitrogen.

2.4.2 High calibration gas

It is recommended that this gas is at least 5% oxygen greater than the low concentration gas.

This will be typically air (20.95% oxygen) or pure oxygen.

NOTE

Ambient air contains water vapour which has the effect of reducing the oxygen content compared to a dry gas. If ambient air is used it should either be passed through a dryer or through the complete sampling system to ensure that the moisture content is the same as the sample gas.

A molecular sieve dryer may significantly alter the oxygen content of the gas.

Consideration of the sample gas dew point may demand that sample gas is not passed through the transmitter unit until warm-up is completed. This prevents the possibility of condensation in the measuring cell which may result in damage.

3 THE USER INTERFACE

3.1 Display and keypad

The 2200 user interface is a 'menu' driven system, controlled by the keypad. A number of 'forms' then enable the user to view system information and change the configuration of the analyser.

This section describes the operation of the keypad and the display, and navigation through the display menus and forms.

It is assumed that commissioning has been completed and that, after pressing the MEASURE key (Item 5, below), the control unit display is similar to that shown in Figure 1.

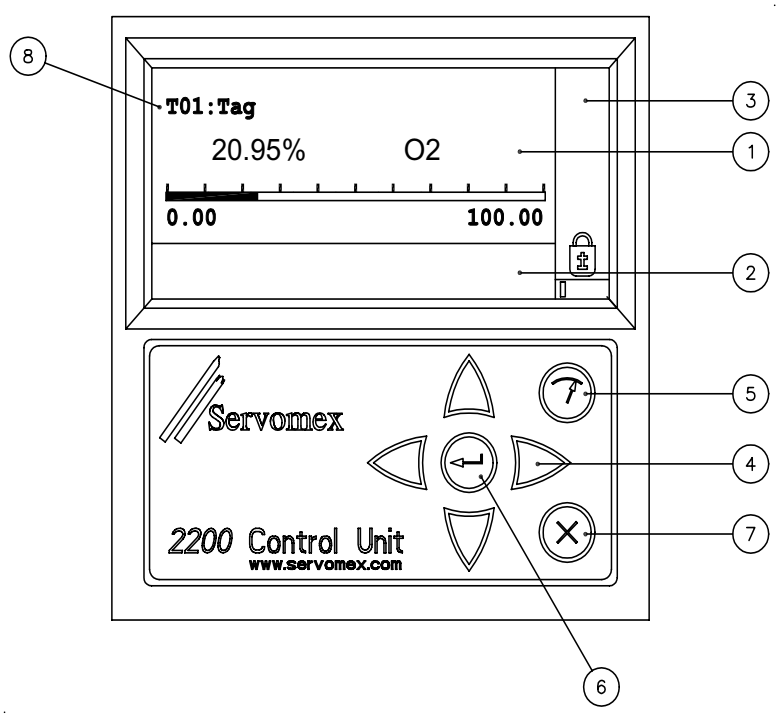


Figure 1 Control unit display and keypad

Key to Figure 1

1 - Main pane
2 - Lower pane
3 - Status pane
4 - CURSOR keys: up, down, left and right
5 - MEASURE key
6 - ENTER key
7 - CANCEL key
8 - Transmitter identity or TAG

3.1.1 Display

The 2200 display is split into three sections; see Figure 1.

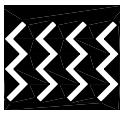
Main pane: Under normal operation this shows the measurement and relevant TAG information as shown in Figure 1. On switch-on it may also show other messages as given in Table 1. The pane is also used to display all menus and forms.

Lower pane: Under normal operation this pane is clear. It is used to display messages, help text and to facilitate data entry.

Scroll indicators will appear in the pane when there are more than four lines of messages. The CURSOR keys may be used to scroll the pane.

Status pane: Under normal operation this shows the locked padlock and an activity monitor as shown in Figure 1. Other icons may appear; see Table 2.

Table 2 Status pane icons

Icon	Description
	Scroll. Shown when a form extends beyond the current viewable area. Horizontal arrows indicate that more than one measurement screen has been configured.
	Fault. Measurement is invalid.
	Maintenance required (for example, a failed calibration).
	Service in progress (for example, autocalibration).
	Warming up. Transmitter not yet at operating temperature.
	Alarm. Sample gas concentration alarm is active.
	Password. Numeral indicates the password level that is enabled. A locked padlock (see Figure 1) indicates that no password is active.
	Activity. Indicates the control unit software is running.

NOTE

If the unit has been powered up for the first time, the maintenance icon will be visible and the maintenance message '`Date/time not set`' **will** be present in the lower pane.

It is not necessary to eliminate entries in either the lower or status panes to proceed with the examples later in this section.

3.1.2 Keypad

There are seven keys on the keypad; see Figure 1.

The four CURSOR keys are used to scroll displays and select menu and form options.

The ENTER key is used to confirm a selection or action and move to the next operation, menu or form as appropriate. **It is also used to access the menu structure from the normal measurement screen.**

The MEASURE key returns the display to the measurement screen. If pressed in order to quit from a form (whilst in edit mode), all parameter changes made to the form will be cancelled.

The CANCEL key typically cancels the current operation. Again, if pressed in order to quit from a form (whilst in edit mode), all parameter changes made to the form will be cancelled. Repeated use of the key will return to the measurement screen.

3.2 Examples

NOTE

The 2200 Control Unit user interface offers a choice of the following languages:

English (default)
French
German

Details of language selection are held in Section 5. However, password entry prohibits change by a user not familiar with the user interface.

The following examples, therefore, assume that the user language is English.

3.2.1 Menu screen

Each menu screen presents a list of options, which can be selected using the CURSOR keys. The selection will appear in 'reverse video' and is confirmed by pressing the ENTER key.

The top level `Menu` screen is shown in the main pane simply by pressing the ENTER key; see Figure 2.

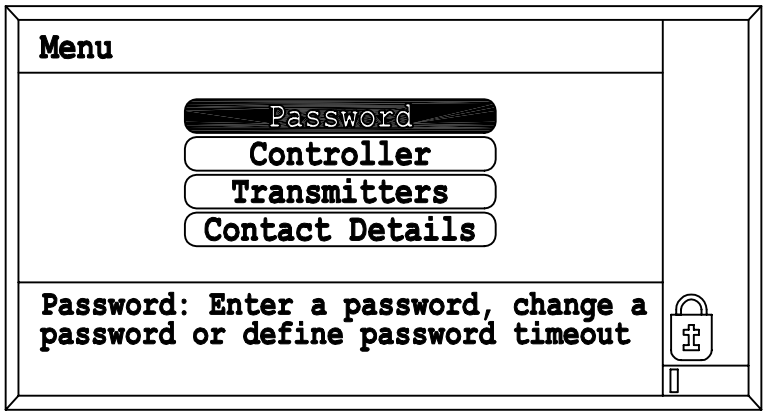


Figure 2 Menu screen

In Figure 2, the name of the menu is on the top line.

The lower pane includes descriptive 'help' text relating to the selected option.

Use the CURSOR keys to highlight different options, noting the change in help text with each option.

Use the MEASURE key to return to the measurement screen.

3.2.2 Form screen

A form contains 'fields'. There are three types of field:

An editable field enables the user to change the analyser configuration

A non-editable field contains information

An action field performs the function described in the field.

From the top level Menu screen found in Figure 2, select Contact Details and press the ENTER key. The Contact Details form will be displayed; see Figure 3.

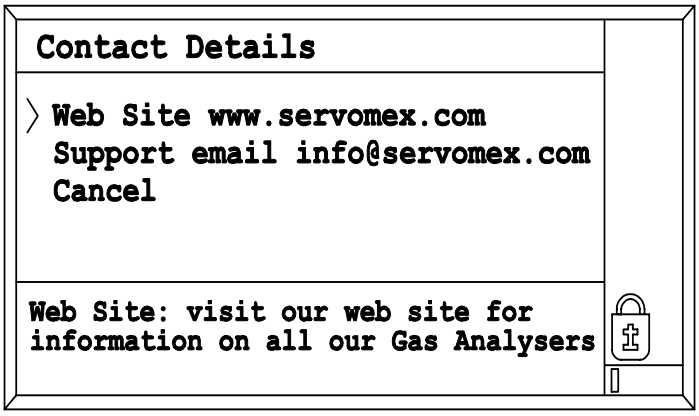


Figure 3 Contact Details form

A form screen has an arrow in the left hand margin which provides additional information:

A solid arrow ▶ indicates that the field can be edited.

An open arrow > indicates that the field is display only **or** that the field cannot be edited at the current password level.

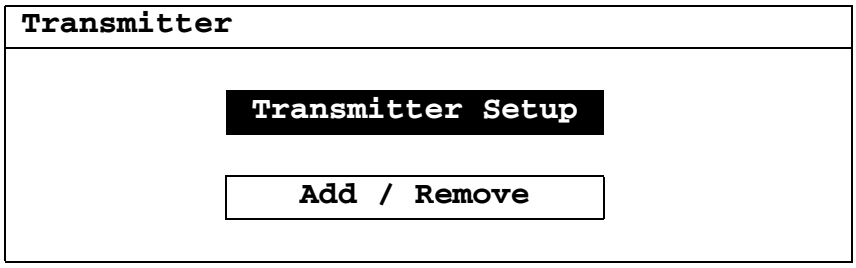
Use the CURSOR keys to scroll down the form. None of the fields in the current form are editable, however, the Cancel function represents an example of an action field.

Use the CANCEL or MEASURE key to go back up the menu structure, alternatively select the Cancel entry on the form and press the ENTER key.

3.2.3 Viewing the calibration gas target values

This example leads the operator through a number of menus and forms to ultimately review calibration target concentrations associated with a transmitter. It is assumed that a type 2223 Transmitter is registered as 'T01'.

1. From the main Menu, select Transmitters using the CURSOR keys and press ENTER to display the Transmitter menu:



2. Select Transmitter Setup using the CURSOR keys.

3. Confirm choice by pressing ENTER to display the `Select Transmitter` form; see Figure 4.

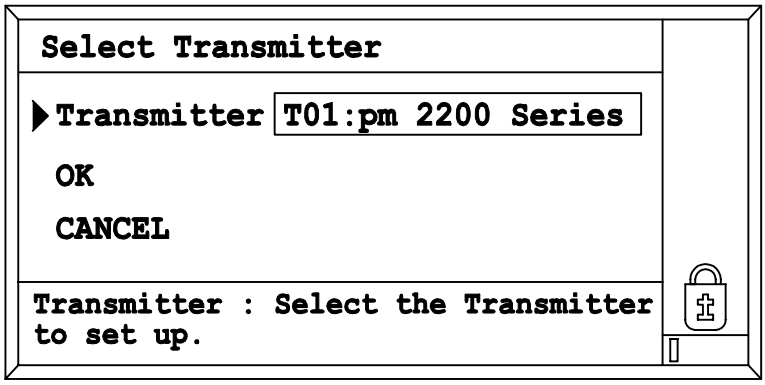
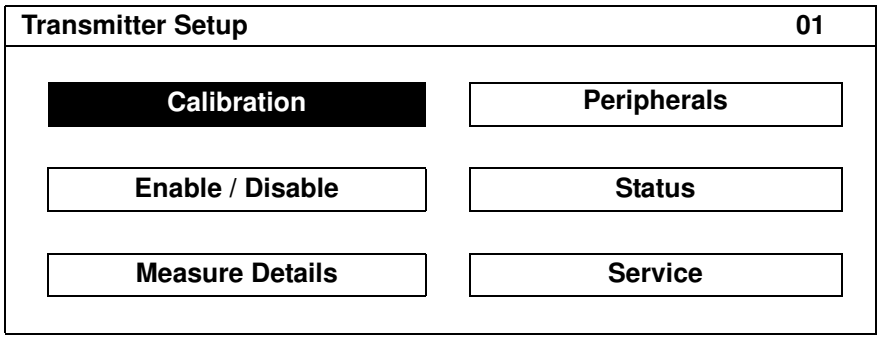
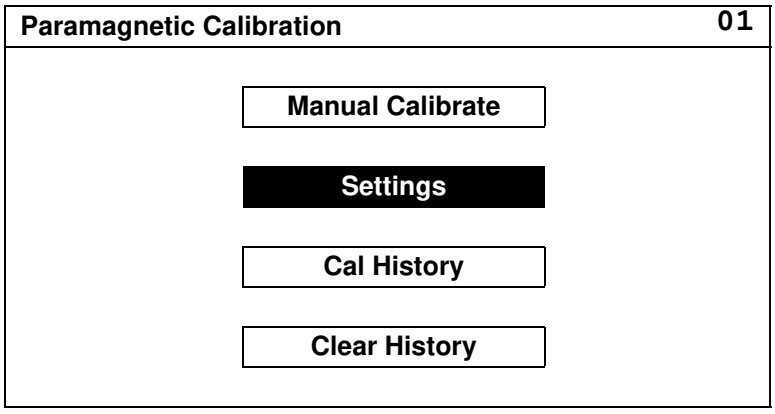


Figure 4 Select Transmitter form

4. Select `OK` using the CURSOR keys.
5. Confirm choice by pressing ENTER to display the `Transmitter Setup` menu. Note that '01' (top right) is the identity of the transmitter.



6. Select `Calibration` by pressing ENTER to display the `Paramagnetic Calibration` menu:



7. Select `Settings` using the up/down CURSOR keys.
8. Confirm choice by pressing ENTER to display the `Calibration Settings` form.

This form is one of the longer forms in the system. To see the complete form, it is necessary to use the up/down CURSOR keys. Users should note the appearance of the scroll icons at the top of the status pane.

9. Press MEASURE to return to the measurement pane.

3.3 Summary

The menu structure is accessed by pressing the ENTER key.

A copy of the menu structure is held in Appendix B.

Use the up/down CURSOR keys to select a parameter (highlighted by 'reverse video').

Press the ENTER key to confirm the choice.

Scroll indicators show when a form extends beyond the display screen.

Press CANCEL to go back one level.

Press MEASURE to return to the measurement screen.

NOTE

Operations so far have been limited, by password, to view only. A password must be entered in order to amend settings.

The next section should be treated as a continuation of 'examples' for the novice user.

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4 PASSWORDS

Passwords control access to operation of the analyser system. The 2200 incorporates five levels:

Password	Function	Parameters which can be changed
Level 0 (locked)	Viewing measured value and other parameters	None
Level 1	Calibration of the analyser system	Initiate calibration functions Password for Level 1
Level 2	Setup of routine functions and parameters	As Level 1, plus target levels for calibration, alarms, analog output ranges etc. Password for Levels 1 and 2
Level 3	Configure the complete analyser system, including transmitter units	All functions appropriate for normal operation Password for Levels 1,2 and 3
Level 4	Service	All functions Password for all Levels

The active password level is shown in the icon at the bottom of the status pane (see Section 3.1.1).

The password need only be entered once to change a series of parameters. Access, however, will time out if no key is pressed within a pre-set time.

In subsequent sections of this manual the minimum password level to change parameters for each operation is given.

4.1 Default passwords

As delivered the 2200 analyser system has the following default passwords:

Level 1 - 111111

Level 2 - 222222

Level 3 - 333333

Level 4 - 444444

NOTE

Passwords for all levels should be changed in order to protect the analyser system from unauthorised operation.

Passwords should be kept in a secure place.

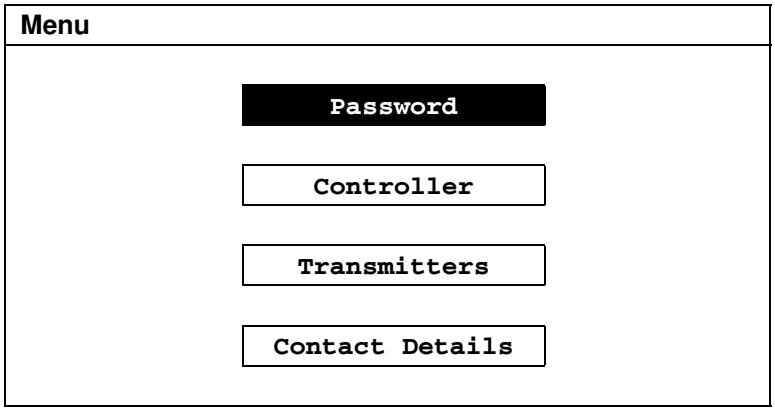
It is strongly recommended that the Level 4 password is only used in emergencies to reset 'forgotten' lower level passwords.

If the Level 4 password is lost, it will be necessary to contact Servomex for recovery details.

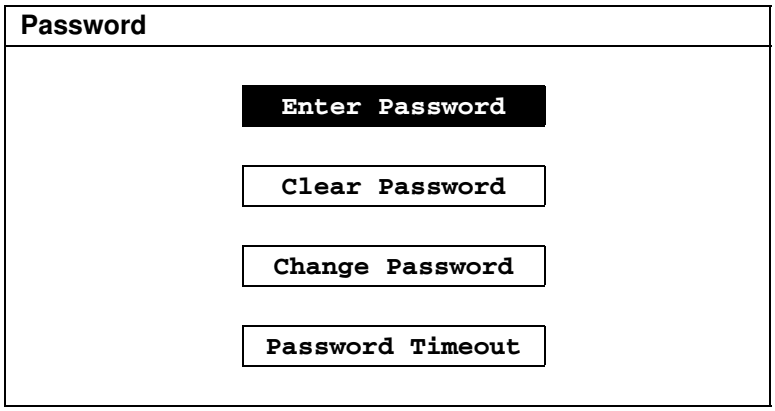
4.2 Entering the password

Minimum user level: 0

1. From the measurement pane, press ENTER to access the `Menu`:



2. Select `Password` by pressing the ENTER key:



3. Select `Enter Password` by pressing ENTER key to display the `Password Entry` form; see Figure 5.

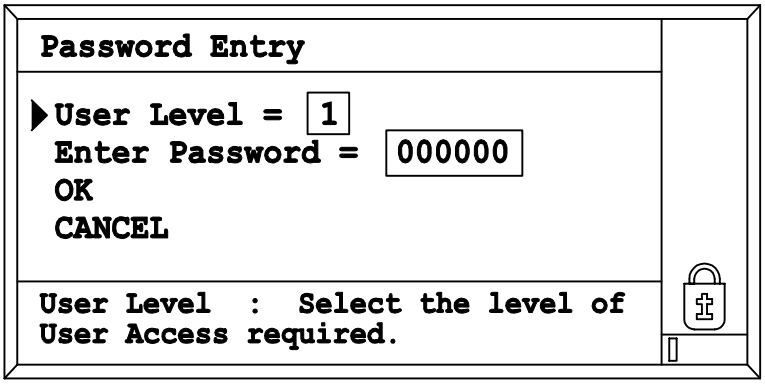


Figure 5 Password Entry form

4. Select `User Level` by pressing the ENTER key. The entire text line is now boxed, indicating that this entry is being edited. A number selection box appears in the lower display pane.
5. Use the CURSOR keys to select the appropriate level and press ENTER.
6. Select `Enter Password` using the CURSOR keys and press ENTER. The entire text line is now boxed, indicating that this field has been accessed for editing.
7. **Press the down CURSOR key.**
8. A number selection box appears in the lower display pane.
9. Select the first digit of the password using the CURSOR keys.
10. Press ENTER to confirm this choice and automatically move to the second digit. The CANCEL key may be used to 'restart' from step 6 above.
11. Repeat steps 9 and 10 to complete the password. There will be a six number entry and the entire text line will still be boxed. If the password is correct, press the ENTER key; this removes the box from the entire text line indicating that the field is no longer being edited.
12. Press the down CURSOR key to select `OK` (or `Cancel` if desired) and press ENTER to confirm. If the new password is accepted, the password icon will change. If it is not accepted, a message will appear in the lower pane.

4.3 Other password forms

4.3.1 Clear password

This clears the current password level before the timeout period (see Section 4.3.3).

4.3.2 Change password

Minimum user level: 1, 2, 3 or 4 as relevant to the password level being changed.

Access to this form will be blocked unless a valid non-zero level password is active.

The `Change password` form is similar to the `Enter password` form, however, the user is asked to enter the new password in two places. The second confirms the change.

4.3.3 Password timeout

Minimum user level: 3

The automatic password timeout feature is used to prevent the analyser system being inadvertently left with an active password.

The timeout begins from the last valid keypress (not from password entry time). At the end of the timeout period, the unit will revert to the measurement pane with level zero password.

The default password timeout is 5 minutes.

It is recommended that this is set to the minimum consistent with convenient operation.

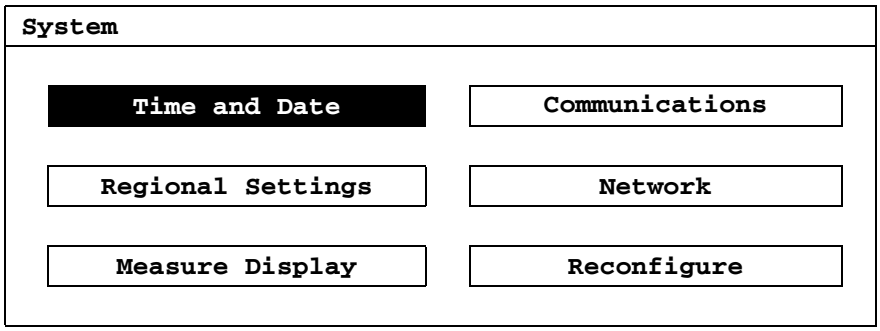
5 INITIAL SYSTEM SETUP

This section configures the basic parameters of the system. These parameters will be common to all units connected to the system.

5.1 Regional (language), date and time settings

Minimum user level: 3

1. From the main `Menu` select `Controller` and confirm by pressing ENTER to display the `Controller` menu.
2. Select `System` and confirm by pressing ENTER to display the `System` menu:



5.1.1 Regional (language) settings

1. From the `System` menu select `Regional Settings` and press ENTER to display the `Regional Settings` form:

Regional Settings	
Language	Select as appropriate from the drop down list displayed in the lower pane
Date Format	Select as appropriate
Date Separator	Select as appropriate
Time Separator	Select as appropriate
Decimal Point Symbol	Select as appropriate
OK	**Accepts the new settings**
Cancel	Cancels changes and exits the form

2. Select the fields to edit using the ENTER key.
3. Confirm choice with `OK` and return to the `System` menu.

5.1.2 Time and date

The control unit is fitted with a real-time clock. It does not, however, recognise daylight saving time. In the event of power-off the clock settings are retained for typically 14 days; if the clock settings are lost the 'Date/time not set' maintenance status will be active.

1. From the `System` menu select `Time & Date` and press ENTER to display the `Time & Date` form:

Time & Date	
Date	Set to the correct date
Time	Set to the correct time
OK	**Accepts the new settings**
Cancel	Cancels changes and exits the form

2. Select the fields to edit using the ENTER key. Remember to press the down CURSOR key to show the numerical keypad.
3. Confirm choice with `OK` and press ENTER to return to the `System` menu.

5.2 Registering transmitter units

Minimum user level: 3

A 2200 system shall consist of at least one transmitter unit connected to a control unit.

As despatched, control units are usually configured to recognise a single transmitter unit. This is identified as 'T01' (under TAG; see Figure 1).

If more than one transmitter unit is connected, the additional units must be 'registered' before the control unit will communicate with them.

NOTE

Registering is necessary if a new transmitter is subsequently added to the system.

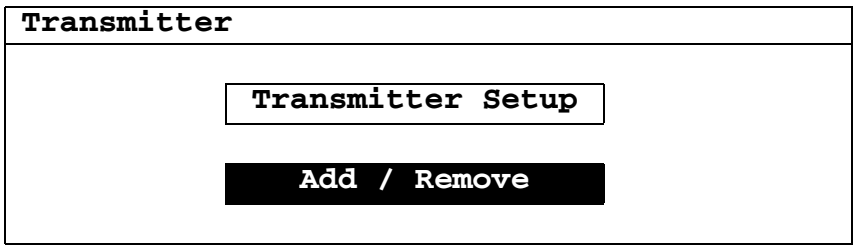
It is essential that every transmitter on a single system is uniquely identified.

Transmitter identity is set on a switch within the transmitter, refer to the installation manual.

(The 'T01' identifier corresponds to the address switch position.)

It is advisable to unregister a transmitter if it is to be permanently removed from the system or replaced by a similar unit. The new unit should be registered in the normal way.

1. From the Main menu select Transmitters and confirm by pressing ENTER to display the Transmitter menu:



2. From the Transmitter menu select Add / Remove and press ENTER to display the Add / Remove Transmitters form:

Add / Remove Transmitters	
Find Unregistered Transmitters	Scans the system to detect any unregistered transmitters
Unregistered	Displays a list of unregistered transmitters
Add	Adds the selected transmitter to the registered list
Remove	Removes the selected transmitter from the registered list
Registered	Displays a list of registered transmitters
OK	**Accepts the new settings**
Cancel	Cancels changes and exits the form

3. Select Find Unregistered Transmitters and press ENTER. **This action may take several seconds.**
4. Select Unregistered and press ENTER to display the list of currently unregistered units.
5. Select the transmitter unit to register from the list using the up/down CURSOR keys and confirm by pressing ENTER.
6. Select Add and confirm by pressing ENTER. This will move the relevant transmitter from the Unregistered list and place it on the Registered list.
7. Repeat steps 5 and 6 to register more units if necessary.
8. **Confirm choice with OK.**
9. Press the MEASURE key to confirm that the transmitter unit measurement is displayed. If more than one transmitter unit is enabled it may be necessary to scroll through the screens (look for horizontal scroll arrows).

10. If the measurement is not present, check the list of registered transmitters and ensure the transmitter has been enabled; see Section 5.3.

5.3 Enabling/disabling transmitter units

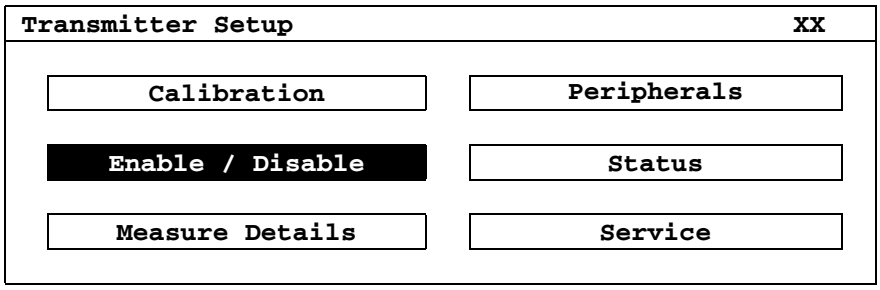
Minimum user level: 3

The default condition for a newly registered transmitter unit is 'Enabled'. A transmitter unit may be 'Disabled' to remove its signals from the analyser system without losing any of the setup settings. This may be useful, for example, during analyser system maintenance.

1. From the `Main` menu select `Transmitters` and press ENTER.
2. From the `Transmitter` menu select `Transmitter Setup` and press ENTER to display the `Select Transmitter` form:

Select Transmitter	
Transmitter	Select a transmitter from a drop down list
OK	**Accepts the selection**
Cancel	Exits the form

3. Select `Transmitter`, press ENTER to display the list of currently registered units, select the transmitter unit to enable/disable from the list using the up/down CURSOR keys and confirm by pressing ENTER.
4. Select `OK` and press ENTER to display the `Transmitter Setup` menu. Note that the transmitter identity is confirmed by a two digit code, 'XX', in the top corner.



5. Select `Enable / Disable` and confirm choice by pressing ENTER to display the `Paramagnetic Enable / Disable` form:

Paramagnetic Enable / Disable	**XX**
Transmitter Enable	A transmitter must be enabled to appear on the system
OK	**Accepts the new settings**
Cancel	Cancels changes and exits the form

6. Select `Transmitter Enable` and press ENTER. Select `Yes` or `No` as appropriate and press ENTER.
7. Select `OK` to return to the `Transmitter Setup` menu.

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6 TRANSMITTER CONFIGURATION

An overview and details of hardware interface requirements, for each transmitter, is given in the appropriate installation manual.

This section concentrates on configuring the transmitter hardware interfaces. Calibration procedures are held in Section 8.

Transmitters must be registered and enabled to allow further configuration.

6.1 Model 2200 paramagnetic oxygen transmitter

Section 6.1.1 contains details of the measurement configuration, including:
- applying filtering to the measurement output
- changing the measurement units, for example from % to vpm
- entering TAG information
- the transmitter software part number.

Section 6.1.2 contains details of the input/output ('peripherals') configuration for:
- the analog (mA) output
- relay (status) outputs, reference NAMUR 64
- analog inputs
- external flow alarm inputs
- internal flow alarm
- digital inputs
- cross-interference compensation
- pressure compensation
- turning the heater off for servicing.

Section 6.1.3 gives an overview of more advanced features:
- reviewing status history (and resetting)
- clearing status messages
- forcing the transmitter status to `service in progress`
- viewing service diagnostics
- performing a transmitter 'reset'.

6.1.1 Measure (TAG) details

As supplied, the 2200 is configured to measure oxygen in percentage terms. It is possible to change the measurement units and description.

A TAG number may also be entered. This will appear on the control unit display alongside the measurement; see Figure 1.

Minimum user level: 3

Progress to the `Transmitter Setup` menu for the relevant transmitter (menu path: `Main - Transmitters - Transmitter Setup` then select transmitter by Txx identifier).

Select `Measure Details` and press ENTER to display the `Measurement Details` form:

Measurement Details **XX**		**User Values**
Filter Factor	Increase the filtering to improve the signal to noise ratio of the output signal (default is no filtering) 0 is no filtering, 30 is maximum filtering A high filter factor will increase the response time of the measurement	
Units	A five character label that appears on the display alongside the measurement value. **The scaling factor for the units is set below.**	
Units Scale Factor	The transmitter measurement is always equivalent to % oxygen. Derived units may obtained by applying a scale factor (eg: factor 1 = %, factor 10000 = vpm). This factor will effect all units-related information, e.g.: Calibration gas target values Analog output Concentration alarms	
Tag	A twelve character display label for a user Tag number	
Transmitter Type	The type of transmitter unit	
Software Identity	The software version installed in the transmitter	
OK	**Accepts the new settings**	
Cancel	Cancels changes and exits the form	

Note that changes to the scale factor may result in out of range numbers in certain fields. Where this occurs, an out of range indication (e.g. ^^^^^^) will appear in the field. These should be edited to acceptable values accordingly.

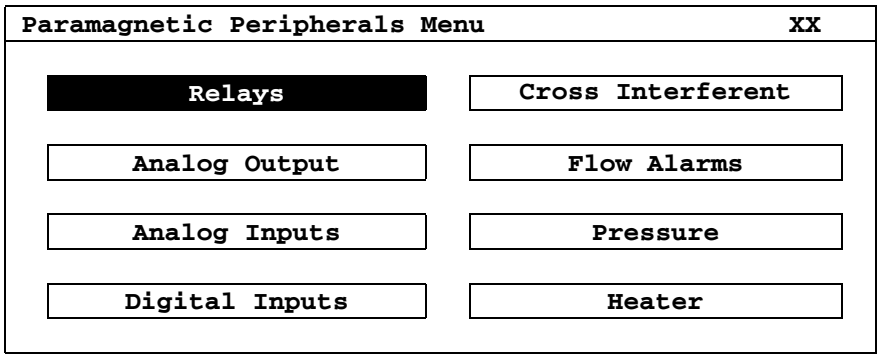
6.1.2 Transmitter unit peripherals

Peripherals will usually be set up as part of initial commissioning.

It is not necessary to configure unused peripherals.

Peripherals may be simply turned on or off (`Enabled/Disabled`) as appropriate.

All peripherals are configured from the `Paramagnetic Peripherals Menu` (select `Peripherals` from the `Transmitter Setup` menu):



6.1.2.1 Analog output

Minimum user level: 2

The analog output includes a test facility that allows the operator to set the output to any value up to 22mA. This test condition is only present for five minutes after initiation. The output also reverts to normal operation as soon as the form is closed.

To configure the output, select `Analog Output` from the `Paramagnetic Peripherals Menu` and press ENTER to display the `Analog Output Settings` form:

Analog Output Settings XX		**User Values**
Output Current Range	Select 0-20mA or 4-20mA	
Analog Output Enabled	Must be `Yes` for the output to be operative	
Measurement 1	For 0/4-20mA operation: the low gas concentration value of the output range (For 20-0/4mA operation: the high gas concentration value of the output range)	
Measurement 2	For 0/4-20mA operation: the high gas concentration value of the output range (For 20-0/4mA operation: the low gas concentration value of the output range)	

Analog Output Settings **XX**		**User Values**
Underrange Current	The lowest current to be output in normal operation when using the 4-20mA option Must be set to 0.00 when using the 0-20mA range	
Jam	The output can be set to 'jam' under fault conditions. Options: `None` `Low` = 0mA `High` = 21mA	
On Service In Progress	The output can follow the oxygen signal or it can be frozen at the last process value Select `Freeze` or `Follow`	
OK	**Accepts the new settings**	
Cancel	Cancels changes and exits the form	
Current Output	The value of the output in mA	
Analog Output Test	Indicates test in progress	
Output Test Current	The mA value required for the internally generated test signal	
Test Analog Output	Starts analog output test, **the test signal replaces the measurement value** Sets `Service In Progress`	
Stop Analog Output Test	Stops analog output test	

6.1.2.2 Relay (Status) outputs

Minimum user level: 2

The transmitter unit has three status outputs compliant with NAMUR recommendation NA64. These are identified as 'relays'.

The unit includes a test facility that may be useful during commissioning. This may be used to force a relay into either an energised or de-energised state. This test condition is only present for five minutes after initiation. The relay also reverts to normal operation as soon as the form is closed.

To configure a relay, select Relays from the Paramagnetic Peripherals Menu and press ENTER to display the Relay Selection form:

Relay Selection	**XX**
Relay	Select the required status output from a drop down list, accessed by pressing the ENTER key. Options: Fault Maintenance Required Service in Progress Confirm choice with the ENTER key
OK	**Accepts the selection**
Cancel	Cancels the form

Selecting OK and pressing ENTER will display the Relay Settings form:

Relay Settings	**XX.X**	**User Values**
Inactive state	Select Energised or De-energised The state of the relay in the normal powered, non-alarmed condition.	
OK	**Accepts the new settings**	
Cancel	Cancels changes and exits the form	
Current State	Displays the current relay state	
Relay Test	Displays if the relay is in test mode	
Energise Relay Test	Sets the relay to energised for test purposes	
De-Energise Relay Test	Sets the relay to de-energised for test purposes	
Stop Relay Test	Ends relay test	

6.1.2.3 Analog inputs

Minimum user level: 2

The transmitter unit has two analog inputs, which will accept signals from external devices.

The inputs may be used for pressure or cross-interference compensation at the transmitter.

NOTE
In addition, an analog input at the transmitter may be configured as a 'measurement' on the display at the control unit.

Configuring the input is shown below. Enabling cross-interference and/or pressure compensation is detailed in Sections 6.1.2.6 and 6.1.2.7 respectively.

The input is configured in terms of a normal operational range (this need not be 4-20 mA). It is also possible to provide a status signal associated with an input outside this range. This is particularly useful for configuring an external pressure input, see the example at the end of this sub-section.

To configure an input, select `Analog Inputs` from the `Paramagnetic Peripherals Menu` and press ENTER to display the `Select Analog Input` form:

Select Analog Input	**XX**
Analog Input	Select the required input from a drop down list, accessed by pressing the ENTER key. Options: `1` or `2` Confirm choice with the ENTER key
OK	**Accepts the selection**
Cancel	Cancels the form

Selecting OK and pressing ENTER will display the Analog Input Settings form:

Analog Input Settings **XX.X**		**User Values**
Analog Input Enable	Must be set to Yes for the input to be operative. Note - subsequently, disabling a fully configured input may be used to temporarily freeze an associated control unit display or analog output.	
Name	If the input is used as a measurement at the control unit (see Section 7) this six character name will appear on the display (the same as O2 in the usual measurement).	
Filter Factor	Increase the filtering to improve the signal to noise ratio of the input signal. 0 is no filtering, 10 is maximum filtering.	
Units	This is a 5 character label (the same as % in the usual measurement).	
Measurement 1	Enter the input value at Current 1	
Current 1	Enter the low current (mA) value.	
Measurement 2	Enter the input value at Current 2	
Current 2	Enter the high current(mA) value,must be > Current 1	
Underrange Current	Enter the current (mA) below which a status alarm is to be made active, must be ≤ Current 1	
Overrange Current	Enter the current (mA) above which a status alarm is to made active, must be > Current 2	
Status Level	Select the required status output from: None Message Service in Progress Maintenance Required Fault	
OK	**Accepts the new settings**	
Cancel	Cancels changes and exits the form	

NOTE

Configuration of an analog input may change the status display on the control unit - return to the measure display to check messages.

Example:

An external device is to be fitted to facilitate pressure compensation.

It is 4-20mA for 0-2bar absolute, however, the user also wishes to display pressure in mbar absolute at the control unit.

Analog Input Enabled	Yes
Name	Psens 1
Filter Factor	0
Units	Mbara
Measurement 1	750
Current 1	10.0
Measurement 2	1500
Current 2	16.0
Underrange current	9.0
Overrange current	17.0
Status Level	Fault

6.1.2.4 Flow alarm inputs

Minimum user level: 2

The transmitter unit has two external flow alarm inputs. An internal flow alarm may be fitted as an option. A flow alarm activates transmitter Fault status.

To configure a flow alarm, select `Flow Alarms` from the `Paramagnetic Peripherals Menu` and press ENTER to display the `Select Flow Alarm` form:

Select Flow Alarm	**XX**

Flow Alarm	Select the required input from a drop down list, accessed by pressing the ENTER key. Options:
	`Internal`
	`External 1`
	`External 2`
	Confirm choice with the ENTER key

OK	**Accepts the selection**
Cancel	Cancels the form

Selecting `OK` and pressing ENTER will display either the `External or Internal Flow Alarm Settings` form:

External Flow Alarm Settings	**XX**	**User Values**
External Flow Alarm Fitted	Select `Yes` or `No`	
Flow Alarm Enabled	The alarm must be enabled for it to be operative	
OK	**Accepts the new settings**	
Cancel	Cancels changes and exits the form	

The internal flow alarm operates in percentage terms. 100% being the normal sample flow.

Two alarm levels may be configured. These are also set in percentage terms.

A level below 100% is used to initiate a low flow alarm, a level above 100% will initiate a high flow alarm.

If both levels are set as low flow (or both as high flow) alarms, the level nearest 100% will activate transmitter Maintenance Required status and the second level will activate transmitter Fault status.

Internal Flow Alarm Settings XX		**User Values**
Ixternal Flow Alarm Fitted	Select `Yes` or `No`	
Flow Alarm Enabled	The alarm must be enabled for it to be operative	
Flow description	A 16 character description field	
Alarm Level 1 Enabled	The alarm level must be enabled for it to be operative	
Alarm Level 1	Set below 100% for a low flow alarm Set above 100% for a high flow alarm	
Alarm Level 2 Enabled	The alarm level must be enabled for it to be operative	
Alarm Level 2	Set below 100% for a low flow alarm Set above 100% for a high flow alarm	
Hysteresis	Set to prevent frequent switching at the alarm point	
OK	**Accepts the new settings**	
Cancel	Cancels changes and exits the form	

NOTE

Configuration of a flow alarm may change the status display on the control unit - return to the measure display to check messages.

See also Section 6.1.3 to clear status in the event that a flow sensor is removed.

6.1.2.5 Digital inputs

Minimum user level: 2

The transmitter unit has the facility for accepting four digital inputs for external signals. These can be assigned to transmitter calibration functions or to generate status conditions.

To configure an input, select `Digital Inputs` from the `Paramagnetic Peripherals Menu` and press ENTER to display the `Select Digital Input` form:

Select Digital Input	**XX**
Digital Input	Select the required input from a drop down list, accessed by pressing the ENTER key. Options: `1, 2, 3` or `4` Confirm choice with the ENTER key
OK	**Accepts the selection**
Cancel	Cancels the form

Selecting OK and pressing ENTER will display the Digital Input Settings form:

Digital Input Settings **XX.X**		**User Values**
Digital Input Enabled	Must be set to Yes for the input to be operative	
Assigned	Select the function from the drop down list. Options: None Message Service in Progress Maintenance Required Fault Low Calibration High Calibration Zero Flow Cal* Normal Flow Cal* (*for internal flow sensor, not currently used)	
Active state	The state that the input must be in to be active	
OK	**Accepts the new settings**	
Cancel	Cancels changes and exits the form	

NOTE

Configuration of a digital input may change the status display on the control unit - return to the measure display to check messages.

6.1.2.6 Cross-interference compensation

Minimum user level: 2

It is essential that an analog input channel has been configured as the compensation signal; see Appendix A and Section 6.1.2.3.

From the `Paramagnetic Peripherals Menu` select `Cross Interferent` and press ENTER to display the `Cross Interference Settings` form:

Cross Interference Settings **XX**		**User Values**
Compensation Enabled	Must be `Yes` for compensation to be operative	
Assigned Analog Input	The analog input (configured in Section 6.1.2.3). Select from a drop down list.	
OK	**Accepts the new settings**	
Cancel	Cancels changes and exits the form	

6.1.2.7 Pressure compensation

Minimum user level: 2

If internal pressure compensation has been fitted at time of order, it will have been factory configured.

If an external device is used to facilitate pressure compensation, it is essential that an analog input channel has been configured as the compensation signal; see Section 6.1.2.3.

NOTE

The transmitter oxygen value calculation includes a pressure value. This value is the pressure reading from either the internal or external device **in the measurement units selected by the operator**.

As despatched, a transmitter does not include an external sensor. Consequently, enabling external pressure compensation will generate a pressure reading that **will significantly effect the oxygen measurement**.

The transmitter must be re-calibrated once pressure compensation configuration is complete.

To configure pressure compensation, select `Pressure` from the `Paramagnetic Peripherals Menu` and press ENTER to display the `Pressure Settings` form:

Pressure Settings **XX**		**User Values**
Current Input	Displays the current input	
New Input	Select the input required from the drop down list	
Change Input	Press ENTER to confirm the change	
Compensation Enabled	Must be `Yes` for compensation to be operative. Note - subsequently, disabling compensation may be used to temporarily freeze an associated control unit display or analog output.	
Description Only available for internal pressure sensor	This name will appear on the analyser display (the same as O2 in the usual measurement) Maximum 6 characters	
Pressure Units Only available for internal pressure sensor	This is a label (the same as % in the usual measurement) Maximum 5 characters	
OK	**Accepts the new settings**	
Cancel	Cancels changes and exits the form	

NOTE

The analog input example (see Section 6.1.2.3) has been configured in terms of a valid pressure measurement, with out of range limits used to indicate erroneous extremes (i.e. it is not sensible to configure the low measurement as 0 mbara equals 4mA, as this represents an invalid pressure measurement).

6.1.2.8 Heater

Minimum user level: 4

The measuring cell in the transmitter unit is controlled at 60°C (110°C, 135°C). The heater can be turned off for servicing, for example. From the `Paramagnetic Peripherals Menu` select `Heater` and press ENTER to display the `Temperature Control Settings` form:

Temperature Control Settings	**XX**
Heater Enabled	Select '`Yes`' or '`No`' as appropriate
Control Temperature	Displays the target temperature for the measuring cell **Not adjustable**
OK	**Accepts the new settings**
Cancel	Cancels changes and exits the form

6.1.3 Service and Status

The following information relates to the more advanced functionality of the transmitter, providing limited details of the `Status` and `Service` options found under the `Transmitter Setup` menu.

The `Status` menu offers four options:

Minimum user level: 2

Current Status	Select to view the current transmitter status
Reset Status	This option will clear all status indications resetting only those that are currently active. May also be used to clear `Maintenance Required` status after a failed calibration.
Status History	Select to view the transmitter status history
Clear History	Clear the transmitter status history

The `Service` menu offers three options:

Minimum user level: 3

Parameters	This may be used to force the transmitter status to `Service in Progress.`
Diagnostics	Select to view the transmitter diagnostic signals, including the oxygen measurement value before and after various compensations have been considered.
Reset	This reconfigures the transmitter, see below.

CAUTIONS

`Reconfigure` will delete all user settings. This includes settings for the analog output and status relays. The analyser system will subsequently require full configuration.

7 CONTROL UNIT CONFIGURATION

This section describes the procedure for setting up the control unit and associated peripherals for the analyser system.

It is assumed that the control unit is connected to a working transmitter unit.

Section 7.1 details configuration of the control unit display:
setting up a new measurement display
configuring the bar graph (located under the measurement).

Section 7.2 details level (gas concentration) alarm configuration:
setting high and low alarms
setting and clearing latched alarms
reviewing alarm history (and resetting).

Section 7.3 details status alarms:
reviewing status history (and resetting)
configuring a user defined fault group.

Section 7.4 details configuring relays.

Section 7.5 details configuring analog (mA) outputs.

Section 7.6 details configuring digital inputs.

Section 7.7 details MODBUS options.

Section 7.8 details other control unit features:
system communication baud rate
resetting the control unit to default conditions
locate the control unit software identity.

7.1 The measurement pane

A typical measurement format is shown below in Figure 6.

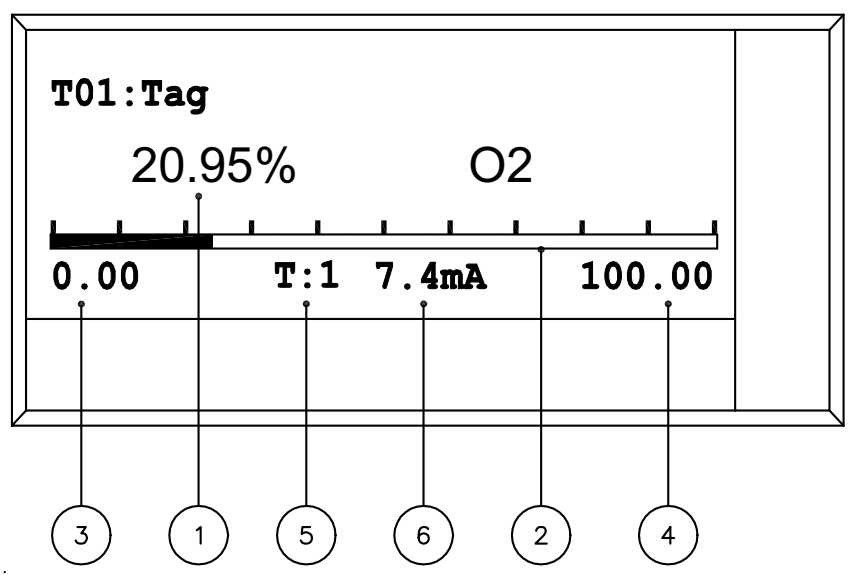


Figure 6 Measurement format

Key to Figure 6

1. Measurement value, units and name
2. Measurement bar graph
3. Bar graph low value
4. Bar graph high value
5. mA output identification
6. mA output actual reading

When appropriate, the measurement value will appear in 'reverse video' to demonstrate that the transmitter is not fully operational - this could be due to the fact that it is still warming up. **Messages beneath the measurement pane will provide relevant information**.

7.1.1 The measurement bar graph

The bar graph may be configured to offer a pictorial rendition of the measurement. Low and high values (see Figure 6) may be user adjusted.

The bar graph may alternatively be used to monitor an analog (mA) output signal from either the transmitter or control unit. In this case the bar graph low and high values shown represent the range of the output and will be displayed in the measurement units (not mA).

When monitoring an analog output, the actual output current is also shown (see 6 above).

Figure 6 shows a measurement of 20.95% oxygen, the bar graph represents the analog output at the transmitter (T01). The output is ranged 0 to 100% oxygen. The actual output current is 7.4mA.

7.1.2 Measurements

A maximum of six transmitters may be registered on a given system and any 'measurement' from a transmitter may be displayed as shown in Figure 6.

The 'measurement' is defined by the type of transmitter.

The 2200 Transmitter can potentially output four measurements to a control unit:

The oxygen measurement

The internal pressure transducer reading (if fitted)

The two analog input channels (if configured).

It is not possible to permanently assign transmitter internal diagnostics to the display screen.

The control unit includes six display pages and permits up to six measurements on each display page; see Figure 7.

A measurement may be shown more than once, each with a different bar graph. Also a critical measurement may be shown on a number of scrolling pages.

Multiple pages may be automatically or manually scrolled.

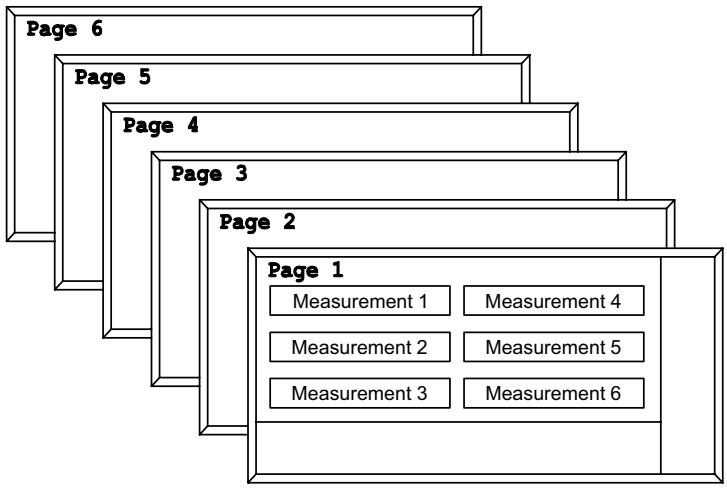


Figure 7 Measurement pages

Two measurements will appear full-size, one above the other. Three or more measurements are scaled to fit the format shown in Figure 7.

By default, when a new transmitter is registered the primary measurement will be allocated to the next available measurement slot. The following section allows the user to change the default configuration as well as adding additional measurements.

The measurement pane is set up in two stages; the first action (see Section 7.1.3) is to define the measurement and its location on a page and the second action (see Section 7.1.4) **is to make sure the relevant page is active**.

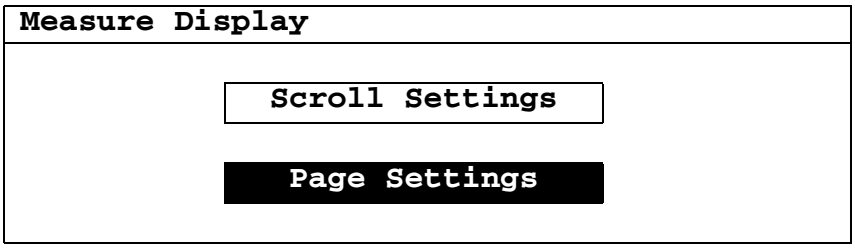
7.1.3 Configuring measurement pages

Minimum user level: 2

NOTE

If only one measurement is required to be displayed, page '1' and position '1' must be chosen in the following routines.

To configure a measurement, access the `Measure Display` menu for the control unit (menu path; `Main - Controller - System - Measure Display`).



Selecting `Page Settings` and pressing ENTER will display the `Select Display Page` form:

Select Display Page	
Page	Select from a drop down list, accessed by pressing the ENTER key, options: `1, 2, 3, 4, 5, 6` Confirm choice with the ENTER key
OK	**Accepts the selection**
Cancel	Cancels the form

Selecting OK and pressing ENTER will display the Measure Display Page Setup form. Note that 'X' is the page number.

Measure Display Page Setup	**X**
Page Position To Edit	Select the page position to edit. A position with a measurement already assigned will show the position, the transmitter identity and measurement name, e.g.: 1:T01 O2 Blank positions are numbered, e.g.: 2: 3: Edit a blank position to insert a new measurement.
Edit Page Position	Opens the Measure Page Position Setup form to allow editing
OK	**Accepts the new settings**
Cancel	Exits the form

Select a page to edit, then highlight `Edit Page Position` and press `ENTER` to show the `Measure Page Position Setup` form. Note that '`X:X`' is 'Page Number : Page Position'.

Measure Page Position Setup	**X:X**
Current Measurement	The current measurement allocated to the page position
New Measurement	Select a new or alternative measurement from a drop down list in the lower pane
Change Measurement	Press ENTER to accept the new measurement (this will now be shown in `Current Measurement`)
Decimal Places	Select the maximum number of decimal places for the measurement display required from a drop down list in the lower pane
Bar Source	A list of sources for the bar graph. Options: `None` `User defined:` see Low/High Scale below `Analog Output:` scaled from an analog output
Low Scale	Set the bar graph low value, only applicable to `User defined`
High Scale	Set the bar graph high value, only applicable to `User defined`
OK	**Accepts the new settings**
Cancel	Cancels changes and exits the form

NOTE

When configuring a new measurement, the `Bar Source` and scale fields will not be present until a `Current Measurement` is selected.

7.1.4 Scrolling measurement pages

If more than one page is defined the pages can be manually or automatically scrolled.

A measurement page must be active in order to view it. To activate a page, it must be allocated to a 'screen'. The control unit has six screens. If fewer than six measurement pages have been defined, screens may be used to allow one page to be viewed more frequently than others.

Minimum user level: 2

To configure scrolling pages, select `Scroll Settings` from the `Measure Display` menu and press ENTER to display the `Measure Display Settings` form:

Measure Display Settings	
Screen 1 Page	Select the page to be shown on each screen as required Whilst it is expected that page 1 appears on screen 1 etc., more complex configurations are permitted The measurement pane will be blank when an empty page is allocated to a screen
Screen 2 Page	
Screen 3 Page	
Screen 4 Page	
Screen 5 Page	
Screen 6 Page	
Auto Scroll Enabled	If `No` is selected, multiple pages will only be viewable by scrolling using the horizontal CURSOR keys
Auto Scroll Interval	Set the interval between automatic screen changes
OK	**Accepts the new settings**
Cancel	Cancels changes and exits the form

7.2 Alarm functions

Alarm and status functions comprise: Level (gas concentration) alarms
Status alarms, e.g. fault and calibration in progress.

This section deals with gas concentration alarms. Refer to Section 7.3 for status alarms and Section 7.4 for allocating alarm/status functions to relays.

7.2.1 Level (gas concentration) alarms

The term 'level' is used since alarms may be allocated to any of the measurements available from a transmitter. For the following text, however, it will be assumed that the alarms relate to gas concentration. Alarms may be set either 'high' or 'low'.

An alarm condition (indicated by the alarm icon and an associated message) will be present when the gas concentration exceeds customer defined levels. The control unit will log alarm history.

A 'latching' function also exists; this means that an alarm condition will remain active even though the gas concentration is back within limits. A latched alarm must be reset manually or by external contact closure (if digital input option board fitted). The alarm message and icon will remain on the display until a latched alarm is cleared. Loss of power to the control unit will also result in clearing latched alarms.

A pictorial representation of the operation of gas concentration alarms is shown in Figure 8.

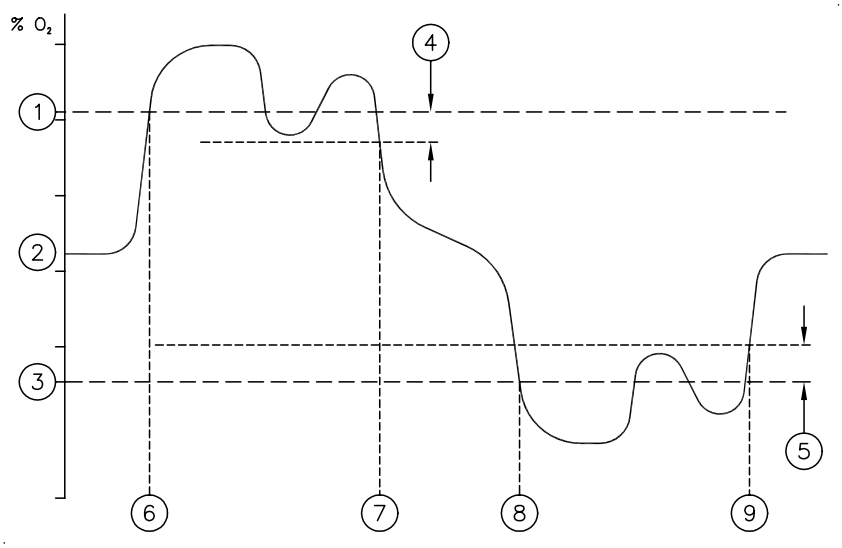


Figure 8 Gas concentration alarms

Key to Figure 8

1. High alarm setting
2. Sample gas concentration
3. Low alarm setting
4. High alarm hysteresis band
5. Low alarm hysteresis band
6. High alarm activated, 'on' entry in history
7. 'off' entry in history and, unless set to latched condition, the alarm relay is de-activated
8. Low alarm activated, 'on' entry in history
9. 'off' entry in history and, unless set to latched condition, the alarm relay is de-activated

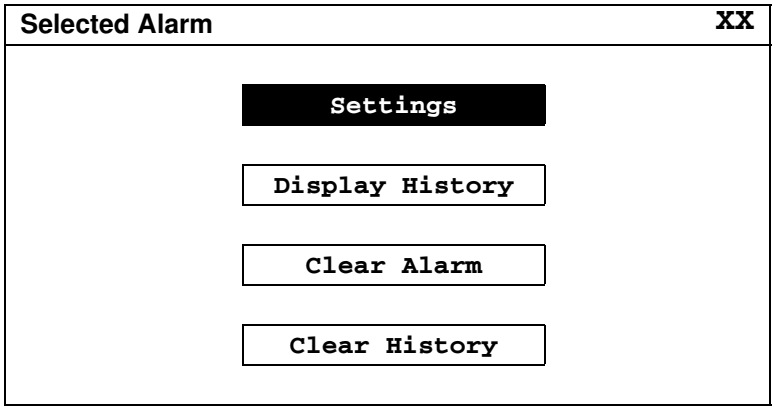
7.2.2 Configure a concentration alarm

Minimum user level: 2

To configure an alarm, select `Alarms` from the `Controller` menu and press ENTER to display the `Select Alarm` form:

Select Alarm	
Alarm	Select from a drop down list, accessed by pressing the ENTER key. Options: `All` To **configure** an alarm, an alarm must be selected by number (below). Do not select `'All'`. `1, 2, 3… 16` Confirm choice with the ENTER key.
OK	**Accepts the selection**
Cancel	Cancels the form

Selecting `OK` and pressing ENTER will display the `Selected Alarm` menu:



Access the Alarm Settings form to configure the alarm:

Alarm Settings	**XX**
Alarm Enabled	The alarm must be enabled to be operative
Current Measurement	The current measurement allocated to the alarm
New Measurement	Select a new or alternative measurement from a drop down list in the lower pane
Change Measurement	Press ENTER to accept the new measurement (this will now be shown in Current Measurement)
Alarm Mode	Select High or Low alarm operation
Level	The gas concentration alarm level
Hysteresis	Use to prevent repeated triggering of the alarm
Alarm Type	Select Latching or Non-Latching
On Service In Progress	Select Freeze or Follow Freeze will prevent action of the alarm when the 'Service In Progress' status alarm is active (during calibration, for example).
OK	**Accepts the new settings**
Cancel	Cancels changes and exits the form

NOTE

When configuring a new measurement, the Alarm Mode etc. fields will not be present until a Current Measurement is selected.

7.2.3 Additional alarm functions

Minimum user level: 2

Additional alarm functions are accessed from:

the `Selected Alarm` menu

by selecting `all` alarms at the `Select Alarm` form.

The available functions are:

`Current States`	Displays the current status of all alarms. If the alarm is latched, but the alarm condition is not present, it is shown as `Off` (only available when all alarms selected).
`Display History`	Displays a list of alarm events appropriate to the selection made at the `Select Alarm` form. The most recent events are shown at the top of a scrollable list. Figure 9 shows a typical alarm history screen for alarm 1. The alarm history 'off' records the time at which the alarm level was no longer exceeded, not the time at which a latched alarm was cleared.
`Clear Alarms`	If an alarm is set to `latched` it will remain in the active state until cleared.
`Clear History`	Clears the alarm history.

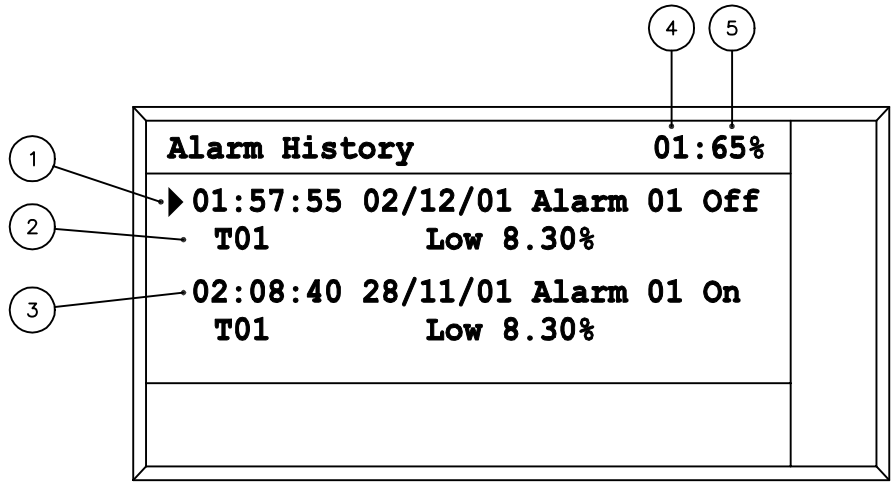


Figure 9 Alarm History screen

Key to Figure 9

1. Time and date stamp. Alarm number and state.
2. Transmitter unit identity and alarm level
3. Previous history entry
4. Identity of the alarm (not shown if `'All'` selected)
5. Percentage of history memory used

The alarm history memory is of finite size. Status messages will be generated when the history is over 80% full. The `Clear History` command must then be used to allow future records to be stored.

7.3 Status functions

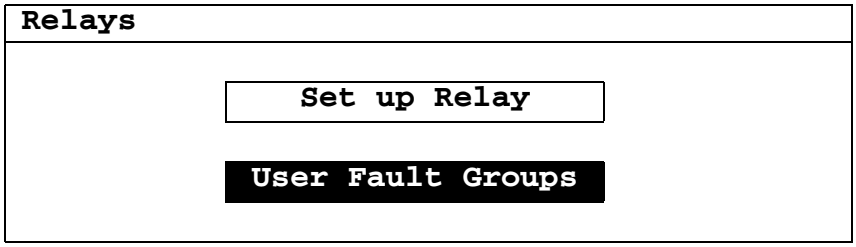
It is expected that in most cases, the three NAMUR 64 status conditions will provide an adequate indication of the system operational state. However, it is possible to specify alternative groups of faults by defining up to eight 'User Fault' groups.

NAMUR conditions User Fault groups may be assigned to relays; see Section 7.4. (As an example, the 'Temperature Low Fault' could be allocated to a relay to operate a solenoid valve isolating a transmitter from a potentially corrosive sample gas.)

7.3.1 Define user fault groups

Minimum user level: 2

User defined fault groups are located under the `Relays` menu for the control unit (menu path: `Main - Controller - Relays`).



To configure a group, select `User Fault Groups` and press ENTER to display the `Select User Defined Fault Groups` form:

Select User Defined Fault Groups	
User Fault Group	Select from a drop down list, accessed by pressing the ENTER key. The names for these groups can be edited. The default options are: `User Fault Group 1, 2, 3 … 8` Confirm choice with the ENTER key
OK	**Accepts the selection**
Cancel	Cancels the form

Selecting OK and pressing ENTER will display the User Fault Group Settings form:

User Fault Group Settings	
Description	An 18 character description for the fault group. Edit using the drop down character field
Source	The current source of status alarms
New Source	A drop down list of available status alarm sources - transmitters or control unit
Change Source	Press ENTER to accept the new source (this will now be shown in Source)
Unass'd	A list of all the fault alarms available from the chosen source, access using the ENTER key
Add	Place the highlighted unassigned fault alarm in the assigned (Ass'd) list
Remove	Remove a fault alarm from the assigned list
Ass'd	A list of assigned fault alarms, access using the ENTER key
OK	**Accepts the new settings**
Cancel	Cancels changes and exits the form

7.3.2 Additional status functions

Minimum user level: 2

Status functions are accessed from the Status menu, under the Controller menu.

The Status menu offers six options:

Current Status	Shows current status of all diagnostics for the control unit
Status History	Lists control unit status messages
Clear History	Clears control unit status history (active status conditions will not be cleared)
System Summary	The summary status of all system components: Prefix C indicates controller Prefix T01, T02 etc. indicates transmitters
All History	Lists transmitter and control unit summary status messages
Clear all History	Clears All History, above

Status history screens are similar to the alarm history screens shown in Figure 9. Remember that detailed transmitter status information is held under the relevant transmitter menu.

The status history memory is of finite size. Status messages will be generated when the history is over 80% full. The `Clear History` command must then be used to allow future records to be stored.

7.4 Relays

The network (MODBUS) connection offers eight virtual relays as standard.

The control unit can also be fitted with up to sixteen physical relays.

Any alarm or status function may be allocated to a relay. It is possible to allocate more than one alarm/status function to a single relay, or the same alarm/status function to more than one relay. .

NOTE

Relays may also be used to control valves associated with automatic calibration. If this is a requirement, first configure calibration parameters (see Section 8) then return to this section.

Relays used to control calibration valves can only be assigned to that one function.

The unit includes a test facility. This may be used to force a relay into either an energised or de-energised state. **This function allows a relay to remain in a forced condition permanently**.

Minimum user level: 2

To configure a relay, select `Set Up Relay` from the Relays menu and press ENTER to display the `Select Relay` form:

Select Relay	
Select Relay	Select from a drop down list, accessed by pressing the ENTER key. Physical relay names will depend on the hardware configuration of the control unit, format: Option board slot: Relay number Network relays are identified as N:1 to N:8 Confirm choice with the ENTER key
OK	**Accepts the selection**
Cancel	Cancels the form

Selecting OK and pressing ENTER will display the Relay Settings form. Note: 'X:Y' where the 'X' is the option board slot and 'Y' is the relay number.

Relay Settings	**X:Y**
Uass'd	A list of functions that may be allocated to the selected relay, access using the ENTER key. Options include: Status functions Alarms 1 to 16 Autocalibration control valves Control unit mA output on secondary range indication User Fault Groups 1 to 8
Add	Place the highlighted unassigned (Uass'd) function in the assigned list
Remove	Remove a function from the assigned list
Assigned	A list of assigned functions
Inactive	Select Energised or De-energised This is the state in the normal powered, non-active condition
OK	**Accepts the new settings**
Cancel	Cancels changes and exits the form
Current State	Display the current status of the selected relay
Relay Test	Shows the relay is in test mode
Energise Relay	Energise the relay for test purposes
De-Energise Relay	De-energise the relay for test purposes
Stop Relay Test	**Ends relay test.** Note that simply exiting the form does not stop the relay test function.

7.5 Analog outputs

The network (MODBUS®) connection offers eight virtual outputs as standard.

The control unit can also be fitted with up to eight physical analog (mA) outputs.

Each output can have two ranges, with external switching or auto switching (dependant upon gas concentration), between ranges. The active range can be indicated on a status output. An output may be allocated to any of the measurements available from a transmitter (see Section 7.1.2).

The analog output includes a test facility that allows the operator to set the output to any value up to 22mA. This test condition is only present for five minutes after initiation. The output also reverts to normal operation as soon as the form is closed.

Minimum user level: 2

To configure an analog output, select `Analog Outputs` from the `Controller` menu and press ENTER to display the `Select Analog Output` form:

Select Analog Output	
Analog Output	Select from a drop down list, accessed by pressing the ENTER key. Physical output names will depend on the hardware configuration of the control unit, format: Option board slot:Output number Network outputs are identified as N:1 to N:8 Confirm choice with the ENTER key
OK	**Accepts the selection**
Cancel	Cancels the form

Selecting `OK` and pressing ENTER will display the `Analog Output Settings` form. Note:`'X:Y'` where the `'X'` is the option board slot and '**Y**' is the output number.

Analog Output Settings	**X:Y**
Analog Output Enabled	The output must be enabled to be operative
Current Measurement	The current measurement allocated to the output
New Measurement	Select a new or alternative measurement from a drop down list in the lower pane
Change Measurement	Press ENTER to accept the new measurement (this will now be shown in `Current Measurement`)
Output Current Range	Select 0-20mA or 4-20mA 20-0mA or 20-4mA operation, see `Measurements` fields on next page

Analog Output Settings	**X:Y**
Output Range	This determines the output range and, optionally, the source for changing the range. Select: `1` for range 1 permanently `2` for range 2 permanently `Auto:` range is changed automatically `External:` a configured digital input will change the range
Underrange Current	The lowest current to be output in normal operation when using the 4-20mA option Must be set to 0.00 when using the 0-20mA range
Jam	The output can be set to 'jam' under fault conditions. Options: `None` `Low =` 0mA `High =` 21mA
On Service In Progress	The output can follow the measurement signal or it can be frozen at the last process value Select `Freeze` or `Follow`
AutoRange Change At	Enter the measurement value at which the output switches from range 1 to range 2
AutoRange Hysteresis	Set to prevent frequent switching between ranges
AutoRange Change When	Change to range 2 when the measurement value is greater than (>) or less than (<) the value set in `AutoRange Change At`
Primary Output Range Settings	Settings for range 1
Measurement 1	For 0/4-20mA operation: the low gas concentration value of the output range (For 20-0/4mA operation: the high gas concentration value of the output range)
Measurement 2	For 0/4-20mA operation: the high gas concentration value of the output range (For 20-0/4mA operation: the low gas concentration value of the output range)
Secondary Output Range Settings	Settings for range 2 Not required if only one range is to be used

Analog Output Settings	**X:Y**
Measurement 1	For 0/4-20mA operation: the low gas concentration value of the second output range (For 20-0/4mA operation: the high gas concentration value of the second output range)
Measurement 2	For 0/4-20mA operation: the high gas concentration value of the second output range (For 20-0/4mA operation: the low gas concentration value of the second output range)
OK	**Accepts the new settings**
Cancel	Cancels changes and exits the form
Current Output	The value of the output in mA
Analog Output Test	Indicates test in progress
Output Test Current	The mA value required for the internally generated test signal
Test Analog Output	Starts analog output test, **the test signal replaces the measurement value.** Sets `Service In Progress`
Stop Analog Output Test	Stops analog output test

NOTE

When configuring a new output, the lower fields will not be present until a `Current Measurement` is selected.

The `Current Output` displays either the value based on the settings when the form is first accessed or the test current. It does not reflect 'live' changes to settings.

7.6 Digital inputs

The network (MODBUS®) connection offers eight virtual inputs as standard.

The control unit can also be fitted with up to thirty two physical digital inputs.

An input may be allocated to activate a number of functions:

1. Initiate autocalibration
2. Inhibit autocalibration
3. Change an analog output range
4. Clear all latched alarms
5. Raise 'external' fault status
6. Raise 'external' maintenance required status
7. Raise 'external' service in progress status
8. Raise 'external' message status

Minimum user level: 2

To configure a digital input, select `Digital Inputs` from the `Controller` menu and press ENTER to display the `Select Digital Input` form:

Select Digital Input	
Digital Input	Select from a drop down list, accessed by pressing the ENTER key. Physical input names will depend on the hardware configuration of the control unit, format: Option board slot: Input number Network inputs are identified as N:1 to N:8 Confirm choice with the ENTER key
OK	**Accepts the selection**
Cancel	Cancels the form

Selecting OK and pressing ENTER will display the Digital Input Settings form. Note: 'X:Y' where the 'X' is the Option board slot and 'Y' is the input number.

Digital Input Settings	**X:Y**
Digital Input Enabled	The input must be enabled to be operative
Unass'd	A list of functions that may be allocated to the input, access using the ENTER key
Add	Place the highlighted unassigned function in the assigned list
Remove	Remove a function from the assigned list
Assigned	A list of assigned functions
Active State	The state of the input for it to be active and perform the assigned function, select 0 or 1 0 corresponds to no signal at the input (0V or open circuit) 1 corresponds to a live signal at the input (24V or closed circuit)
OK	**Accepts the new settings**
Cancel	Cancels changes and exits the form
Current State	Display the current status of the selected input

7.7 MODBUS® settings

The control unit has one of the following network communications options fitted:

- MODBUS serial, RS485 interface
- MODBUS TCP, Ethernet interface

Details of the register mapping including the use of network relays, network analog outputs and network digital inputs are shown in the installation manual. MODBUS communication settings are accessed as follows:

Minimum user level : 3

From the `Controller` menu select `System` then `Network`. This will display one of the following MODBUS Settings forms depending on the option fitted.

7.7.1 MODBUS serial, RS485 interface

MODBUS Settings	
MODBUS Enabled	The network must be enabled to be operative
Address	Set a three digit number from `001` to `247`
Mode	Select from `ASCII` or `RTU`
Baud Rate	Set as appropriate
Data bits	`7` or `8` for ASCII, `8` for RTU
Parity	Select `odd`, `even` or `none`
OK	**Accepts the new settings**
Cancel	Cancels changes and exits the form

7.7.2 MODBUS TCP, Ethernet interface

`MODBUS Settings`	
`MODBUS Enabled`	The network must be enabled to be operative
`IP Address`	Sets the required IP address for the control unit in standard notation. Each of the four number fields must be in the range 000 to 255. If the address is set to 000.000.000.000 the control unit will first look for a DHCP server. If none is found it will then attempt to allocate an AutoIP address. It the address is set to 000.000.001.000 then DHCP will be enabled but AutoIP disabled.

Subnet Mask	Sets the subnet mask for the network. A provisional mask is generated automatically by the control unit whenever a new IP address is entered that falls into a different class. The mask may then be altered manually if required.
Gateway Address	Sets the required Gateway IP address.
OK	**Accepts the new settings**
Cancel	Cancels changes and exits the form

7.8 Ancillaries

The following information relates to the more advanced functionality of the control unit, providing limited details of additional options found under the following.

The Controller menu:

Information	This provides details of the control unit software

The Controller - System menu:

Communications	The system baud rate, 57600 as standard (Minimum user level: 4)
Reconfigure	This option reconfigures the control unit (Minimum user level: 3)

CAUTION

Changing the baud rate may result in loss of communications between the control unit and transmitters.

Reconfigure will delete all user settings. This includes de-registering transmitters.

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8 CALIBRATION

'Calibration' in this context is the process by which measurement calibration factors are updated by the user.

Calibration is an essential part of routine maintenance associated with every transmitter.

8.1 Calibration principles

Calibration by the user involves passing a gas of known measurement concentration through a transmitter and adjusting calibration factors, if necessary, until the output measurement corresponds to the known value.

This is usually done at two known concentrations, typically either side of the normal sample concentration. It should be noted that calibration gases have a tolerance associated with them. In order to reduce the effects of such tolerances, transmitters will benefit from calibration at two known concentration points as far apart as practical.

Any transmitter may be calibrated manually.

Measurement calibration in the 2200 includes the ability to set 'tolerance' bands associated with each known ('target') concentration. Tolerance checks are made during calibration to ensure validity. If these checks are not passed, the calibration factors are not updated.

Transmitters connected to a control unit may also be:

1. configured for automatic calibration

   calibration gases are passed though the transmitter, automatically controlled by solenoid valves connected to relays (option board) within the control unit

2. configured for checking calibration

   checking calibration initiates the usual calibration routines, however, calibration factors are never updated

It is initially recommended that calibration is conducted on a regular basis and a record kept of the calibration error – the difference between the actual value and the target value. This error may be used as a basis for adjusting calibration intervals. (Note that the control unit automatically records calibration errors – reviewed under `Calibration History` later in this section.)

A successful measurement calibration or check will result in an entry in the `Calibration History`. Failure to check or calibrate activates the `Maintenance Required` status condition. No entry is made in the `Calibration History`, since no calibration factors are updated.

Frequency of calibration depends on the reliance placed upon the analyser system and may need to be modified as a result of operating experience. This may also indicate that calibration at one concentration may be conducted less frequently than at the other.

Manual calibration of a transmitter requires configuration of parameters specific to the transmitter (the gas target concentrations, for example). These transmitter parameters are also used during autocalibration, however, autocalibration requires additional parameters to be set up. The following sections may be summarised as follows:

Section 8.2 details configuration of autocalibration parameters - **it may be omitted if the facility is not used.**

Section 8.3 lists details specific to each transmitter, including manual calibration.

8.2 Automatic calibration

Details of automatic calibration system options are given in the relevant control unit installation manual.

Automatic calibration or 'autocalibration' allows instrument calibration to be updated without user intervention. It is also possible to just check the calibration (often referred to as autovalidation). When autocalibration valves are configured, a manual calibration will also use the valves to select the appropriate gases.

The autocalibration process can be initiated in three ways, by:

an internal timer

an external signal (contact closure or network link)

operator request through the user interface.

NOTE

The time and date must be correctly set before initiating autocalibration by internal timer.

Autocalibration facilities are offered to either adjust or check the following:

transmitter low point calibration

transmitter high point calibration

transmitter low and high point calibration.

8.2.1 Autocalibration cycle

The 2200 utilises a generic autocalibration cycle that may be adjusted to suit actual requirements. This 'timer' cycle is best described pictorially, see Figure 10.

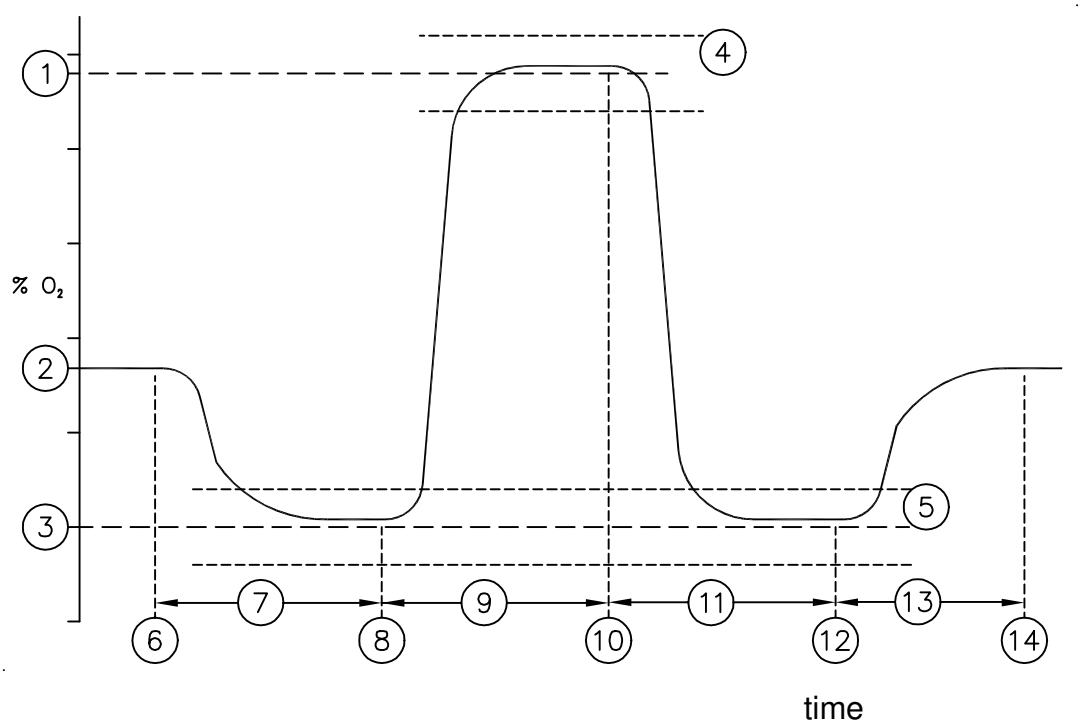


Figure 10 Autocalibration cycle

Key to Figure 10

1. High calibration gas target concentration
2. Sample gas concentration
3. Low calibration gas target concentration
4. High calibration gas tolerance concentration
5. Low calibration gas tolerance concentration
6. Start of autocalibration, gas changes from sample to low calibration gas
7. Customer configurable pre-flush (inerting) time
8. Gas stream changes from low to high calibration gas
9. Customer configurable flush time
10. Gas stream changes from high to low calibration gas
11. Low calibration gas left running for a customer configurable flush time
12. Gas stream changes from low calibration gas to sample
13. Customer defined post-flush time
14. End of autocalibration

The full autocalibration cycle offers the ability to totally isolate the sample gas from one of the calibration gases. This is done by adding the extra 'inerting' stage (see 7 in Figure 10) at the beginning of the cycle. It is acceptable to eliminate the inerting stage by setting the relevant flush time to zero.

NOTE

During setup, calibration gases are identified by number:

Calibration gas number 1 always flows during stages 7 and 11

Calibration gas number 2 always flows during stage 9

Figure 10 shows the low calibration gas assigned as calibration gas 1. However, it is permissible to assign it as calibration gas 2.

In such cases the solenoids would switch as follows:

6	Sample to High Calibration gas
8	High to Low Calibration gas
10	Low to High Calibration gas
12	High Calibration gas to Sample

The following parameters are deemed transmitter specific:

High calibration gas target

Low calibration gas target

High calibration gas tolerance

Low calibration gas tolerance

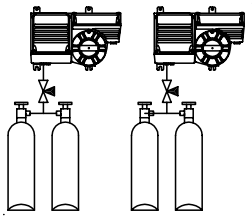
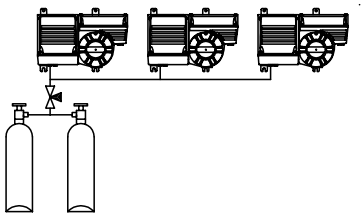
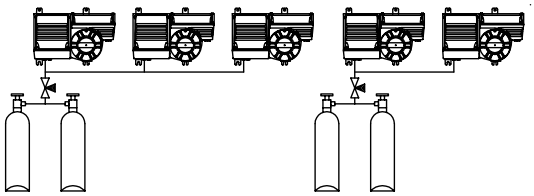
Low calibration gas is calibration gas 1 or 2.

These are configured for each transmitter (see Section 8.3). The remaining parameters *may* apply to a number of transmitters and will be defined by 'calibration group', see next section.

8.2.2 Calibration groups

The 2200 Control Unit may be connected to up to six transmitters. Whilst it is expected that most operators will calibrate each transmitter on an individual basis, some may wish to calibrate all transmitter units at the same time.

The 2200 utilises the concept of calibration groups to allow full flexibility. Table 3 shows three potential options, however, a full range of combinations are possible since up to six calibration groups may be configured.

Table 3 Autocalibration groups	
	Two transmitter units connected to the control unit To be calibrated in isolation Two calibration groups must be configured
	Three transmitter units connected to the control unit To be calibrated at the same time Only one calibration group is configured
	Five transmitter units connected to the control unit Two calibration groups must be configured

Autocalibration can only be performed on one calibration group at a time.

If an autocalibration is in progress and a request to calibrate a *different* group is received, a queuing mechanism is used to ensure that the next autocalibration is performed as soon as possible. Repeated requests to calibrate the same group will be ignored.

Whilst not required for transmitters of the same type, it is possible to configure a group of transmitters in which the gas used for the low calibration of one transmitter is the high calibration gas of another.

8.2.3 Setup of autocalibration functions

NOTE

All transmitter specific parameters must be set up prior to configuring autocalibration functions. See Section 8.3, then return to this section. In particular, a transmitter unit must be assigned to a calibration gas group to allow configuration of the group.

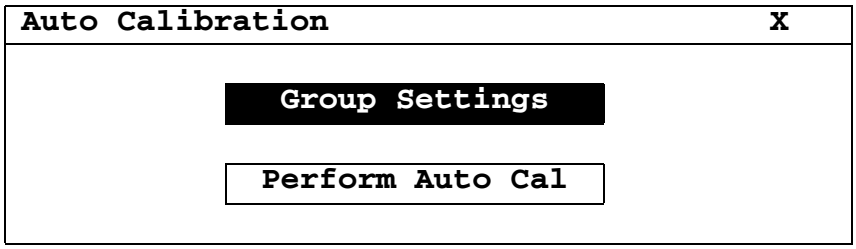
Configuration of autocalibration includes data relating to gas flush periods; see Figure 10. These may be determined by conducting manual calibrations.

Minimum user level: 2

To configure a calibration group, select `Auto Calibration` from the `Controller` menu and press ENTER to display the Select `Calibration Group` form:

Select Calibration Group	
Auto Calibration Group	Select the group number from a drop down list, accessed by pressing the ENTER key. The number selected must be the same as the number of the group specified during transmitter setup (Section 8.3).
OK	**Accepts the selection**
Cancel	Cancels the form

Selecting `OK` and pressing ENTER will display the `Auto Calibration` menu. Note that `'x'` is the number of the gas group.



Select `Group Settings` and press ENTER to display the `Auto Calibration Group Setup` form:

Auto Calibration Group Setup		**X**
Remote Calibration Enabled	Select `Yes` to enable remote initiation by either digital input or network connection	
Timed Calibration Enabled	Select `Yes` if regular automatically initiated calibrations are required	
Calibration Type	Select `Calibration` or `Check`	
Next Calibration Date	The date and time at which the next autocalibration is to be initiated (this automatically updates after initial entry)	
Next Calibration Time		
Calibration Interval	The calibration interval is set in terms of days and hours in these two fields	**hours**
Calibration Interval		**days**
Pre-Flush Time	Time period 7 in Figure 10	
Calibration Gas 2 Time	Time period 9 in Figure 10	
Calibration Gas 1 Time	Time period 11 in Figure 10	
Post-Flush Time	Time period 13 in Figure 10	
Inert on Abort	It is possible to abort an autocalibration in progress. Select the `Yes` option to ensure that calibration gas 1 is passed through the transmitter before returning to sample if an abort is requested.	
OK	**Accepts the new settings**	
Cancel	Cancels changes and exits the form	

NOTE

Relays should now be assigned to control the calibration valves; see Section 7.4.

8.2.4 Starting and stopping autocalibration

The autocalibration process can be initiated in three ways by:

1. The internal timer:

   once fully configured no further action is required.

2. An external signal. Configure either:

   a digital input allocated to this function; see Section 7.6
   or the network connection; see Section 7.7.

   A momentary signal then initiates autocalibration.

3. An operator request through the user interface:

   Minimum user level: 2
   From the `Auto Calibration` menu, select `Perform Auto Calibration` and press ENTER to display the form:

Perform Auto Calibration	**X**
Start Auto Calibration	Starts autocalibration
Cancel	Exits the form

Autocalibrations may be initiated by external signal or by operator request irrespective of any internal timer settings.

During an autocalibration:

1. The transmitter `Service In Progress` status alarm will be activated.
2. The control unit `Service In Progress` status alarm will be activated (these enable the 'Freeze' function for suitably configured analog outputs and/or alarms).
3. The control unit `Auto Cal Group In Progress` status alarm will be active.
4. The option to `Abort Auto Calibration` appears on the `Auto Calibration` menu.

An autocalibration in progress may only be stopped by operator request through the user interface:

Minimum user level: 2

Select `Abort Auto Calibration` from the `Auto Calibration` menu.

8.2.5 Inhibiting autocalibration

Autocalibration for a group may be inhibited by:

1. Setting entries for `remote` and `timed calibration enabled` to '`No`' ; see Section 8.2.2.
2. An external signal:

   a digital input allocated to this function; see Section 7.6.

   a continuous signal then inhibits autocalibration.

8.3 Manual calibration

Manual calibration routines will be specific to the type and build of a transmitter.

Transmitter calibration parameters ('settings') must be configured before any measurement calibration can be initiated.

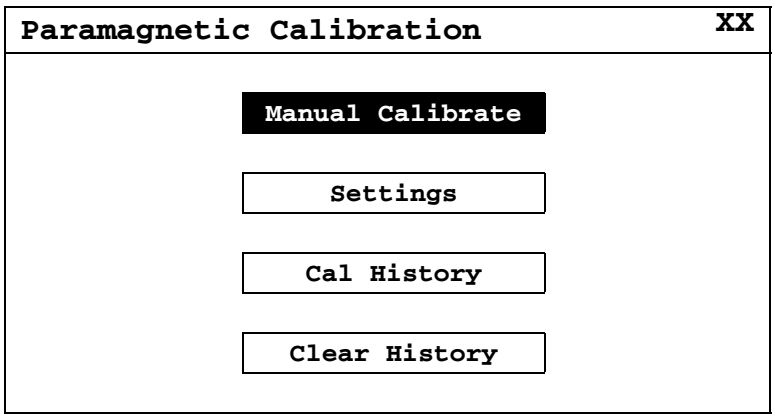
Certain features within transmitters (e.g. internal pressure) may also offer calibration.

8.3.1 Model 2200 paramagnetic oxygen transmitter

8.3.1.1 Calibration settings

Minimum entry level: 2

From the appropriate `Transmitter Setup` menu, select `Calibration` to display the `Paramagnetic Calibration` menu:



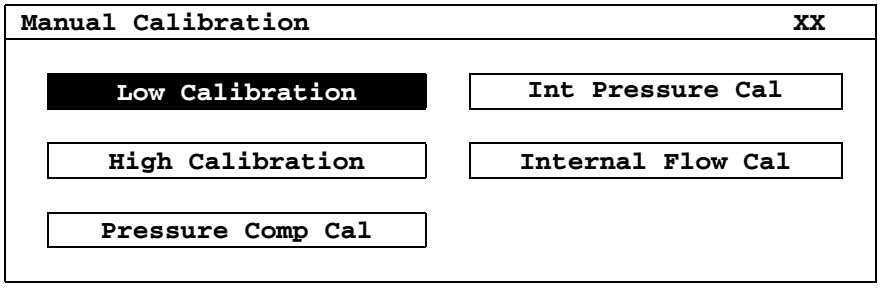
Select `Settings` and press ENTER to display the `Calibration Settings` form:

Calibration Settings	**XX**
Calibration Group	Assign the transmitter to an `autocalibration gas group` if autocalibration is to be used
Low Target	The oxygen value of the low concentration gas
Low Tolerance	The tolerance associated with low calibration (≤10%) Low point calibration will fail if the measurement value differs from the target value by more than the tolerance
Perform Low Auto Calibration	Select `Yes` if low calibrations are to be performed during autocalibration
High Target	The oxygen value of the high concentration gas
High Tolerance	The tolerance associated with high calibration (≤50%) High point calibration will fail if the measurement value differs from the target value by more than the tolerance
Perform High Auto Calibration	Select `Yes` if high calibrations are to be performed during autocalibration
Low Calibration Gas	Assign 1 or 2 as appropriate (only used during autocalibration).
Pressure Cal Targe	Only appears if an internal pressure transducer is installed, allows calibration of the device in absolute units
Minimum O_2 Change	Only relevant if internal pressure compensation is enabled, ensures correct calibration of the compensation; see Section 8.3.1.6.
OK	**Accepts the new settings**
Cancel	Cancels changes and exits the form

8.3.1.2 Low calibration

Minimum entry level: 1

1. From the `Paramagnetic Calibration` menu, select `Manual Calibrate` and press ENTER to display the `Manual Calibration` menu:



2. Select `Low Calibration` and press ENTER to display the `Low Calibration` form:

Low Calibration	**XX**
Target Concentration	Displays the calibration target concentration
Current Concentration	**Displays the oxygen reading prior to pressure correction and/or cross interferent compensation**
Check	An action button that compares the current reading with the low calibration gas
Calibrate	An action button that compares the current reading with the low calibration gas and updates the calibration factors if appropriate
OK	**Exits the form**

Entry to the form will:

activate `Service in Progress` status

activate the low gas valve if autocalibration is configured.

3. If autocalibration is not configured, the appropriate calibration gas should now be introduced.
4. Wait until the `Current Concentration` reading is steady.
5. Select `Check` to perform a check or `Calibrate` to re-calibrate the transmitter.
6. If autocalibration is not configured, the calibration gas should now be removed.
7. Press `OK` to exit the form.

Exiting the form will:

de-activate `Service in Progress` status

de-activate the low gas valve if autocalibration is configured.

8.3.1.3 High calibration

Minimum entry level: 1

1. From the `Manual Calibration` menu, select `High Calibration` and press ENTER to display the `High Calibration` form:

High Calibration	**XX**
Target Concentration	Displays the calibration target concentration
Current Concentration	**Displays the oxygen reading prior to pressure correction and/or cross interferent compensation**
Check	An action button that compares the current reading with the high calibration gas
Calibrate	An action button that compares the current reading with the high calibration gas and updates the calibration factors if appropriate
OK	**Exits the form**

Entry to the form will:

activate `Service in Progress` status

activate the high gas valve if autocalibration is configured.

2. If autocalibration is not configured, the appropriate calibration gas should now be introduced.
3. Wait until the `Current Concentration` reading is steady.
4. Select `Check` to perform a check or `Calibrate` to re-calibrate the transmitter.
5. If autocalibration is not configured, the calibration gas should now be removed.
6. Press `OK` to exit the form (`OK` is used rather than `Cancel` to prompt the operator to confirm that the calibration gas has been removed).

Exiting the form will:

de-activate `Service in Progress` status

de-activate the high gas valve if autocalibration is configured.

8.3.1.4 Failure to calibrate

Failure to check or calibrate will raise `Maintenance Required` status. This can be cleared by conducting a successful check or calibration. It may also be cleared by performing a transmitter status reset; see Section 6.1.3. Failure to calibrate can be due to:

Reason	Corrective action
Incorrect target values entered	Check target values and gas cylinders
Failure of calibration gas flow	Check gas flow to transmitter
Tolerance values too low	Check target and tolerance values

8.3.1.5 Calibration of internal pressure sensor

It is expected that this will be re-calibrated on an annual basis.

The internal pressure sensor signal is intended primarily to facilitate pressure compensation of the oxygen measurement. The internal pressure sensor measurement may also be displayed on the control unit; see Section 7.1.

The measurement is factory calibrated in mmHg (mercury) absolute. It can be re-calibrated in any preferred absolute units, (i.e. mBara, kPa, etc.). Refer to Section 6.1.2.7 to change the units label.

The pressure calibration target is set up in the `Calibration Settings` form; see Section 8.3.1.1. **This must be the actual pressure at the time of calibration.**

NOTE

Re-calibration of the internal pressure signal will effect the pressure compensated oxygen reading.

The oxygen measurement must be re-calibrated after calibration of the internal pressure signal.

Minimum entry level: 2

1. From the `Manual Calibrate` menu select `Int Pressure Cal` and press ENTER to display the `Internal Pressure Calibration` form (entry to the form will activate `Service in Progress` status).

Internal Pressure Calibration	**XX**
Pressure Cal Target	The target calibration pressure
Current Pressure	Displays the current internal pressure measurement
Calibrate Pressure Sensor	Calibrates the pressure signal
OK	**Exits the form**

2. Wait for the `Current Pressure` reading to stabilise.
3. Select `Calibrate Pressure Sensor` and press ENTER.
4. Press `OK` to exit the form.
5. **Recalibrate the oxygen measurement.**

8.3.1.6 Calibration of internal pressure compensation

Pressure compensation, when derived from the internal pressure sensor, is factory calibrated. It is expected that this will only be re-calibrated by the user on an annual basis.

(Routine gas measurement calibrations do not invalidate pressure compensation calibration).

NOTE

Pressure compensation must be enabled.

A successful low and high calibration must be conducted as part of this procedure.

The gas used for the high calibration must have an oxygen concentration above 10% oxygen.If this is not the usual high calibration gas, the calibration target concentration setting must be adjusted accordingly.

A means of putting a back pressure on the transmitter is required. This is discussed in the relevant transmitter installation manual but will typically provide a 5 to 10% increase in the absolute pressure inside the measuring cell.

The calibration settings form (see Section 8.3.1.1) includes an entry labelled `Minimum O2 Change`.This is used to ensure that measurable changes in both oxygen and pressure occur during calibration. The figure is calculated, in percentage oxygen, by considering the effect of the typical pressure change on the high calibration gas.

E.g. for a 20% oxygen calibration gas, the typical back pressure will change the reading by at least 1% oxygen. The `Minimum O2 Change` should be set at 1.0% oxygen.

Minimum entry level: 2

1. Perform a low calibration.
2. Perform a high calibration.
3. Leave the high calibration gas running through the transmitter.
4. From the `Manual Calibrate` menu, select `Pressure Comp Cal` and press ENTER to display the `Pressure Compensation Cal` form (entry to the form will activate `Service in Progress` status).

Pressure Compensation Cal	**XX**
Target Concentration	The high concentration calibration gas target
Current Concentration	**Displays the oxygen reading prior to pressure correction and/or cross interferent compensation**
Capture Low Pressure	An action button that captures the gas concentration and pressure at the low (ambient) pressure point
Capture High Pressure	An action button that captures the gas concentration and pressure at the higher pressure point
Check Pressure Compensation	Check the data captured is acceptable
Calibrate Pressure Compensation	Calibrates pressure compensation
OK	**Exits the form**

5. Wait for the oxygen reading to stabilise.
6. Select `Capture Low Pressure` and press ENTER.
7. Apply the back pressure and check that the `Current Concentration` has increased by at least the specified `Minimum` O_2 `Change.`
8. Wait for the oxygen reading to stabilise.
9. Select `Capture High Pressure` and press ENTER.
10. Select `Check Pressure Calibration` and press ENTER to ensure validity of captured data.
11. Select `Calibrate Pressure Compensation` and press ENTER to complete calibration.
12. Remove the back pressure.
13. Press `OK` to exit the form.

Failure to calibrate pressure compensation can be due to:

Reason	Corrective action
Oxygen value is too low	The gas should be at least 10% oxygen
Pressure change is too small	The pressure increase must cause a change in the oxygen reading greater than the `Minimum` O_2 `Change`

8.3.1.7 Calibration of internal flow alarm

The flow alarm is factory calibrated using nitrogen as the sample gas. If the actual sample gas is significantly different the alarm may require a new calibration. Subsequently it is expected that this will only be re-calibrated by the user on an annual basis.

Calibration is conducted at two points, one (0% target) at zero flow and one at the normal sample flow through the transmitter. This latter point is defined as the 100% flow rate.

Minimum entry level: 2

1. From the `Manual Calibrate` menu select `Internal Flow Cal` and press ENTER to display the `Internal Flow Calibration` form (entry to the form will activate `Service in Progress` status).

Internal Flow Calibration	**XX**
Zero Flow	The 'raw' voltage signal at time of previous zero flow calibration
Normal Flow	The 'raw' voltage signal at time of previous normal flow calibration
Current Flow	The current 'raw' voltage reading
Capture Zero Flow	An action button that captures the zero flow point
Capture Normal Flow	An action button that captures the normal flow point
Apply Calibration	Calibrates the flow signal
OK	**Exits the form**

2. Turn off the sample gas and wait for the `Current Flow` reading to stabilise.
3. Capture the zero flow point.
4. Turn on the sample gas at the normal flow rate and wait for the `Current Flow` reading to stabilise.
5. Capture the normal flow point.
6. Apply calibration
7. Press OK to quit the form and update the 'raw' values for Zero and Normal flow.

8.4 Calibration history

Minimum user level: 2

The `Paramagnetic Calibration` menu also offers two further options:

`Cal History`	The history of successful transmitter oxygen calibrations
`Clear History`	The calibration history may be cleared

Calibration history screens are similar to the alarm history screens shown in Figure 9. Remember that detailed transmitter status information is held under the relevant transmitter menu.

The calibration history memory is of finite size. Status messages will be generated when the history is over 80% full. The `Clear History` command must then be used to allow future records to be stored.

Appendix A Paramagnetic background gas correction

Oxygen is a strongly paramagnetic gas (it is attracted to a magnetic field). Virtually all other gases are weakly diamagnetic (they are repelled by a magnetic field). Servomex paramagnetic oxygen analysers are typically calibrated with oxygen-free nitrogen for 0.00% and a suitable span gas of known oxygen concentration. The scale is linear between these two points.

Some other gases in the sample may have a slight +ve or -ve effect (compared to nitrogen). This effect is common to all oxygen analysers using the paramagnetic measuring technique. However, there are a number of ways to compensate:

1. If the application is measuring low oxygen concentrations in a binary mixture (for example O_2 in CO_2) it is recommended that the primary component (in this case CO_2 with <0.005% O_2) is used as the low calibration gas.
2. A separate analyser may be used to measure the background gas and provide a signal subsequently used to correct the oxygen reading. This method will usually only be required where the concentration of the interfering gas varies significantly.
3. If the concentration of the interfering gas in the sample is stable a correction can be applied to the value of the zero offset by using a non-zero value for the low calibration gas. Nitrogen is then used as the low calibration gas.

Table A1 provides offset factors for a number of pure gases at a range of temperatures.

Example 1:

A 2223 Transmitter (60°C operation) measuring a stable sample, typically 5% oxygen in a complex background gas.

The effect for each component is calculated by extrapolation from pure gas information, given in Table A1, to show the following:

Gas	**Sample Concentration**	**Offset for pure gas in % O2**	**Actual effect in % O_2**
Oxygen	5%	100.00	5.00
Ethylene	25%	-0.22	-0.055
Ethylene oxide	2%	-0.61	-0.012
Carbon dioxide	8%	-0.30	-0.024
Argon	7%	-0.25	-0.017
Methane	50%	-0.18	-0.090
Nitrogen	3%	0.00	0.000
Total	**100%**		**+4.80% O_2**

The implication is that if the analyser is zeroed on nitrogen and spanned on air (20.95% O_2), this mixture will read 4.80% O_2.

The overall effect of the background gas (i.e. the non oxygen constituents) is the difference between the apparent and the actual oxygen concentrations, **i.e. -0.20 % oxygen**.

It is unlikely that a low calibration gas mixture could be blended to represent the sample or that an analyser could provide a signal proportional to the background effect. Therefore compensation must be by offset, i.e.:

> Calibrate using nitrogen but set the zero point target concentration to +0.20%. (Note that the offset of +0.20% O_2 is of the opposite sign to the effect of the background gas.)

Example 2:

A 2223 Transmitter (60°C operation) measuring a variable oxygen concentration in a measurable (nitrogen dioxide) background gas.

The sample stream has a nitrogen dioxide (NO_2) concentration that varies between 10% and 15%. From Table A1, 100% NO_2 will give an offset of 20% O_2.

If the oxygen concentration were constant, the NO_2 variation would yield a variable error in the oxygen reading as shown below:

at 10% NO_2 = +2.0% O_2

at 15% NO_2 = +3.0% O_2

This is unlikely to be correctable using a zero point offset calibration as in example 1.

A recommended solution is to measure the nitrogen dioxide and feed a compensation signal in via one of the analog input channels available on the 2223 Transmitter. Thus:

Assume a NO_2 analyser with a 4-20mA output for 0 to 25% NO_2.

At 25% NO_2 the error is 25% of 20 = 5.0% O_2.

The values entered into the `Analog Input Settings` form are:

`Measurement 1`	0.0%
`Current 1`	4mA
`Measurement 2`	-5.0%
`Current 2`	20mA

Note that the polarity of `Measurement 2` is opposite to the NO_2 effect and is in units of oxygen.

At 15% NO_2, a current of 13.6mA at the input generates an offset of -3.0% O_2, thereby cancelling the background gas effect.

Blank tables are located at the end of this appendix for customer use.

Table A.1 Zero offset factors for a selection of pure gases

Pure Gas	Formula	Molar mag.susc x 10^{-6}	Zero offset			
			20°C	50°C	60°C	110°C
Acetaldehyde	CH_2CHO	-22.70	-0.31	-0.34	-0.35	-0.40
Acetic acid	CH_3CO_2H	-31.50	-0.56	-0.62	-0.64	-0.74
Acetone	CH_3COCH_3	-33.70	-0.63	-0.69	-0.71	-0.82
Acetylene	HCCH	-20.80	-0.25	-0.28	-0.29	-0.33
Acrylonitrile	CH_2=CHCN	-24.10	-0.35	-0.39	-0.40	-0.46
Allyl alcohol	CH_2CHCH_2OH	-36.70	-0.71	-0.79	-0.81	-0.93
Ammonia	NH_3	-18.00	-0.17	-0.19	-0.20	-0.23
Argon	Ar	-19.60	-0.22	-0.24	-0.25	-0.29
Benzene	C_6H_6	-54.84	-1.24	-1.36	-1.41	-1.62
Boron chloride	BCl_3	-59.90	-1.38	-1.53	-1.57	-1.81
Boron trifluoride	BF_3	-19.00	-0.20	-0.22	-0.23	-0.26
Bromine	Br_2	-73.50	-1.78	-1.96	-2.02	-2.32
1,2 Butadiene	C_4H_6	-35.60	-0.68	-0.75	-0.77	-0.89
1,3 Butadiene	C_4H_6	-30.60	-0.54	-0.59	-0.61	-0.70
N-Butane	C_4H_{10}	-50.30	-1.11	-1.22	-1.26	-1.45
iso-Butane	$(CH_3)_2CHCH_2$	-51.70	-1.15	-1.26	-1.30	-1.50
1 Butene	CH_3CH_2CH=CH_2	-41.10	-0.84	-0.93	-0.96	-1.10
N-Butyl acetate	$CH_3COOC_4H_9$	-77.50	-1.89	-2.09	-2.15	-2.47
iso-Butylene	$(CH_3)_2CH$=CH_2	-44.40	-0.94	-1.03	-1.06	-1.22
1 Butyne (Ethylacetylene)	$CH_3C_3H_2$	-43.50	-0.91	-1.00	-1.03	-1.19
Carbon dioxide	CO_2	-21.00	-0.26	-0.29	-0.30	-0.34
Carbon disulphide	CS_2	-42.20	-0.87	-0.96	-0.99	-1.14
Carbon monoxide	CO	-9.80	0.06	0.07	0.07	0.08
Carbon tetrachloride	CCl_4	-66.60	-1.58	-1.74	-1.79	-2.06
Carbon tetrafluoride	CF_4	-31.20	-0.55	-0.61	-0.63	-0.72
Chlorine	Cl_2	-40.50	-0.82	-0.91	-0.94	-1.08
Chloro ethanol	$ClCH_2CH_2OH$	-51.40	-1.14	-1.25	-1.29	-1.49
Chloroform	$CHCl_3$	-59.30	-1.37	-1.51	-1.55	-1.78
Cumene	$(CH_3)_2CHC_6H_5$	-89.53	-2.24	-2.47	-2.55	-2.93
Cyclohexane	C_6H_{12}	-68.13	-1.62	-1.79	-1.84	-2.12
Cyclopentane	C_5H_{10}	-59.18	-1.36	-1.50	-1.55	-1.70
Cyclopropane	C_3H_6	-39.90	-0.81	-0.89	-0.92	-1.05
Diacetylene	C_4H_2	-37.50	-0.74	-0.81	-0.84	-0.96
Dichloroethylene	$(CHCl)_2$	-49.20	-1.07	-1.18	-1.22	-1.40
Diethyl ether	$(C_2H_5)_2O$	-55.10	-1.25	-1.37	-1.41	-1.63
2,2 Difluoro 1 chloroethane	$CClH_2CHF_2$	-52.40	-1.17	-1.29	-1.33	-1.52
1,2 Difluoro 1,2 dichloroethylene	CFCl=CFCl	-60.00	-1.39	-1.53	-1.58	-1.81
Difluoro dichloro methane (Freon 12)	CCl_2F_2	-52.20	-1.16	-1.28	-1.32	-1.5
Dimethoxy methane	$CH_2(OCH_3)_2$	-47.30	-1.02	-1.12	-1.16	-1.33
Dimethylamine	$(CH_3)_2NH$	-39.90	-0.81	-0.89	-0.92	-1.05
Dimethylether	CH_3OCH_3	-26.30	-0.41	-0.46	-0.47	-0.54
Dimethylethylamine	$(CH_3)_2NC_2H_5$	-63.60	-1.49	-1.64	-1.69	-1.95
Enflurane (Ethrane)	$C_3H_2F_5ClO$	-80.10	-1.97	-2.17	-2.24	-2.57
Ethane	C_2H_6	-26.80	-0.43	-0.47	-0.49	-0.56
Ethanol	C_2H_5OH	-33.60	-0.62	-0.69	-0.71	-0.82
Ethyl acetate	$CH_3COOC_2H_5$	-54.20	-1.22	-1.34	-1.39	-1.59
Ethyl amine	$C_2H_5NH_2$	-39.90	-0.81	-0.89	-0.92	-1.05
Ethyl benzene	$C_6H_5C_2H_5$	-77.20	-1.88	-2.08	-2.14	-2.46
Ethyl bromide	C_2H_5Br	-54.70	-1.23	-1.36	-1.40	-1.61

Pure Gas	Formula	Molar mag.susc x 10^{-6}	Zero offset			
			20°C	50°C	60°C	110°C
Ethyl chloride	C_2H_5Cl	-46.00	-0.98	-1.08	-1.12	-1.28
Ethylene	C_2H_4	-18.80	-0.20	-0.22	-0.22	-0.26
Ethylene glycol	$(CH_2OH)_2$	-38.80	-0.77	-0.85	-0.88	-1.01
Ethylene oxide	$(CH_2)_2O$	-30.70	-0.54	-0.60	-0.61	-0.71
Ethyl mercaptan	$C_2H_5OSO_3H$	-47.00	-1.01	-1.11	-1.15	-1.32
Fluorochlorobromomethane	CFClBr	-58.00	-1.33	-1.46	-1.51	-1.74
Fluorodichloromethane (Freon 21)	$CHCl_2F$	-48.80	-1.06	-1.17	-1.21	-1.39
Fluroxene	$CF_3CH_2OCHCH_2$	-56.70	-1.29	-1.42	-1.47	-1.69
Freon 114	$C_2Cl_2F_4$	-77.40	-1.89	-2.08	-2.15	-2.47
Furan	C_4H_4O	-43.09	-0.90	-0.99	-1.02	-1.17
Germanium tetrachloride	$GeCl_4$	-72.00	-1.73	-1.91	-1.97	-2.26
Halothane	$C_2HBrClF_3$	-78.80	-1.93	-2.13	-2.19	-2.52
Helium	He	-1.88	0.29	0.32	0.33	0.38
N-Heptane	C_7H_{16}	-85.24	-2.12	-2.33	-2.40	-2.76
N-Hexane	C_6H_{14}	-73.60	-1.78	-1.96	-2.02	-2.32
Hydrogen	H_2	-3.98	0.23	0.26	0.26	0.30
Hydrogen bromide	HBr	-35.30	-0.67	-0.74	-0.76	-0.88
Hydrogen chloride	HCl	-22.60	-0.31	-0.34	-0.35	-0.40
Hydrogen cyanide	HCN	-14.50	-0.07	-0.08	-0.08	-0.09
Hydrogen iodide	HI	-48.20	-1.05	-1.15	-1.19	-1.37
Hydrogen selenide	H_2Se	-39.20	-0.79	-0.87	-0.89	-1.03
Hydrogen sulphide	H_2S	-25.50	-0.39	-0.43	-0.44	-0.51
Isoflurane (Forane)	$C_3H_2F_5ClO$	-80.10	-1.97	-2.17	-2.24	-2.57
Isoprene	C_5H_8	-44.80	-0.95	-1.04	-1.08	-1.24
Ketene	CH_2CO	-15.70	-0.11	-0.12	-0.12	-0.14
Krypton	Kr	-28.80	-0.49	-0.54	-0.55	-0.63
Methane	CH_4	-17.40	-0.16	-0.17	-0.18	-0.20
Methanol	CH_3OH	-21.40	-0.27	-0.30	-0.31	-0.35
Methoxyfluorane	$CHCl_2CF_2OCH_3$	-87.10	-2.17	-2.39	-2.47	-2.83
Methyl acetate	CH_3COCH_3	-42.60	-0.88	-0.97	-1.00	-1.15
Methyl cyclopentane	C_6H_{12}	-70.20	-1.68	-1.85	-1.91	-2.20
Methylene chloride	CH_2Cl_2	-46.60	-1.00	-1.10	-1.14	-1.31
Methylethlyketone	$CH_3COCH_2CH_3$	-45.50	-0.97	-1.07	-1.10	-1.26
Methyl fluoride	CH_3F	-25.50	-0.39	-0.43	-0.44	-0.51
Methyl formate	$HCOOCH_3$	-32.00	-0.58	-0.64	-0.66	-0.75
Methyl iodide	CH_3I	-57.20	-1.31	-1.44	-1.48	-1.71
Methyl iso-butyl ketone (MIBK)	$C_4H_9COCH_3$	-69.30	-1.66	-1.82	-1.88	-2.16
Methyl mercaptan	CH_3SH	-35.30	-0.67	-0.74	-0.76	-0.88
Molybdenum hexafluoride	MoF_6	-26.00	-0.40	-0.45	-0.46	-0.53
Monochlorobenzene	C_6H_5Cl	-70.00	-1.68	-1.85	-1.90	-2.19
Neon	Ne	-6.70	0.15	0.17	0.17	0.20
Nitric oxide	NO	1461.00	42.56	42.96	42.94	41.62
Nitrobenzene	$C_6H_5NO_2$	-61.80	-1.44	-1.59	-1.63	-1.88
Nitrogen	N_2	-12.00	0.00	0.00	0.00	0.00
Nitrogen dioxide	NO_2	150.00	5.00	16.00	20.00	35.00
Ortho-Nitrotoluene	$C_6H_4CH_3NO_2$	-72.30	-1.74	-1.92	-1.98	-2.28
para-Nitrotoluene	$C_6H_4CH_3NO_2$	-76.90	-1.88	-2.07	-2.13	-2.45
Nitrous oxide	N_2O	-18.90	-0.20	-0.22	-0.23	-0.26

Pure Gas	Formula	Molar mag.susc x 10^{-6}	Zero offset			
			20°C	50°C	60°C	110°C
N-Nonane	C_9H_{20}	-108.13	-2.78	-3.06	-3.16	-3.63
N-Octane	C_8H_{18}	-96.63	-2.45	-2.70	-2.78	-3.19
Oxygen	O_2	3449.00	100.0	100.0	100.0	100.0
Ozone	O_3	6.70	0.54	0.60	0.61	0.71
iso-Pentane	C_5H_{12}	-64.40	-1.51	-1.67	-1.72	-1.98
N-Pentane	C_5H_{12}	-63.10	-1.48	-1.63	-1.68	-1.93
0.01%Phenol	C_6H_5OH	-60.21	-1.39	-1.54	-1.58	-1.82
Phosphine	PH_3	-26.00	-0.40	-0.45	-0.46	-0.53
Phosphorous oxychloride	$POCl_3$	-69.00	-1.65	-1.82	-1.87	-2.15
Propane	C_3H_8	-38.60	-0.77	-0.85	-0.87	-1.00
iso-Propanol	$(CH_3)_2CHOH$	-47.60	-1.03	-1.13	-1.17	-1.34
Propene	$CH_3CH=CH_2$	-31.50	-0.56	-0.62	-0.64	-0.74
N-Propyl acetate	$CH_3COOC_3H_7$	-65.90	-1.56	-1.72	-1.77	-2.03
Propyl amine	$C_3H_7NH_2$	-52.40	-1.17	-1.29	-1.33	-1.52
Propyl chloride	C_3H_7Cl	-56.10	-1.27	-1.40	-1.45	-1.66
Propylene	C_3H_6	-31.50	-0.56	-0.62	-0.64	-0.74
Propylene oxide	OCH_2CHCH_3	-42.50	-0.88	-0.97	-1.00	-1.15
iso-Propyl ether	$(CH_3)_4CHOCH$	-79.40	-1.95	-2.15	-2.21	-2.54
Propyl fluoride	C_3H_7F	-52.20	-1.16	-1.28	-1.32	-1.52
Pyridine	$N(CH)_5$	-49.21	-1.08	-1.19	-1.22	-1.40
Silane	SiH_4	-20.50	-0.25	-0.27	-0.28	-0.32
Silicon tetrachloride	$SiCl_4$	-88.30	-2.20	-2.43	-2.50	-2.88
Styrene	$C_6H_5CH=CH_2$	-68.20	-1.62	-1.79	-1.85	-2.12
Sulphur dioxide	SO_2	-18.20	-0.18	-0.20	-0.20	-0.23
Sulphur hexafluoride	SF_6	-44.00	-0.92	-1.02	-1.05	-1.21
Tetrachoroethylene	$Cl_2C=CCl_2$	-81.60	-2.01	-2.22	-2.28	-2.63
Tetrahydrofuran	C_4H_8O	-52.00	-1.16	-1.27	-1.31	-1.51
Toluene	$C_6H_5CH_3$	-66.11	-1.56	-1.72	-1.78	-2.04
1,1,2 Trichloroethane (Freon 113)	$CHCl_2CH_2Cl$	-66.20	-1.57	-1.73	-1.78	-2.05
Trichloroethylene	$CHCl=CCl_2$	-65.80	-1.55	-1.71	-1.77	-2.03
Trifluorochloroethylene	C_2F_3Cl	-49.10	-1.07	-1.18	-1.22	-1.40
Trimethylamine	$(CH_3)_3N$	-51.70	-1.15	-1.26	-1.30	-1.50
Tungsten fluoride	WF_6	-40.00	-0.81	-0.89	-0.92	-1.06
Urethane	$CO(NH_2)OC_2H_5$	-57.00	-1.30	-1.43	-1.48	-1.70
Vacuum	-	0.00	0.35	0.38	0.39	0.45
Vinyl bromide	$CH_2=CHBr$	-44.80	-0.95	-1.04	-1.08	-1.24
Vinyl chloride	$CH_2=CHCl$	-35.60	-0.68	-0.75	-0.77	-0.89
Vinyl fluoride	$CH_2=CHF$	-28.80	-0.49	-0.54	-0.55	-0.63
Water	H_2O	-13.00	-0.03	-0.03	-0.03	-0.04
Xenon	Xe	-43.90	-0.92	-1.02	-1.05	-1.20
Xylene	$(CH_3)_2C_6H_4$	-77.78	-1.90	-2.09	-2.16	-2.48

Blank tables for customer use

1. Compensation by offset:

Gas	Sample Concentration	Offset for pure gas in % O2	Actual effect in % O_2
Total	**100%**		

If the analyser is zeroed on nitrogen, this mixture will read: _____% oxygen.

The overall effect of the background gas is _____ % oxygen.

Hence, using nitrogen, the zero point target concentration is _____%.

2. Compensation by analog input:

Pure interferent gas is _____, with an offset of _____%O_2.

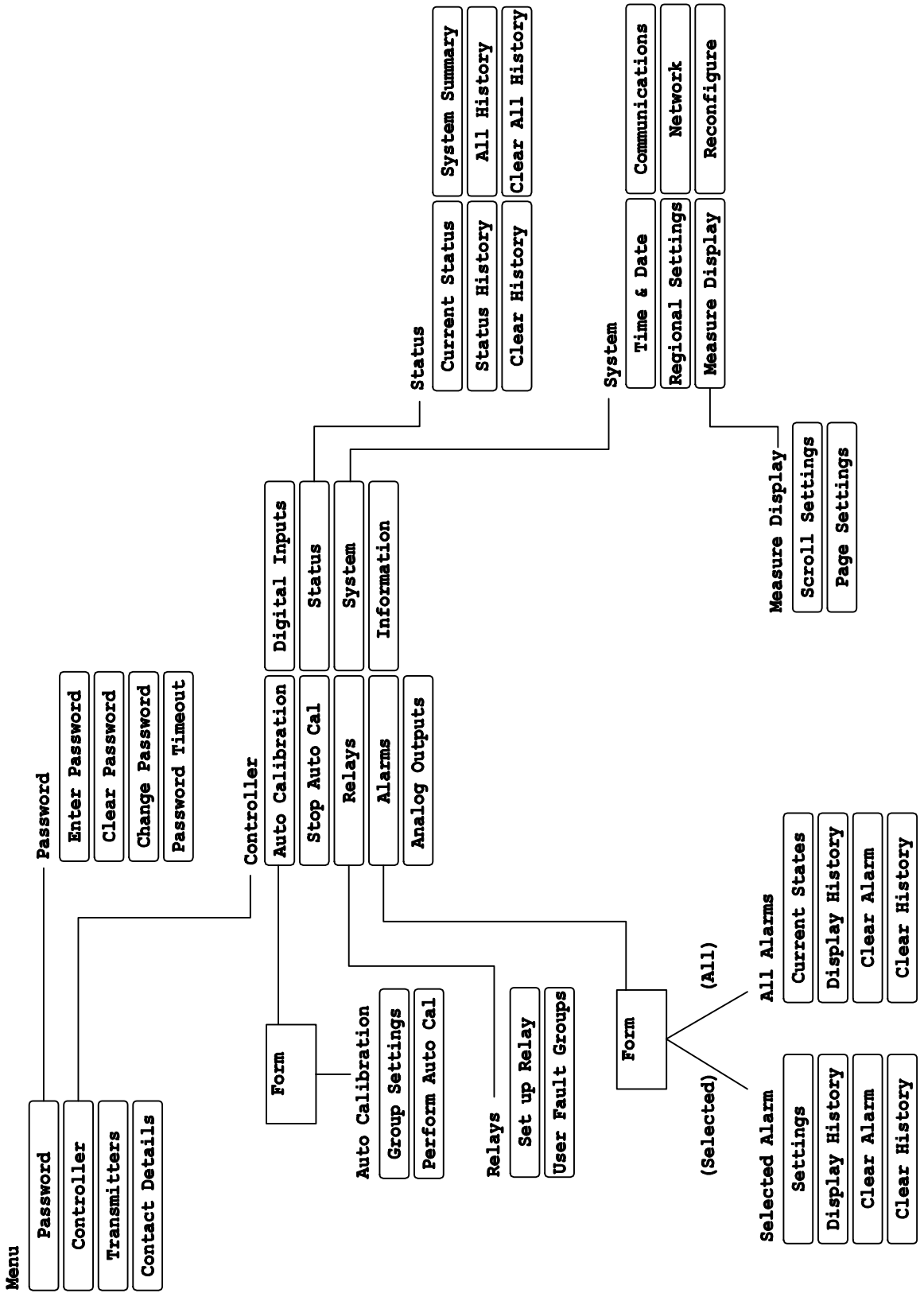
Signal output limits are _____mA =_____% interferent =_____% oxygen
and
_____mA =_____% interferent =_____% oxygen.

The values entered into the `Analog Input Settings` form are:

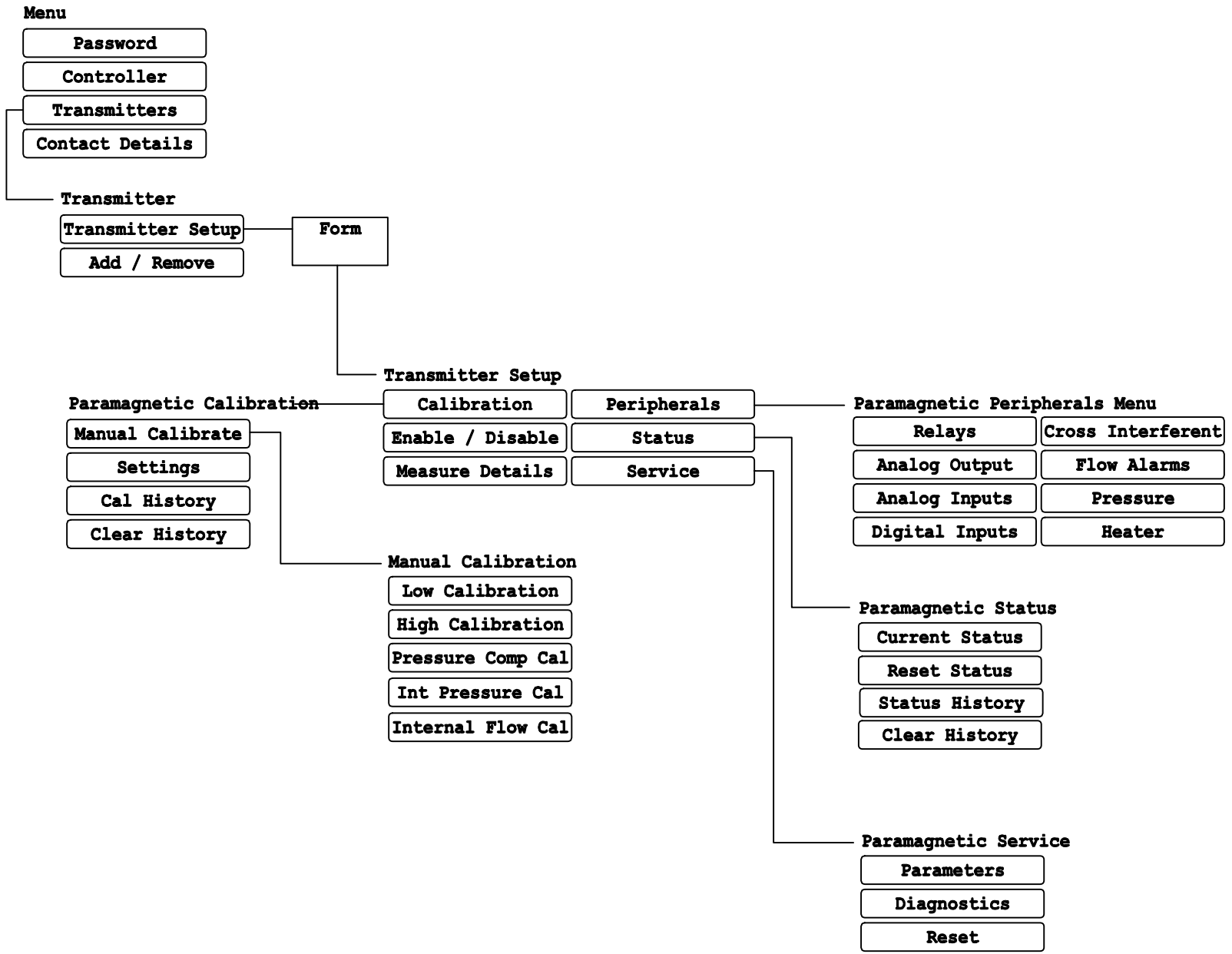
Measurement 1	
Current 1	
Measurement 2	
Current 2	

Please remember that the polarity of `measurements` is opposite and is in units of oxygen.

Appendix B User menu tree



Continued overleaf


Menu
Password
Controller
Transmitters
Contact Details
Transmitter
Transmitter Setup
Add / Remove
Form
Transmitter Setup
Paramagnetic Calibration
Calibration
Peripherals
Enable / Disable
Status
Measure Details
Service
Manual Calibrate
Settings
Cal History
Clear History
Manual Calibration
Low Calibration
High Calibration
Pressure Comp Cal
Int Pressure Cal
Internal Flow Cal
Paramagnetic Peripherals Menu
Relays
Cross Interferent
Analog Output
Flow Alarms
Analog Inputs
Pressure
Digital Inputs
Heater
Paramagnetic Status
Current Status
Reset Status
Status History
Clear History
Paramagnetic Service
Parameters
Diagnostics
Reset