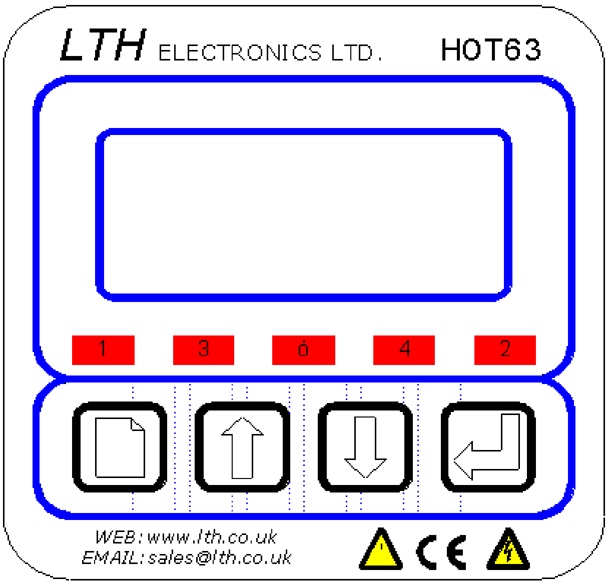
HOT63

DISSOLVED OXYGEN TRANSMITTER



OPERATION GUIDE

PREFACE

Product warranty

The HOT63 has a warranty against defects in materials and workmanship for three years from the date of shipment. During this period LTH will, at its own discretion, either repair or replace products that prove to be defective. The associated software is provided 'As is' without warranty.

Limitation of warranty

The foregoing warranty does not cover damage caused by accidental misuse, abuse, neglect, misapplication or modification.

No warranty of fitness for a particular purpose is offered. The user assumes the entire risk of using the product. Any liability of LTH is limited exclusively to the replacement of defective materials or workmanship.

There are no user serviceable parts, including fuses etc., within the unit. Any attempt to dismantle the instrument will invalidate the warranty.

Disclaimer

LTH Electronics Ltd reserves the right to make changes to this manual or the instrument without notice, as part of our policy of continued developments and improvements.

All care has been taken to ensure accuracy of information contained in this manual. However, we cannot accept responsibility for any errors or damages resulting from errors or inaccuracies of information herein.

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Fourth edition: August 2005

Document part number: 6148

LTH Electronics Ltd
Chaul End Lane
Luton
Bedfordshire
LU4 8EZ
England

Telephone +44 (0)1582 593693
Fax +44 (0)1582 598036
Email sales@lth.co.uk
Web www.lth.co.uk

Manufacturing Standards

Electromagnetic compatibility

This instrument has been designed to comply with the standards and regulations set down by the European EMC Directive

Safety

This instrument has been designed to comply with the standards and regulations set down by the European Low Voltage Directive using BS EN 61010-1 : 1993

Quality

This instrument has been manufactured under the following quality standard: ISO 9001:2000. Certificate No : FM 13843

Note: The standards referred to in the design and construction of LTH products are those prevailing at the time of product launch. As the standards are altered from time to time, we reserve the right to include design modifications that are deemed necessary to comply with the new or revised regulations.

CONTENTS

GLOSSARY

DO	Dissolved Oxygen
LCD	Liquid crystal display
LED	Light Emitting Diode
ppm	Parts per million.
pO2	Partial Pressure of Oxygen
ppt	Parts per thousand
PRT	Platinum Resistance Thermometer.
PSD	Programmable System Devices.
RTD	Resistive Temperature Device
SP	Set point.

1 Introduction

1.1 About the HOT63

The HOT63 is a microprocessor-controlled dissolved oxygen measurement instrument. The unit utilises a multifunction LCD to display readings and provide feedback to the operator. It is available with different options to provide fully configurable control, alarm and feedback with up to two relays and two 0/4-20mA current output sources.

1.2 Unit Specification

Sensor input	Galvanic (Mackereth) 0 to 9.999mA or Polargraphic (Clark) 0 to 500.0nA.
Sensor bias voltage	Software Programmable, -1.000 to +1.000V, Resolution ±1mV, Output Accuracy ±3mV
Sensor membrane correction factor	Software Programmable 0 to 9999
Sensor cable	Up to 10 metres
Ranges of measurement	0 - 199.9 % saturation, 0 - 30.00 ppm Concentration, 0 – 999.9 mmHg (Calibration specific) 0 – 9999 mBar pO_2 (Calibration specific)
Accuracy	±3μA (Galvanic Mode), ±1.0nA (Polargraphic Mode)
Linearity	±0.1% of Range
Repeatability	±0.1% of Range
Temperature sensor	2 wire interface, operating with up to 10 metres of cable. Software selectable sensor type including PT1000 RTD, LTH1K and BJC 22K
Measurement range	-50°C to +300°C (PT1000)
Temperature accuracy	±0.2°C (Dependant on Sensor Configuration)
Operator adjustment (temperature)	± 50°C, or ± 122°F
Temperature compensation	Automatic, or Manually set from 0°C to 100°C
Pressure compensation	Advanced model only. Actively from 4-20 mA input (Direct or 24V loop powered from the HOT63). Software Scalable or User Programmable from 0.50 – 9.99 bar, with user selectable pressure damping
Salinity compensation	User Programmable from 0 – 40.0 ppt

Ambient operating temperature	-20°C to +50°C (-4°F to +122°F) for full specification.
Ambient temperature variation	±0.01% of range / °C (typical)
User interface	Large 4 character 7-segment display for measured value, with alphanumeric dot matrix characters for units, information and programming. Easy to use four button user interface for programming.
Current output (1 standard, 2 optional)	Selectable 0-20mA or 4-20mA operation into a 750Ω maximum load, fully isolated to 2kV. Selectable transmission of either sensor reading or temperature, and software scalable within the operating range.
Operator adjustment (Current)	±1mA zero and ±1mA span for remote monitor calibration
Set point / alarm relays (2 optional)	Relays can be configured to operate at set points or on alarm conditions. Relay SP1 controls an internally-derived DC supply. Relay SP2 has volt free changeover contacts. The SP2 contacts are rated at 5A 30V DC / 5A 250VAC (non-inductive). Red LEDs indicate relay energised. **Set point modes:** Fully configurable set points On/Off, Time Proportioning, Pulse Proportioning, and Band modes selectable for two relays. Adjustable delay timers up to 10:00 mm:ss in the On/Off mode. Hysteresis 0 to 9.9% in the On/Off mode. Adjustable dose alarm timer up to 15:00 mm:ss in all modes

Set point / alarm relays (cont.)	**Cleaning mode:** Either relay can be set to initiate a cleaning cycle. See *Section 14 Cleaning Menu*. Relay SP1 can supply 24V DC to control a rotary electrode cleaning system.
Off-line facility (for calibration and commissioning)	Initiated by remote contact closure or software selection. Relays 1 & 2 are de-energised and the current outputs are held at the last On-Line value.
EMC Immunity	BS EN 50082-2 1995
EMC emissions	BS EN 50081-1 1992
Safety	Designed and manufactured in accordance with BS EN 61010-1 1993
Power supply	15 – 30V AC or DC at 200 mA.
Unit housing	Conductive ABS blue plastic, rated to IP66.
Weight	600g (instrument only)
Dimensions	110 x 116 x 145 mm (h x w x d), excluding connectors

2 Safety & EMC

This chapter describes how to install and mount the HOT63 and how to connect the unit to a power source and auxiliary equipment.

Although today's electronic components are very reliable, it should be anticipated in any system design that a component could fail and it is therefore desirable to make sure a system will **fail safe**. This could include the provision of an additional monitoring device, depending upon the particular application and any consequences of an instrument or sensor failure.

2.1 Wiring Installation

The specified performance of the HOT63 is entirely dependent on correct installation. For this reason, the installer should thoroughly read the following instructions before attempting to make any electrical connections to the unit.

WARNING! : ALWAYS REMOVE THE MAIN POWER FROM THE SYSTEM BEFORE ATTEMPTING ANY ALTERATIONS TO THE WIRING. ENSURE THAT BOTH POWER INPUT LINES ARE ISOLATED. MAKE SURE THAT THE POWER CANNOT BE SWITCHED ON BY ACCIDENT WHILST THE UNIT IS BEING CONNECTED. FOR SAFETY REASONS AN EARTH CONNECTION MUST BE MADE TO THE EARTH TERMINAL OF THIS INSTRUMENT.

ADHERE STRICTLY TO LOCAL WIRING AND SAFETY REGULATIONS WHEN INSTALLING THIS UNIT. SHOULD THESE REGULATIONS CONFLICT WITH THE FOLLOWING INSTRUCTIONS, CONTACT LTH ELECTRONICS OR AN AUTHORISED LOCAL DISTRIBUTOR FOR ADVICE.

To maintain the specified levels of Electro Magnetic Compatibility (EMC, susceptibility to and emission of electrical noise, transients and radio frequency signals) it is essential that the types of cables recommended within these instructions be used. If the installation instructions are followed carefully and precisely, the instrument will achieve and maintain the levels of EMC protection stated in the specification. Any equipment to which this unit is connected must also have the same or similar EMC control to prevent undue interference to the system.

- Terminations at the connectors should have any excess wire cut back so that a minimal amount of wire is left free to radiate electrical pick-up close to the instrument.

Note: The use of CE marked equipment to build a system does not necessarily mean that the completed system will comply with the European requirements for EMC.

2.2 Noise suppression

In common with other electronic circuitry, the HOT63 may be affected by high level, short duration noise spikes arising from electromagnetic interference (EMI) or radio frequency interference (RFI). To minimise the possibility of such problems occurring, the following recommendations should be followed when installing the unit in an environment where such interference could potentially occur.

The following noise generating sources can affect the HOT63 through capacitive or inductive coupling.

- Relay coils
- Solenoids
- AC power wires, particularly at or above 100V AC
- Current carrying cables
- Thyristor field exciters
- Radio frequency transmissions
- Contactors
- Motor starters
- Business and industrial machines
- Power tools
- High intensity discharge lights
- Silicon control rectifiers that are phase angle fired

The HXT63 series is designed with a high degree of noise rejection built in, to minimise the potential for interference from these sources, but it is recommended that you apply the following wiring practices as an added precaution. Cables transmitting low level signals should not be routed near contactors, motors, generators, radio transmitters, or wires carrying large currents.

If noise sources are so severe that the instrument's operation is impaired, or even halted, the following external modifications should be made, as appropriate:

- Fit arc suppressors across active relay or contactor contacts in the vicinity.
- Run signal cables inside steel tubing as much as is practical.
- Use the internal relays to switch external slave relays or contactors when switching heavy or reactive loads.
- Fit a power supply filter close to the power terminals of the instrument.

3 Installation

3.1 Wall-mounted Version Mechanics

This version is mounted on a wall and connects to sensors via a (maximum) 10m cable. Figure 1 shows the dimensions and fixing points of the unit.

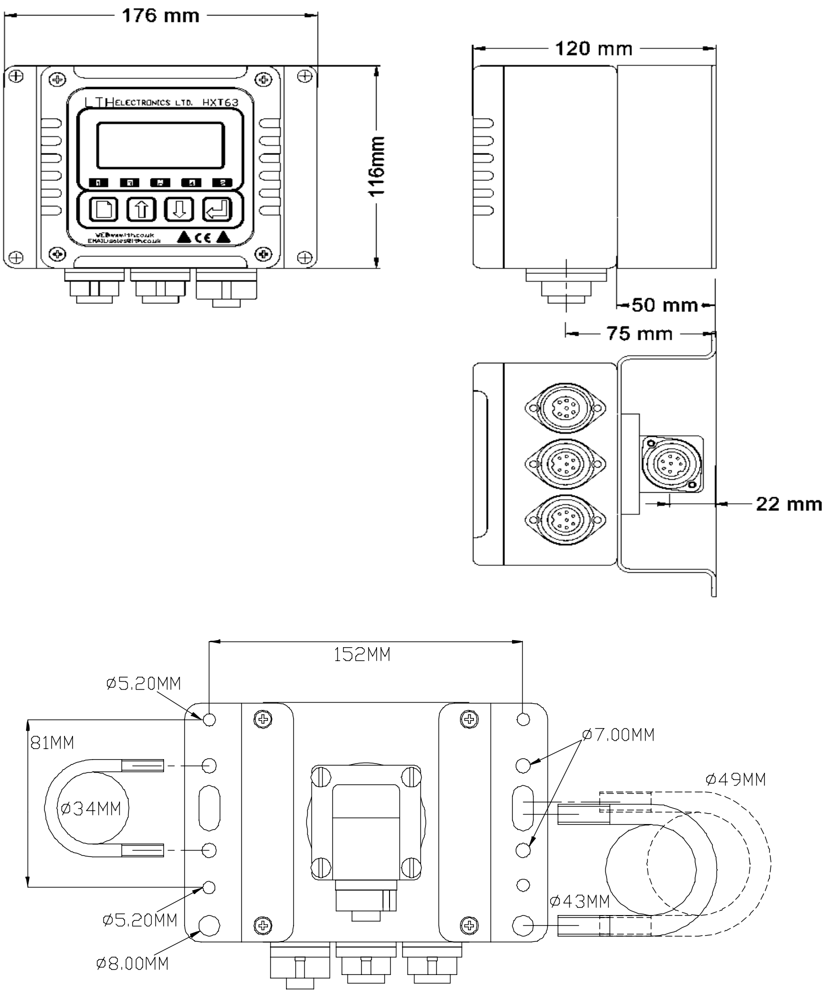


Figure 1 unit dimensions

3.2 Connections

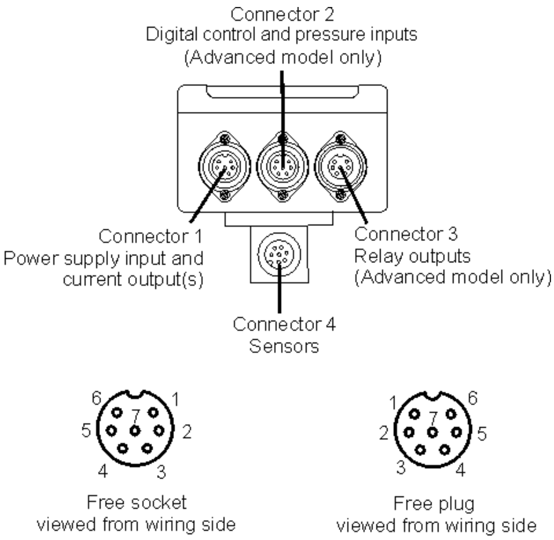


Figure 2 : Panel mount unit, rear view

Connections to the unit are made via the three circular connectors on the side of the unit plus an underside connector. The connections are as follows:

3.2.1 Connector 1 Power Supply Input and Current Outputs

Free female socket.

Pin	Function
1	Common 0V (supply and outputs)
2	24V supply
3	Current A output
4	Current B output (Advanced version only)
5	Not used
6	Not used
7	Earth – Connect to power supply earth pin1 to ensure shielding of electrical circuits.

3.2.2 Connector 2 Pressure and digital range selection inputs

Free female socket. Advanced version only. See *Section 3.3 Digital Inputs*.

The pressure input can be loop powered or externally powered. See *Section 12 Pressure Input*.

Pin	Function
1	Digital input - common
2	No connection
3	Pressure +
4	Digital input 3
5	Digital input 1
6	Digital input 2
7	Pressure – (0V)

3.2.3 Connector 3 Relay outputs

Free male plug. Advanced version only. See *Sections 3.2.7 and 3.2.8.*

Pin	Function
1	Not used
2	Relay 1 normally open – switched low voltage supply
3	Relay 1 normally closed – switched low voltage supply
4	Relay 2 common
5	Relay 2 normally open
6	Relay 2 normally closed
7	Relay 1 return (0V).

Relay 1 contacts are not volt-free. They are wired internally to provide switched low-voltage outputs that can be used for controlling a rotary sensor cleaning device or other equipment.

3.2.4 Connector 4 Sensor Connections

Free male plug (114/041).

3.2.4.1 Galvanic Sensor Inputs

Colours are for LTH54D cable.

Pin	Colour	Function
1	Coax core	Cathode
2	Coax screen	Galvanic anode
3	Not used	
4	Yellow	Temperature input A
5	Black	Temperature input B
6	Outer screen (green/yellow)	Cable screen
7	Not used	

3.2.4.2 Polargraphic Sensor Connections

Colours are for AX-5000-D4-DXXFF cable.

Pin	Colour	Function
1	White	Cathode
2	Not used	
3	Red	Polargraphic anode
4	Brown	Temperature input A
5	Black	Temperature input B
6	Outer screen (green)	Cable screen
7	Not used	

3.2.5 Power Supply

The unit requires a supply between 15 and 30V (24V nominal) at 200 mA.

Note: The maximum current output load resistance depends on the unit supply voltage: R_{load} (Ohms) = (V_{supply}-2) / 0.04

3.2.6 Current Output Connections

The Basic HOT63 has a single current output of 0-20 or 4-20 mA. The Advanced version has two such outputs designated A and B. The current output ranges are selected via the instrument menu.

For best noise immunity use a screened twisted pair cable, with the screen connected to Earth at one end.

Use a sufficiently large cable to avoid a high resistance in the overall current loop.

3.2.7 Relay 1 Connections

The relay outputs are available only on the Advanced version. For relay operating information, see *Section 8 Set Point Relays*.

Relay 1 switches the incoming DC supply as standard.

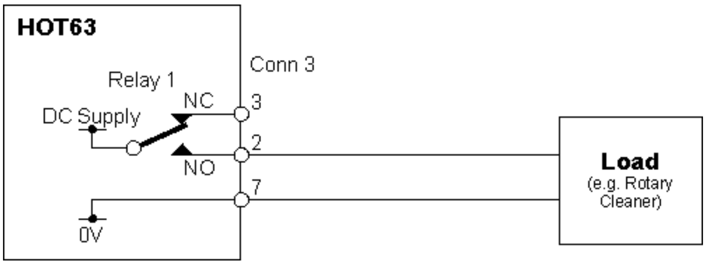


Figure 3 : Relay 1 contact connection

3.2.8 Relay 2 Connections

The relay outputs are available only on the Advanced version. Relay 2 has volt-free (electrically isolated) contacts and can handle up to 5A at 30V DC or 250V AC. **They must be connected in series with a 5 Amp fuse.** For relay operating information, see *Section 8 Set Point Relays*.

Relay 1 switches a 24V internal supply as standard

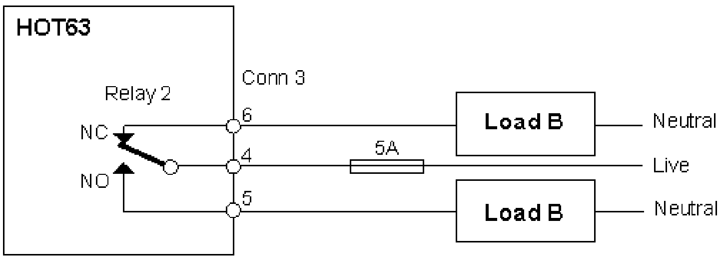


Figure 4 : Relay 2 contact connection

Depending on the load, a contact arc suppressor may be required to prevent excessive electrical noise. To switch more than 5 Amps, use a slave relay.

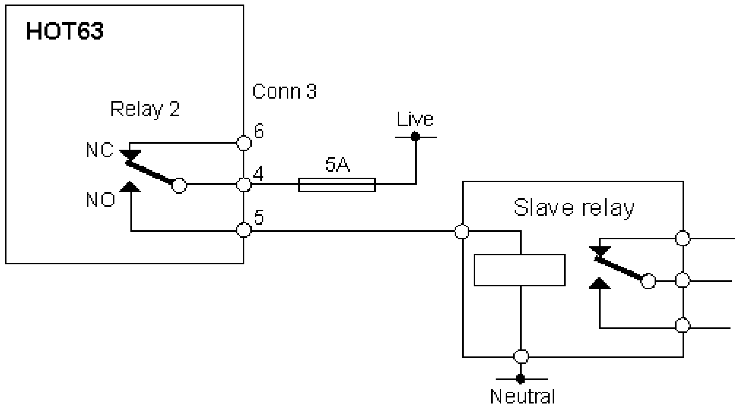


Figure 5 : Slave relay connection to Relay 2

3.3 Digital Inputs

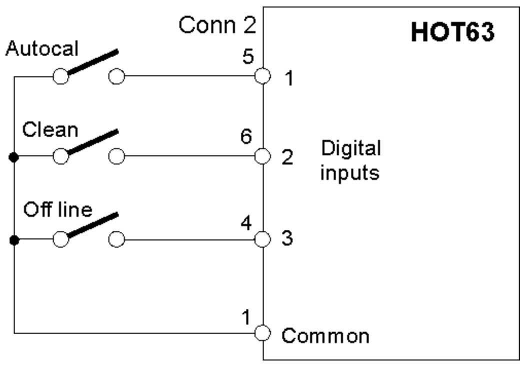
The digital inputs are used to externally initiate Autocal, a cleaning cycle or to take the unit off line. These inputs are intended to be switched using a volt-free link, switch or relay. Closing a contact initiates the action.

The connections to Connector 2 are as follows:

Common to pin 5 = Autocal. This input initiates a span calibration.
See *Section 10.3.2 Span Calibration in Free Air*.

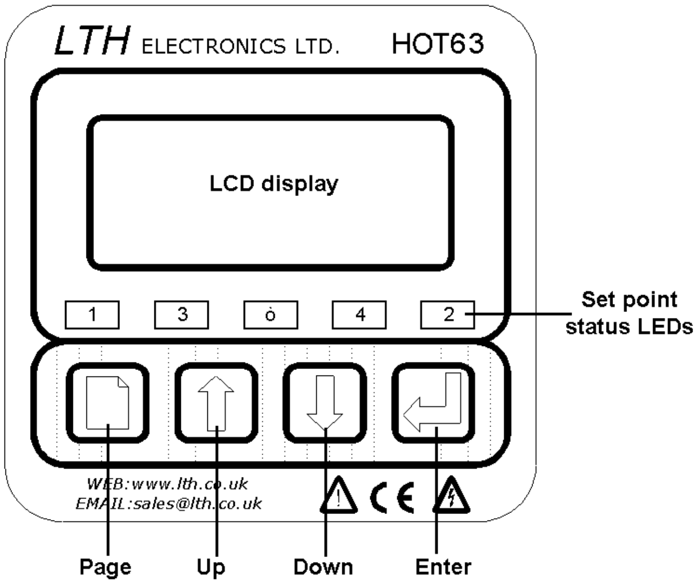
Common to pin 6 = Clean – This initiates a manual clean cycle.
See *Section 14 Cleaning Menu*.

Common to pin 4 = Off line – This takes the unit off line.
See *Section 10.1 On-Line/Off-Line Operation*.



4 User Interface

WARNING! Before proceeding, ensure that the installation instructions have been followed correctly. Failure to do so may result in an electrically hazardous installation or degraded instrument performance.



Programming buttons

When shipped, the HOT63 is configured to the default % Saturation set-up (see Appendix C – Factory Defaults). In this state the instrument can perform all of the necessary function for a basic pH monitoring instrument.

4.1 The Front Panel

The HOT63 uses a versatile LCD to display all of the settings and readings. The seven segment digits at the top of the display indicate the primary measured value during normal operation. The six character display to the right of these indicates the units of measurement when a value is being displayed. The sixteen characters on the bottom of the display to indicate secondary readings or states, and display scrolling error messages.

Along with the LCD display, the front panel also incorporates five LEDs. The two outer LEDs (labelled 1 and 2) indicate the set point status, i.e. when the LED is illuminated the indicated relay is active. The centre LED indicates when the unit is Off-line. *Note: Not all relay channels may be fitted.*

The four keys - , ,  and  - allow the user to control and configure the unit. The keys are used for changing display options, navigating around the menu system and for changing unit parameter values. To operate a key, press it until the display responds (about half a second). If you hold a key down, the display will cycle through the available options at a rate of about one per second.

4.2 The Menu System

The fold-out sheet at the end of the manual shows the menu system. Each column constitutes a menu. Use the (Page) key to move from one menu column to the head of the next. When you select the next menu, the display shows the menu title e.g. Parameters. Pressing with moves backwards through the menus.

Use the and keys to move up and down the menu options in each column. Depending on the current settings, some menu options may not be present. For example, if Set Point 1 is disabled, the screen displaying Set Point 1 will not appear.

When the instrument is switched on, it shows the main display screen. You can use the and keys to select various display options, depending on the configuration of the unit. However, on pressing the (page) key to reach the configuration menus, the first screen encountered is the Access Code screen. To proceed beyond this screen you must enter an access code as detailed in *Section 18 Menu* Access.

Note: *When in the menu structure, if none of the buttons are pressed for two minutes, the unit will time out and return to the main display. The Access Code display will be reset to 0000, 30 seconds after returning to the main display.*

4.3 Unit Configuration

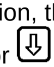
The unit can be configured by navigating around the menu system and setting up the various unit facilities.

The general principle of setting a parameter is as follows:

1. Use the , , and  keys to navigate to the parameter to be changed.
2. Press the  key to select the parameter for editing. The current parameter value will start to flash, indicating that it can be changed.
3. Use the  and  keys to cycle through the available values of the parameter to the required value.
4. Press the  key to confirm your selection of the required value. The parameter value will stop flashing, indicating that it has been set.
5. Use the , , and  keys to navigate to the next parameter to be changed.

This method can be used for:

- Turning a facility on or off, e.g. **Temperature Compensation** in the **Parameters** menu. The  and  keys toggle the facility on and off.
- Selecting between several options, e.g. **Unit** types in the **Parameters** menu.
- Setting a numeric value such as an access code or trigger level. See *Section 4.4 Number entry*.

For functions such as Resets and Restoring Setups, press the  key to initiate the function, the system will then ask for confirmation. Press  to confirm the function:  or  to cancel.

4.4 Number entry

The [⇧], [⇩] and [⏎] keys allow you to set up a number between 0000 and 9999 on the main seven-segment display as a parameter value or access code.

To set up a number, proceed as follows:

1. Press [⏎] to begin editing a number. The first (left-hand) digit will start to flash.
2. Use the [⇧] and [⇩] keys to increment or decrement the flashing digit.
3. When the flashing digit is correct, press [⏎] to confirm the setting. The next digit will start to flash.
4. Repeat steps 2 and 3 to set the remaining three digits.
5. After pressing [⏎] to confirm the last digit, none of the digits will be flashing and the number is then ready for use.

If the number is an access code, the Padlock symbol on the display will change to a Key symbol if the new code you have entered is correct. If the number is a parameter value, the parameter has now been set to that value.

4.5 Error Messages

If the internal diagnostics have detected an error condition, the appropriate error message will flash on the bottom row of the display. A reference to these error messages can be found in *Appendix H – Error Messages*. Pressing the [⏎] key when an error message is flashing will scroll a more detailed description of the error along the bottom line. Pressing [⏎] again will return the unit to the flashing display. The error messages can be disabled within the **Configuration** menu (see *Section 13.1 Error Messages*). If the error messages are disabled, the display will flash a bell symbol on the far right of the bottom row when an error is detected. It is possible to configure a set point relay to provide external signalling of error conditions (see *Section 8.5 Alarms*).

5 Main Display

There are two modes of display operation – digital and bargraph. The mode can only be changed via the Configuration menu, requiring a Level 2 access code.

In bargraph mode, the display shows an analogue representation of Output A or B, or both, alternating. The output identity and units are shown in the upper display.

In digital mode, the display shows the sensor reading, in the units assigned via **Parameters/Units**, on the top row and a secondary reading on the bottom row. The user can select the desired secondary reading parameter by means of the ⇧ and ⇩ keys.

If bargraph display has been enabled, digital readings can be selected but the bargraph display will be restored after a timeout period. The secondary parameters vary according to the instrument configuration, and are as follows:

Sec. display	Comment
Sat: %	Percentage saturation when display units are concentration
Conc: ppm	Concentration in ppm when display units are % saturation.
Press: mBar	Pressure in mBar
Press: mm Hg	Pressure in mm Mercury
Curr: nA/uA	Sensor current in nA or uA.
SP1	This appears when Set Point 1 is enabled and trigger is set to Low or High. It shows set point value in the assigned units.
SP1H	This appears when Set Point 1 is enabled and trigger is set to Band, Latch Lo or Latch Hi. It shows set point upper value in the assigned units.
SP1L	This appears when Set Point 1 is enabled and trigger is set to Band, Latch Lo or Latch Hi. It shows set point lower value in the assigned units.
SP2	This appears when Set Point 2 is enabled and trigger is set to Low or High. It shows set point value in the assigned units.
SP2H	This appears when Set Point 2 is enabled and trigger is set to Band, Latch Lo or Latch Hi. It shows set point upper value in the assigned units.
SP2L	This appears when Set Point 2 is enabled and trigger is set to Band, Latch Lo or Latch Hi. It shows set point lower value in the assigned units.
Temp. input	Units C or F, as selected via **Parameters/Temperature Units**, when **Compensation** = **Auto**
Man IP	Fixed temperature, when **Compensation** = **Manual**.
Salin	Fixed salinity setting in ppt.
Press	Pressure input in atm (or fixed setting if **Compensation** = **Manual**.
Output A	This shows the output current from Channel A in mA.
Output B	This shows the output current from Channel B (if fitted) in mA.
Zero Cal	Zero (0% saturation) calibration. Available only when **Cal Access** option on **Calibration** menu is set to **Full**.
Span Cal	Span (100% saturation) calibration. Available only when **Cal Access** option on **Calibration** menu is set to **Span** or **Full**.

Calib pressure Displays calibration pressure on completion of Span Calibration. (Calibration pressure can be set manually via the **Calibration** menu.

The default secondary parameter can be set by selecting the parameter and pressing the ⏎ key (provided that no error messages are present). This is the parameter that is displayed on the bottom line when the unit is switched on, or as a result of a timeout back to the normal display mode.

If the unit has detected an error, an error message will flash alternately with the secondary parameter or bargraph. See *Appendix H – Error Messages*.

6 Menu Access

The instrument parameters are protected against unauthorised or accidental tampering by access codes.

There are three levels of access – Basic, Level 1 and Level 2. For Basic access, no access code is required but access is restricted to the main display modes. A user with Level 1 access can change some parameters and Set Point trigger levels. A user with Level 2 access has full access to all user-selectable parameters. The pull-out chart at the rear of this manual shows the access permitted the three levels.

When the unit is switched on, it shows the main display screen. To reach the menu system from there, press the [page key] key to reach the Access Code screen and then enter the Level 1 or Level 2 access code. A character on the right of the display indicates whether or not access is permitted. The character will be a key for permitted access and a padlock for denied access.

As supplied, the unit has the following default access codes:

0001 Restricted access at Level 1.
0002 Full access at Level 2.

On first use, it is recommended that the user change the access codes to restrict unauthorised access. See *Section 6.1 Changing the Access Code*.

Entering the access code for a level, e.g. for Level 2, gives access to that level. The procedure for entering the access code is detailed in *Section 4.4 Number entry*. On entering a valid code, the padlock character on the display changes to a key.

6.1 Changing the Access Code

On first use, it is recommended that the user change the access codes to restrict unauthorised access.

You need Level 2 access in order to change the Level 2 access code. You can change the Level 1 access code if you have either Level 1 or Level 2 access.

1. From the Main Display screen, press [page key] once to reach the Access Code screen.
2. Use the [up key] and [down key] keys to reach the Set Level 1 (or 2) Code screen.
3. Use the [up key], [down key] and [enter key] keys to edit and store the new access code, as described in *Section 4.4 Number entry*.

7 Parameters

The **Parameters** menu contains the basic configurations for the sensor inputs. The various parameters can be changed using the method described in *Section 4.3 Unit Configuration*.

The Parameters menu structure is as follows:

```
Parameters
    Units
    |       % Sat
    |       ppm
    |       pO2
    |       mm Hg
    |       Current
    Probe
    |       Galvanic
    |       Polargraphic
    T Units
    |       °C
    |       °F
    TC Mode (Temperature Compensation)
    |       Auto
    |       Manual
    |       |       0-100 °C
    Input Salinity
    P Comp (Pressure Compensation)
    |       Auto (set by active 4-20 mA input)
    |       Manual
    |       |       P Units
    |       |       |       Atm
    |       |       |       Bar
    |       |       |       kPa
    |       |       |       m H2O
    |       |       |       psi
    |       |       |       mm Hg
    |       |       Input Pressure
    Simulated input
```

7.1 Units

The HOT63 primary display can be setup to display in % (saturation), ppm (Concentration), pO2 (partial pressure of Oxygen) or input current. This is achieved by simply setting the appropriate units. The relationship between these parameters is determined by several factors including temperature, pressure and the salinity of the solution being measured. (See Appendix A).

7.2 Sensor Type

The HOT63 can scale its input readings to operate with either a Galvanic (Mackereth) or Polargraphic (Clark) sensor. This enables the instrument to be used with a variety of different manufacturers' sensors. Both types of sensor provide a current output, but Polargraphic sensors require a polarising voltage to be applied across the Anode and Cathode. Other parameters will need to be set such as the bias voltage, membrane correction and temperature sensor type. These settings will need to be obtained from the manufacturer of the sensor

7.3 Temperature Input

Temperature has a significant effect on the output from the sensor, and it is therefore necessary to compensate for the variations in the liquid and the sensor. The HOT63 provides the facility to measure and automatically compensate for these temperature variations, or alternatively, if no temperature sensing is available, the user can select manually the temperature at which the unit compensates. It is recommended that unless a stable measurement temperature is achievable, the automatic compensation be used.

The operator can apply automatic or manual temperature compensation to the dissolved oxygen measurement via the **TC Comp** menu item in the **Parameters** menu. For automatic compensation, the correct temperature sensor must be selected in the **Configuration** menu. When the **Manual** mode of operation is selected, the user can enter the required fixed process temperature.

Note: If a Temperature sensor fault is detected, the unit defaults to the **Manual** setting for compensation purposes, and displays an error condition.

The operator can choose to display all temperatures in °C or °F by setting the **T Units** parameter. All temperature-related displays will use the units selected in this menu.

Note: The system will normally convert all temperature-related variables when the units are changed. However it may be wise to check that changing the units has not altered the set points or current outputs.

7.4 Salinity

The salinity of the solution has a significant effect when converting % Saturation to concentration. The user can compensate for this by setting the **Input Salinity** parameter to the correct level - in ppt (parts per thousand).

7.5 Pressure Compensation

The advanced version of the HOT63 can accept a 4-20 mA input from a pressure transmitter to permit automatic compensation for variations in the pressure. Set the **P Comp** parameter to **Auto,** if it is available***.*** If not, set the **P Comp** parameter to **Manual** and set the measurement pressure at the **Input Pressure** parameter. The units for pressure display can be set to **Bar**, **Atm*,* psi, kPa, m H_2O** or **mm Hg** at the **P Units** parameter. Variations of pressure can have a significant effect on the sensor output.

7.6 Simulated Input

The **Simulate current outputs** options are only available when the chosen output source is enabled.

These options provide simulated inputs to allow testing of the set point and current output operations.

Select the required menu option, for Current A or Current B output, and press the key to display the simulation menu. Press the and keys to cycle the displayed value between its minimum and maximum levels in steps of approximately 1% of its input range. Alternatively press with or to change the value in 10% steps. The relays and current output will respond as if the displayed value were an actual input, thus allowing you to debug the set point and current output configurations.

Note: Only one input can be simulated at a time.

8 Set Point Relays

Two Set Point relays, designated SP1 and SP2, are fitted on the Advanced version of the HOT63. No relays are fitted on the basic version. Indicators on the front panel show when a relay has operated. For relay connections, see *Sections 3.2.7* and *3.2.8*.

A relay can be set to operate when a sensor or temperature set point is exceeded or when an alarm occurs. The menu structures for set points 1 and 2 are identical, and provide a high level of flexibility in the configuration of the relay outputs, as follows:

```
SPn Source (SP1 or SP2)
        Disabled  - no further SPn options are available
        Sensor IP (or Temp IP)
        |    Trig: Hi (or Lo)
        |    |        Set point n value
        |    |        SPn: Mode
        |    |        |        On/Off
        |    |        |        PP – Pulse Proportional
        |    |        |        TP – Time Proportional
        |    |        SPn: Dose Alarm No
        |    |        |        Yes - SPn Alarm time
        |    |        SPn: Delay (On/Off mode only)
        |    |        SPn: Hysteresis (On/Off mode only)
        |    |        SPn: Cycle Time (TP mode only)
        |    |        SPn: Proportion (PP and TP modes only)
        |    Trig: Lo – see Trig: Hi
        |    Trig: Band
        |    |        High set point
        |    |        Low set point
        |    |        SPn: Dose Alarm No
        |    |        |        Yes - SPn Alarm time
        |    |        SPn Delay
        |    |        SPn Hysterisis
        |    Trig: Latch Hi (or Lo)
        |    |        High set point
        |    |        Low set point
        |    |        SPn Dose Alarm No
        |    |        |        Yes - SPn Alarm time
        |    Trig: Latch Lo – see Trig: Latch Hi
        Temp IP  - see Sensor IP
        Alarm
        |    Alm: Disabled
        |    Alm: Sensor Err
        |    Alm: Dose Alarm
        |    Alm: Calibration
        |    Alm: Off-line
        |    Alm: Any Error
```

Cleaning – see *Section 14 Cleaning Menu*
| Duration
| Interval
| On/Off-line
| Recovery time (Off-line) or Delay Y/N (On-line)

8.1 Set Point Source

Each set point relay can be disabled or triggered from a sensor input (the default), a temperature input or from an alarm.

8.2 Set Point Trigger

The set points can be configured to trigger from the sensor or temperature source in six ways:

Trig: Hi	The relay will be activated when the source input becomes greater than the set point. Delay and hysteresis can be applied.
Trig: Lo	The relay will be activated when the source input becomes less than the set point. Delay and hysteresis can be applied.
Trig: Band	The relay will become activated when it is either greater than the Band High set point, or lower than the Band Low set point. Delay and hysteresis can be applied.
Trig: Latch Lo	the relay energises when the source input falls below the **Band Low** level and remain energised until it rises above the **Band High** level. It then remains de-energised until the sensor input falls below the **Band Low** level again.
Trig: Latch Hi	the relay energises when the source input rises above the **Band High** level and remain energised until it falls below the **Band Low** level. It then remains de-energised until the sensor input rises above the **Band High** level again.

8.3 Set Point Mode

The relays can operate in one of three modes.

8.3.1 On/Off Mode

The On/Off mode is the default mode of operation for the relays. The relay energises when the set point is activated and is de-energised when the set point is de-activated.

Delay*:* In order to prevent short duration changes at the input affecting the relay operation a delay can be set before the relay energises. If the input is still the same after the delay, then the relay will be energised.

Hysteresis*:* A facility to apply hysteresis to the set point level allows the user to avoid relay chatter when the sensor input level approaches the set point level. Chatter is caused when the sensor input is sufficiently close to the set point value and noise on the signal repeatedly crosses the set point level, thus causing the relay to switch on and off rapidly.

The hysteresis level should therefore be set to be a little larger than the input noise level.

In addition to the On/Off mode the HOT63 also provides two forms of pseudo proportional control, which can be used to control the levels to a defined value when used in conjunction with a pump or valve. When the reading deviates from the programmed set point level the relay pulses at a rate proportional to that deviation.

8.3.2 Time Proportional Mode

The unit provides two forms of pseudo proportional control, which can be used to control the levels to a defined value when used in conjunction with a pump or valve. When the reading deviates from the programmed set point level, the relay pulses at a rate proportional to that deviation. It is possible to control any on/off device such as a solenoid valve or dosing pump using the proportional mode.

The proportional band is displayed as a percentage of the full range value. For example, a proportional band of 20% on the dissolved oxygen range of 0-30 ppm would give a band of 6 ppm. If the set point trigger was selected as LOW and the set point value was 10 ppm, the band would cover 4 to 10 ppm. When the reading falls below 4 ppm the relay would be energised. As the input rises and approaches the set point the output relay starts to cycle on and off with the on time reducing and the off time increasing, respectively. The cycle time can be set by the user and is the sum of the on and off times.

8.3.3 Pulse Proportional Mode

The Pulse Proportional (or PP) mode is intended to drive solenoid type dosing pumps which have the facility to accept an external pulse input. The proportional band operates in the same way as the Time Proportional mode. The output relay now operates by producing a series of pulses of fixed duration. The pulse rate increases as the measurement moves further from the set point, until it reaches the maximum frequency at the limit of the proportional band (i.e. 4 ppm in the previous example).

8.4 Dose Alarm Timers

The dose alarm timer can be used to prevent overdosing under many different fault conditions , such as sensor failure or wiring faults. When the timer is enabled the user can set the **Alarm Time**. If the associated relay remains energised for longer than the **Alarm Time** the alarm will activate, de-energising the relay to prevent over-dosing and flash the set point LED on the front panel. The display will also flash a warning message when the alarm is activated.

Note: During pulse or time proportional operation, the cumulative on-time that the set point is active will be taken.

To cancel the warning, and reactivate the set point, press the  key on the front panel.

Note: If more than one Alarm is active, set point 1 takes priority over set point 2 and they are cancelled in that order by additional presses of the ↵ key.

8.5 Alarms

The two set point relays can be configured as an alarm output triggered by one of the following events:

- Sensor error
- Dose alarm
- Calibration – when a calibration is in progress.
- Off-line – unit has been taken off line, e.g. for servicing.
- Any error – when any system error is detected.

To set an alarm output, choose the SP1 or SP2 menu, select **Alarm** from the menu options and then select the required trigger.

9 Current Output

The current output menu structure contains all of the necessary set-up functions to configure the current output source(s). If one current output is fitted, then the menu will be as follows. If two current outputs are fitted they are referred to as A and B respectively.

The menu structure is as follows:

O/P Source (A or B)
Sensor IP
| Select Output (0/4-20 mA)
| Output A/B Zero
| Output A/B Span
Temp IP
| Select Output (0/4-20 mA)
| Output Zero
| Output Span
Disabled

On Error = (No, 22 mA or 0 mA)

The maximum load resistance that the current output can drive depends on the power supplied to the unit and is: R_{load} (Ohms) = (Vpower –2) / 0.04.

9.1 Input

The unit can use the sensor input or the temperature input as the sources for the current outputs. Alternatively, the source can be switched off by selecting **Disabled** for that source.

9.2 Select Output

The output range for the current output can be set to one of two ranges, either 0 – 20 mA or 4-20 mA. This selection sets the limits of the zero and span output levels. The output will continue to provide an extrapolated output above (>20 mA) and below (<4 mA) these points but will flag an error message on the main display. The maximum current limit is approximately 22 mA, the minimum limit is 0 mA (i.e. the unit cannot source a negative current)

9.3 Zero & Span

The zero and span levels define the limits of the source input. This provides a totally flexible method of configuring the current output. The zero can be set anywhere within the input source range and the span up to 5% of the range, providing total control of the output range and offset. An inverse relationship can easily be achieved by simply setting the zero level to be higher than the span level.

9.4 Proportional Control

Many devices such as motor speed controllers, valve actuators, or stroke positioners will accept an analogue 4-20 mA control signal.

It is possible to use the measurement signal from the instrument as a control signal. By setting the point at which the output is 4 mA as the set point (e.g. 7.00 ppm) and the point at which the output is 20 mA as the proportional band (e.g. 4.00 ppm) a simple form of proportional control is achieved. If this signal were used to drive a valve actuator, the valve would be fully open at 4.00 ppm, half open at 5.50 ppm and closed at 7.00 ppm.

9.5 Error Condition

The current outputs can be programmed to output 22 mA or 0 mA when an error is detected on the source (i.e. Sensor Fault, Temperature Over or Under Range). This can provide remote warning of error conditions or to ensure fail safe operation. The default state is disabled (parameter set to **No)**.

10 Calibration

The HOT63 provides the facility within the **Calibration** menu to adjust the sensor inputs and current output levels to tailor the unit to the system in which it is operating.

The menu structure is as follows:

- Mode:
  - On-line
  - Off-line
- Cal Access
  - None
  - Full – full access to span and zero calibration
  - Span – access to span calibration only
- Cal Units
  - % Sat
  - ppm
  - pO2
  - mm Hg
- Enter Pressure
- Sensor Zero
- Set Span Cal Pt
- Sensor Span
- AutoCal
  - Yes
  - No
- Temperature - calibration (if **Parameters/TC Mode** is **Auto**)
- Pressure Input – if **Parameters/P Comp** is set to **Auto**
- Current Output A/B calibration
  - Are you sure?
  - Adjust 0 mA
  - Adjust 4 mA
  - Adjust 20 mA
- Reset User Cal
  - Are you sure?
  - Resetting

10.1 On-Line/Off-Line Operation

Selecting the **Mode** menu will allow the user to place the unit in the **Off-line** state. If the state is set to **Off-line** the relays will be de-energised and the current output level frozen for the duration of the **Off-Line** state. When **On-Line** is selected the relays and current output will operate normally. The middle LED on the front panel display will indicate when the unit is **Off-Line**. Off-line operation can be selected by a digital input – see *Section 3.3 Digital Inputs*.

10.2 Calibration Access

A feature has been included in the HOT63 to allow users to access the sensor calibration from the main display. To enable this feature, set **Cal Access** to **Full** or

Span. The **Full** option gives the user access to both zero and span calibration. The **Span** option gives access to span calibration only. To disable this feature, thus preventing the users from altering the calibration from the main display, set **Cal Access** to **None**. A span calibration can also be initiated by a digital input – see *Section 3.3 Digital Inputs*.

10.3 Sensor Calibration Procedures

The calibration procedure can be accessed either from the **Calibration** menu or from the main display (if the **Cal Access** option has been set to **Full** or **Span**). The procedure is the same in both cases, except that zero calibration is not available from the main display if **Cal Access** has been set to **Span**.

Observe normal good practices when calibrating DO systems. When the instrument is first connected to the oxygen sensor, i.e. when the unit is first installed, or whenever the oxygen sensor is changed or the membrane replaced, the user should perform a zero check and span calibration of the system using the following procedure. If necessary the user can use a span calibration other than 100% by simply setting the span calibration level in the **Set Span Level** item in the **Calibration** menu.

Notes.

- As an aid to stable air calibration, a partially covered bucket can be used to shield the sensor from the temperature variations which arise from exposure to the wind and sunlight.
- It is recommended that, because the OE15 oxygen cartridge has a finite life, a spare cartridge should be stocked where a significant down time is not acceptable to the application.
- The OE15 sensor requires a minimum fluid flow of 0.5 ms^{-1} to refresh the depletion layer which forms around the sensor membrane. This applies to both air and solution readings.
- All calibration is done in % Saturation, even if the required operating mode is concentration.
- Approximate sensor current is 700uA = 100% Sat with Galvanic sensor and 60nA = 100% Sat with Polargraphic sensor.

10.3.1 Zero Check in a De-oxygenated Solution

1. Prepare a fresh solution of approximately 2% wt/vol. of sodium sulphite in de-mineralised water.
2. Wash off any process chemicals or water from the sensor that may contaminate the solution. Use de-mineralised water or follow the manufacturers cleaning instruction as necessary.
3. Set the instrument to read sensor current, via the **Parameters/Units** menu. Select % saturation as the secondary reading. Allow the output to settle in air at (or close to) 100% saturation. Place the sensor in the sodium sulphite

solution and observe the current reading. The reading should drop below 10% of the air saturated reading within 35 seconds.

4. If this time is exceeded, cycle the sensor between the free air and the solution to improve the speed of the response. If cycling it 3 or 4 times does not improve the response significantly, store the sensor overnight in the solution and then re-test it with a fresh solution the following day. If it still does not respond within the specified time the cartridge membrane should be checked and replaced if necessary, otherwise the electrolyte will have to be replaced (this must be done at the factory for OE15 probes).

5. If the sensor responds quickly enough, check that within another 3 minutes the current reading has fallen to virtually zero (less than 5µA).

6. If the current reading is greater than 5µA, select the **Zero Cal** function from the main menu, or the **Sensor Zero** option from the **Calibration** menu. Press the ⏎ key and the unit will correct the 0% saturation point to the current input at this point.

10.3.2 Span Calibration in Free Air

Span Calibration can be initiated remotely via the digital inputs, enabling one operator to both position the sensor and activate the calibration (see *Section 3.3 Digital Inputs*.

The frequency of this check depends upon the application, but should be made generally once a month.

1. Wash off any process chemicals or water from the sensor. Use de-mineralised water or follow the manufacturers cleaning instructions as necessary.

2. Set the instrument to read Current via the **Parameters/Units** menu. Select % Saturation as the secondary reading.

3. Stabilise the sensor by leaving it in the process solution for up to 10 minutes. This will allow the temperature compensator networks to reach equilibrium.

4. Lift the sensor so that it is just above the process solution, and therefore as close to the temperature of that solution as possible. Observe the instrument readings and wait until the output stabilises. If necessary enable the sensor filter to obtain a stable reading.

5. If necessary check and set the calibration level (100%) in the **Calibration** Menu.

6. Select the ***S*pan Cal** function from the main menu, or the **Sensor Span** option from the **Calibration** menu. Press the ⏎ key and the unit will correct the 100% saturation point to the current input at this point.

7. Enter the pressure level at the span calibration from the **Calibration/Pressure Input** menu option. It is important to have the sensor pressure level correctly entered, especially when the sensor is measuring in a system where pressure can vary over a wide range. If automatic temperature compensation is selected, the unit will automatically store the measured temperature at the instance of the 100% span calibration. If, however, the **Temperature**

Compensation is **Manual**, the user will need to ensure that the “fixed” temperature input is set to the temperature the sensor is experiencing at the instance of calibration, as this will be taken as the calibration temperature.

10.4 Temperature Offset Calibration

Use this option to calibrate the temperature sensor against a solution at a known temperature. Proceed as follows:

1. Ensure that the sensor is immersed in a solution of known temperature.
2. From the **Calibration/Temperature** page, press the ⏎ key. The screen will display ‘Are you sure?’.
3. Press ⏎ to confirm (or any other key to abandon calibration). On pressing ⏎, the (flashing) display will show the measured temperature reading.
4. Use the ⇧ and ⇩ keys to set the reading to the known correct temperature.
5. Press ⏎ to confirm the correct reading. For information, the display will show the calculated offset of the true reading from the measured reading.

10.5 Pressure Input Current Calibration

Use this option to ensure that the HOT63 correctly measures the 4 and 20 mA inputs from a pressure transducer. Use the options on the **Pressure Input** menu (*Section 12*) to calibrate the HOT63 to the actual pressure values measured by the transducer.

1. Ensure that the pressure transducer is connected to Connector 2 of the HOT63.
2. Go to the **Calibration/Pressure Input** page.
3. Press ⏎ to confirm (or any other key to abandon calibration). On pressing ⏎, the display will show ‘Set Input to 4mA’.
4. Set the pressure transducer to provide a 4 mA output.
5. Press ⏎ to start. The unit will sample the 4 mA input and display ‘Sampling’. On completion of the measurement, the display will show ‘Set Input to 20mA’.
6. Set the pressure transducer to provide a 20 mA output.
7. Press ⏎ to start. The unit will sample the 20 mA input and display ‘Sampling’. On completion of the measurement, the display will return to the **Pressure Input** screen.
8. Press ⇩ to proceed to the next menu option.

10.6 Current Output Calibration

This option provides a means of calibrating the current output(s) at 0, 4 and 20 mA, as measured by an external monitor. The maximum offset is ±2mA. Proceed as follows:

1. Connect the external monitoring instrument to the current output terminals.
2. From the **Calibration** menu, select the **Current Output** option for channel A or B, as appropriate.
3. Press [⏎] to start calibration. The message ‘Are you sure?’ will appear.
4. Press [⏎] to confirm. The message ‘Adjust 0mA’ appears and the HOT63 supplies a zero current output.
5. Check the current as measured by the external instrument and use the [⇧] and [⇩] keys to set this reading to zero. Note that the actual current output cannot go below 0 mA.
6. Press [⏎] to finish. The message ‘Adjust 4mA’ appears and the HOT63 supplies a 4 mA output current.
7. Check the current as measured by the external instrument and use the [⇧] and [⇩] keys to set this reading to 4 mA.
8. Press [⏎] to finish. The message ‘Adjust 20mA’ appears and the HOT63 supplies a 20 mA output current.
9. Check the current as measured by the external instrument and use the [⇧] and [⇩] keys to set this reading to 20 mA.
10. Press [⏎] to finish the calibration.

10.7 Resetting the User Calibration

This option resets all of the user calibrations to their defaults. From the **Reset User Cal** page, press the [⏎] key. The message ‘Are you sure?’ will appear. Press [⏎] to confirm and continue with the reset, or any other key to abandon the reset.

11 Save/Restore

This facility allows you to save and recover two instrument set-ups. The menu structure is as follows:

Save/Restore
- Save as Setup A
- Save as Setup B
- Restore Setup A
- Restore Setup B
- Default Galvanic
- Default Polargraphic

To use these functions select the **Save/Restore** menu item and use the ⇧ and ⇩ keys to select the required function. Pressing the ⏎ key will prompt the unit to ask for confirmation. Pressing the ⏎ key again will initiate the function. The unit will then perform the function and then return to the main menu.

This facility is very useful for testing or fault finding. The set-up can be stored prior to testing and restored once testing is complete. The default set-ups are provided to give a basic instrument set-up for each configuration.

Note: There is no protection for the set-up stores other than the systems request for confirmation, so be very careful not to overwrite already saved set-ups.

There are three banks of data that can be interchanged as required.

- **Working Data**: the operating data and set-up parameters that are used by the instrument and which can be changed or viewed on the display by the user.
- **Primary backup**: the A stores can be written to or read back as a block of data. Data in these stores cannot be viewed without first loading it into the Working data stores. This read back will overwrite the existing Working data, leaving the A store data unchanged.
- **Secondary backup**: the B stores can be written to or read back as a block of data. Data in these stores cannot be viewed without first loading it into the Working data stores. This read back will overwrite the existing Working data, leaving the B store data unchanged.

When an individual parameter is saved, the corresponding data is copied into a single non-volatile memory location. (This simply means the data is not lost when the power is removed or interrupted.)

When a complete programme sequence or set-up has been entered into the working data stores, the whole set-up can be copied (using Save/Restore) into either the A or B stores. We strongly recommend that this feature is used.

It is also possible to restore the default parameters. This can be useful for fault finding, since a working configuration can quickly and easily be programmed in to aid commissioning or testing the instrument. Remember to Save the normal set-up first and restore it afterwards.

If corruption of data is reported by the software with an error message, the saved set-up can be copied back into the Working stores from either the A or B stores.

12 Pressure Input

This menu is only available if the **P Comp** parameter in the **Parameters** menu is set to **Auto**.

```
Pressure
    Mode
    |       Input
    |       24V loop
    Units
    |       Atm
    |       Bar
    |       kPa
    |       m H2O
    |       psi
    |       mm Hg
    Set 4mA input
    Set 20mA input
    Damping
    |       Disabled
    |       Enabled
    Pressure limit A
    Pressure limit B
```

12.1 Input Mode

The HOT63 is designed to accept either direct 4-20mA input or to interface to a 24V loop powered transmitter. Ensure that the cable resistance is not too great, leading to excessive voltage drop over length of the cable.

For the direct input configuration, the input resistance is 100Ω. The necessary supply voltage will depend on whether there are any other monitors in the loop. The maximum required will be = 22mA X Total In-Line resistance (including the cable resistance).

12.2 Pressure Damping

This facility allows the user the dampen the effect of rapid changes in pressure that might lead the unit to activate the set point relays before the sensor has had a chance to react to the change in pressure (which would give a false reading). When pressure damping is activated, the unit holds the sensor readings and flashes a 'Pressure Damping' message on the display for 20 seconds. After this period, the unit will update the sensor readings, compensated to whatever level the pressure input has settled to, having allowed the sensor to "catch up". If the pressure input returns to the level it was at prior to damping being applied, then the damping will be cancelled, whether the twenty seconds has expired or not. The user may also cancel the pressure damping by pressing the ↵ key when the 'Pressure Damping' message is flashing on the display.

To use this facility simply set the **Damping** item in the **Pressure Input** menu to **Enabled**. The limits A (From) and B (To) can be tailored by the user to provide the necessary response. For example :

- If Limit A ("From") is set to 1.00 Atm and Limit B ("To") is set to 2.5 Atm, then when the input pressure rises from an input below 1.00 Atm to one greater than 2.5 Atm, pressure damping will be applied
- If Limit A ("From") is set to 2.3 Atm and Limit B ("To") is set to 1.2 Atm, then when the input pressure falls from an input above 2.3 Atm to one less than 1.2 Atm, pressure damping will be applied.

13 Configuration

Options on the Configuration menu allow you to set up some basic operating parameters. The menu structure is as follows:

Configuration
- Language (some units only)
  - English
  - Francais
  - Espanol
  - Italiano
- Temperature Input sensor (T input)
  - PT1000
  - LTH 1K – 1k thermistor used in OE15
  - BJC 22K – 22k thermistor used in ProcessProbe™
  - Disabled
- Bias Voltage – for polargraphic probe
- Membrane Correction factor
- Errors
  - Enabled
  - Disabled
- IP Filter
  - Out
  - 10 Secs
  - 20 Secs
  - 40 Secs
  - 1 Min
  - 3 Min
  - 5 Min
- Bar Graph
  - Off
  - A
  - B
  - A & B alternating
- Software version

13.1 Language

This option is not available on some (English-only) units.

Use the ⇧ and ⇩ keys to select the required language and the ⏎ key to confirm your selection.

13.2 Temperature Input Sensor

Use the ⇧ and ⇩ keys to select or disable the temperature sensor and the ⏎ key to confirm your selection.

13.3 Error Messages

Use this option to display or hide any error messages that may occurs. Error messages flash alternately with the secondary parameters on the display.

13.4 Input Filtering (Averaging)

When very noisy environments are encountered, this function will allow the user to filter the sensor readings by taking a running average over the time period selected (from 10 seconds to 5 minutes).

13.5 Bargraph

The display can include a bargraph that shows the state of the current outputs. Use the Bargraph configuration option to turn the bargraph off or to display output current A or B, or both, alternating.

If the unit is configured to show a bargraph display, this will be the default. The user will be able to select digital displays using the ⇧ and ⇩ keys but the selected digital display will time out after five minutes and the bargraph display will be restored.

13.6 Software Version

This option displays the version number of the software embedded in the unit.

14 Cleaning Menu

Cleaning
| Duration
| Interval
| On/Off-line
| Recovery time (Off-line) or Delay Y/N (On-line)

A set point relay can be configured to operate a jet spray wash or rotary electrode cleaning system on a timed cycle. The purpose is to prevent accumulation of particulate matter on the active surfaces of the sensor. The Set Point relay would control the supply to the cleaning device.

The **Cleaning** item on the Set Point menu (see *Section 8 Set Point Relays*) has the following parameters:

Duration – The duration of the cleaning operation (5s to 10 min.)

Interval – The interval between cleaning operations (5 min to 48 hours).

On/Off line – The required system state during a cleaning operation. When Off line, the other current output and relays are disabled.

Recovery – This option only appears if Off-line has been selected. This is the time allowed for the sensor to recover from cleaning. It is the time from the end of cleaning to the return to the On-line state (5s to 10 min).

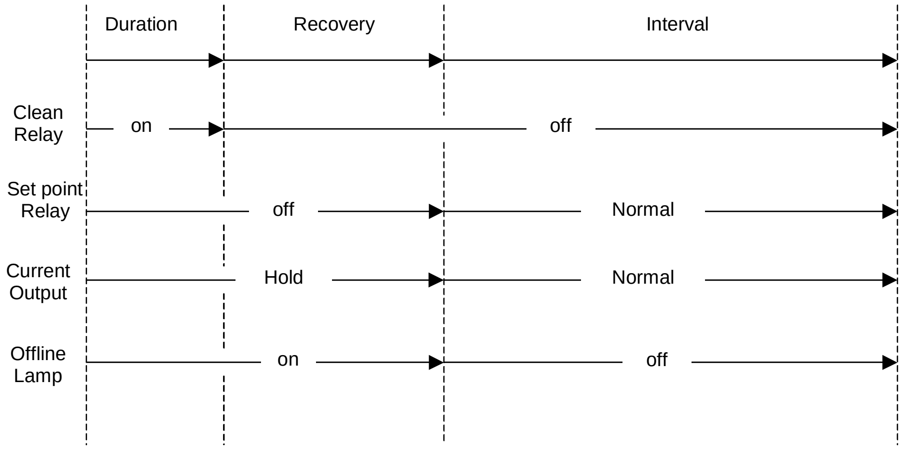
Delay Y/N – This option only appears if On-line has been selected. If unit is to remain On line during cleaning, a **Y** option forces the cleaning to wait until all relays are inactive. While cleaning is being delayed, a Cleaning Delayed message will be displayed.

The instrument can be taken off-line during a 'Clean' cycle. This will de-energise the set point relay and freeze the current output which could otherwise cause chaos in the control system as a result of cleaning solution being sprayed onto the sensor.

By selecting the automatic Off-Line facility in the menu, spurious relay / current output changes are prevented during the **Duration** and **Recover** periods. Normal operation is restored during the **Interval** period. The clean **Delay** function gives priority to the control relays. This means that a 'Clean' cycle will be delayed for as long as necessary until the control relays are in the Off state.

A manual clean cycle can be initiated by a remote switch/contacts connected to the instrument digital input terminals (see *Section 3.3 Digital Inputs*). The 'Clean' cycle software, if selected, runs automatically and continuously from power up, beginning with the **Interval** period. It can only be stopped by changing the operating mode of the Set Point relay or Current output which it is controlling.

Typical Operation with Clean Offline



15 Fault Finding

NOTE : THERE ARE NO USER SERVICEABLE PARTS INSIDE THE UNIT

The HOT63 has been designed to include a wide range of self diagnostic tests, some of which are performed at switch on and some on a continuous basis. This guide aims to provide a route to diagnosing and correcting any faults that may occur during normal operation. The table shown in Appendix H – Error Messages gives a list of the error messages that the HOT63 generates, along with their probable causes. If the fault has not been cleared after these checks have been made, contact LTH. Please have as much of the following information available as possible, in any communication with LTH, to enable quick diagnosis and correction of the problem.

- Serial number of the instrument,
- The approximate date of purchase.
- Details of the program settings and application
- Electrical environment and supply details
- Circumstances under which the fault occurred.
- The nature of the fault or faults
- Any error messages that are displayed
- The sensor type, cable length and type
- Current output configuration
- Relay connection configuration
- Software version.

It is often worthwhile to check the measurement by an independent method, for example using a handheld meter. (See also *Section 2.2 Noise suppression.*)

The Instrument Appears Dead

Check that power is available to the unit. Using a voltmeter, set to AC or DC (as appropriate), check the power supply voltage at the connector. The unit can accept from 15 to 30V AC or DC. Check that the power cable is securely and correctly attached – wired as detailed in *Section 3.2 Connections*. There are no user serviceable fuses fitted within this unit.

The Access Code Does Not Work

It is probable that the access code has either been changed or the operator does not recall the code correctly. Contact LTH or your local distributor should this problem arise.

The Sensor Reading Is Constantly Over-range or Under-range

- Ensure that the sensor and temperature inputs are correctly connected, and check that the sensor is not faulty or damaged.

- Check that the correct probe type has been selected ensure all probe protective caps have been removed.
- Check that any junction boxes used are correctly connected.
- Check for damaged or broken cables.
- Where extension cables have been used, try connecting the sensor directly to the instrument.
- Check the sensor using a hand held meter.

The Sensor Reading Is Incorrect

- Check the temperature compensation mode. If the compensation is set to “Manual” check that the fixed temperature is at the correct level. If the compensation is “Automatic” check that the temperature reading on the main display is correct.
- Use another instrument to check the sensor.
- Check that the sensor gives sensible readings in air (100%) and Sodium Sulphite Solution (0%)
- Check the Pressure and Salinity Compensation values
- Check that no error messages are being displayed.

The Temperature Reading Is Incorrect

- Check that the temperature sensor is correctly attached.
- Check that the temperature sensor type is correctly selected in the “Configuration” menu.
- Where practical check the temperature sensor resistance against the table in Appendix F.
- Check the user calibration.

Current Output is Incorrect or Noisy

- Check that the maximum load for the current loop has not been exceeded. (750Ω, reducing with supply voltage)
- Check that the terminals have been wired correctly .
- Check that the cable screen is attached to Earth at one end, and that the cable does not pass too close to a power cable. Check that the current output has been configured properly.
- Check the user calibration.

Pressure Input is Incorrect or Noisy

- Check that the maximum load for the current loop has not been exceeded.

- Check that the terminals have been wired correctly and that the cable screen is attached to Earth at one end. Make sure that the cable does not pass too close to a power cable.
- Check that the Pressure Input has been configured properly. Try performing a user calibration.

Relays Appear to Malfunction

- Check that the unit is “On-Line”
- Check that the set point configuration is correct
- If the relays are vibrating or “chattering” as they pass the set point, check the hysteresis setting and increase if necessary.
- Ensure that the relays are connected properly and that the voltage/current levels are not exceeding the specification
- Check that the instrument input cables are not picking up excessive noise,
- A Bell Symbol is Flashing on the Display

The system has detected an error but the error messages have been disabled in the **Configuration** menu. Enable the error messages, correct the error and then disable the error messages only if absolutely necessary.

OE15 DO Probe Maintenance

In order to achieve the maximum reliability from the overall system the sensor will require regular calibration and maintenance. The period for this will depend upon the application; e.g. in aeration tanks, a weekly check on calibration and fouling would be a reasonable estimate, for rivers a longer period, and in ditches it may need to be more frequent. The zero check in Sodium Sulphite would be less frequent, probably once a month.

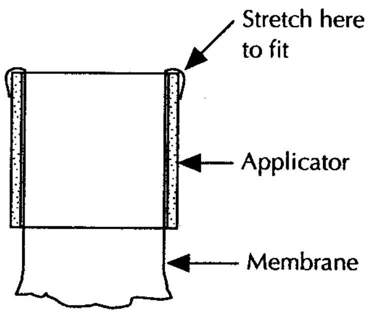
The OE15 electrode incorporates a number of features to simplify maintenance. The electrolyte contained within the cartridge is gelled and sealed. The cartridge is detachable. It can be removed by undoing the large stainless steel bolt at the bottom of the electrode.

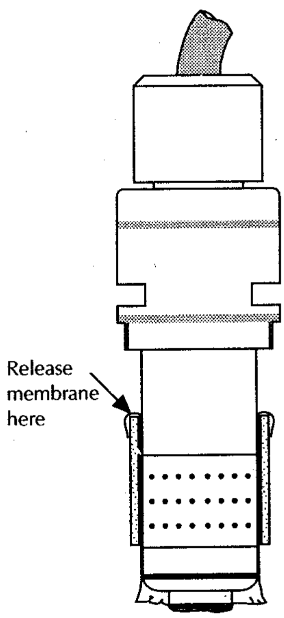
Due to the Galvanic action of the sensor, the cartridge has a finite life. It will provide at least 12 months of continuous use before replacement becomes necessary. LTH Electronics operates an exchange service for electrodes, but we recommend the purchase of a spare cartridge if the process being monitored is continuous. The electrode should contain a weak solution of Sodium Sulphite, which absorbs any residual oxygen in the probe and conditions the electrode for immediate use.

16 OE15 Membrane Replacement

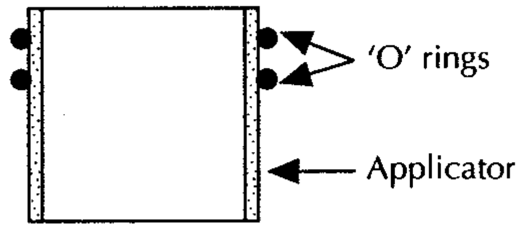
The electrode membrane is very delicate and may be damaged by careless use. Inspect the electrode periodically for signs of membrane damage and replace it if necessary.

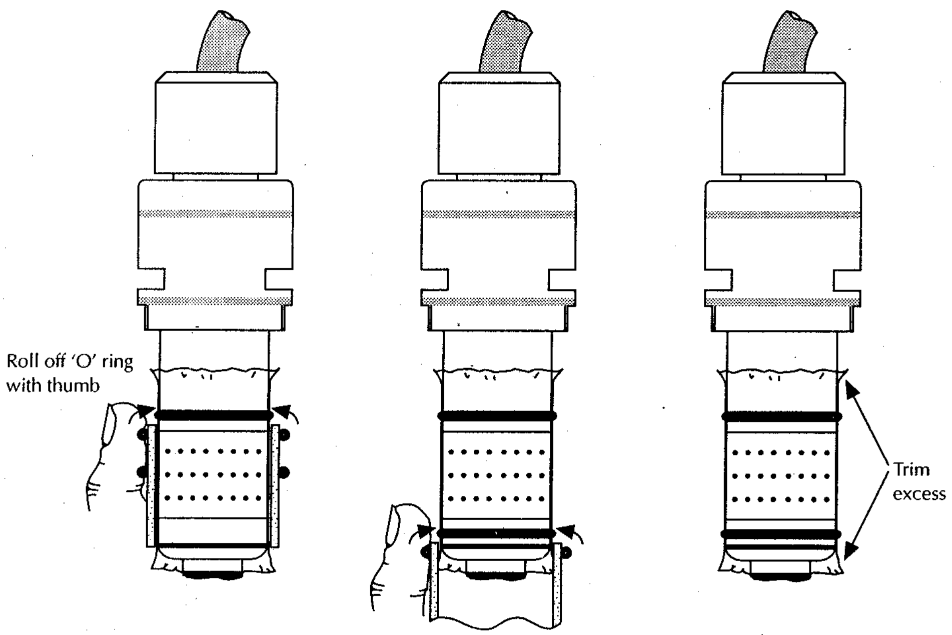
1. Remove the damaged membrane and the two 'O' rings retaining it and set these aside.
2. Cut a 120mm length of membrane and fit to the applicator as shown by passing it through the middle and evenly stretching the front edge back over the outside.
3. Slide the applicator carefully over the electrode taking care not to stretch the membrane.
4. Release the membrane at the top and withdraw the applicator.





5. Place the two 'O' rings on the applicator and slide this over the electrode taking care not to touch the membrane covering the silver cathode. Push off the first 'O' ring to locate in the top groove without stressing the membrane. Fit the second 'O' ring in a similar fashion and trim off the excess membrane not enclosed within the 'O' rings.





17 Guarantee and Service

Products manufactured by LTH Electronics Ltd are guaranteed against faulty workmanship and materials for a period of three years from the date of despatch, except for finished goods not of LTH manufacture, which are subject to a separate agreement.

All sensors made by LTH Electronics Ltd are thoroughly tested to their published specification before despatch. As LTH have no control over the conditions in which their sensors are used, no further guarantee is given, although any complaints concerning their operation will be carefully investigated.

Goods for attention under guarantee (unless otherwise agreed) must be returned to the factory carriage paid and, if accepted for free repair, will be returned to the customer's address free of charge. Arrangements can also be made for repair on site, in which case a charge may be made for the engineer's time and expenses.

If any services other than those covered by the guarantee are required, please contact LTH direct.

Note: Overseas users should contact their LTH nominated representative. Special arrangements will be made in individual cases for goods returned from overseas.

18 Appendix A – DO Measurement

18.1 Sensor Interface

The output signal from a Dissolved Oxygen (DO) probe is in the form of a constant DC current which is proportional to the partial pressure of the liquid being measured. In a 100% saturated solution at room temperature and pressure, the output from a Galvanic probe will be of the order of hundreds of micro-amps (10^{-6} Amps), whereas the output from a Polargraphic probe will be of the order of hundreds of nano-amps (10^{-9} Amps).

In addition, Polargraphic probes require a bias voltage to be applied between the cathode an anode of the DO cell to excite an output.

The equation for converting current input to % saturation is as follows :

$$\% \text{ Saturation} = (I/I_o) \times P_c \times M \times 100$$

Where:
- I = Measured Input Current
- I_o = 100% Saturation Current
- P_c = Pressure Correction Term
- M = Membrane Correction Term

The pressure correction term compensates for the effect that pressure has on the solubility of oxygen in water. This is almost directly proportional, i.e. a 10% variation in pressure will lead to a 10% variation in the solubility and therefore saturation of the liquid.

The pressure correction term is defined as follows :

$$P_c = \frac{P_o - P_{vapor(To)}}{P - P_{vapor(T)}}$$

Where :
- Po = Pressure at 100% Calibration
- $P_{vapor(T}$ = Saturation Vapour Pressure at T
- P = Pressure
- T = Temperature
- To = Temperature at 100% Calibration

18.2 Membrane Correction

The membrane correction term is defined as follows :

$$M = e^{A([1/T]-[1/To])}$$

Where : A = Membrane Correction Factor
T = Temperature (in °K)
To = Temperature at calibration (in °K)

The membrane correction factor is specific to each make of probe and characterises the type and thickness of the membrane material in terms of how its permeability to Oxygen varies with temperature. From this, it can be seen that the membrane correction term can contribute a variation in the saturation value of as much as 3% for each degree of change in temperature (for a typical membrane correction factor of 2220).

The above equations demonstrate the benefits of having active temperature and pressure measurement when an accurate reading is required. For systems where active pressure or temperature measurement is not available, manual compensation is available.

18.3 Oxygen Solubility

The Oxygen solubility is easily defined as : % Saturation X Maximum Theoretical Solubility of Oxygen in water. The maximum theoretical solubility is heavily dependant on the temperature, pressure and salinity of the measured liquid. Tables of data for Oxygen solubility are readily available from a number of sources such as BS EN 25814, ISO5814 , and see solubility table.

18.4 Partial Pressure of Oxygen (pO_2)

The concentration of a gas dissolved in a solution at equilibrium is proportional to the partial pressure of the gas in contact with the solution (Henry's Law). The partial pressure of the gaseous component of the air in contact with the solution remains proportional to the total pressure of the air sample.

The partial pressure of Oxygen in air at atmospheric pressure of 1 Bar (1000mBar) is 210mBar (air is 21% Oxygen), so if a solution of pure water were 100% saturated with Oxygen at atmospheric pressure the partial pressure of Oxygen in solution would be 210mBar. e.g. 20% saturation at a pressure of 1 Bar gives a reading of 42mBar, 50% saturation at a pressure of 3 Bar gives a reading of 315mBar.

19 Appendix B – Probe Parameters

The following table gives the necessary configuration data for a number of DO probes :

Probe Type	Temperature Sensor Type	Membrane Correction Factor	Bias Voltage
LTH OE15	1K Thermistor	3965	N/A
BJ ProcessProbe™	22K Thermistor	2220	+0.675V
Hamilton Oxysens™	22K Thermistor	2700	+0.670V

20 Appendix C – Factory Defaults

Parameters	Galvanic	Polargraphic
Units	% Saturation	% Saturation
Probe Type	Galvanic	Polargraphic
Temperature Units	°C	°C
Temperature Compensation	Automatic	Automatic
Fixed Temperature Input	+25.0°C	+25.0°C
Fixed Salinity Input	0.00 ppt	0.00 ppt
Pressure Compensation	Manual	Manual
Pressure Units	Atm	Atm
Fixed Pressure Input	1.00 Atm	1.00 Atm
Set Points		
SP1 Source	Sensor	Sensor
SP1 Trigger	Low	Low
SP1 Level (Latch High)	50.0%	50.0%
SP1 Latch Low	20.0%	20.0%
SP1 Mode	On/Off	On/Off
SP1 Dose Alarm	No	No
SP1 Alarm Time (mm:ss)	05:00	05:00
SP1 Delay (mm:ss)	00:00	00:00
SP1 Hysteresis (% of SP Level)	1.0%	1.0%
SP1 Cycle Time (mm:ss)	00:30	00:30
SP1 Proportional Latch (% of range)	20.0%	20.0%

Parameters	Galvanic	Polargraphic
SP2 Source	Sensor	Sensor
SP2 Trigger	High	High
SP2 Level (Latch High)	50.0%	50.0%
SP2 Latch Low	20.0%	20.0%
SP2 Mode	On/Off	On/Off
SP2 Dose Alarm	No	No
SP2 Alarm Time (mm:ss)	05:00	05:00
SP2 Delay (mm:ss)	00:00	00:00
SP2 Hysteresis	1.0%	1.0%
SP2 Cycle Time (mm:ss)	00:30	00:30
SP2 Proportional Band	20.0%	20.0%
Cleaning		
Duration (mm:ss)	00:05	00:05
Interval (hh:ss)	01:00	01:00
Mode	Off-Line	Off-Line
Recovery (mm:ss)	00:05	00:05
Delay	N	N

Parameters	Galvanic	Polargraphic
Current Outputs		
Input A	Sensor	Sensor
Output A	4-20mA	4-20mA
Output A Zero	0.0%	0.0%
Output A Span	100.0%	100.0%
Input B	Temperature	Temperature
Output B	4-20mA	4-20mA
Output B Zero	0.0°C	0.0°C
Output B Span	100°C	100°C
Pressure Input		
Mode	Input	Input
Units	Atm	Atm
4mA Level	0.40 Atm	0.40 Atm
20mA Level	2.00 Atm	2.00 Atm
Pressure Damping	Disabled	Disabled
Pressure Limit A (“From”)	0.00 Atm	0.00 Atm
Pressure Limit B (“To”)	0.00 Atm	0.00 Atm
Calibration		
Mode	On-Line	On-Line
Calibration Access	No	No
Configuration		
T Input	LTH 1K*	BJ 22K**
Bias Voltage	0.000V	+0.675V**
Membrane Correction Factor	3965*	2220**
Errors	Enabled	Enabled
Input Filter	Out	Out

* Default for use with the OE15 Probe

** Default for use with the ProcessProbe™

21 Appendix D – Customer Setup

Instrument Serial No. : ______________________

Sensor Serial/Type No. : ______________________

Parameters	
Units	
Probe Type	
Temperature Units	
Temperature Compensation	
Fixed Temperature Input	
Fixed Salinity Input	
Pressure Compensation	
Pressure Units	
Fixed Pressure Input	
Set Point 1	
SP1 Source	
SP1 Trigger	
SP1 Level (Latch High)	
SP1 Latch Low	
SP1 Mode	
SP1 Dose Alarm	
SP1 Alarm Time (mm:ss)	
SP1 Delay (mm:ss)	
SP1 Hysteresis (% of SP Level)	
SP1 Cycle Time (mm:ss)	
SP1 Proportional Band (% of range)	

Set Point 2	
SP2 Source	
SP2 Trigger	
SP2 Level (Latch High)	
SP2 Latch Low	
SP2 Mode	
SP2 Dose Alarm	
SP2 Alarm Time (mm:ss)	
SP2 Delay (mm:ss)	
SP2 Hysteresis (% of SP Level)	
SP2 Cycle Time (mm:ss)	
SP2 Proportional Band (% of range)	
Cleaning	
Duration (mm:ss)	
Interval (hh:ss)	
Mode	
Recovery (mm:ss)	
Delay	
Current Outputs	
Input A	
Output A	
Output A Zero	
Output A Span	
Input B	
Output B	
Output B Zero	
Output B Span	

Pressure Input	
Mode	
Units	
4mA level	

20mA Level	
Damping	
Limit A (“From”)	
Limit B (“To”)	
Calibration	
Mode	
Calibration Access	
Configuration	
T Input	
Bias Voltage	
Membrane Correction	
Errors	
Input Filter	

22 Appendix E – Temp. Sensor Data

The table below lists approximate resistance values of temperature sensors that may be used with the HXT63 series. Not all options are available on all models.

Temperature (°C)	PT1000 RTD	LTH 1K Thermistor	BJC 22K Thermistor
0	1000.0Ω	2691Ω	64.88 kΩ
10	1039.0Ω	1779Ω	41.34 kΩ
20	1077.9Ω	1204Ω	26.97 kΩ
25	1097.3Ω	1000Ω	22.00 kΩ
30	1116.7Ω	833.7Ω	18.03 kΩ
40	1155.4Ω	589.0Ω	12.30 kΩ
50	1194.0Ω	423.9Ω	8.57 kΩ
60	1232.4Ω	310.5Ω	6.07 kΩ
70	1270.7Ω	231.0Ω	4.38 kΩ
80	1308.9Ω	174.5Ω	3.21 kΩ
90	1347.0Ω	133.6Ω	2.39 kΩ
100	1385.0Ω	103.6Ω	1.80 kΩ

23 Appendix F – Pressure Conversions

The following table provides conversions between all the common pressure units

	Atm	Bar	kPa	m H_20	psi	mm Hg
mm Hg	760	750	7.50	73.36	51.72	1
psi	14.696	14.504	0.145	1.422	1	0.0194
m H_20	10.33	10.20	0.102	1	0.703	0.0136
kPa	101.33	100	1	9.81	6.895	0.133
Bar	1.0133	1	0.01	0.0981	0.069	0.00133
Atm	1	0.987	0.00987	0.0968	0.061	0.00132
	Atm	**Bar**	**kPa**	**m H_20**	**psi**	**mm Hg**

24 Appendix G – Oxygen Solubility

Solubility of Oxygen in Pure water				
Temp	**ppm O_2**		**Temp**	**ppm O_2**
0	14.59		21	8.90
1	14.19		22	8.73
2	13.81		23	8.55
3	13.44		24	8.40
4	13.08		25	8.24
5	12.75		26	8.08
6	12.42		27	7.94
7	12.12		28	7.80
8	11.82		29	7.66
9	11.54		30	7.54
10	11.27		31	7.41
11	11.01		32	7.28
12	10.75		33	7.15
13	10.52		34	7.04
14	10.28		35	6.93
15	10.07		36	6.82
16	9.85		37	6.71
17	9.64		38	6.61
18	9.44		39	6.51
19	9.25		40	6.41
20	9.07			

The solubility of oxygen in pure water varies considerably with temperature. The table on the previous page gives the variation of oxygen concentration in ppm (=mg/litre) across a temperature range of 0 – 40 C in pure water at equilibrium with water vapour saturated air at 1 Atmosphere standard pressure (= 760 mm Mercury).

For other operating pressures, such as those which are used in bio-reactors, see more advanced tables available in good chemistry / physics text books for conversion factors.

25 Appendix H – Error Messages

Switch On Diagnostic Errors

E01	**Processor RAM Read/Write Error** Try switching the unit off then on again. If the message persists, consult with your supplier, as this unit will require to be returned for repair.
E02	Reserved for future use
E03	**PSD RAM Read/Write Error** Try switching the unit off then on again. If the message persists, consult with your supplier, as this unit will require to be returned for repair.
E04	**Setup Checksum Error** The instrument configuration has for some reason become corrupted. Restore a setup from store A or B, or one of the two default setups.
E05	**Store A Checksum Error** The data in setup store A has been corrupted. Save the current setup back to store A.
E06	**Store B Checksum Error** The data in setup store B has been corrupted. Save the current setup back to store B.
E07	**Factory Calibration Checksum Error** The factory calibration data for this instrument has been corrupted. The instrument will need to be re-calibrated. Consult your supplier.
E08	**User Calibration Checksum Error** The user calibration data has been corrupted. Reset the user calibration and re-enter
E11-23	Not used.

Sensor Input Errors

E31	**Sensor +Sat** The sensor input at positive saturation.
E32	**Sensor -Sat** The sensor input at negative saturation.
E33	**Sensor Input Over-range** The sensor input over the specified range

E34	**Sensor Input Under-range** The sensor input is under the specified range
E35	**Temperature Sensor Fault** The temperature sensor is reading open or closed circuit, due in most cases to a damaged sensing element or incorrect wiring. Check Configuration menu Temperature Sensor is set to the correct type. Under this condition, the unit will default to the fixed temperature setting for compensation purposes.
E36	**Temperature Input Over-range** Temperature input is greater than +300.0°C Could be a result of the faults listed under Error E35.
E37	**Temperature Input Under-range** Temperature input in less than -50.0°C Temperature. Could be a result of the faults listed under Error E35.
E38	**Compensation Outside Limits** The temperature input is outside the operating temperature limits for the attached probe

Current Output Errors

E41	**Current Output A Hardware Fault** The current output circuit has detected an error in the output. This is most commonly due to either a broken loop or too large a load resistor. It can also be caused by insufficient supply voltage for the load (see *Section 3.2.5 Power Supply*).
E42	**Current Output B Hardware Fault** The current output circuit has detected an error in the output. This is most commonly due to either a broken loop or too large a load resistor. It can also be caused by insufficient supply voltage for the load (see *Section 3.2.5 Power Supply*).
E43	**Sensor Input < Current OP A Zero Level** The sensor input level is below that set for current output A zero.
E44	**Sensor Input > Current OP A Span Level** The sensor input level is above that set for current output A span.
E45	**Sensor Input < Current OP B Zero Level** The sensor input level is below that set for current output B zero.
E46	**Sensor Input > Current OP B Span Level** The sensor input level is above that set for current output B span.

Floating Point Maths Errors

These errors are only flagged when an internal maths calculation fails. As such, they should not appear if the software is functioning properly. The error message should time out after approx. 5 seconds. If the error continues to be displayed, call LTH or an authorised distributor for advice.

E51	**Overflow Error**
E52	**Underflow Error**
E53	**Divide by 0 Error**
E54	**Too Large For Conversion**
E55	**Too Small For Conversion**

4-20mA Pressure Sensor Input Errors

E71	**Press > Max.** The pressure input is greater than the maximum specified limit for the probe.
E72	**Press < Min.** The pressure input is less than the minimum specified limit for the probe.
E73	**Input > 20mA** The current input is greater than 20mA
E74	**Input < 4mA** The current input is less then 4mA

Index

Sensor & Secondary [2]	ACCESS CODE	PARAMETERS	SET POINTS 1&2	CURRENT OUTPUT	CALIBRATION	SAVE / RESTORE	PRESSURE INPUT	CONFIGURATION
Sensor & Set points 1/2	Edit Level 1 access code	Display units	SP1 source	O/P A source	Online / offline	Save as Setup A	Mode	Language
Sensor & Temperature	Edit Level 2 access code	Probe type	SP1 range	O/P A mode (0/4-20 mA)	Cal Access	Save as Setup B	Units	Temperature sensor
Sensor & Manual temp		Temperature units	SP1 trigger	O/P A zero	Calibration units	Restore Setup A	Set 4/20 mA inputs	Bias Voltage
Sensor & Salinity setting		Temp.Comp. mode	SP1 level (band high)	O/P A span	Enter pressure	Restore Setup B	Damping on/off	Membrane correction factor
Sensor & Pressure input		Input salinity	SP1 band low	O/P B source	Sensor calibration	Restore default galvanic	Pressure limit A	Error messages
Sensor & Curr.outputs		Pressure comp. mode	SP1 mode	O/P B mode (0/4-20 mA)	Autocal yes/no	Restore default polargraphic	Pressure limit B	Input filter
Sensor & Zero/span		Pressure comp. units	SP1 dose alarm	O/P B zero	Temperature calibration			Bargraph on/off
OR		Pressure comp. input	SP1 delay	O/P B span	Pressure input			Software issue
Bargraph		Simulated current outA	SP1 hysteresis	Source error	Current output calibration			
		Simulated current outB	SP1 cycle time		Reset User Cal			
			SP1 proportion band					
			Alarms[3]					
			Cleaning[3]					

Key

- Universal access
- Level 1 access
- Level 2 access

Notes :

1. Depending on unit settings, some menu items may not appear.
   (See the appropriate sections in the main text.)
2. The Primary display shows the sensor reading in the units selected via the Parameters menu. Use ⇧ ⇩ keys to choose parameters/units on Secondary display.
3. Alternative menu structures appear if either the Alarms or the Cleaning option on the Set Points menu is selected.

LTH Electronics Ltd
Chaul End Lane
Luton
Bedfordshire
LU4 8EZ
United Kingdom

Telephone : +44 (0) 1582 593693
Fax : +44 (0) 1582 598036
e-mail : sales@lth.co.uk
web : www.lth.co.uk