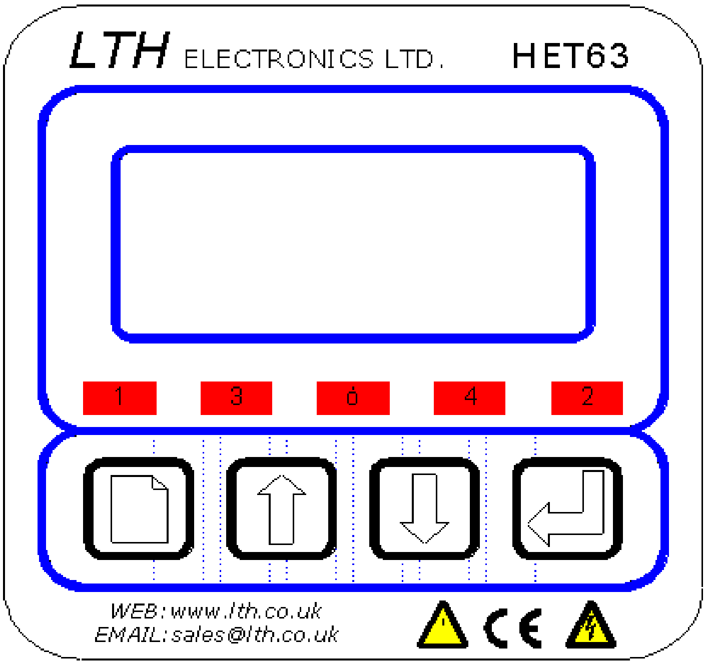
KLAY-INSTRUMENTS B.V.
Nijverheidsweg 5
Postbus 13
Tel. 0521-591550
Fax 0521-592046
7991 CZ DWINGELOO
7990 AA DWINGELOO
Nederland
E-mail: info@klay.nl

HET63

Electrodeless Conductivity Transmitter



OPERATION GUIDE

PREFACE

Product warranty

The HET63 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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LTH Electronics Ltd
Chaul End Lane
Luton
Bedfordshire
LU4 8EZ
United Kingdom

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

LCD	Liquid crystal display
LED	Light Emitting Diode
LSB	Least Significant Bit
MSB	Most Significant Bit
ppm	Parts per million.
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 HET63

The HET63 is a microprocessor controlled electrodeless conductivity measurement instrument with the facility to display in % concentration. 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 and feedback with up to two control relays and two 0/4-20mA current output sources.

1.2 Unit Specification

Measurement input	ECS20, ECS40 or ECS60 Series electrodeless conductivity sensor.
Cell constant adjustment	0 – 10.0 for other sensors than those shown above.
Range of measurement	0 to 999.9 uS/cm, 9.999, 99.99 and 999.9 mS/cm. 0 to 16.00% NaOH 0 to 30.00% NaCl 0 to 15.00% HCl 0 to 25.00% H_2SO_4 0 to 25.00% H_3PO_4 0 to 41.00 ppt Salinity 0 to 99.9% Custom from 2 to 9 points can be entered.
Range selection	Internal single or auto range, or external range selection via digital inputs.
Accuracy	±1% of range
Linearity	±0.1% of range
Repeatability	±0.1% of range
Operator adjustment	Solution ±20% offset
	Conductivity ±10% slope
Connection cable	Up to 10 metres 54H cable
Temperature sensor	PT1000 RTD input. Temperature sensor can be mounted in the sensor or separately.
Temperature range	-50°C to +300°C. (-58 to +572°F), resolution 0.01°C
Temperature accuracy	±0.2°C
Operator adjustment (temperature)	± 50.0°C, or ± 122°F.

Temperature compensation type	Automatic or manual 0 to 100°C, base 20 or 25°C (conductivity only), slope 0 to 9.9%/°C.
Off-line facility (for calibration and commissioning)	The relays are de-energised and the current output is held at the last on-line value.
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).
Display	Custom backlit LCD module. 4 digit + sign main display, 3x2 characters for units indication, and 16 characters for information and programming.
Digital input	3-bit digital input for remote selection of range.
Current output (1 standard, 2 optional)	Select 0-20mA or 4-20mA, fully isolated to 2kV. (750 Ohm Max. load). Expandable up to 5% of any operating range (mS, %, °C) and offset anywhere in that range. Operator adjustments**:** +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. Relays have volt free changeover contacts rated at 5A 30V DC / 5A 250VAC (non-inductive). Red LEDs indicate relay energised. **Set point modes:** Fully configurable set points (mS, % and °C) On/Off, Time Proportioning, Pulse Proportioning, and Band modes selectable for up to three 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 90:00 mm:ss in all modes Adjustable cycle time, and proportional band in the proportional modes.

Set point / alarm relays (2 optional) (continued)	**Alarm modes:** Relays can be configured to energise on: any error, off-line, calibration error, dose alarm, sensor error
Switches	Four tactile feedback push buttons
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 – 30 V AC or DC at 200 mA
Head Mount Housing	Conductive ABS blue plastic, rated IP66 Weight: 600 g (instrument only) Dimensions: 100 x 116 x 145 mm (h,w,d) excluding cnnectors

2 Safety & EMC

This chapter describes how to install and mount the panel-mounting and surface-mounting versions, 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 HET63 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 inside or close to the instrument housing.

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 HET63 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 HET63 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 an in-line mains filter close to the power terminals of the supply.
- In cases of very high background RF and HF noise environments, LTH can supply a length of proprietary RF suppressing mains cable.

3 Installation

3.1 Head-mounted Version Mechanics

This version of the HET63 is designed for mounting on a pipe T-piece with the sensor in the main current flow.

Figure 1 shows the dimensions of the components required for installation.

Figure 2 shows the dimensions of the completed assemblies.

The two cells are physically similar.

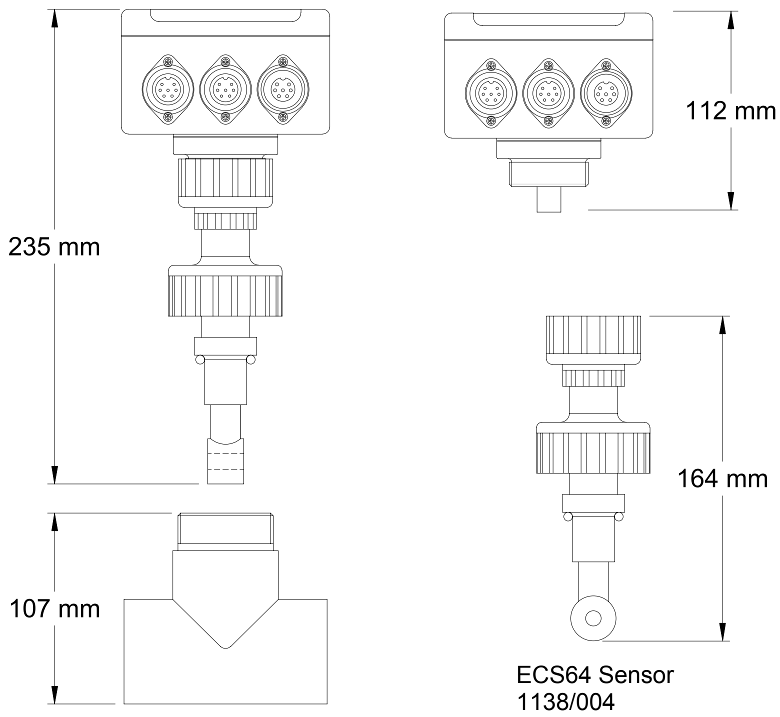


Figure 1 Head-mounting Installation components

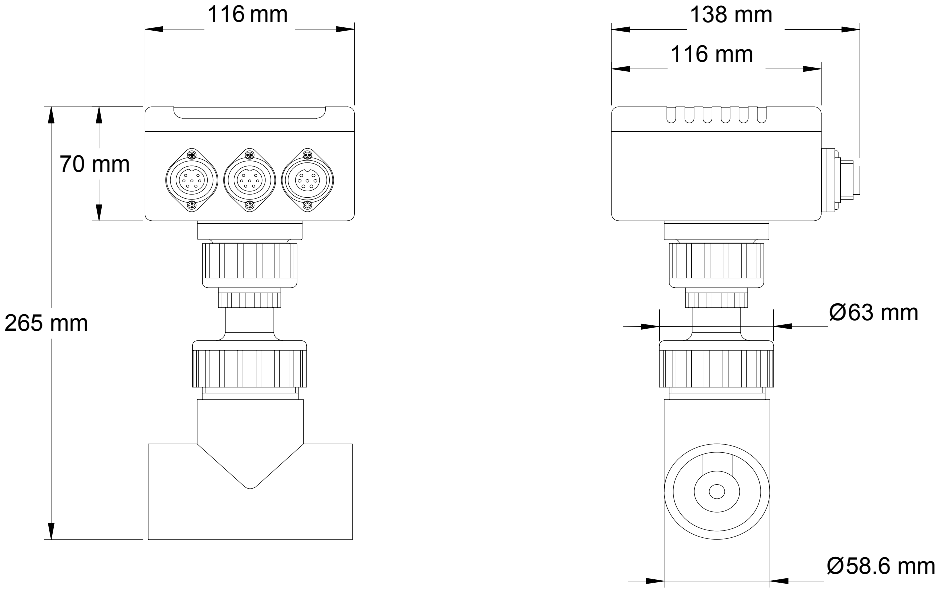


Figure 2 Head-mounting component dimensions

3.2 Wall-mounted Version Mechanics

This version is mounted on a wall and connects to sensors via a (maximum) 10m cable. Figure 2 shows the dimensions and fixing points of the unit.

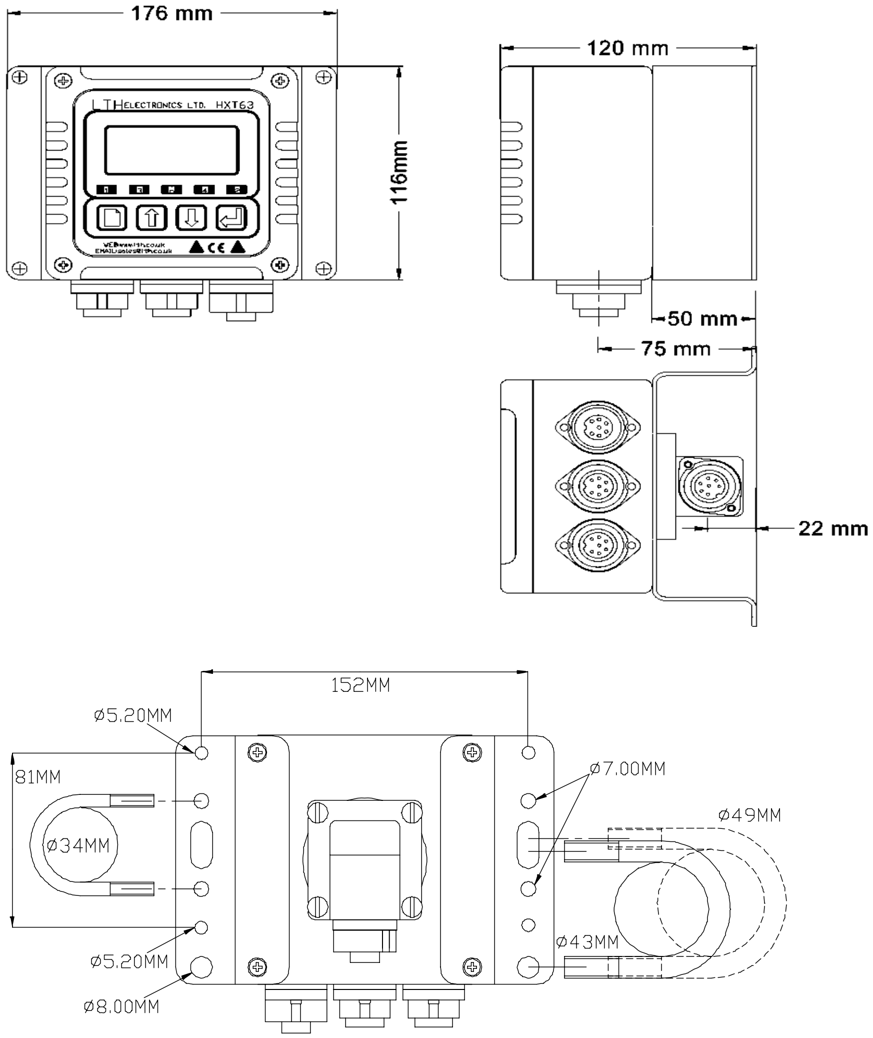


Figure 2 Wall-mounted unit dimensions

3.3 Connections

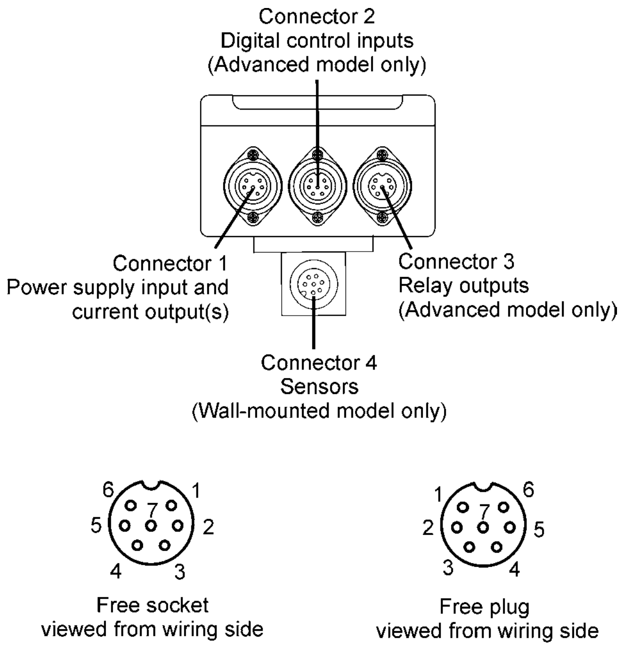


Figure 4 Wall mount unit, rear view

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

3.3.1 Connector 1 Power supply and current outputs

Free female socket

Pin	**Function**
1	Common 0V
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.

3.3.2 Connector 2 Digital range selection inputs

Free female socket. Advanced version only.

Pin	Function
1	Digital common
2	Not used
3	Not used
4	Digital input 3
5	Digital input 1
6	Digital input 2
7	Not used

3.3.3 Connector 3 Relay outputs

Free male plug. Advanced version only.

Pin	Function
1	Relay 1 common
2	Relay 1 normally open
3	Relay 1 normally closed
4	Relay 2 common
5	Relay 2 normally open
6	Relay 2 normally closed
7	Not used

3.3.4 Connector 4 Sensor cable

Free male plug. Wall-mounted version only.
(Colours are for LTH 54H cable.)

Pin	Colour	Function
1	Yellow	Temperature input A
2	Blue	Temperature input B
3	Clear coax core	Drive +
4	Clear coax screen	Drive -
5	Green coax core	Return +
6	Green coax screen	Return -
7	Outer screen	Earth

3.3.5 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

3.3.6 Current Output Connections

The Basic HET63 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.

3.3.7 Relay Connections

The relay outputs are available only on the Advanced version. The relay contacts are volt-free (electrically isolated) and can handle up to 5A at 30V DC or 250V AC. **They must be connected in series with a 5 Amp fuse.**

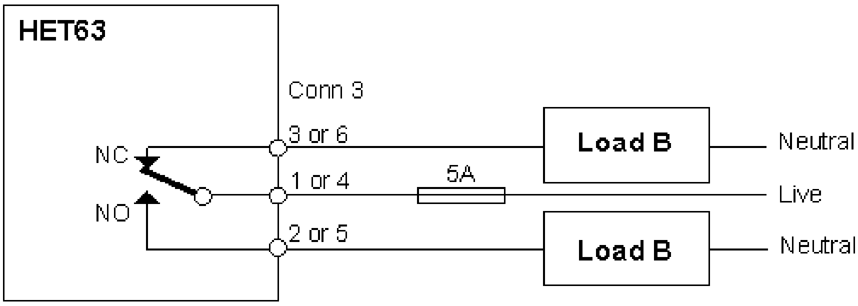


Figure 5 : Relay contact connection

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.

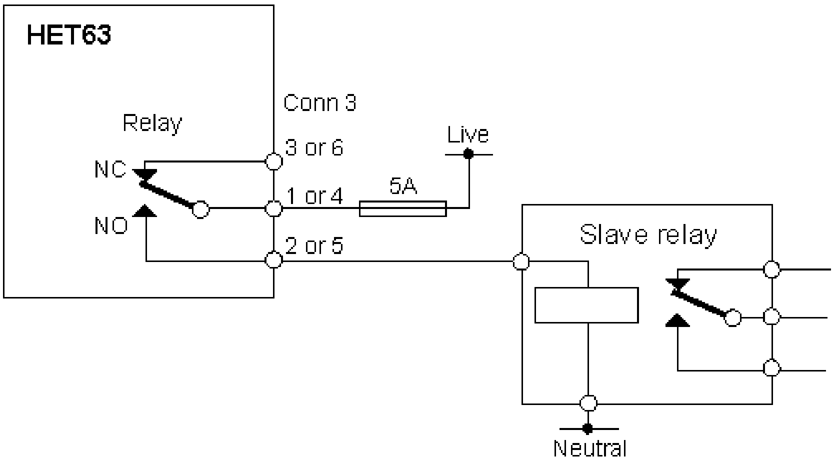


Figure 6 : Slave relay connection

3.3.8 Digital Inputs

The digital inputs are used to change the display ranging of the unit. This also affects both the Set Point range and the Current Output range. When the digital inputs are set for internal ranging the unit will revert to its internal range settings (see *Section 7.3 Range*). When "Autoranging" is selected, the Set Points and Current Output will revert to the internally set ranges (see Sections *8 Set Point Relays* and *9 Current Output*). On the following table the input combination assumes that "0" is an open contact and "1" is a contact shorted to the common pin 1.

Digital Inputs			**Conductivity range setting**	**Solution range setting**
1	**2**	**3**		
0	0	0	Internal	Internal
0	0	1	999.9µS/cm	%NaOH
0	1	0	9.999mS/cm	%NaCl
0	1	1	99.99mS/cm	%H2SO4
1	0	0	999.9mS/cm	%HCl
1	0	1	Autoranging	%H3PO4
1	1	0	Autoranging	%HNO3
1	1	1	Autoranging	Custom

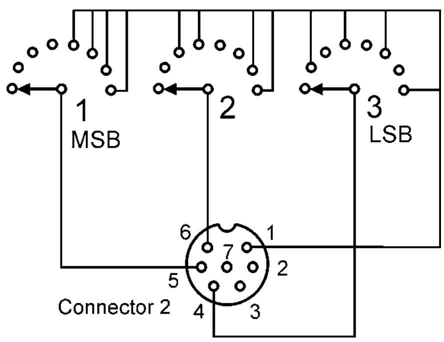
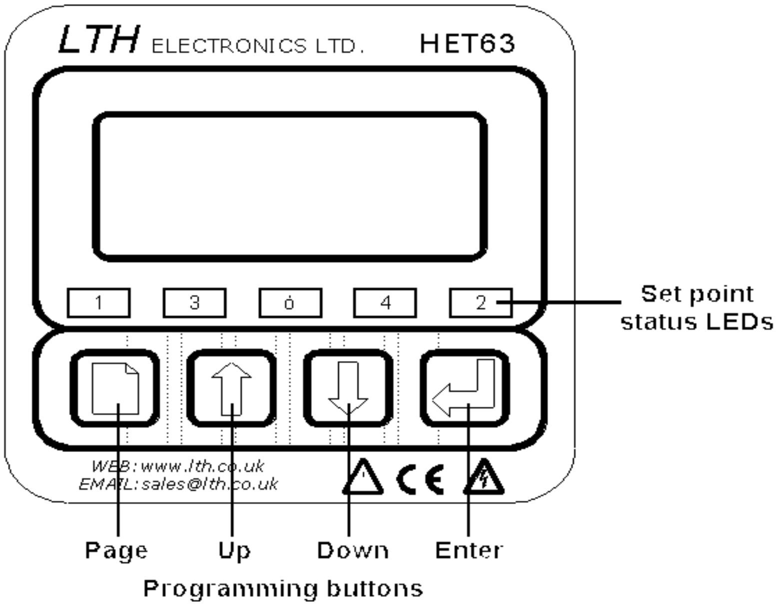


Figure 7 : Rotary switch connections

4 User Interface

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



When shipped, the HET63 is configured to the default conductivity set-up (see *Appendix A – Factory Settings*). In this state the instrument can perform all of the necessary function for a basic conductivity monitoring instrument.

4.1 The Front Panel

The HET63 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 6 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 G – 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 12.3 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 8.6 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
Temp. input	Units C or F, as selected via **Parameters/Temperature Units**
Output A	This shows the output current from Channel A in mA.
Output B	This shows the output current from Channel B in mA.
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.

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 G – 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 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 once to reach the Access Code screen.
2. Use the and keys to reach the Set Level 1 (or 2) Code screen.
3. Use the , and 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
    |       Siemens
    |       Solution
    Sensor
    |       ECS20
    |       ECS40
    |       ECS60
    |       Custom
    Range (range depends on selected units)
            (Siemens)       (Solution)
    |       999.9 uS/cm     %NaOH
    |       9.999 mS/cm     %NaCl
    |       99.99 mS/cm     %HCl
    |       999.9 mS/cm     %H3PO4
    |       Auto            %HN03
    |                       Custom
    |                       Salinity
    T Units
    |       °C
    |       °F
    TC (Temperature Compensation  - if Siemens units selected)
    |       Out
    |       In
    TC Base (if TC is In)
    |       20/25 °C
    TC Slope (if TC is In)
    |       0-9.99 %/°C
    TC Mode (if TC is In)
    |       Auto/Manual
    Manual Temp IP (if TC Mode is Manual)
    |       0-100 °C
    Sim current OutA
    Sim current OutB (advanced model only)
```

7.1 Units

The HET63 can be setup to display conductivity in Siemens/cm or solution concentration as "%wt/vol". This is achieved by setting the units. The rest of the menu structure responds by enabling and disabling the appropriate menu items. When "Siemens" are selected, the instrument displays the input conductivity. All appropriate set points etc have their units changed automatically.

When "Solution" is selected the HET63 will automatically apply the correct conversion and temperature compensation and display the concentration as "%" with an indication of the solution type selected (see range selection). All of the set point units will then be set to '%'.

7.2 Sensor Type

The HET63 can use ECS20, ECS40 or ECS60 series electrodeless conductivity sensors. This enables the unit to enter sensor type so that the system can apply the correct nominal cell constant. If your sensor type is not shown, select Custom and enter the correct cell constant in the Calibrate menu.

7.3 Range

The range options that are displayed will depend upon the units selected. If Solution is selected, an option for Custom range is available. This allows the operator to enter their own Conductivity/Concentration lookup table (see *Section 10.6 Custom Range*).

7.4 Temperature Input

The HET63 has a very accurate PRT temperature measurement facility. With this the user can apply automatic temperature compensation to the sensor measurement.

The T. Units option allows you to select a temperature display in either °C or °F. All temperature related displays will reflect the units selected in this menu.

Note: Under normal conditions the system will 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 Temperature Compensation settings.

The temperature compensation is enabled by setting the ***Temp Comp*** menu item to **In**. (This option is not shown when **Units** are set to **Solution** – the option is automatically set to **In**.) The operator can then select between **Auto** and **Manual** compensation via the ***TC Mode*** menu item. If a temperature sensor is not connected to the instrument, then TC should be **Disabled** in the **Configuration** Menu see *Section 12.2 Temperature Input Sensor*. In this mode, the instrument can be set with the TC **Out** which will provide a non compensated measurement, or with the TC set to **In** and the **Manual** temperature set to the average solution temperature. When the manual mode of operation is selected, the user can enter the fixed process temperature under the **Fixed Temp** menu option.

*Note: When the automatic mode is selected, the **Fixed Temp** menu option will not be present.*

*Note: When a fault is detected in the Temperature sensor, the unit will default to the **Fixed Temp** setting for compensation purposes, but will display an error condition*

The Slope and Base for the Temperature Compensation can be modified by selecting the appropriate menu items.

7.5 Simulated Current Outputs

The **Simulate current outputs** options are only available when the display range is set to a fixed range (not to Autoranging) and the chosen output source is not disabled.

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 HET63. No relays are fitted on the basic version. Indicators on the front panel show when a relay has operated.

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)
        |    Set point range (Sensor IP only, if Autoranging selected)
        |    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
        |    |        SPn Delay
        |    |        SPn Hysterisis
        |    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

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 Range

If the main sensor display has been set to Autoranging then the Sensor Set Point is scaled according to the setting of the **Set Point Range** menu item. The range can be set from 999.9 μS/cm to 999.9 mS/cm.

8.3 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 **SPx Low** level and remain energised until it rises above the **SPx High** level. It then remains de-energised until the sensor input falls below the **SPx Low** level again.

Trig: Latch Hi — the relay energises when the source input rises above the **SPx High** level and remain energised until it falls below the **SPx Low** level. It then remains de-energised until the sensor input rises above the **SPx High** level again.

8.4 Set Point Mode

The relays can operate in one of three modes.

8.4.1 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 HET63 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.

8.4.2 Time Proportional Mode

It is possible to control any on/off device such as a solenoid valve or dosing pump using the time proportional mode.

The proportional band is displayed as a percentage of the full range value. For example, a proportional band of 20% on the 99.99 μS/cm range would give a band of 20.0 μS/cm. If the set point trigger was selected as LOW and the set point value was 50.0 μS/cm, the band would cover 30.0 to 50.0 μS/cm. When the reading falls below 30.0 μS/cm 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.

8.4.3 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. 30.00 μS/cm in the previous example).

8.5 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.

8.6 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 Output Range, 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 selected 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.

Since the Span can only be specified as a four-digit number between 0000 and 9999, the Output Range option allows you to specify the value represented by the Span you enter. Hence, if you specify an Output Range of 99.99 µS then a Span entry of 1500 represents a span of 15.00 µS. The Output range only has to be specified if the display range, set via **Parameters/Range**, has been set to **Auto**. If **Parameters/Range** has been set to a specific range, the Current Output will operate on that range.

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. 50.00 µS/cm) and the point at which the output is 20 mA as the proportional band (e.g. 20.00 µS/cm) a simple form of proportional control is achieved. If this signal was used to drive a valve actuator, the valve would be fully open at 20.00 µS/cm, half open at 35.00 µS/cm and closed at 50.00 µS/cm.

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 HET63 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:

Calibration
    Mode:
    | On-line
    | Off-line
    Cal Access Y/N
    Sensor Calib (see Section 10.3)
    | Are You Sure?
    | Set IP=OC
    | Sampling
    | Attach Pink Loop
    | Sampling
    | Attach Green Loop
    | Sampling
    | Attach Blue Loop
    | sampling
    | Attach Black Loop
    | Sampling
    | Calibration Pass/Fail
    Solution Calib. (see Section 10.4)
    | Are You Sure?
    | Concentration (display and adjustment)
    | Solution Offset display
    Cell Constant 1.00-10.00 (if Custom sensor selected)
    Custom Input? Y/N (if **Units** are **Solution** and **Range** is **Custom**)
        (see Section 10.6)
    | No. of Points (2-9)
    | Range (999.9 uS – 999.9 mS)
    | Conduct. Point *n* and Solution Point *n* (for selected No. of Points)
    Temperature Calibration(if TC mode set to Auto)
    | Are you sure?
    | Temperature reading displayed/adjusted
    | Offset displayed
    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**.

10.2 Calibration Access

A feature has been included in the HET63 to allow users to access the sensor calibration from the main display. To enable this feature, set **Cal Access*?*** to **Y**. To disable this feature, thus preventing the users from altering the calibration from the main display, set **Cal Access** to **N**.

10.3 Sensor Calibration

The sensor calibration is a one-off configuration calibration, to allow for losses due to cable length and sensor output variations. Calibrate the zero point with the sensor in air and the span with a loop resistor, using the following procedure.

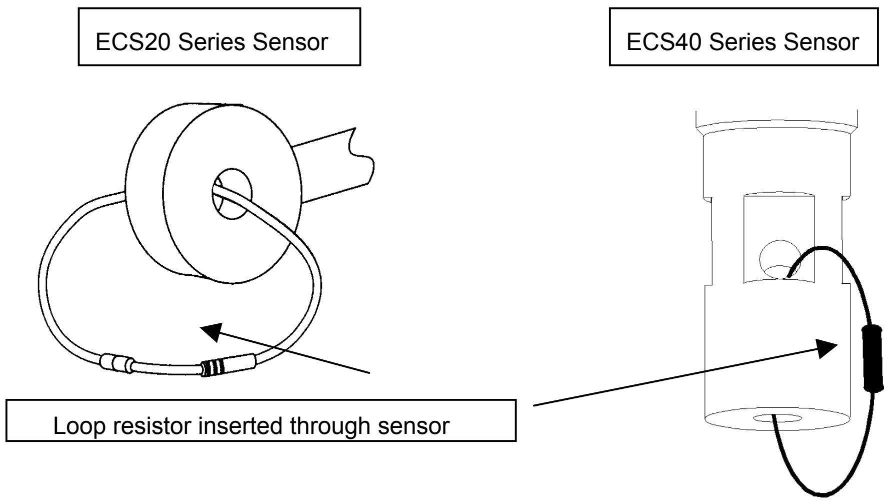
With the sensor removed from solution and no loop fitted in the sensor:

1. Select the **Calibration** menu option and press ⇩ repeatedly until **Sensor Calib** appears.
2. Press ⏎ to select it. **Are you Sure** appears.
3. Press ⏎ to confirm your choice. Set **Loop = OC** (Open Circuit) appears.
4. Press ⏎ to start zero (OC) calibration. The display shows **Sampling**.

Each measurement range of the instrument is automatically sampled and the zero adjusted. As each range is completed a ***** is indicated on the display. Sampling the last (lowest) range may take a few minutes, particularly in electrically noisy environments where pickup could interfere with the low level sensor signal. It is possible to abort the lowest range zero calibration by pressing the ⏎ button.

5. On completion of the zero calibration, the display shows **Attach Pink Loop**.

6. Attach a pink (5Ω) loop resistor to the sensor as shown below.



7. Press ⏎ to start sampling. The unit will sample the sensor input and the display will show **Sampling**. On completion of the sampling, the display shows **Attach** <**Green**, **Blue** or **Black**> **Loop**.
8. Repeat steps 6 and 7 for green (50Ω), blue (500Ω) and black (5000Ω) loops.

If the calibration for open circuit and all four loops was OK, the display shows '**0000 All OK calibration pass'**.

If the open circuit calibration failed, the display shows the range on which the failure occurred – **0005 R**, **0050 R** or **0500 R** – **OC** and **Calibration Fail**.

If the open circuit calibration was OK but a loop calibration failed, the display shows the loop that failed – **0005 R**, **0050 R, 0500 R** or **5000 R** – and <**Pink**, **Green**, **Blue** or **Black**> **loop failed**.

On any calibration failure, error E11 is flagged. To clear the error, run the calibration again. The calibration runs that passed can be skipped by holding down the ⏎ button.

When sampling is finished, the **Solution Calib** menu item will appear.

Remove the black loop resistor from the sensor before installing the sensor into a pipe or tank. Keep the resistors in a safe place as they will be useful for future checks, or if a probe or cable is changed.

10.4 Solution Calibration

This calibration feature allows the user to fine-tune the reading on the instrument to a standard solution or to a titrated sample.

Refer to *Appendix C Calibration* for instructions on the best practice.

1. Immerse the sensor in a solution of known composition and concentration.
2. Ensure that **Solution** units are selected under the **Parameters** menu.
3. Select the **Calibration** menu and press ⇩ repeatedly until **Solution Calib** appears.
4. Press ⏎ to select it. **Are you Sure** appears.
5. Press ⏎ to confirm your choice. The display shows the solution measurement with **Concentration** flashing on the bottom line.
6. Use the ⇧ and ⇩ keys to set the reading to the correct value.
7. Press ⏎ to confirm your setting. The display will show the resultant **Solution Offset**.
8. Press ⇩ to go to the next menu option.

10.5 Cell Constant

This option is only available if a Custom sensor is in use, as selected under the Parameters menu. Enter the cell constant value for the cell using the method described in *Section 4.4 Number entry*.

10.6 Custom Range

The HET63 provides the user with the facility to set up a customised conversion from conductivity to % concentration, for solutions not specifically defined in the standard ranges. To use this facility, first ensure, on the **Parameters** menu, that the **Units** are set to **Solution** and that the **Range** is set to **Custom**. Under these conditions, the **Custom Input** menu item will appear in the **Calibration** menu.

The unit measures solution conductivity and provides a % concentration reading based on the slope defined at between two and nine points in the desired range. Before commencing the procedure, fill out the worksheet on the following page so as to define the slope of the conversion graph.

Worksheet

No. of points _______

TC Slope: _________%/°C

Conductivity range:

- [ ] 999.9 µS/cm
- [ ] 9.999 mS/cm
- [ ] 99.99 mS/cm
- [ ] 999.9 mS/cm

Point	Conductivity	Concentration
1	___________	___________
2	___________	___________
3	___________	___________
4	___________	___________
5	___________	___________
6	___________	___________
7	___________	___________
8	___________	___________
9	___________	___________

Note that the worksheet does not include the zero point. The unit assumes that zero is 00.00% at 000.0 µS/cm.

On the worksheet, enter the data for each point along the slope in ascending order of conductivity. The last designated point should be greater than the highest conductivity value to be measured. For input levels greater than this, the unit will generate an over-range error (Error 31).

1. Take a copy of the worksheet and enter the details of the required calibration on the copy.
2. Ensure that **Solution** units are selected under the **Parameters** menu.
3. Ensure that the **Range** is set to **Custom** under the **Parameters** menu.
4. Ensure that the **Temperature Compensation Slope** in the **Parameters** menu correctly (see Section 7.4).
5. Select the **Calibration** menu and press ⇩ repeatedly until **Custom Input?** appears.
6. Use the ⇩ key to select **Y** and press ⏎ to confirm it. The **No of points** screen appears.
7. Use the ⇧ and ⇩ keys to set the number of calibration points to be used, as specified on the worksheet.
8. Press ⏎ to confirm your choice. The display will show the **Custom Range** screen.
9. Use the ⇧ and ⇩ keys to select the conductivity range over which the slope is to be defined.
10. Press ⏎ to confirm your choice. The display will show the **Cond. Point 1** screen.
11. Set the conductivity reading to the required value for point 1 (defined on the worksheet) as described in *Section 4.4 Number entry*.
12. Press ⇩ to go to the **Solution Point 1** screen.
13. Set the % concentration reading to the required value for point 1 (defined on the worksheet) as described in *Section 4.4 Number entry*.
14. Press ⇩ to go to the next **Cond Point** screen.
15. Repeat steps 11 to 14 for each slope definition point on the worksheet. After defining the last point, the **Temperature** calibration screen will appear.

10.7 Temperature 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 **Temperature Calibration** 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 display will show the temperature reading.
4. Use the ⇧ and ⇩ keys to set the reading to the known correct temperature.
5. Press ⏎ to confirm the correct reading. The display will show the slope calculated by the instrument (where 100% is the default).

10.8 Current Output Calibration

The user is provided with an opportunity to adjust the current output, to calibrate any equipment that may be being used to monitor the current output signal. To adjust the current output select the **Current Output** menu item in the **Calibration** menu. Please keep in mind that the current output cannot go below 0mA. The maximum offset is ±2mA. If two current outputs are fitted they are referred to as A and B respectively.

10.9 Resetting the User Calibration

This option resets all of the user calibrations to their default. 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 Cond-ity
- Default Concentn

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 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
        |       Disabled
        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
```

12.1 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.

12.2 Temperature Input Sensor

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

12.3 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.

12.4 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).

12.5 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.

Digital display can only be restored by changing the Bargraph option under the Configuration menu.

12.6 Software Version

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

13 Fault Finding

NOTE : THERE ARE NO USER SERVICEABLE PARTS INSIDE THE UNIT

The HET63 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 G – Error Messages gives a list of the error messages that the HET63 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.*)

Note: Low conductivity = high resistivity

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 3.3 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

1. Ensure that the sensor and temperature inputs are correctly connected (wall-mounted version only, see *Section 3.3 Connections*) and that the sensor is not faulty or damaged.
2. Check that the correct range and Cell Constant have been selected within the Parameters menu if in doubt set to **Auto** Range (see *Section 7.1 Units*).
3. Check the temperature compensation state (see *Section 7.4 Temperature Input*
4. 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 (see *Section 5 Main Display*).
5. Check the sensor using a hand held meter.
6. Check that the sensor is seeing a representative sample, trapped air will give a low reading.
7. Ensure the input is correctly connected and the sensor is not faulty or damaged.
8. Check the sensor and its cable for possible short circuits. Consider the fact that the conductivity may be higher than the range of the instrument.
9. Check the Pt1000 RTD temperature sensor connections.
10. Check that any in-line junction boxes and extension cables have been fitted and wired up correctly.

The display reads zero

1. Check for open circuit sensor (conductivity or TDS modes)
2. Check for short circuit sensor (resistivity mode)
3. Check for damage to the sensor connecting cable (wall-mounted version only).
4. Check that all input connections are secure.
5. Check the sensor is wired up correctly (wall-mounted version only).
6. Check that the sensor bore is not blocked or completely filled with air.
7. Check the sensor is immersed in the solution, i.e. the T-piece or pipe is full and not an ‘air-trap’.

Instrument display appears to malfunction

1. Switch the instrument power off and on again.
2. Check that the display back-light is on, indicating power is reaching the unit.
3. See that it displays meaningful text (software issue number etc.) in it’s start-up sequence, indicating processing activity.

The Sensor Reading Is Incorrect

1. Low reading due to incomplete immersion or contamination of the electrodes.
2. There may be some trapped matter within the sensor bore.
3. High conductivity readings caused by a short circuit or leakage of liquid contamination into the sensor moulding.
4. The sensor should be checked, when dry, with an ohmmeter. Disconnect it at the instrument and check the resistance between the E and C terminals. It should be greater than 50 MΩ between E & C. Check the leakage from E & C in turn to the terminated screens (inner and outer). Again, 50 MΩ should be the minimum isolation resistance between them all.
5. Low conductivity can be caused by accumulation of trapped air or gas coming out of solution. Check that no air traps exist in the sensor installation.
6. High conductivity readings caused by leakage of solution into the sensor. This usually indicates that the sensor material has been fractured and the sensor must be replaced.
7. First check that the temperature resistance is correct, otherwise the temperature compensation circuit will cause false or erratic readings. Temporarily switching out the temperature compensation can help to show if this is the cause of the problem.
8. If another conductivity sensor is available, this can be used to determine whether the fault lies with the instrument or the sensor (wall-mounted version only).
9. Check that the sensor cable is not damaged or broken and that the outer screen does not make contact with any other terminals or metal work (wall-mounted version only).
10. Check that the inner screen (G) does not contact any other terminals or metalwork at the sensor end. It should not be grounded (wall-mounted version only).
11. Check that the sensor cable is sufficiently distant from power cables or electrical noise sources (wall-mounted version only).
12. Check that the correct sensor type has been installed.
13. Check that the correct range has been selected.
14. Check that the correct sensor calibration values have been used.
15. Check that the calibration procedure has been followed precisely.
16. Check that the temperature compensation has been set up as required.
17. Check that the sensor cable does not exceed the maximum specified length (10m) (wall-mounted version only).

The Temperature Reading Is Incorrect

1. Check that the temperature sensor is wired correctly. (wall-mounted version only) (see *Section 3.3 Connections*).
2. Check that the temperature sensor is correctly selected in the Configuration menu (see *Section 12.2 Temperature Input Sensor*).
3. Where practical check the temperature sensor resistance against the table in *Appendix F – Temperature Sensor Data*.

Current Output is Incorrect or Noisy

1. Check that the maximum load has not been exceeded. See *Section 3.3.5 Power Supply*.
2. Check that the connectors have been wired correctly (see *Section 3.3 Connections*).
3. 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.
4. Check that he current output has been configured properly (see *Section 9 Current Output*).

Relays Appear to Malfunction

1. Check that the unit is On-Line (see *Section 10.1 On-Line/Off-Line Operation*)
2. Check that the set point configuration is correct (see *Section 8 Set Point Relays*)
3. If the relays are vibrating or chattering as they pass the set point, check the hysteresis setting (see *Section 8.4.1 On/Off Mode*) and increase if necessary.
4. Ensure that the relays are connected properly (see *Section 3.3.7 Relay Connections*) and that the voltage/current levels are not exceeding the specification (see *Section 1.2 Unit Specification*).
5. Check that the instrument input cables are not picking up excessive noise, (see *Section 2.1 Wiring Installation*).

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 (see *Section 12 Configuration*). Enable the error messages, correct the error and then disable the error messages only if absolutely necessary.

14 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.

15 Appendix A – Factory Settings

Parameters	Conductivity	Concentration
Units	Siemens	Solution
Sensor Type	ECS40	ECS40
Range	Auto	NaOH
Temperature Units	°C	°C
TC	In	N/A
TC Base	25°C	N/A
TC Slope	2%/°C	N/A
TC Mode	Automatic	Automatic
Manual Temperature Input	+25.0°C	+25.0°C
Set Points 1&2		
SP1 Source	Sensor	Sensor
SP1 Range	99.99 mS/cm	N/A
SP1 Trigger	Low	Low
SP1 Level (Band High)	10.00 mS/cm	3%
SP1 Band Low	1.000 mS/cm	1%
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 Band (% of range)	20.0%	20.0%
SP2 Source	Sensor	Sensor
SP2 Range	99.99 mS/cm	N/A
SP2 Trigger	High	High
SP2 Level (Band High)	10.00 mS/cm	5%
SP2 Band Low	1.00 mS/cm	3%
SP2 Mode	On/Off	On/Off
SP2 Dose Alarm	No	No
SP2 Alarm Time (mm:ss)	05:00	05:00
SP2 Hysteresis (% of SP Level)	1.0%	1.0%
SP2 Cycle Time (mm:ss)	00:30	00:30
SP2 Proportional Band (% of range)	20.0%	20.0%

Current Output(s)		
Input A	Sensor	Sensor
Output A	4-20 mA	4-20 mA
Output A Range	99.99 mS/cm	% NaOH
Output A Zero	0.0 mS/cm	0.0%
Output A Span	10.00 mS/cm	5.0%
Input B	Sensor	Temperature
Output B	4-20 mA	4-20 mA
Output B Range	99.99 mS/cm	N/A
Output B Zero	0.0 mS/cm	0°C
Output B Span	10.00 mS/cm	100°C
On error	No	No
Calibration		
Mode	On-Line	On-Line
Calibration Access	No	No
Configuration		
Language	English	English
Sensor	Pt1000	Pt1000
Errors	Enabled	Enabled
IP Filter	Out	Out

16 Appendix B – Customer Setup

Use this appendix to record unit settings.

Instrument Serial No ....

Sensor Serial/Type No ....

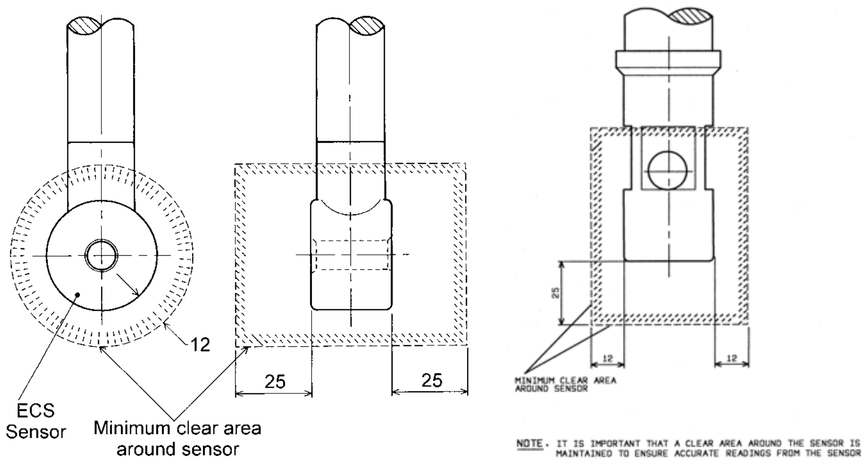
Parameters	Settings
Units	
Sensor Type	
Range	
Temperature Units	
TC	
TC Slope	
TC Mode	
Manual Temperature Input	
Set Points	
SP1 Source	
SP1 Range	
SP1 Trigger	
SP1 Level (Band High)	
SP1 Band Low	
SP1 Mode	
SP1 Dose Alarm	
SP1 Alarm Time (mm:ss)	
SP1 Delay (mm:ss)	
SP1 Hysteresis (% of SP Level)	
SP1 Cycle Time (mm:ss)	
SP1 Proportional Band (% of range)	
SP2 Source	
SP2 Range	
SP2 Trigger	
SP2 Level (Band High)	

SP2 Band Low	
SP2 Mode	
SP2 Dose Alarm	
SP2 Alarm Time (mm:ss)	
SP2 Hysteresis (% of SP Level)	
SP2 Cycle Time (mm:ss)	
SP2 Proportional Band (% of range)	
Current Output(s)	
Input A	
Output A	
Output A Range	
Output A Zero	
Output A Span	
Input B	
Output B	
Output B Range	
Output B Zero	
Output B Span	
Calibration	
Mode	
Calibration Access	
Configuration	
Language	
Sensor	
Errors	
IP Filter	

17 Appendix C Calibration

Normal good practices should be observed when calibrating an electrodeless conductivity system.

- Two calibration procedures are provided with the HET63.
- An initial installation calibration, that matches the sensor, cable and instrument, using a loop resistor. This only needs to be performed when the system is commissioned and when a sensor or cable is changed.
- A solution calibration that will allow the user to fine tune the calibration.
- Always clean the sensor, before making adjustments.
- The HET63 can be taken offline, which de-energises the relays and holds the current output at the last value. This facility is useful when calibrating the system, however the operator must ensure the relays are in a safe state when using this feature.
- Temperature has a large effect on conductivity measurements, it is essential that an understanding of the relationship between conductivity and temperature, for the application being measured, is understood when calibrations are made.
- The electrodeless sensor will need a minimum clearance around it when installed or making measurements in a sample. Do not rest it on the bottom of a tank or vessel. See Figure 8 for details.



ECS20 Series

ECS40 Series

Figure 8 Sensors

17.1 Calibration with Standard Solutions

This calibration must be carried out under strictly controlled conditions due to the temperature effect on conductivity measurements and the possibility of contamination of the standard solution. The advantage of this calibration method is that the sensor and cable are an integral part of the calibration. LTH strongly recommends a lower limit of 500µS/cm for this type of calibration. Conductivity is a very sensitive measurement and even trace contamination of the standard solution will be detected.

Most standards are made up from a solution of KCl dissolved in high purity water. BS 6438 provides details of the concentrations of KCl necessary to produce industry standard conductivity solutions. Ready made solutions are available from LTH with traceable certification if required.

Stadard solutions will be supplied with a conductivity value quoted at a reference temperature. This temperature is the base temperature and the calibration should be performed at that temperature, with the temperature compensation switched out. Alternatively, the temperature compensation should be switched on and a temperature slope and base temperature equal to that of the calibration solution can be used to configure the instrument. For example this would be 1.76%/°C for a KCl solution between 1000 to 10,000µS/cm. For more details on calculating the slope of a different solution, refer to *Appendix D Solution Conversion*.

17.2 Calibration by Comparison with Another Instrument

This can provide the easiest method for in-situ calibrations but does have the disadvantage of only being able to check a single measurement point. As measurements are made by comparison of the readings taken in the same solution, temperature effects are less critical. However, it is essential that settings for temperature compensation are the same on both instruments.

18 Appendix D Solution Conversion

The following table provides some of the data points which have been used in the HET63 to make the conversion between conductivity and solution concentration

Temperature Compensated Conductivity (mS/cm @ 25°C)							
% wt / vol	**NaOH**	**NaCl**	**HCl**	**H_2SO_4**	**H_3PO_4**	**HNO_3**	**Salinity**
1	53.2	17.6	103.0	48.5	11.25	60.0	20.0
5	223.0	78.3	432.0	237.0	32.9	275.0	90.0
10	358.0	140.0	709.0	427.0	61.1	498.0	170.0
20	414.0	226.0	--------	709.0	117.0	763.0	320.0

Note: Salinity range is displayed by the HET63 in parts per thousand concentration (p.p.t.), which is the concentration in % shown above, multiplied by 100.

Temperature Compensation Slope (% / ° C)							
% / °C	**NaOH**	**NaCl**	**HCl**	**H_2SO_4**	**H_3PO_4**	**HNO_3**	**Salinity**
----------	1.79	1.90	1.27	1.03	0.86	1.19	1.92

19 Appendix E Temperature Coefficient

19.1 Calculating the temperature coefficient of a solution

If the temperature coefficient of the solution being monitored is not known, the HET63 can be used to determine that coefficient. You should set the HET63 to a suitable range and the temperature coefficient to 0.0% or ***T.C.OUT***

The following measurements should be made as near to the normal operating point as practical, between 5°C and 70°C for the highest accuracy. Immerse the measuring cell in at least 500 ml of the solution to be evaluated, allow sufficient time to stabilise, approximately one or two minutes, and then record both the temperature and conductivity readings. Raise the solution temperature by at least 10°C and again record the temperature and conductivity readings. Using the following equation, the temperature compensation slope can be calculated in percentage terms:

$$\alpha = \frac{(Gx-Gy) \times 100\%}{Gy(Tx-25) - Gx(Ty-25)} \qquad \text{(base temperature 25°C)}$$

Note: If the base temperature is set to 20°C, then replace 25 with 20 in the above equation.

Term	Description
Gx	Conductivity in µS/cm at temperature Tx
Gy	Conductivity in µS/cm at temperature Ty

Note: One of these measurements can be made at ambient temperature.

Set the temperature compensation slope to the calculated value. The temperature compensation is now set up for normal operation.

If it is difficult or impossible to evaluate the temperature compensation slope using this method, a 2.0 % / °C setting will generally give a good first approximation until the true value can be determined by independent means.

20 Appendix F – Temperature 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**
0	1000.0Ω
10	1039.0Ω
20	1077.9Ω
25	1097.3Ω
30	1116.7Ω
40	1155.4Ω
50	1194.0Ω
60	1232.4Ω
70	1270.7Ω
80	1308.9Ω
90	1347.0Ω
100	1385.0Ω

21 Appendix G – 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

Calibration Errors

E11	**Snsr Cal Err** Sensor calibration is out of specification.
E12	Not used.
E13	**Min Temp Cal** Temperature Zero calibration is out of specification.
E14	**Max Temp Cal** Temperature Span calibration is out of specification.
E15-18	Not used.

Set Point Errors

E21	SP1 Dose Alarm
E22	SP2 Dose Alarm

Sensor Input Errors

E31	**Sensor OR Error** Sensor input is over specified range.
E32	Not used.
E33	Not used
E34	Not used
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
E37	**Temperature Input Under-range** Temperature input in less than -50.0°C Temperature
E38	**Compensation Outside Limits** The temperature reading is less than 0.0°C or greater than 100.0°C, leading to an error in compensation.

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 3.3.5 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 insfficient supply voltage for the load (see *Section 3.3.5 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**

Index

Sensor & temperature	ACCESS CODE	PARAMETERS	SET POINTS 1 & 2	[1] CURRENT OUTPUT	CALIBRATION	SAVE / RESTORE	CONFIGURATION
⇧ ⇩	⇧ ⇩	⇧ ⇩	⇧ ⇩	⇧ ⇩	⇧ ⇩	⇧ ⇩	⇧ ⇩
Sensor & current O/P A	Edit Level 1 access code	Display units	SP1 source	O/P A source	Online / offline	Save as Setup A	[2] Language
⇧ ⇩	⇧ ⇩	⇧ ⇩	⇧ ⇩	⇧ ⇩	⇧ ⇩	⇧ ⇩	⇧ ⇩
Sensor & current O/P B	Edit Level 2 access code	Sensor type	SP1 range	O/P A mode (0/4-20 mA)	Calibration access enable	Save as Setup B	Temperature sensor
⇧ ⇩	⇧ ⇩	⇧ ⇩	⇧ ⇩	⇧ ⇩	⇧ ⇩	⇧ ⇩	⇧ ⇩
Sensor & set point 1 *		Range	SP1 trigger	O/P A range	Sensor Calibration	Restore Setup A	Error messages
⇧ ⇩		⇧ ⇩	⇧ ⇩	⇧ ⇩	⇧ ⇩	⇧ ⇩	⇧ ⇩
Sensor & set point 2		Temperature units	SP1 level (band high)	O/P A zero	Solution calibration	Restore Setup B	Input filter
⇧ ⇩		⇧ ⇩	⇧ ⇩	⇧ ⇩	⇧ ⇩	⇧ ⇩	⇧ ⇩
Solution calibration		Temperature compensation	SP1 band low	O/P A span	Cell constant adjust	Restore default conductivity	Bargraph on/off
⇧ ⇩		⇧ ⇩	⇧ ⇩	⇧ ⇩	⇧ ⇩	⇧ ⇩	⇧ ⇩
Solution conductivity		TC base	SP1 mode	O/P B source	Custom solution input	Restore default concentration	Software issue
⇧ ⇩		⇧ ⇩	⇧ ⇩	⇧ ⇩	⇧ ⇩	⇧ ⇩	⇧ ⇩
		TC slope	SP1 dose alarm	O/P B mode (0/4-20 mA)	Temperature calibration		
		⇧ ⇩	⇧ ⇩	⇧ ⇩	⇧ ⇩		
OR		TC mode	SP1 delay	O/P B range	Current output calibration		
		⇧ ⇩	⇧ ⇩	⇧ ⇩	⇧ ⇩		
Bargraph		Manual temperature	SP1 hysteresis	O/P B zero	Reset user calibration		
		⇧ ⇩	⇧ ⇩	⇧ ⇩	⇧ ⇩		
		Sim Current OutA	SP1 cycle time	O/P B span			
		⇧ ⇩	⇧ ⇩	⇧ ⇩			
		Sim Current OutB	SP1 proportion band	Source error			
		⇧ ⇩	⇧ ⇩	⇧ ⇩			
			SP2 source				
			⇧ ⇩				
			Etc, as SP1				

Key:

- Universal access
- Level 1 access
- Level 2 access

Notes :

1. The Current Output menu will only appear when the unit is configured for Current Outputs.
2. The Language option is not available on some (Englilsh-only) units.
3 Depending on unit settings, some menu items may not appear.
(See the appropriate sections in the main text.)

HET63

KLAY-INSTRUMENTS B.V.

Nijverheidsweg 5
Postbus 13
Tel. 0521-591550
Fax 0521-592046

7991 CZ DWINGELOO
7990 AA DWINGELOO
Nederland
E-mail: info@klay.nl