

## USM Water Quality Meter INSTRUCTION MANUAL



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# 1. SPECIFICATION.

Specifications	Universal Smart Meter – Level Meter
Inputs	pH/ISE probe. ModBus probe.
Temperature Range	-5 - 50 °C
Display	Graphic LCD 124x64 dots Negative Blue
Relays	3 SPDT, 5A
Current Output	4 – 20 mA galvanic isolated
Mains Supply	100 – 240 VAC 50/60Hz. Switched-mode power supply.
DC Supply	12V or 24V
Power Consumption	5VA
Weight	450 grams, Wall Mount Version
Enclosure Dimensions	160 mm x 130 mm x 60 mm
Mounting Dimensions (including cable glands, etc.)	185 mm x 155 mm x 60 mm

*Table 1-1 Device Specification*

## 2. GENERAL INFORMATION.

The information contained in this manual has been carefully checked and is believed to be accurate. However, Smart Storm assumes no responsibility for any inaccuracies that may be contained in this manual. In no event will the Smart Storm be liable for direct, indirect, special, incidental, or consequential damages resulting from any defect or omission in this manual, even if advised of the possibility of such damages. In the interest of continued product development, Smart Storm reserves the right to make improvements in this manual and the products it describes at any time, without notice or obligation. Revised editions may be found on the Smart Storm's web site [www.smartstormgroup.com](http://www.smartstormgroup.com).

### 2.1. Safety information

Please read this entire manual before unpacking, setting up or operating this equipment. Pay attention to all danger, warning and caution statements. Failure to do so could result in serious injury to the operator or damage to the equipment. Make sure that the protection provided by this equipment is not impaired, do not use or install this equipment in any manner other than that specified in this manual.



**DANGER**






Smart Storm products are designed for outdoor use are provided with a high level of ingress protection against liquids and dust (see specification for rating). If these products are connected to a mains electricity socket by means of a cable and plug rather than by fixed wiring, the level of ingress protection of the plug and socket connection against liquids and dust is considerably lower. It is the responsibility of the operator to protect the plug and socket connection in such a manner that the connection has an adequate level of ingress protection against liquids and dust and complies with the local safety regulations. When the instrument is used outdoors, it should be connected only to a suitable socket with at least IP44 rating (protection against water sprayed from all directions).

## 2.2. Use of hazard information

<b>DANGER</b>
Indicates a potentially or imminently hazardous situation which, if not avoided, could result in death or serious injury.
<b>WARNING</b>
Indicates a potentially or imminently hazardous situation which, if not avoided, could result in death or serious injury.
<b>CAUTION</b>
Indicates a potentially hazardous situation that may result in minor or moderate injury.
<b>NOTICE</b>
Indicates a situation that, if not avoided, could result in damage to the instrument. It also indicates information that requires special notice.

## 2.3. Precautionary labels

Read all labels and tags attached to the instrument. Personal injury or damage to the instrument could occur if not fully observed.

	This symbol, if noted on the instrument, references the instruction manual for operation and/or safety information.
	This symbol, when noted on a product enclosure or barrier, indicates that a risk of electrical shock and/or electrocution exists
	This symbol, if noted on the product, indicates the need for protective eye wear.
	This symbol, when noted on the product, identifies the location of the connection for Protective Earth (ground).
	This symbol, when noted on the product, identifies the location of a fuse or current limiting device.



## 2.4. Wiring and Handling Precautions

### DANGER

Electrocution Hazard. Always disconnect mains supply before removing covers and connecting any external wiring.  
Only qualified Electricians should install this product. IET BS7671:2008 wiring regulations must be adhered to when installing the product.

### NOTICE

Delicate internal electronic components can be damaged by static electricity, resulting in indeterminate instrument performance or eventual failure. Smart Storm recommends taking the following steps to prevent ESD damage to your instrument:

Before touching any instrument electronic components (such as printed circuit cards and the components on them) discharge static electricity from your body. The user can accomplish this by touching an earth - grounded metal surface for 3 seconds such as the chassis of an instrument, or a metal conduit or pipe.

To reduce static build-up, avoid excessive movement. Transport static-sensitive components in anti-static containers or packaging.

To discharge static electricity from your body and keep it discharged, wear a wrist strap connected by a wire to earth ground, especially when handling circuit boards. Handle all static - sensitive components in a static - safe area. If possible, use anti-static floor pads and work bench pads.

### DANGER

Electrocution hazard. Always install a ground fault interrupt circuit (GFIC)/ residual current circuit breaker (RCCB) with a maximum trigger current of 30 mA. If installed outside, provide overvoltage protection through a MCB rated not greater than 5 Amps.

### DANGER

With fixed wiring, a disconnecting device (local interruption) must be integrated into the power supply line. The disconnecting device must meet BS7671:2008 standards and regulations. It must be installed near the device, be able to be reached easily by the operator and labelled as a disconnecting device.  
If the connection is established using a mains connection cable that is permanently connected to the power supply, the plug of the mains connection cable can serve as local interruption.

### DANGER

Ensure the relays are not subjected to loads great than 5 Amps as this will cause internal damage and possible product destruction.

### 3. ABOUT THE USM pH/ISE METER.

The instrument is designed to read a range of environmental measurements associated with the wastewater industry with an optional on-board data logger for recording and downloading to the Smart Storm Inquisitor data viewing platform.

Three relays (with LED indication) and two 4-20mA outputs are provided to control ancillary equipment and the meter can be interrogated remotely using Modbus RTU (RS485) communication.

#### 3.1. USM PROBES.

The USM can be used with one ISE probe **AND** one digital probe from the following lists.

##### 3.1.1. ISE Probes.

The following ISE probes can be used with the USM:

- pH
- Redox
- Ammonia
- Ammonium
- Calcium
- Chloride
- Fluoride
- Nitrate
- Potassium



### 3.1.2. Digital Probes.

The following Digital probes can be used with the USM:

- pH/Redox



- Turbidity



- Dissolved Oxygen



- Conductivity C4E



- Conductivity CTZ



- TSS



### **3.2. USM CONNECTIONS.**

The connection terminals are accessible by removing the cover of the USM. All connections should be made through appropriate cable glands to maintain the IP rating of the unit.

The unit is factory built to either 100 – 240 Vac input (CONN2) or DC input (CONN3).

CONN4 provides access to three configurable relays with Common (COM), Normally Open (NO) and Normally Closed (NC) connections available.

CONN5 provides two isolated 4-20mA outputs.

CONN6 - top row provides the RS485 connections for remote access to the USM measurements (Building Management System BMS).

CONN6 - bottom row provides the RS485 connections for the connection of a digital probe. The power connections for the probes are also available.

CONN7 – provides the connection for the ISE probe including a PT100 temperature input and a connection for grounded probes.

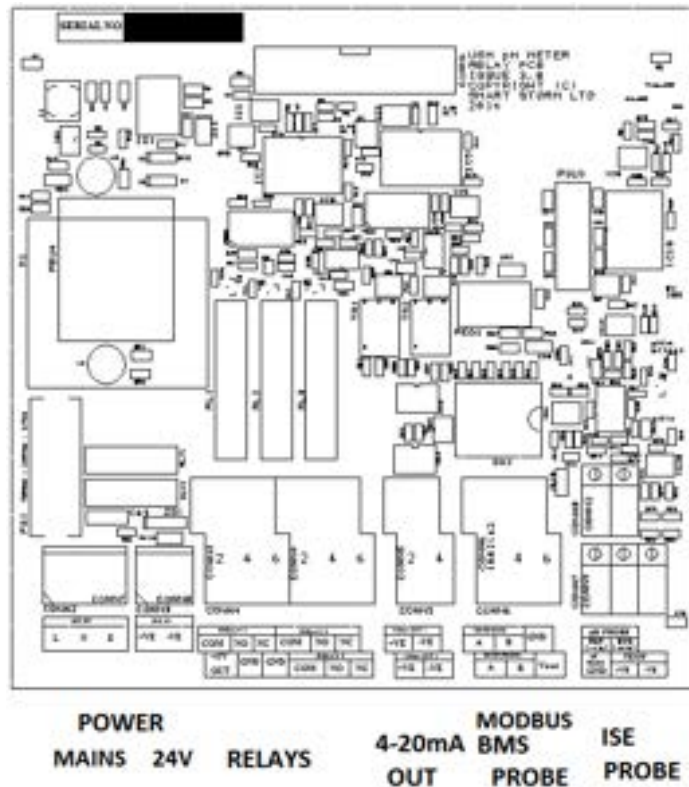


Figure 3-1 Relay Board Connections

### 3.3. TURN ON.

When the unit is turned on a splash screen (Figure 1) will be shown detailing the contact details of Smart Storm. This will remain on for a few seconds while the USM measurements stabilise.




Figure 3-2 Smart Storm Screen

This will be followed automatically by the Home Screen (Figure 2).

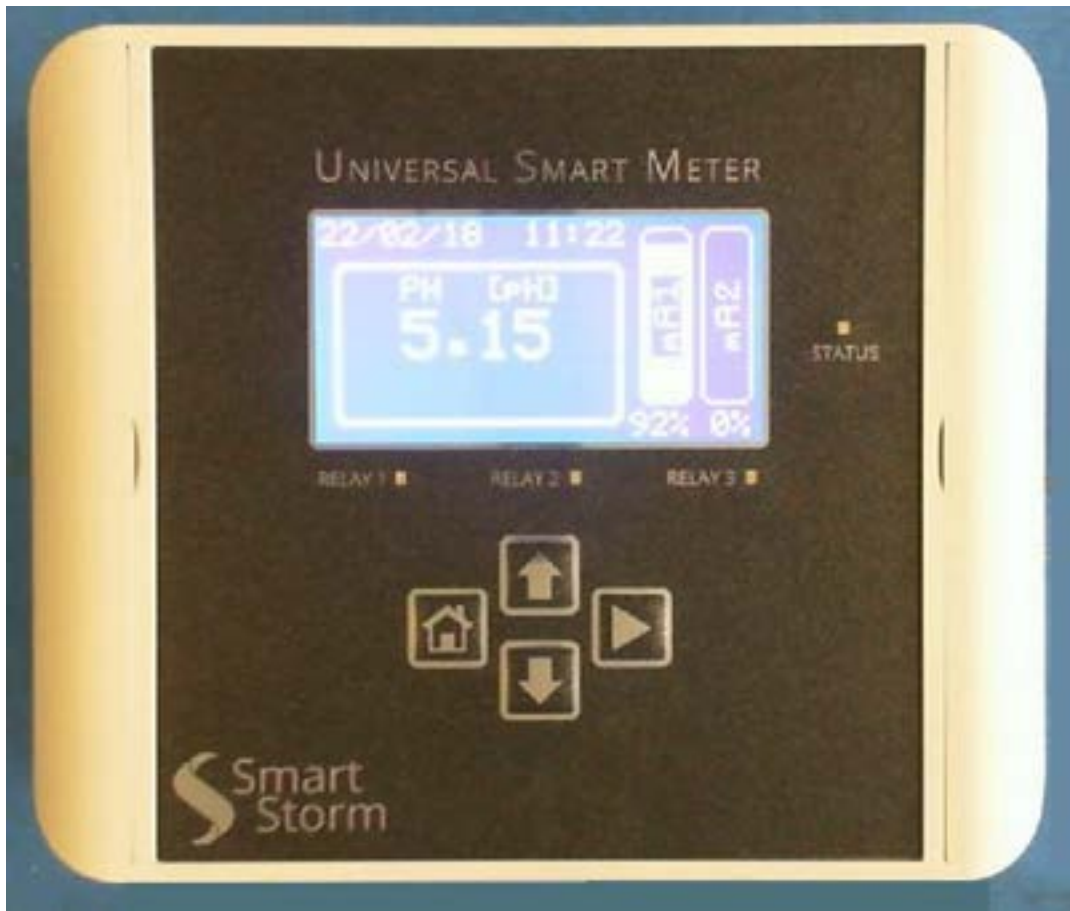


*Figure 3-3 Home Screen*

The Home Screen shows the selected Main Display Parameter (in the selected units) with a bar graph and percentage indicating either the Level or Distance. When the unit is first turned on the display will be inaccurate as flow device parameters will not have been set. Further display options are outlined in Section 5. The red LED at the side of the display will flash at a rate of 2Hz. This indicates data is being received.





Pressing the Home Button  will return the Display to the Home Screen from all other display screens.

## 4. CONFIGURING THE USM.



*Figure 4-1 USM*

The USM is configured using the four push buttons.

Button	Action
	Scroll Right or Enter
	Scroll up, Increment Numbers
	Scroll down, Decrement Numbers
	Return to previous menu level or to Home Screen and Abort

*Table 4-1 Key Functionality*





#### 4.1. CONFIGURATION MENU ACCESS.

The unit is configured through the MENU page which is password protected.

From the Home Screen, press  button to access the PASSWORD page.



*Figure 4-2 Password Screen.*

Use  and  buttons to select the desired digit at each location and press  button to select the next digit. If a digit is entered incorrectly press  to return to the Home Screen.

The factory set password to access the configuration menu is '0000'. This can be changed.

If an incorrect password is entered 3 times the USM will lock the menu for 5 minutes.

If PASSWORD is correct, access to The Configuration MENU page is granted.







*Figure 4-3 Configuration Menu Screen*



## 4.2. CONFIGURATION MENU.

There are 13 sub menus to the Configuration menu:

1. ANALOGUE PROBE SET UP
2. DIGITAL PROBE SET UP
3. TEMPERATURE SET UP
4. MBUS BMS SET UP
5. 420mA SET UP
6. 420mA TEST
7. RELAY SET UP
8. RELAY TEST
9. NEW USER PASSWORD
10. SET DATE AND TIME
11. SCREEN SAVE MODE
12. LOGGER INTERVAL
13. ENGINEERING MENU


Use  and  buttons to align the cursor with required sub menu and press  button to select. The key  will return the USM to the Home Screen.

The ENGINEERING menu contains settings which should only be changed by Smart Storm and requires an additional password.

**N.B. When the Configuration Menu is entered, the status of the relays and the 4-20mA output are not updated.**




**if no key is pressed for 2 minutes the USM will exit the Configuration Menu and return to the Home Screen without saving any changes.**

### 4.3. ANALOGUE PROBE SET UP.


Select ANALOG PROBE on the MENU page and press  button. The following screen will be accessed.



*Figure 4-4 Probe Type Screen*

Use the  and  buttons to select the probe type and press  to confirm the selection.




#### 4.3.1. pH Calibration.

Select pH and press  button to confirm the selection. For the probe to correctly measure the pH it must first be calibrated.



*Figure 4-5 pH Calibration Buffer 1*

The USM uses two-point calibration for pH. Fresh buffer solutions should be used to calibrate the probe and discarded after use.

Use the  and  buttons to enter the pH value of the first buffer solution and press  to confirm. In the above example a buffer solution of pH 4 is being used.

Ensure the probe is clean and dry and place it in the first buffer solution, ensuring the bulb of the probe is completely submerged.




*Figure 4-6 pH Calibration Buffer 1 Sampling*

The USM will display the mV reading being measured and the corresponding pH value using the last calibration parameters.

After a few seconds the reading will stabilize, and the screen will change






*Figure 4-7 pH Calibration Buffer 1 Stable.*

Press  to accept the reading. The second point can now be calibrated.




*Figure 4-8 pH Calibration Buffer 2.*

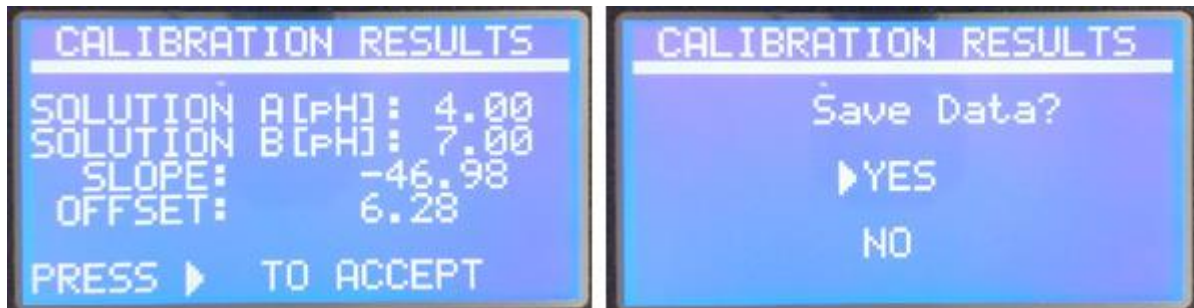
Use the  and  buttons to enter the pH value of the second buffer solution and press  to confirm. In the above example a buffer solution of pH 7 is being used.

Ensure the probe is clean and dry and place it in the second buffer solution, ensuring the bulb of the probe is completely submerged.





*Figure 4-9 pH Calibration Buffer 2 Stable*

Wait for the reading to stabilize and press  to confirm. The USM will display the results of the calibration.



*Figure 4-10 pH Calibration Results.*

Press  to accept the values and confirm the data is to be saved. If the Home key  is pressed at any stage before the Save Data is confirmed, the USM will quit the calibration and restore the previous calibration results.

An ideal pH probe will have an offset (the mV reading in pH 7) of 0mV and a slope of -59.16 mV/pH @ 25°C. pH probes are not ideal and will deteriorate over time and will eventually require replacing.

The USM has limits beyond which it will reject the calibration as invalid as the readings could not be trusted. The following screen will appear.



*Figure 4-11 pH Calibration Results Out of Range*

The USM assesses the validity of a calibration using the absolute mV readings recorded and it is not dependent on any previous calibration of the instrument.

Before replacing the probe check that:


- The Calibration has been performed correctly – at least one more attempt at calibration should be made.
- Ensure that the probe is clean and dry before placing in the buffer solutions.
- Ensure the buffer solution and clean and have been made correctly.

### 4.3.2.Redox Calibration

The redox uses a single point calibration (using 0mV to determine the slope).



Figure 4-12 Redox Calibration.

Select REDOX as the probe type and press  to confirm the selection.

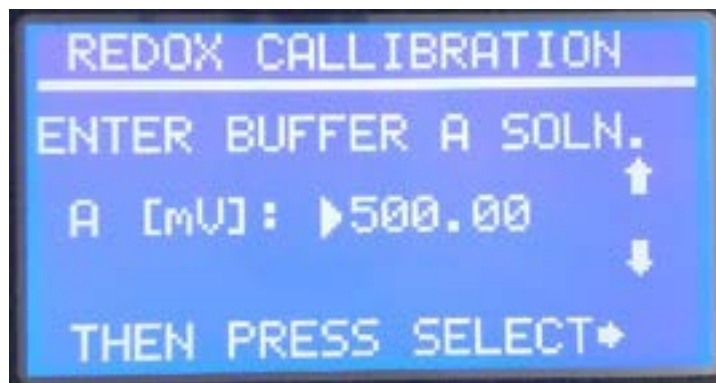



Figure 4-13 Redox Buffer Solution.

Enter the value of the Redox buffer solution in mV and press  to confirm the selection.

Ensure the probe is clean and dry and place it in the buffer solution, ensuring the bulb of the probe is completely submersed.

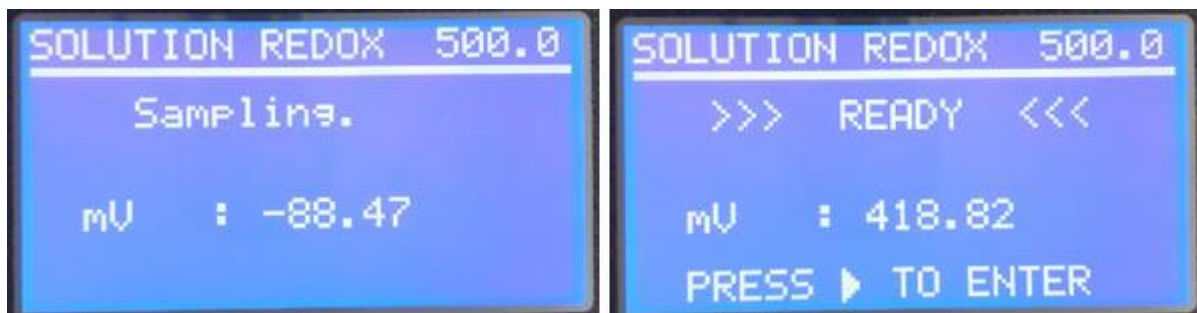
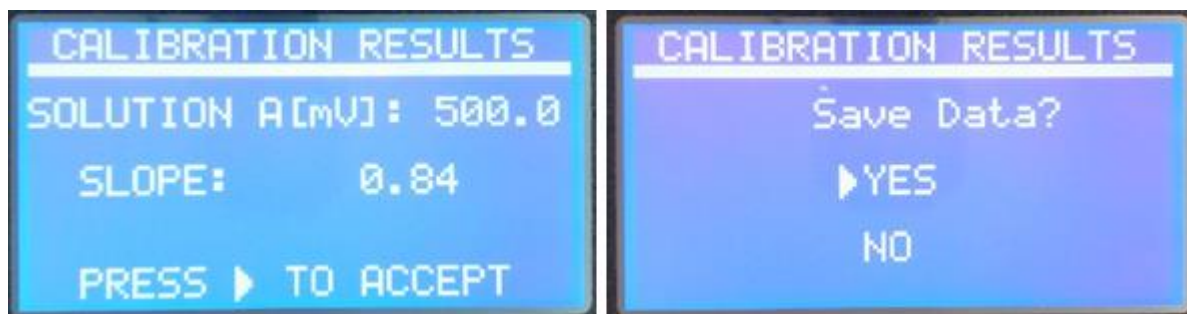


Figure 4-14 Redox Sampling.



The USM will display the mV reading being measured. After a few seconds the reading will stabilize, and the screen will change to display READY.

Press **▶** to accept the value. The USM will display the results of the calibration. A perfect calibration would return a slope of 1.00.



*Figure 4-15 Redox Calibration Results.*

Press **▶** to accept the values and confirm the data is to be saved. If the Home key **■** is pressed at any stage before the Save Data is confirmed, the USM will quit the calibration and restore the previous calibration results.

### **4.3.3. Calibration of Other ISE Probes.**

The remaining ISE probes ([see 3.1.1](#)) use a two-point calibration method using decade buffers (i.e. 10ppm, 100ppm, 1000ppm etc.).

Select two buffer solutions which fall within the probe limits shown in [APPENDIX A](#).






*Figure 4-16 Select ISE Probe*

From the CALIBRATE PROBES screen use the **↑** and **↓** buttons to select the probe type and press **▶** to confirm the selection.



Figure 4-17 Select Buffer A.

Use the  and  buttons to select the Decade Buffer Solution A and press  to confirm the selection. In this example an Ammonium Probe is being calibrated so the Buffer Solutions can be 1, 10, 100 or 1000ppm.

Ensure the probe is clean and dry and place it in the first buffer solution, ensuring the bulb of the probe is completely submersed.

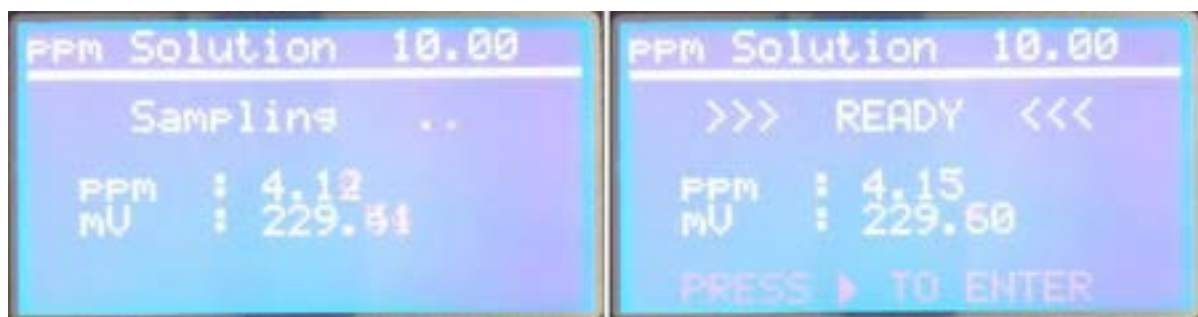


Figure 4-18 ISE Sampling of Buffer A.

The USM will display the mV reading being measured for solution A and the corresponding ppm value using the last calibration parameters.





After a few seconds the reading will stabilize, and sampling will change to ready. Ensure the value is stable and press  to save the reading.



Figure 4-19 Select Buffer B.

Use the  and  buttons to select the Decade Buffer Solution B and press  to confirm the selection.



Ensure the probe is clean and dry and place it in the first buffer solution, ensuring the bulb of the probe is completely submerged.



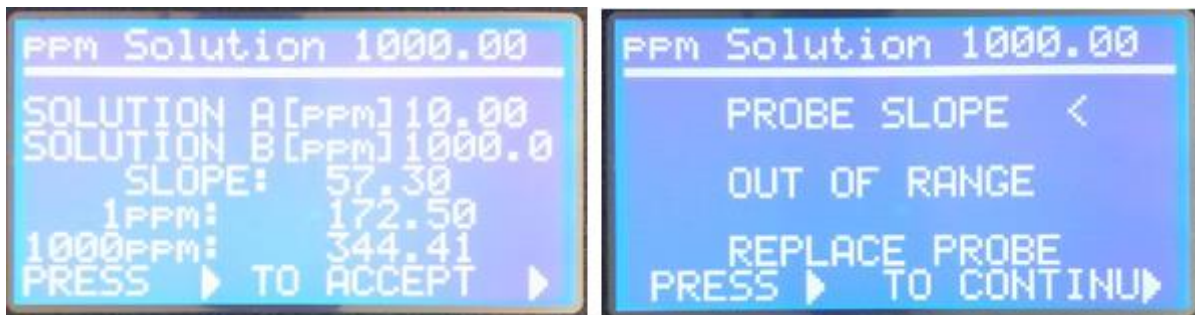
*Figure 4-20 ISE Sampling of Buffer B.*

The USM will display the mV reading being measured for solution B and the corresponding ppm value using the last calibration parameters.

After a few seconds the reading will stabilize, and sampling will change to ready. Ensure the value is stable and press **►** to save the reading.

If the slope is within an acceptable range the USM will display the calibration information for from the two buffer solutions.

The slope and nominal values for the different ISE probes are detailed in [APPENDIX A](#). If the slope is out of range an error message will appear.






*Figure 4-21 Calibration Information.*

If the readings are correct press **►** to proceed to the save data screen.




Use the **↑** and **↓** buttons to select YES and press **►** to confirm the selection.

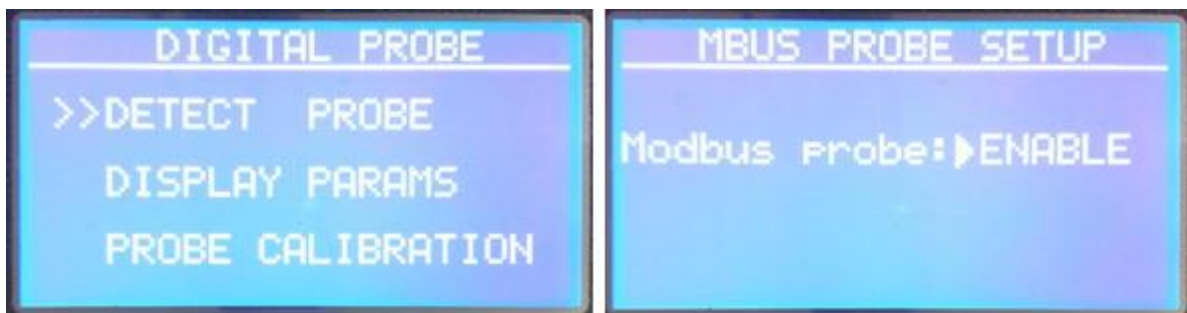
The ISE probe is now calibrated.

## 4.4. DIGITAL PROBE SET UP.




Use the  and  buttons to select the DIGITAL PROBE and press  to confirm the selection.

### 4.4.1. Detect Probe.

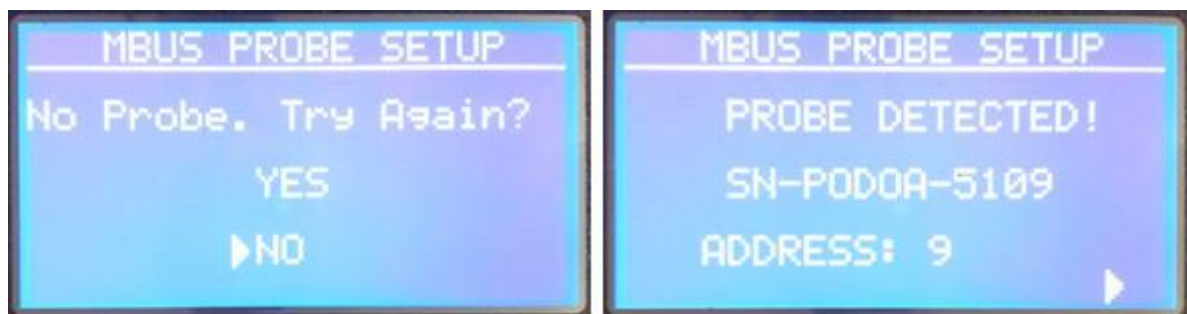
Before the probe can be configured or calibrated it must first be detected. Use the  and  buttons to select the DETECT PROBE and press  to confirm the selection.



*Figure 4-22 Digital Probe Detect.*


Use the  or  buttons to toggle the selection to ENABLE and press  to confirm the selection (this screen can be used to DISABLE a digital probe).

The USM will scan the range of Modbus addresses to try to detect the probe. After a few seconds the result of the scan will appear.



*Figure 4-23 Digital Probe Scan Result.*

If no probe is detected check the wiring is correct and re-scan for the probe. If the probe is detected the serial number and address of the probe will be displayed. The displayed Parameters will be set to first two measurements returned from the probe – these can be changed in DISPLAY PARAMS.

Press  to return to the Digital Probe menu.




#### 4.4.2. Display Parameters.

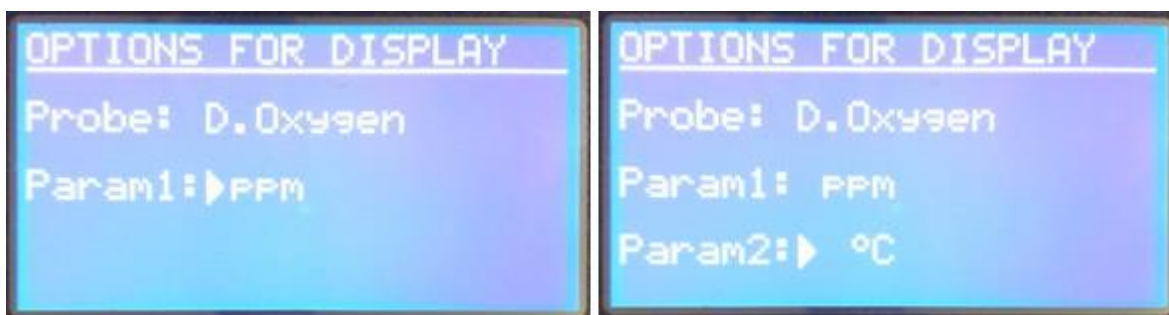
The main Digital Probe Display Screen shows two of up to four parameters measured by the probe in large font.

The default settings after a probe is detected are the first two registers of the probe.




Probe	Param 1	Param 2	Param 3	Param 4
pH/Redox	Temperature (°C)	pH	Redox (mV)	
Turbidity	Temperature (°C)	Turbidity NTU	Turbidity FNU	Turbidity mg/L
DO	Temperature (°C)	Oxygen (% sat)	Oxygen (mg/L)	Oxygen (ppm)
Conductivity C4E	Temperature (°C)	Conductivity uS/cm	Salinity ppt	TDS-Kcl ppm
Conductivity CTZ	Temperature (°C)	Conductivity CTZ with temp. comp. mS/cm	Salinity g/Kg	Conductivity CTZ no temp. comp. mS/cm




*Table 4-2 Digital Probe Parameters.*

To change the displayed parameters. from the Digital Probe Menu, use the  or  buttons to move the cursor to DISPLAY PARAMS and press  to confirm the selection.



*Figure 4-24 Display Digital Probe Parameters.*

The cursor will point at the Param1 value. Use the  or  buttons to step through the available measurements and press  to confirm the selection.

The cursor will point at the Param2 value. Use the  or  buttons to step through the available measurements and press  to confirm the selection.

Confirm the settings are to be saved before returning to the Digital Probe Menu.




### 4.4.3. Digital Probe Calibration.

#### 4.4.3.1. pH/Redox.

#### 4.4.3.2. Turbidity.

#### 4.4.3.3. Dissolved Oxygen.

### 4.4.4. Conductivity C4E.

Use the  and  buttons to select the DIGITAL PROBE and press  to confirm the selection.

Probe connection diagram for Conductivity:

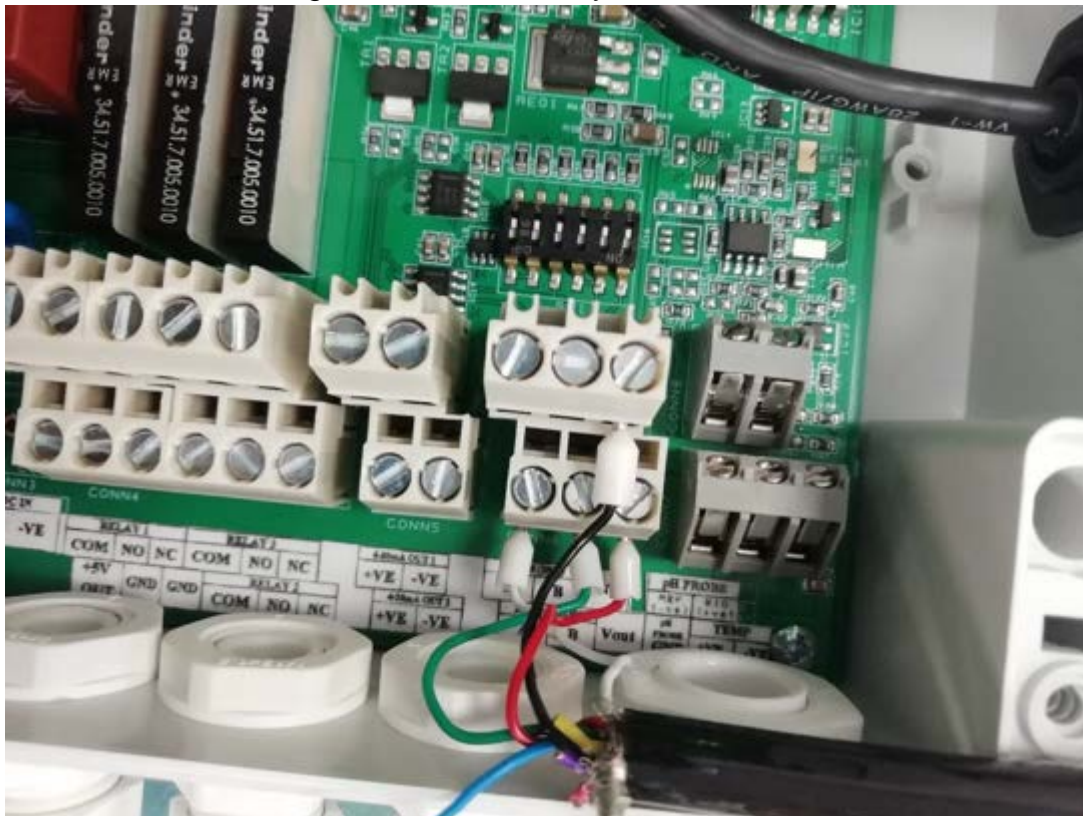



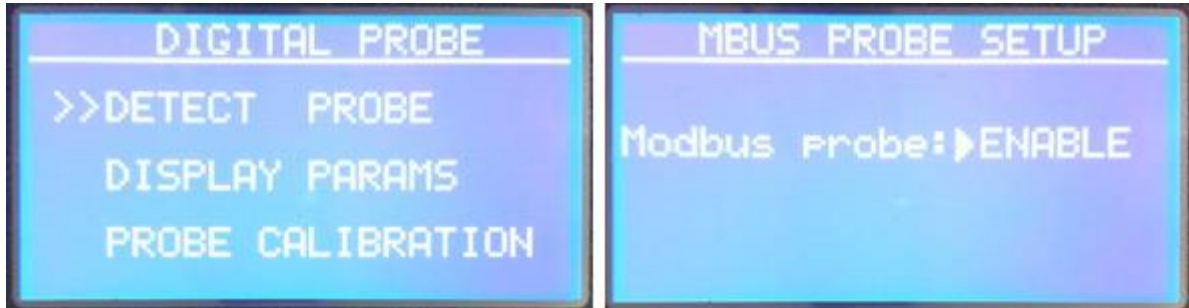


Figure 4-25 Conductivity wiring diagram






## 4.5. Probe Detection:

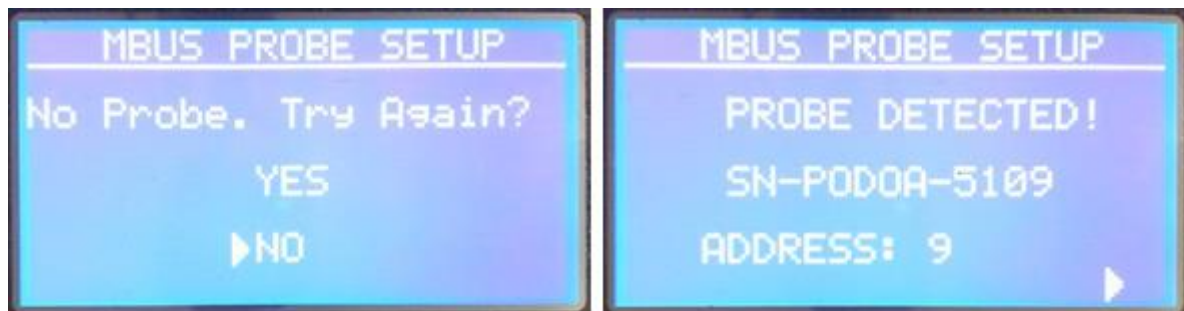
Before the probe can be configured or calibrated it must first be detected. Use the  and  buttons to select the DETECT PROBE and press  to confirm the selection.



*Figure 4-26 Digital Probe Detect.*


Use the  or  buttons to toggle the selection ENABLE and press  to confirm the selection (this screen can be used to DISABLE a digital probe).

The USM will scan the range of Modbus addresses to try to detect the probe. After a few seconds the result of the scan will appear.



*Figure 4-27 Digital Probe Scan Result.*

If no probe is detected check the wiring is correct and re-scan for the probe. If the probe is detected the serial number and address of the probe will be displayed. The displayed Parameters will be set to first two measurements returned from the probe – these can be changed in DISPLAY PARAMS.

Press  to return to the Digital Probe menu.




### 4.5.1. Display Parameters.

The main Digital Probe Display Screen shows two of up to four parameters measured by the probe in large font.

The default settings after a probe is detected are the first two registers of the probe.

Probe	Param 1	Param 2	Param 3	Param 4
pH/Redox	Temperature (°C)	pH	Redox (mV)	
Turbidity	Temperature (°C)	Turbidity NTU	Turbidity FNU	Turbidity mg/L
DO	Temperature (°C)	Oxygen (% sat)	Oxygen (mg/L)	Oxygen (ppm)
Conductivity C4E	Temperature (°C)	Conductivity uS/cm	Salinity ppt	TDS-Kcl ppm
Conductivity CTZ	Temperature (°C)	Conductivity CTZ with temp. comp. mS/cm	Salinity g/Kg	Conductivity CTZ no temp. comp. mS/cm

Table 4-3 Digital Probe Parameters.

To change the displayed parameters from the Digital Probe Menu, use the  or  buttons to move the cursor to DISPLAY PARAMS and press  to confirm the selection. (*Please refer to table 4-3 above for measuring units as it differs from probe to probe*)

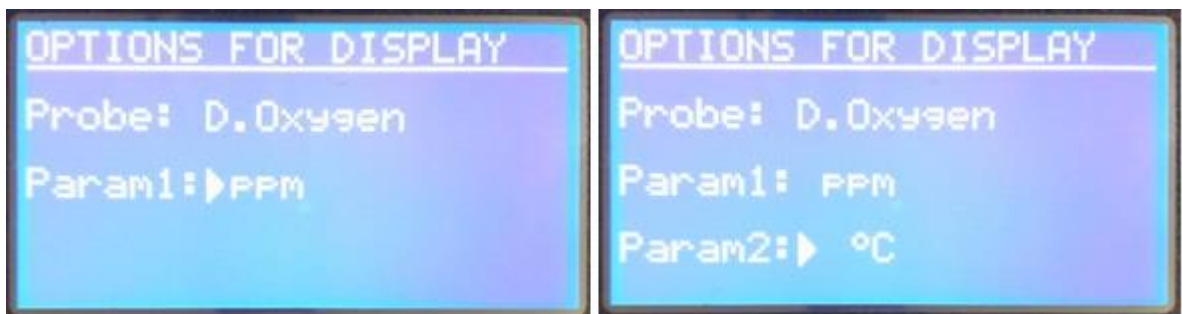








Figure 4-28 Display Digital Probe Parameters.

The cursor will point at the Param1 value. Use the  or  buttons to step through the available measurements and press  to confirm the selection.

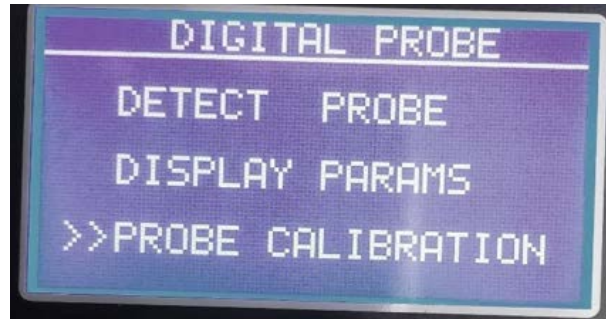
The cursor will point at the Param2 value. Use the  or  buttons to step through the available measurements and press  to confirm the selection.




Confirm the settings are to be saved before returning to the Digital Probe Menu.

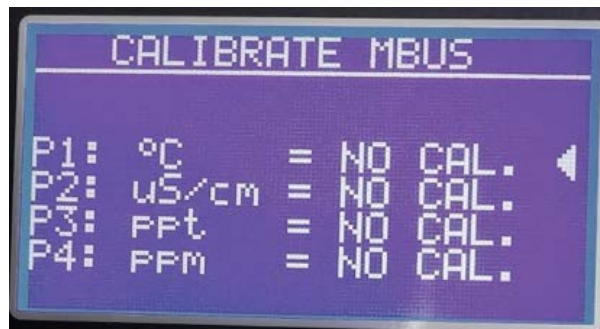
\




### 4.5.1.1. Conductivity Calibration

Select DIGITAL PROBE on the MENU page and press  button. The following screen will be accessed.






Use the  and  buttons to select the probe calibration and press  to confirm the selection.



The cursor will point at the Param1 value. Use the  or  buttons to step through the available measurements depending on your chosen params and press  to confirm the selection.




The cursor will point at the Param1 value. Use the  or  buttons to step up to your required value and press  to confirm the selection.

Leave the probe into buffer A solution while the sampling period is completing.

Repeat the above process with Buffer B solution for two points calibration.



Press  to confirm the result and save the data configuration. Use the home button to check your result on display screen 1.

#### **4.6. TEMPERATURE SET UP.**

The USM can be set to compensate for changes in temperature of the measured liquid. Two temperature compensation methods are available:

- MANUAL
- AUTO

In MANUAL mode the temperature on the buffer solutions should be entered prior to calibration. After calibration the temperature of the effluent should be entered. Manual mode should be used when the effluent stream is at a relatively constant temperature that is significantly different to the temperature of the buffer solutions.

In MANUAL mode if the temperature of the effluent changes the temperature can be re-entered without recalibrating the probe.

In AUTO mode the USM uses a PT100 temperature probe (usually integral to the probe) to measure the temperature of the effluent and automatically adjust the pH reading.





Select SETUP TEMPERATURE on the MENU page and press  button. The following screen will be accessed.





Figure 4-29 Temperature Mode

Use the  and  buttons to select the Temperature Mode (MANUAL, AUTO, OFF), press  to enter and confirm that a change of Mode is to be save.

If a Digital probe is detected an additional option is available (DIGITAL). This does not provide any compensation but displays the digital temperature on the Home Screen.

**N.B. After changing the temperature mode the probe must be re-calibrated.**

#### 4.7. MODBUS BMS SET UP.

The USM can be integrated to supply current measurements to remote applications (e.g. Building Management System) using a two wire RS485 connection. The Modbus registers are defined in **Appendix B**.

To configure the Modbus, use the  and  buttons to select the MBUS BMS SETUP and press  to confirm the selection.

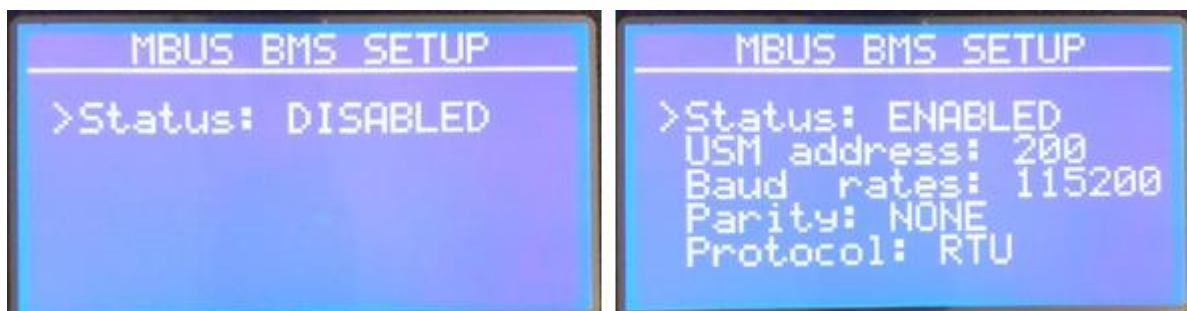




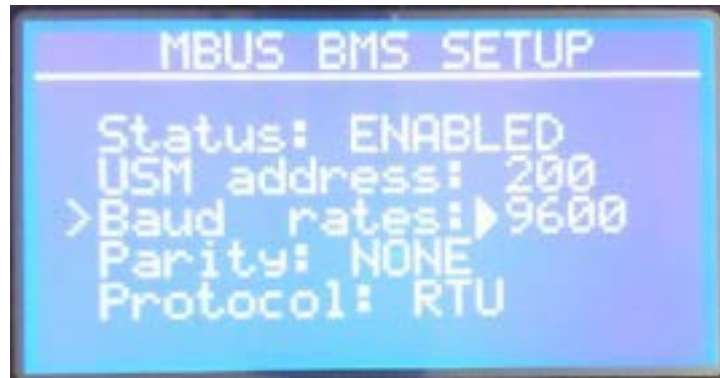





Figure 4-30 MODBUS Setup

With Status selected the  can be used to toggle between DISABLED and ENABLED. When enabled is selected the configurable parameters are displayed.

Use the  and  buttons to select the parameter to be configured and press  to confirm the selection. A cursor will be displayed next to the current value.



*Figure 4-31 MODBUS Parameter Select.*

Use the  and  buttons to change the parameter and press  to enter the value.


The following Parameter options are available:

**USM address:** 10 – 240

**Baud Rate:** 9,600, 19,200, 38,400, 57,600, 115200

**Parity:** Even, Odd, None.

**Protocol:** RTU, ASCII (ASCII is not implemented on the current software release – Please contact Smart Storm if it is a requirement).

After configuring all the parameters press Home key  and confirm the data is to be saved.

#### **4.8. 4-20mA SET UP.**

The USM provides two 4-20mA outputs which can be used for controlling ancillary devices such as dosing pumps. The output can be controlled by the Analogue (ISE) probe or either of the two enabled Digital probe measurements.




To configure the 4-20mA, use the  and  buttons to select 420mA SETUP and press  to confirm the selection. The current Status of the channels is displayed.



Figure 4-32 4-20mA Status Screen.







Use the  and  buttons to select Output channel to be configured and press  to confirm the selection.




Figure 4-33 4-20mA Set UP Screen.

With the cursor pointing at Status, the  button can be used to toggle the channel between ENABLED and DISABLED. When the channel is disabled the output will be 0mA.

The  and  buttons are used to select the parameter to be changed. The sequence is dictated by the selections and options available:

- The Mode is only selectable if a Digital Probe is connected and configured.
- The Param is only selectable when Mode is set to DIGITAL.
- The values of Param are limited to the parameters selected when configuring the DIGITAL probe.

To change a parameter, move the cursor to the parameter to be changed and press the  button.

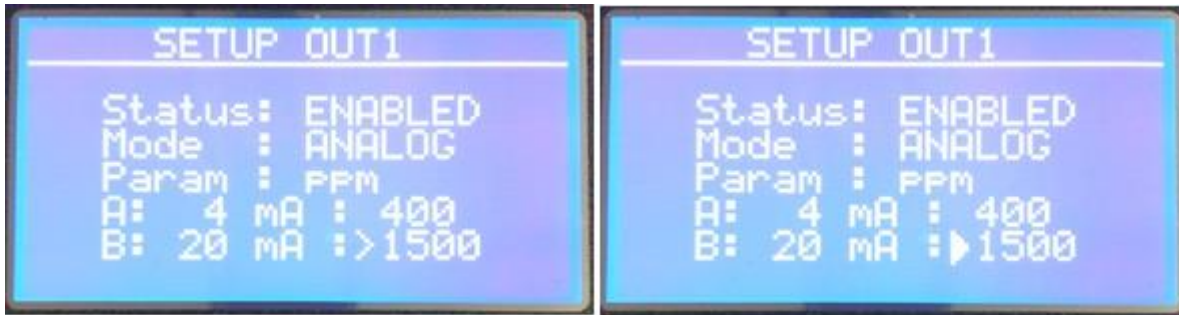








Figure 4-34 4-20mA Parameter Selection.

The cursor will change from a > to a solid triangle ►. The  and  buttons are now used to change the value of the selected parameter. When the correct value is entered press the  button and the cursor will return to a > and the  and  buttons will return to parameter select.

The mA values can be changed in 1mA steps although they would normally be kept as 4mA and 20mA. The values entered at this mA are limited by the range of the probe (e.g. an Ammonia probe is limited to 0 - 17000 ppm). See **Appendix A** for the valid probe ranges.

After configuring all the parameters press Home key  and confirm the data is to be saved.

#### 4.8.1. Typical 4-20mA SET UP for pH Balancing.

The 4-20mA outputs may typically used to balance the pH of a discharged effluent stream. Channel 1 could be used to drive a Caustic dosing pump and Channel 2 to drive an Acid dosing pump.

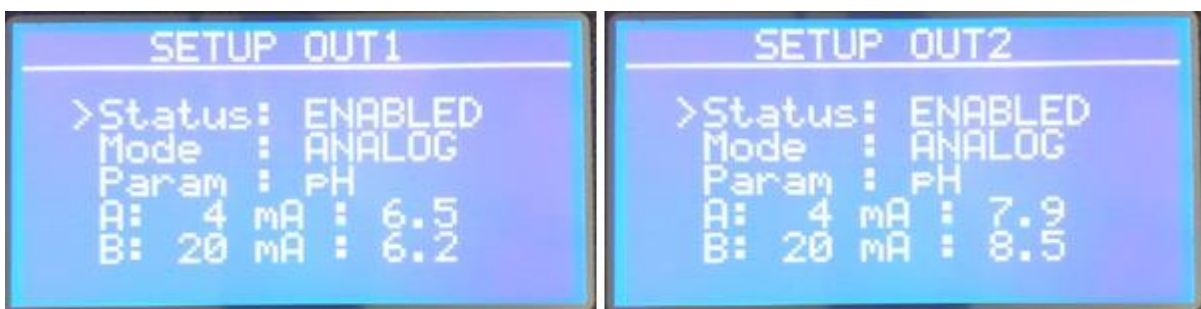



Figure 4-35 4-20mA for pH balancing.

The above settings are to maintain the pH between pH 6 and pH 9. If the pH falls below 6.5 the output of Channel 1 will increase, and the effluent will be dosed with caustic. The output will increase proportional if the pH continues to fall and at pH 6.2 the output will be 20mA and dosing will be at a maximum.

Similarly, if the pH goes above 7.9 Channel 2 will turn on the Acid dosing with the maximum dosing at pH 8.5.




#### 4.9. 4-20mA TEST.



The 4-20mA outputs can be controlled directly using the 4-20mA Test screen. This can be used to check the outputs are working correctly or to directly control the outputs independently of the parameter they are monitoring.

To test the 4-20mA, use the  and  buttons to select 420mA TEST OUTPUT and press  to confirm the selection.



*Figure 4-36 4-20mA Testing*

Use the  and  buttons to select the output to be tested and confirm press  to confirm the selection.

A solid triangle ► will appear beside the mA value. The  and  buttons are now used to change output in 1mA steps.




*Figure 4-37 Change the mA Output.*

After testing the channel press  to return to the output select.

The 4-20mA output can be tested directly using a multi-meter with a mA current input or by connecting a resistor across the output and measuring voltage (with a 100 ohm resistor 4mA will give a reading of  $100 * 0.004 = 400\text{mV}$  and 20mA will give a reading of  $100 * 0.02 = 2\text{V}$ ).

The test screen can be used to directly drive ancillary equipment such as dosing pumps (20mA would drive the dosing pump at its maximum independently of any measured pH) and to give a constant current to allow external equipment to be calibrated to the USM output.

After testing is complete press Home key  to return to the Configuration menu.



## 4.10. RELAY SET UP.

The USM provides 3 relay outputs which can be wired as Normally Open or Normally Closed. The relay is active in the configured position. The relays can be controlled by the Analogue (ISE) probe or either of the two enabled Digital probe measurements.

To configure the Relay, use the **↑** and **↓** buttons to select RELAYS SETUP and press **▶** to confirm the selection. The current Status of the relays is displayed.

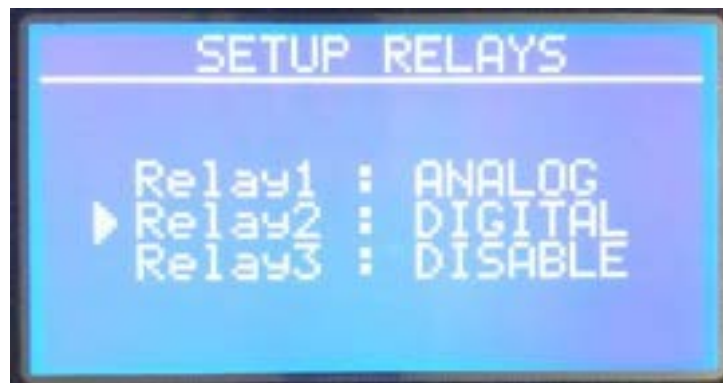


Figure 4-38 Relay Status Screen.

Use the **↑** and **↓** buttons to select Output channel to be configured and press **▶** to confirm the selection.




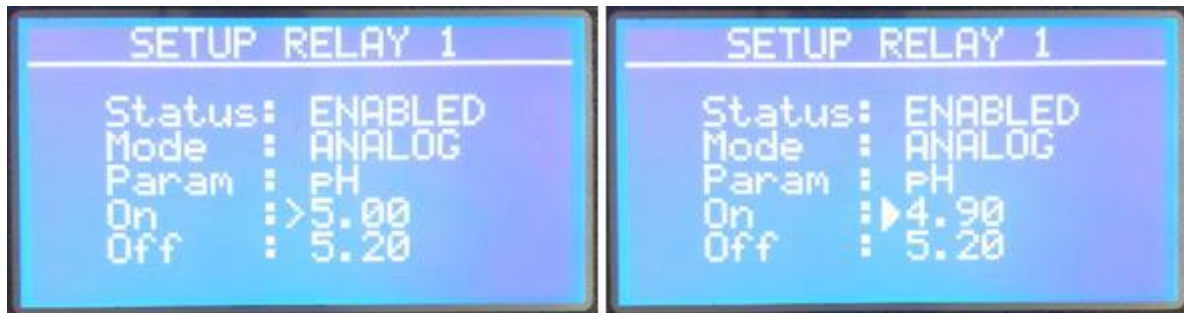
Figure 4-39 Relay Set Up Screen.

With the cursor pointing at Status, the **▶** button can be used to toggle the channel between ENABLED and DISABLED. When the relay is disabled (or OFF) the Common to Normally Closed will be short circuit and the Common to Normally Open will be open circuit.







The **↑** and **↓** buttons are used to select the parameter to be changed. The sequence is dictated by the selections and options available:

- The Mode is only selectable if a Digital Probe is connected and configured.
- The Param is only selectable when Mode is set to DIGITAL.
- The values of Param are limited to the parameters selected when configuring the DIGITAL probe.

To change a parameter, move the cursor to the parameter to be changed and press the  button.



*Figure 4-40 Relay Set Up Parameter Change.*

The cursor will change from a solid triangle . The  and  buttons are now used to change the value of the selected parameter. When the correct value is entered press the  button and the cursor will return to a > and the  and  buttons will return to parameter select.

The above example shows a Relay set as a low pH alarm. Consider a starting position of pH 7 from which the pH starts to fall. The pH would fall below 5.2 (the OFF setting) without triggering the relay. When the pH falls below 4.9 (the ON position) the relay would activate.

The relay would remain ON until the pH rose above pH 5.2 (the OFF position). It can be seen that between the ON and the OFF position the state of the relay depends on whether the relay has been activated.







## 4.11. RELAY TEST.

The Relays can be controlled directly using the Relays Test screen. This can be used to check the outputs are working correctly or to directly control the outputs independently of the parameter they are monitoring.

To test the relays, use the  and  buttons to RELAYS TEST and press  to confirm the selection.





*Figure 4-41 Relay Testing.*

Use the  and  buttons to select the relay to be tested and use the  button to toggle the state of the relay. Press Home key  to return to the configuration menu.

## 4.12. NEW USER PASSWORD.




The default password on the USM is set to 0000. This can be changed by selecting the NEW USER PASSWORD and following the on-screen instructions. The new password will come into immediate operation once the it is saved, and the configuration menu exited.

## 4.13. SET DATE AND TIME.




To set the date and time, use the  and  buttons to select Set DATE AND TIME and press  to confirm the selection.

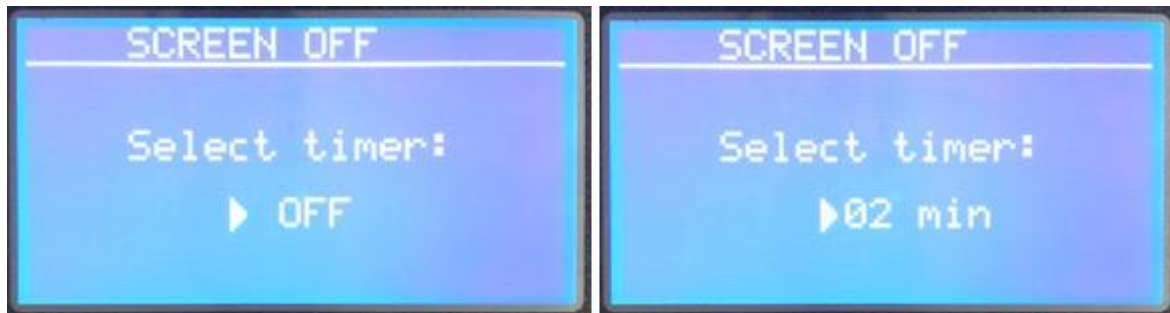


*Figure 4-42 Time and Date Setting.*




Use the  and  buttons to change the value and press  to enter and move to the next value. When all values are set save the settings and return to the configuration menu.

#### 4.14. SCREEN SAVE MODE.

The USM has a Low Power in which the backlight of the LCD is turned off. Use the  and  buttons to select SCREEN SAVER MODE and press  to confirm the selection.



*Figure 4-43 Screen Saver Setting.*

Use the  and  buttons to step through the available timer options and press  to confirm the selection and go to the save screen.

The available timer options are:

- OFF (the backlight is permanently on)
- 2 minutes
- 5 minutes
- 10 minutes
- 30 minutes




#### 4.15. LOGGER INTERVAL.

Some versions of the USM are available with a build in Data Logger. The measurements can be recorded and displayed using Smart Storm's Inquisitor Software. The interval at which the measurements are logged can be set on the Logger Interval Screen.

Use the  and  buttons to select LOGGER INTERVAL and press  to confirm the selection.



*Figure 4-44 Logger Interval Setting.*

Use the  and  buttons to step through the available interval options and press  to confirm the selection and go to the save screen.

The available interval options are:

- OFF (No data is logged)
- 2 minutes
- 5 minutes
- 10 minutes
- 30 minutes

#### **4.16. ENGINEER MENU.**

The ENGINEERING MENU is used for the setting of factory calibrated parameters and should not be accessed. Contact Smart Storm if you require further details.

## 5. USM DISPLAY SCREENS.

Several Display Screens are included in the USM to enable information to be seen without accessing the configuration Menu. Relays and 4-20mA output are updated whilst on any Display screen.

### 5.1. HOME SCREEN.



*Figure 5-1 Home Screen ISE .*

If an Analogue/ISE Probe is selected the Home Screen shows the probe type and the current measurement from the ISE probe. The current date and time are displayed along with bar graphs to indicate the percentage output of the two 4-20mA channels.



*Figure 5-2 Home Screen ISE with Temperature.*

Additional, if selected the temperature will also be shown on the home screen. T/M indicates the temperature has been set manually, T/A is the temperature reading from a probe.

If no Analogue/ISE Probe is selected and the USM is only being used with a Digital Probe the USM will display the Parameter 1 measurement from the Digital Probe. The temperature shown will be the temperature from the Digital Probe.



*Figure 5-3 Digital Probe Only.*

Pressing the Home Key  from any Display Screen returns the display to the Home screen.

Other screens are accessed using the  and  buttons with the following available:

HOME 

DIGITAL PROBE SCREEN 1

DIGITAL PROBE SCREEN 2

RELAY1 & 2 STATUS SCREEN

RELAY2 & 3 STATUS SCREEN

4-20mA CHANNEL 1 STATUS SCREEN

4-20mA CHANNEL 2 STATUS SCREEN

ANALOGUE PROBE CONFIGURATION SCREEN

DATE AND TIME SCREEN

COMMS CONFIGURATION SCREEN

ABOUT USM SCREEN

SMART STORM SPLASH SCREEN

HOME 

## 5.2. DIGITAL PROBE SCREEN 1.

The first Digital Probe Screen shows the values of the two parameters selected from the [Digital Probe Display Params setting](#).



*Figure 5-4 Digital Probe Screen 1.*

If no probe is detected an error message ("Probe not detected") will appear on the screen.

## 5.3. DIGITAL PROBE SCREEN 2.

The second Digital Probe Screen shows all the measurements available from the probe along with the probe type, serial number and address of the probe.



*Figure 5-5 Digital Probe Screen 2.*

If no probe is detected an error message ("Probe not detected") will appear on the screen.



## 5.4. Relay Status Screens.

The USM has two relay screens which show the Set Up and state of the three relays. Relay Page 1 covers **Relay 1** and **Relay 2**, whilst Relay Page 2 repeats **Relay 2** and additionally shows **Relay 3**.

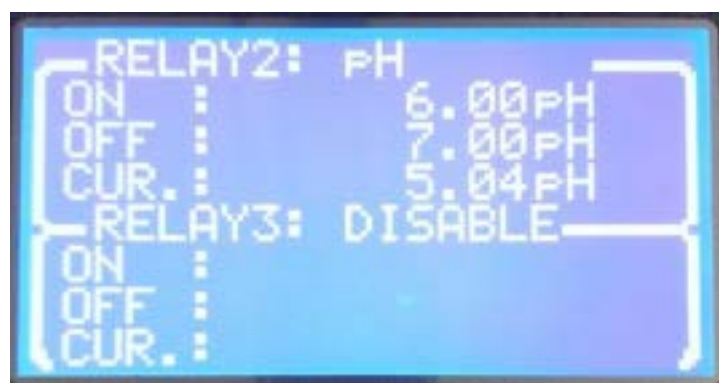


*Figure 5-6 Relay Page 1.*

Figure 5.6 shows Relay 1 and Relay 2 set to pH. The current reading of pH is 5.06 and it can be seen that Relay 1 is OFF (RELAY 1 LED below the screen is not illuminated) and Relay 2 is ON.

Relay 1 will come ON when the pH rises above pH 6 and remain ON until the pH falls below pH 5. It can therefore be seen that the pH has not been above pH 6, since last being below pH 5.

Relay 2 is ON as the pH is below pH 6. It will remain ON until the pH rises above pH 7.



*Figure 5-7 Relay Page 2.*

The screen relay screen repeats the information for Relay 2 and additionally shows Relay 3 (in this case the relay is not Enabled).

## 5.5. 4-20mA Screens.



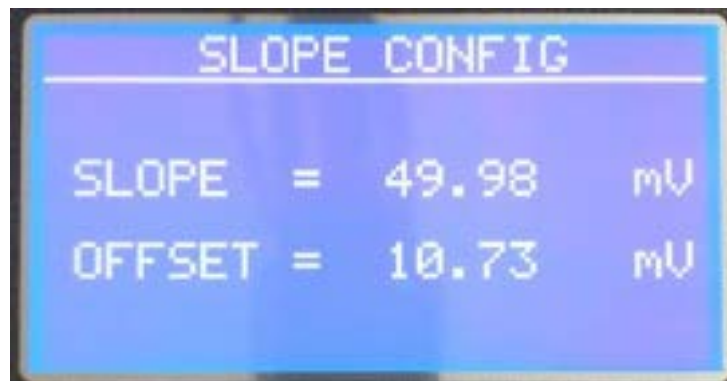
*Figure 5-8 4-20mA Screen.*

The USM 4-20mA screen shows the current Set Up of the 4-20mA along with the current value (CUR) of the selected measurement and the mA output for the value of that measurement.

A similar page is available for 4-20mA OUT2.

## 5.6. Slope Configuration Screen.

If an analogue ISE probe is selected the configuration parameters are shown on the Slope Configuration Screen. These values will change after a calibration and it is recommended a record of the value is taken before a calibration to ensure there is not excessive drift in the probe.



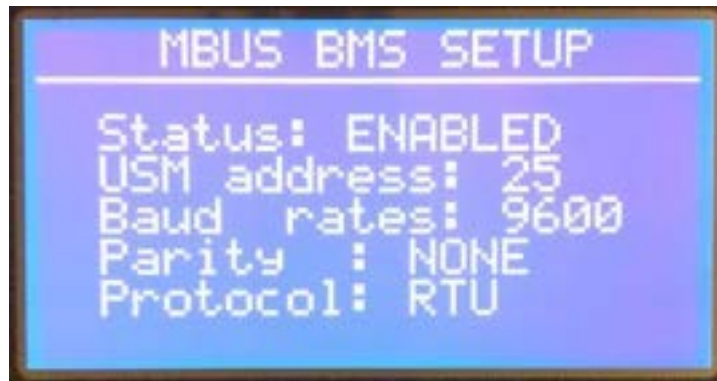
*Figure 5-9 Slope Configuration.*



## 5.7. Date and Time Screen.

The current date and time are displayed. Please ensure these values are correct as these settings are used by the logger.

## 5.8. Modbus Set Up Screen.



*Figure 5-10 Modbus Set Up Screen.*

The current setting for the Modbus BMS (Building Management System) are displayed on this screen. See [Appendix B](#) for register information.

## 5.9. About USM.

Displays the serial number and software release of the USM.

## 6. Fault Finding

Fault	Possible Cause	Solution
No Display	Lost Power	Check external and internal fuses
No Display	Ribbon Cable disconnected from Main PCB	Carefully remove each end of enclosure. Separate top of enclosure from the bottom. Identify cable and carefully push back onto connector. Reassemble
No Current output on the 4 – 20 mA output	4 – 20 mA Setup not enabled. Setting enabled but set to zero. Incorrect wiring	Check Configuration.  Ensure +ve and –ve terminals are connected correctly.
Current mA Output read 24V	No load on 4-20mA output	Check the wiring of the 4-20mA output
Relay not triggering at set point	Relay_x is DISABLED. Set points not reached	Check the configuration of the relay

*Table 6-1 Fault Finding.*

## 7. APPENDICES.

### 7.1. APPENDIX A. ISE PROBES

PROBE TYPE	LIMITS	NOMINAL SLOPE	NOMINAL VALUE
pH	pH 0 – pH 14	-59.16 mV/pH	0mV @ pH 7
REDOX	-1000mV – 1000mV	N/A	N/A
Ammonia	0.02 ppm – 17000 ppm	+59.16 mV/dec	
Ammonium	0.9 ppm – 9000 ppm	+59.16 mV/dec	350mV @ 1000 ppm
Calcium	0.02 ppm – 4010 ppm	+29.58 mV/dec	475mV @ 1000 ppm
Chloride	1 ppm – 35,500 ppm	-59.16 mV/dec	
Fluoride	0.02 – 1900 ppm	-59.16 mV/dec	-500mV @ 1000 ppm
Nitrate	0.4 ppm – 6200 ppm	-59.16 mV/dec	200mV @ 1000 ppm
Potassium	0.04 ppm – 39000 ppm	+59.16 mV/dec	

## 7.2. APPENDIX B. MODBUS REGISTERS

The Modbus RTU uses the following format:

### SEND

ADD	COMMAND	START ADDRESS	NUMBER OF BYTES	CRC16
XX	03	XXXX	XXXX	XXXX
01 – 240	READ	0000 – 0018	0004 or 0008	CRC16

### REPLY

ADD	COMMAND	NUMBER OF BYTES	VALUE	CRC16
XX	03	XX	XXXXXXXX OR	XXXX
01 – 240	READ	00 – FF	0004 or 0008	CRC16

The following commands are available

PARAMETER	COMMAND	REPLY	UNITS
	XX 03 0000 0004 XXXX	XX 03 04 XXXX XXXX	
	XX 03 0004 0004 XXXX	XX 03 04 XXXX XXXX	
	XX 03 0008 0004 XXXX	XX 03 04 XXXX XXXX	
	XX 03 000C 0004 XXXX	XX 03 04 XXXX XXXX	
	XX 03 0010 0008 XXXX	XX 03 08 XXXX XXXX XXXX	
	XX 03 0018 0004 XXXX	XX 03 04 XXXX XXXX	

*Table 7-1 ModBus Registers.*

The maximum response time of the USM is 200ms.

REGISTER ADDRESS	REGISTER	TYPE
0x11	Serial Number	ASCII STRING
0x52	Analogue probe value	float
0x54	modbus parameter 1	float
0x58	modbus parameter 2	float
0x5C	analogue probe value MAX	float
0x60	analogue probe value MIN	float
0x64	modbus parameters 1 & 2	2 x float
0x76	modbus parameters 1, 2, 3 & 4	4 x float

*Table 7-2 ModBus RTU Registers.*

To read analogue probe from USM with Modbus address 10

0A 03 00 50 00 02 C5 61

## 8. Declaration of Conformity

### *Declaration of Conformity*

We  
Smart Storm Limited  
The Old Mill  
Wainstalls  
Halifax  
HX2 7TJ

Declare under our sole responsibility that the products:

USI, Hydrocell, USM, Avocet 9000, Mudsens, Greasebuster FS

to which this declaration relates, is in conformity with the following directive.

The Electromagnetic Compatibility (EMC) Directive 2004/108/EC

And the following harmonised European Norms (EN standards), IRC and Environment Agency standards.

<u>Standard</u>	<u>Issue</u>
BS EN 50081-1 Emissions	1992
BS EN 50082-2 Immunity	1995
IEC 801 Immunity	1992
BS EN61010-1 Low Voltage	1993

We also declare that the products:

Named above.

are of UK origin and are manufactured and tested to Smart Storm internal quality standards defined in the company's formal ISO9001:2015 quality manual.

Dr John Duffy  
Managing Director

