USI Environmental

&

Expansion Board

Version : 1.1
Date   : 12/07/2021

Contents

- **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.smartstorm.eu

- **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).

Use of hazard information

DANGER
Indicates a potentially or imminently hazardous situation which, if not avoided, could result in death or serious injury.

| WARNING |
|---|
| Indicates a potentially or imminently hazardous situation which, if not avoided, could result in death or serious injury. |

CAUTION
Indicates a potentially hazardous situation that may result in minor or moderate injury.

NOTICE
Indicates a situation that, if not avoided, could result in damage to the instrument. It also indicates information that requires special notice.

- **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.
⚡ High voltage	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.

1. Connections.

1.1. USI.

The pH probe is connected to CONN5 of the USI Relay Board. If a ground shield wire is included this should be attached to a mains earth (either the incoming power connection – ensuring the power is turned off or attach under one of the screws holing the PCB to the enclosure).

The USI is connected to the expansion board via the RS485-S connections of CONN7.

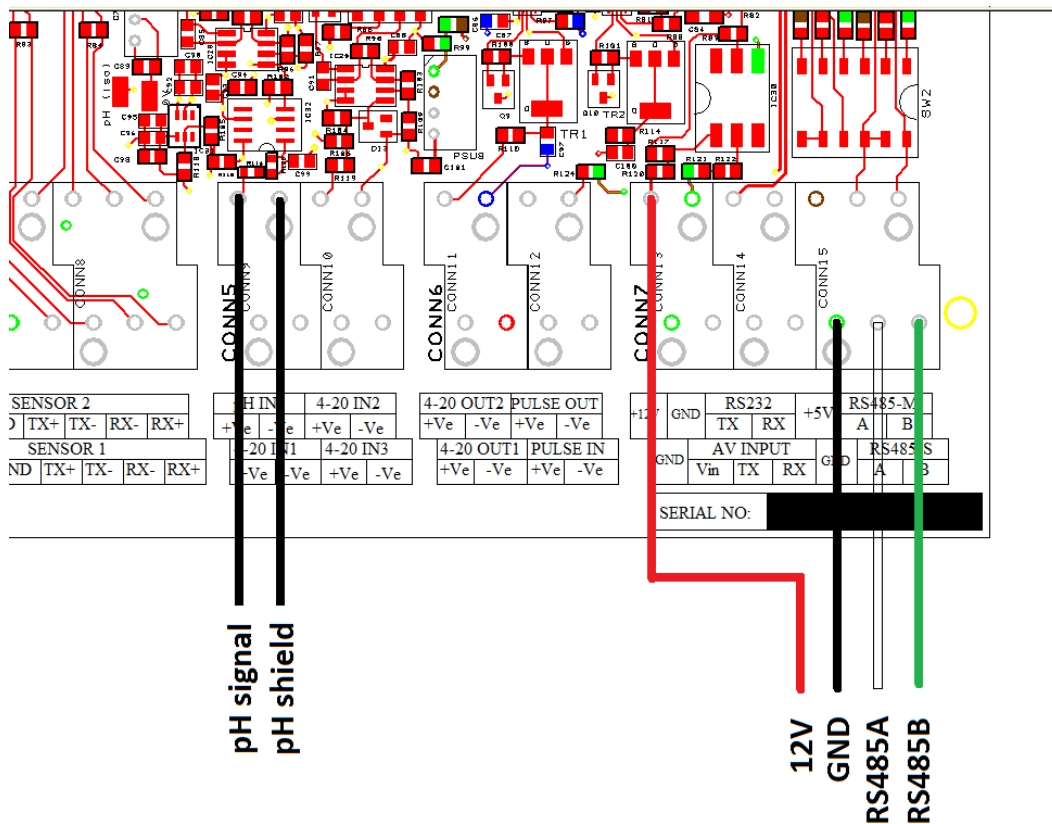| USM CONNECTIONS			pH Probe Connections	
12V	-	RED	pH IN +ve	- Copper Transparent Cover
Gnd	-	BLACK	pH IN -ve	- BLACK
RS485A	-	WHITE	EARTH (MAINS) – GREEN	
RS485B	-	GREEN		

Figure 1 USI Connections.

1.2. USM Expansion Board Connections.

The USI is connected to the expansion board via the RS485-S connections of USI IN.

12V	-	RED
Gnd	-	BLACK
RS485A	-	WHITE
RS485B	-	GREEN

The Expansion Board can take up to 4 ISE probes and 3 Modbus probes.

Modbus probe connections.   **ISE Probes.**

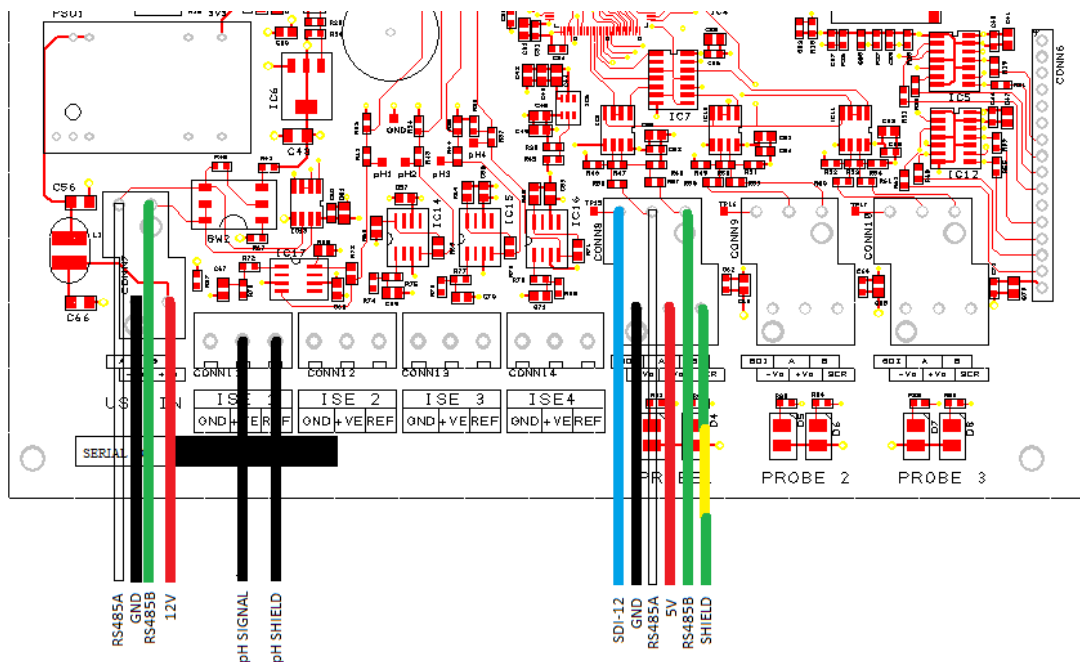|					
5V	-	RED	+VE	-	Copper Transparent Cover
Gnd	-	BLACK	REF	-	BLACK (Heat Shrink)
RS485A	-	WHITE			
RS485B	-	GREEN			
SDI-12	-	BLUE (not required)			
SHEILD	-	GREEN/YELLOW (not required)			

Figure 1.2 USM Expansion board Connections.

2. Configuration of the USI.

The USI configuration is set when the unit is initially turned on and stored in a configuration file on the USI SD card. If no configuration file is present (the first time the USI is powered up or if the file has been deleted to allow reconfiguration) the USI will scan all Modbus addresses to see if an Expansion Board is present and determine which Modbus probes are connected.

The USI will then create the screens to allow the probes to be displayed calibrated.

3. Calibrating the ISE probes.

3.1. Internal pH.

The internal pH is shown on the 1st screen of the USI. Three other inputs are included but disabled. These are for future development of 4-20mA and additional ISE probes.
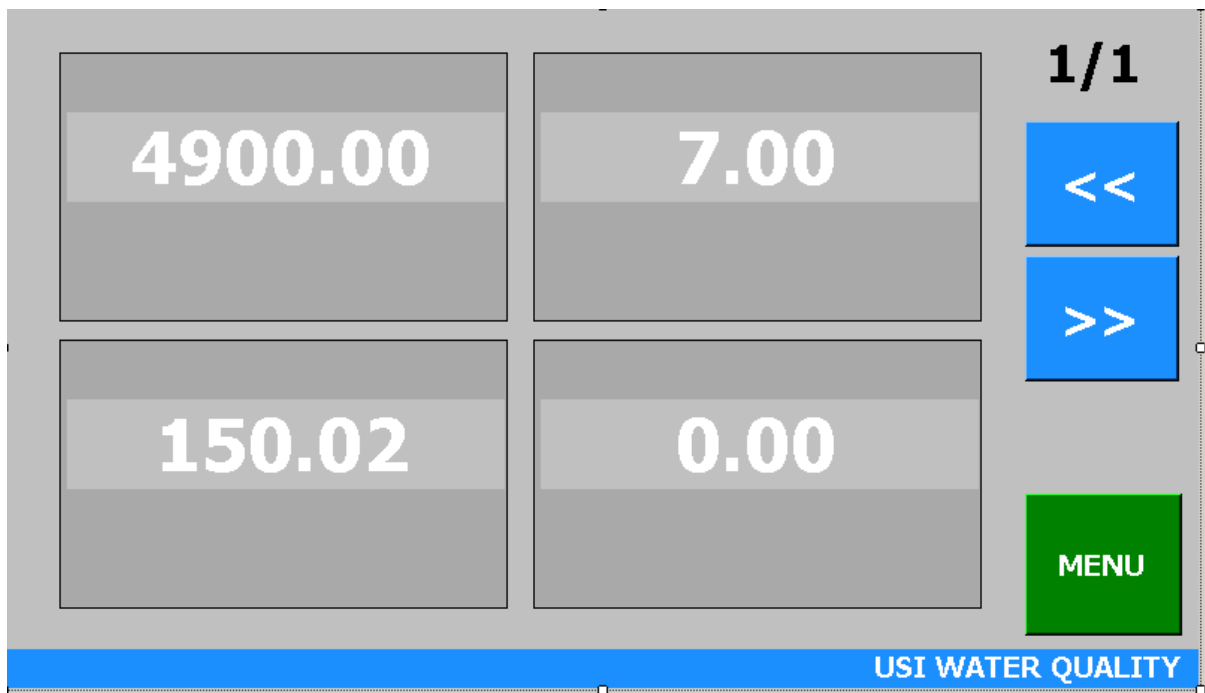

Figure 3.1 Home Screen.

Press the button in the bottom left-hand corner to access the configuration menu.
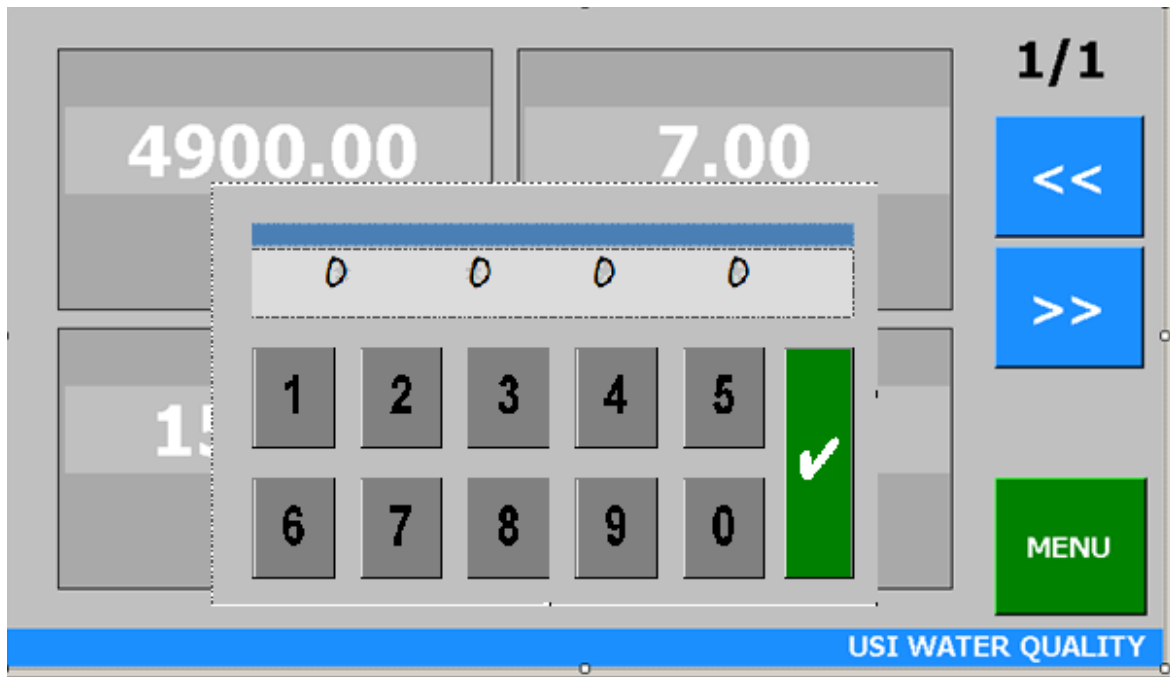
Figure 3.2   *Password Screen.*

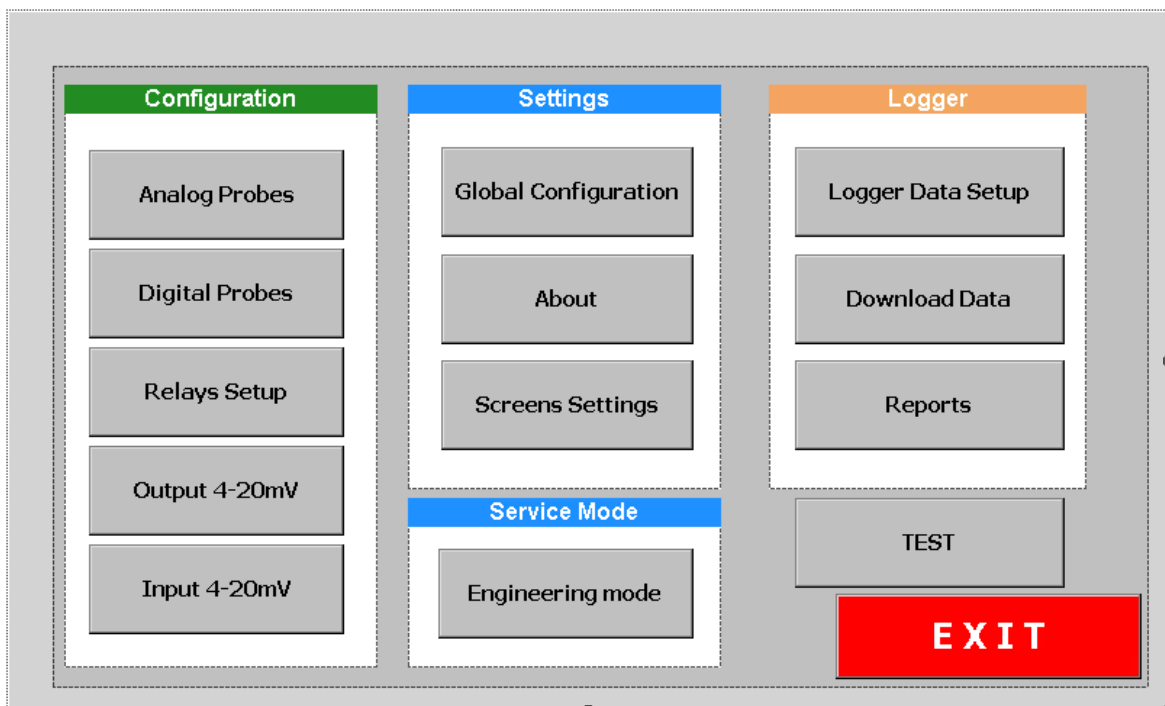Enter the Password 0 0 0 0 to access the Menu.

Figure 3.3   *Menu Screen.*

Select Analog Probe option from the MENU to calibrate given ISE sensors.
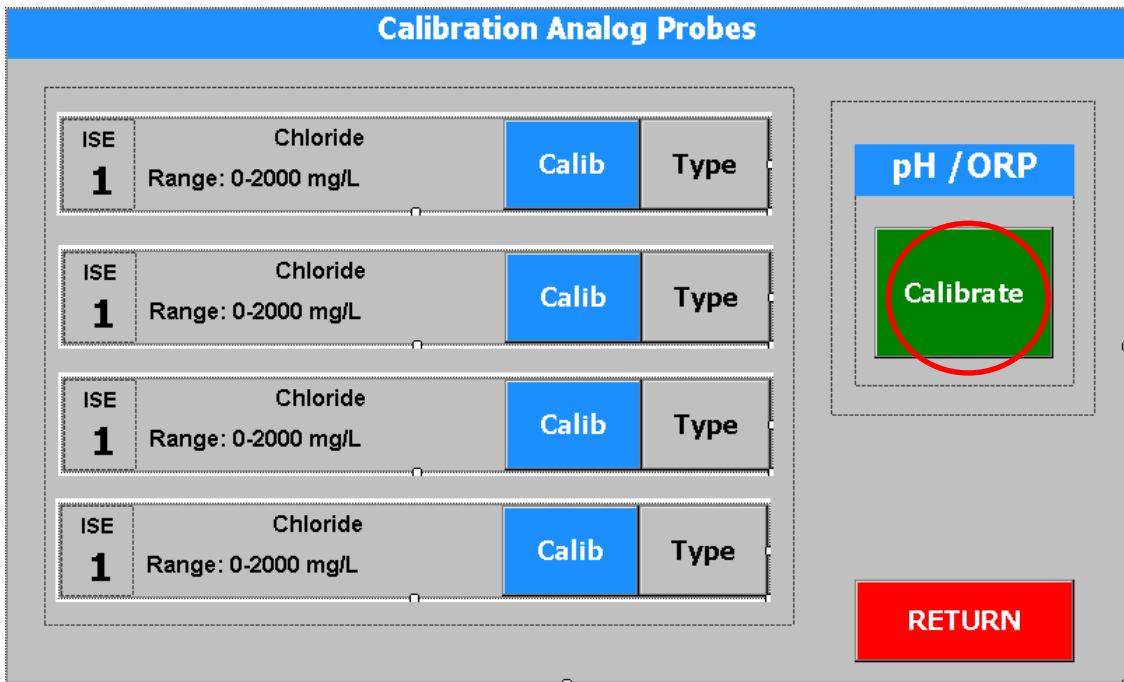
Figure 3.4   Calibrate pH

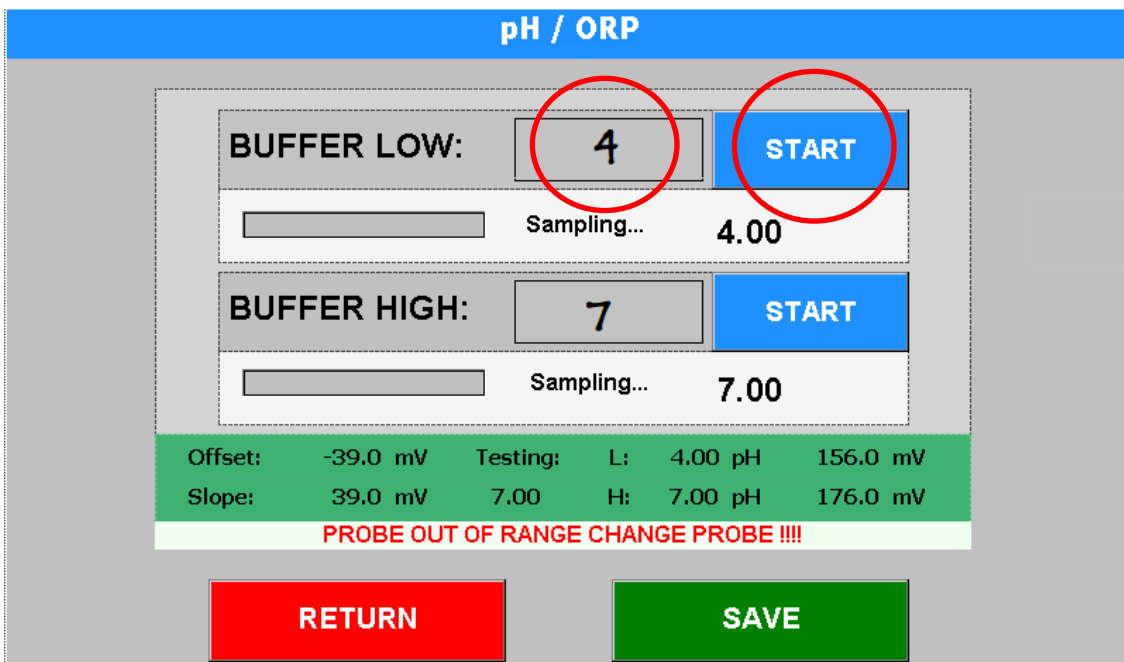For pH/ORP, Press the Calibrate Button under pH/ORP.

Figure 3.5 Calibrate the Low Buffer Solution.

Place the pH probe in the first Buffer Solution. The value of the Buffer Solution can be altered by pressing the number and entering the value of buffer using the keypad.

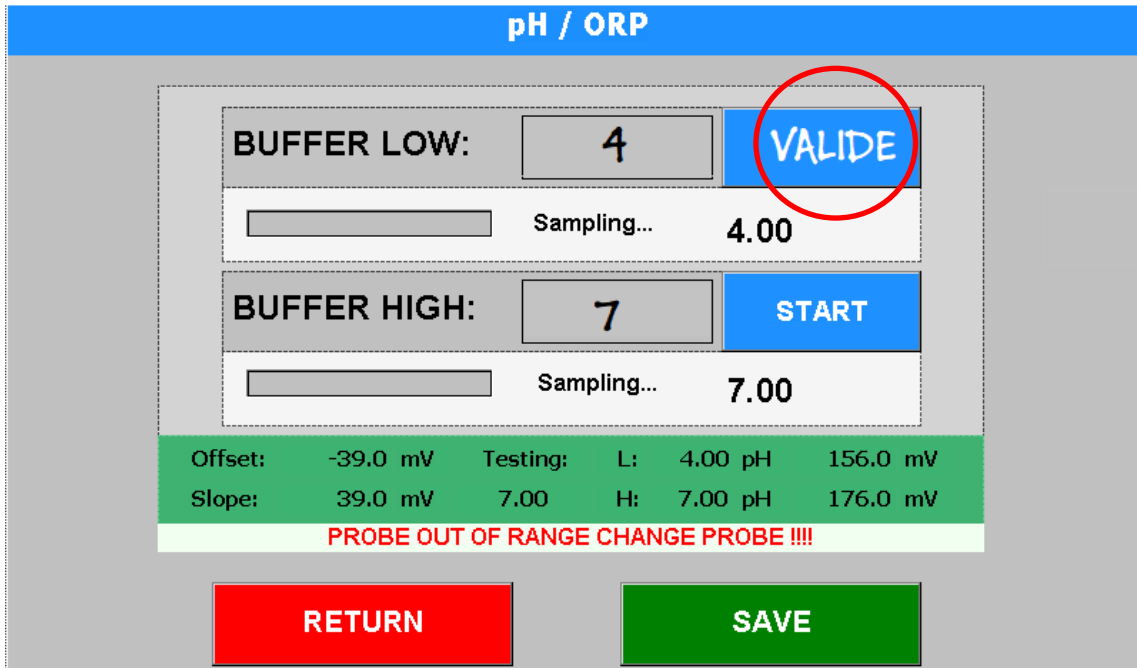Press the Start Button to begin the Calibration.

Figure 3.6 Validate the Calibration.

Wait for the mV reading (196.98 in figure 3.6) to settle and press the VALIDATE Button.

Repeat the procedure for the 2nd Buffer Solution.

Check the Slope and Offset and Save the calibration. Return to the Home Screen and check the calibration has been saved.

3.2. Expansion Board ISE Probes.
If an Expansion Board is connected to the USI a second Screen will be available.
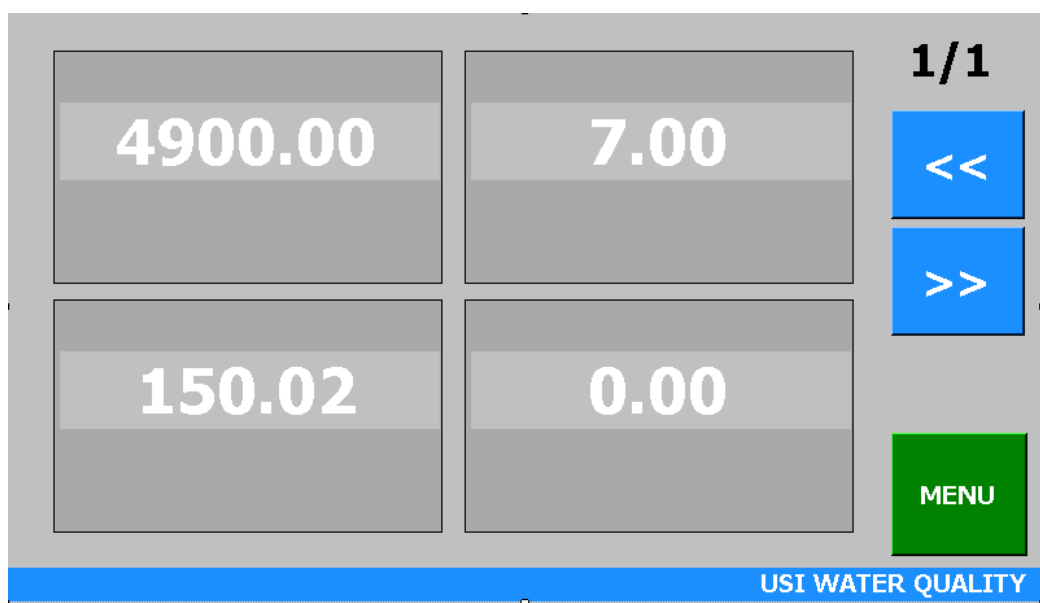

Figure 3.7 Expansion Board ISE Probes.

Press the Menu Button and enter the Password 0 0 0 0. **Select Calibration Analog.**
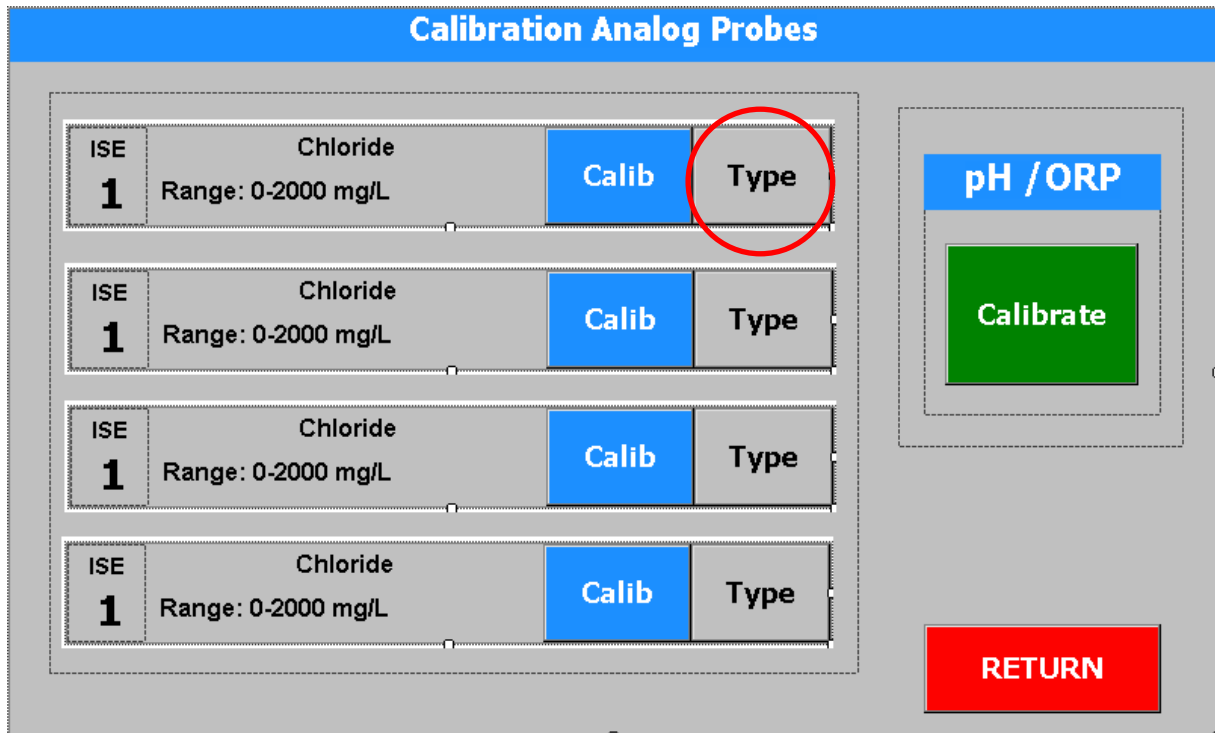

Figure 3.8-A Analogue Calibration Screen.

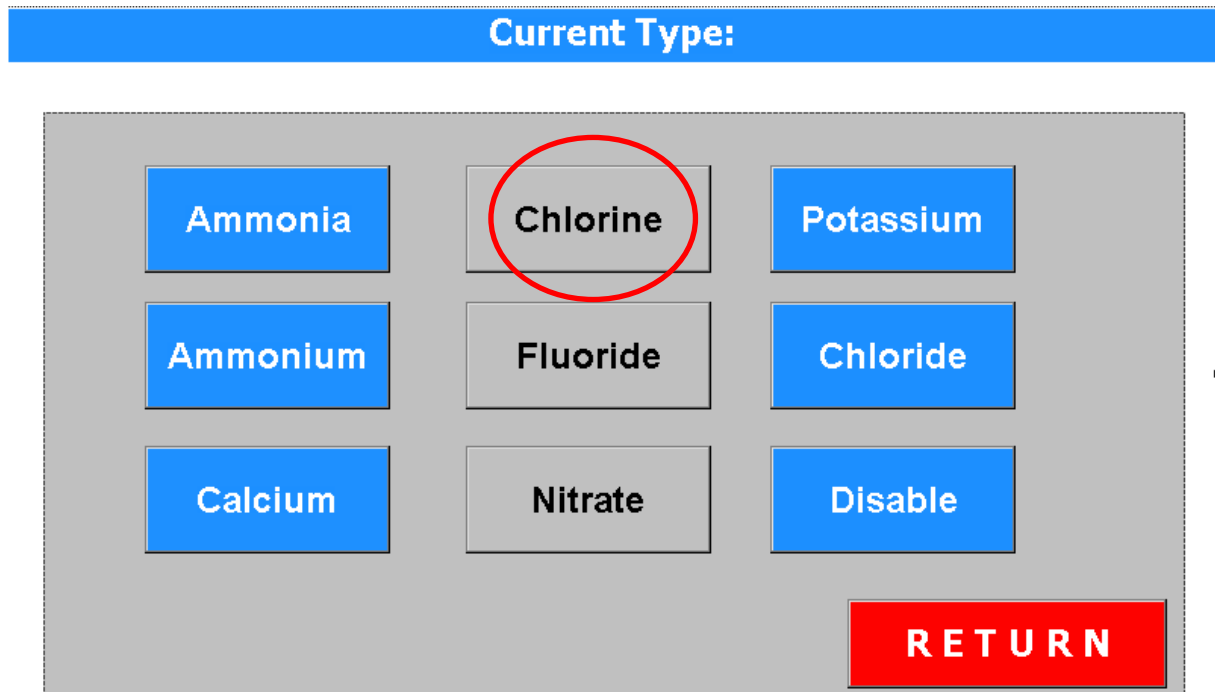Press the **Type** Button and select the probe type from the list.

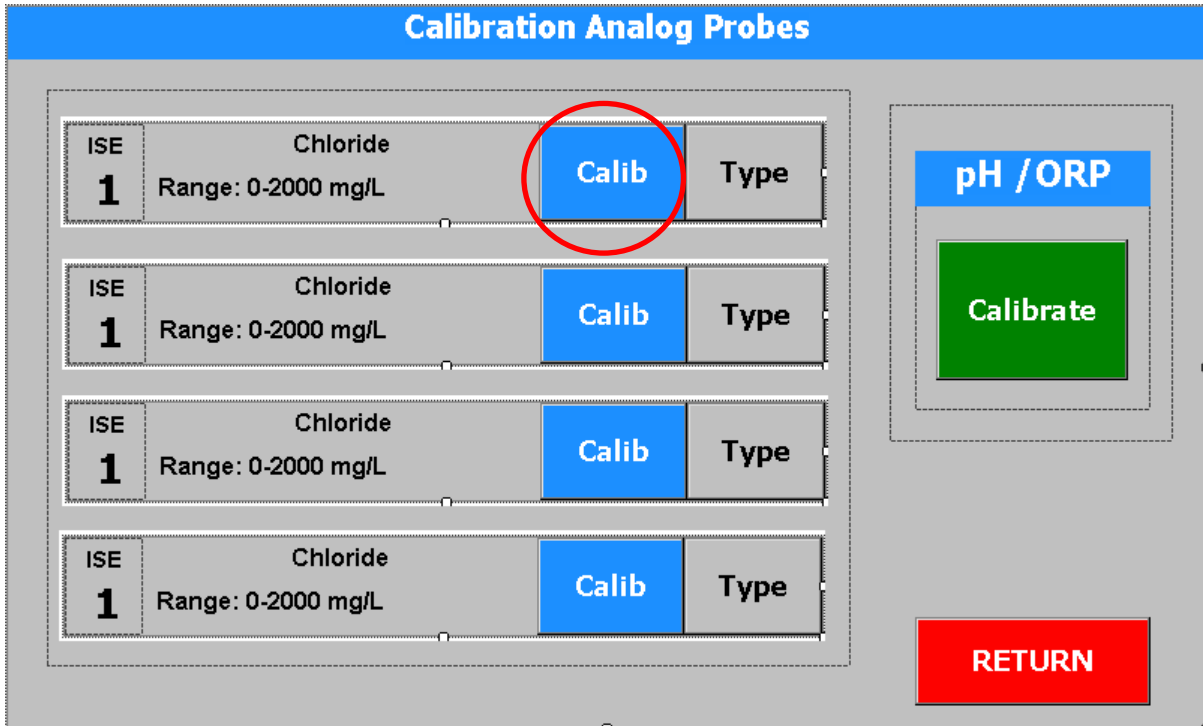*Figure 3.8-B ISE Calibration Type Screen.*

Figure 3.9 Analogue Calibration Screen.

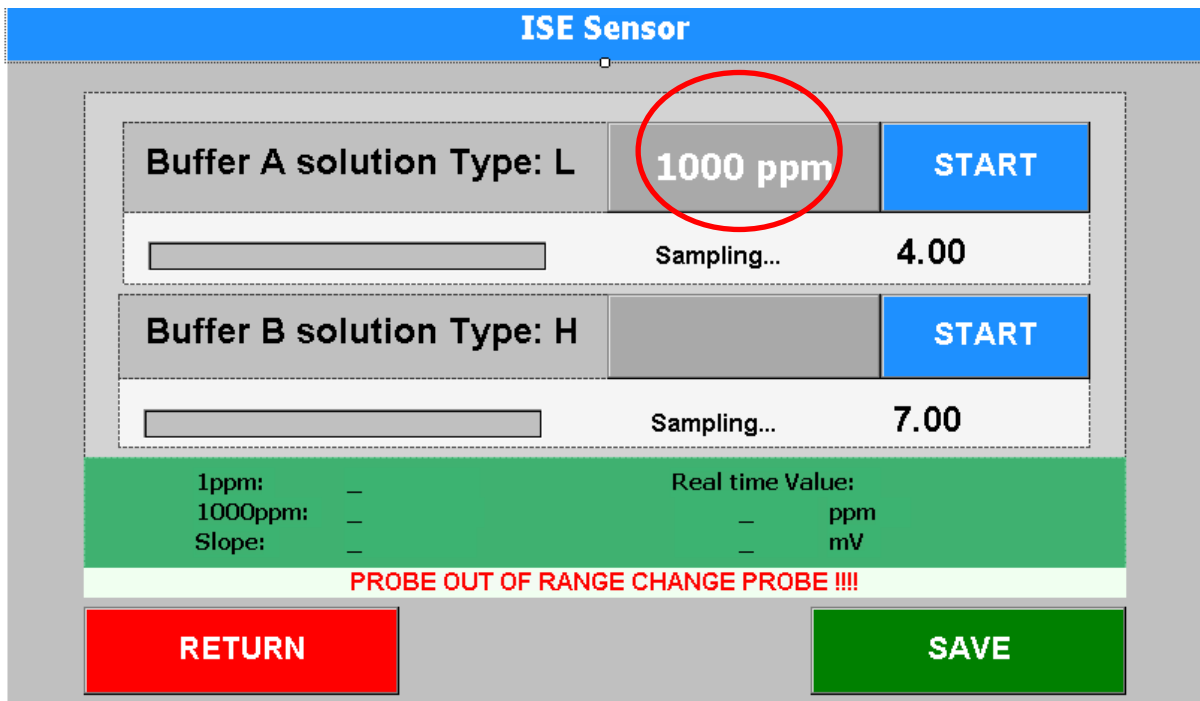Press the Calib Button for the required probe to access the Calibration Screen.

Figure 3.10 ISE Probe Calibration Screen.

Press the ppm Button until the value changes to the value of the 1st Buffer Solution. Place the ISE Probe in the Buffer Solution and press the START Button.
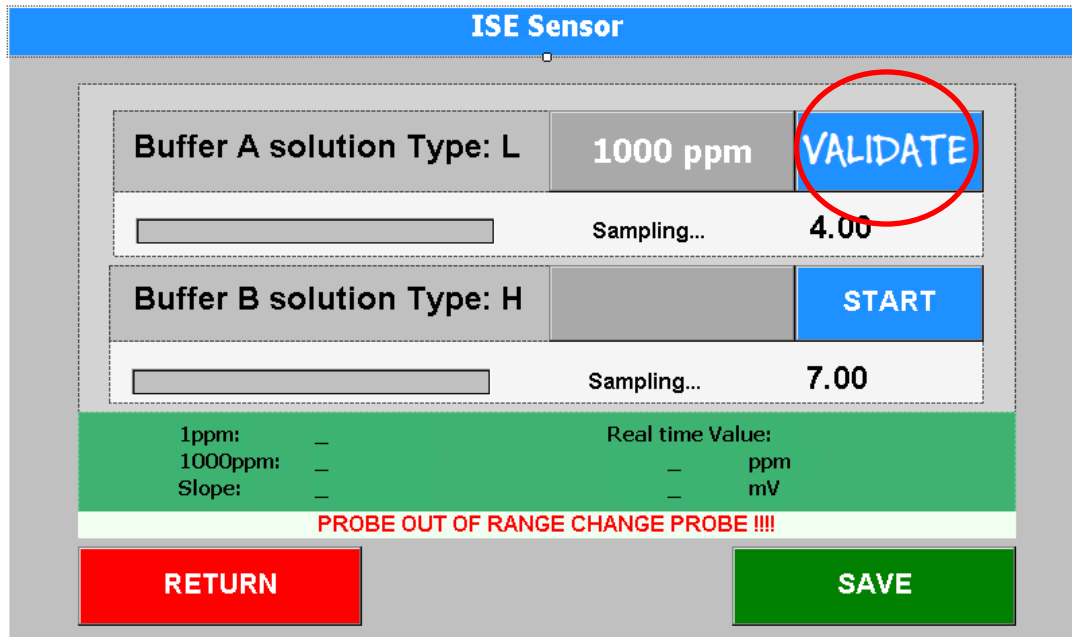
Figure 3.11 Validate the ISE Calibration.

Wait for the mV reading (354.09 in figure 3.11) to settle and press the VALIDATE Button?

Repeat the procedure to calibrate the 2nd Buffer Solution range starting from figure 3.8-A above.
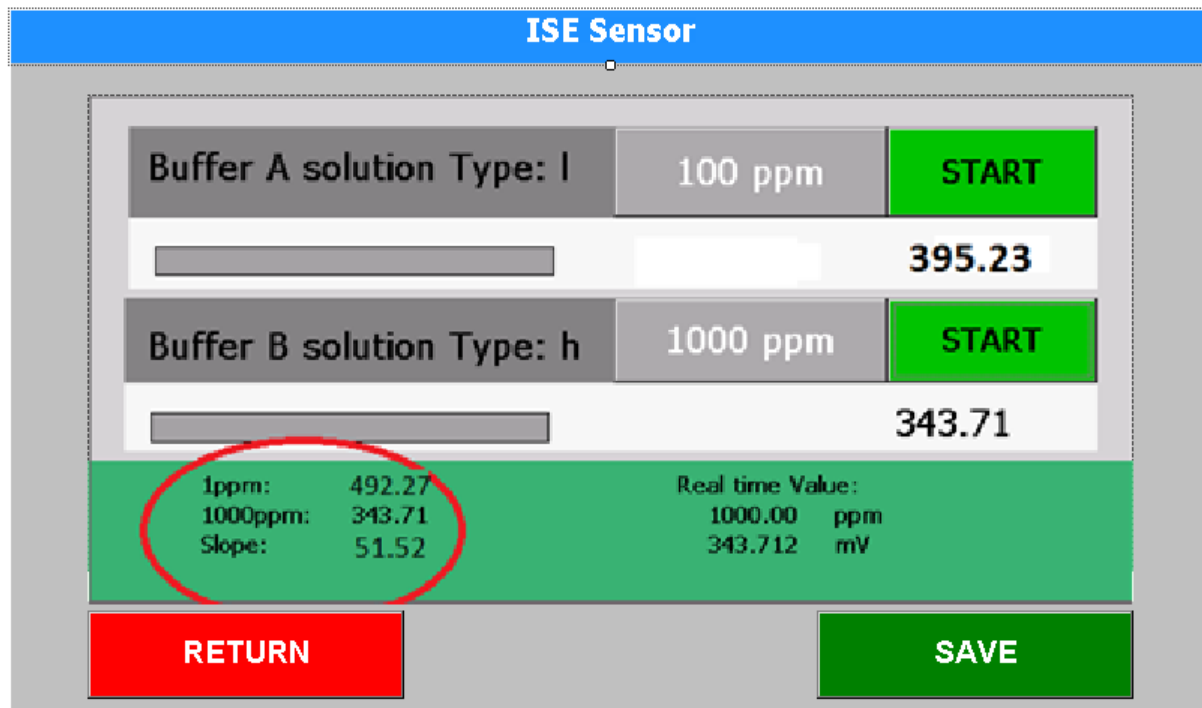

Figure 3.12 Check the ISE Calibration.

Then check the Mv reading, ppm and slope values. Save the Calibration.
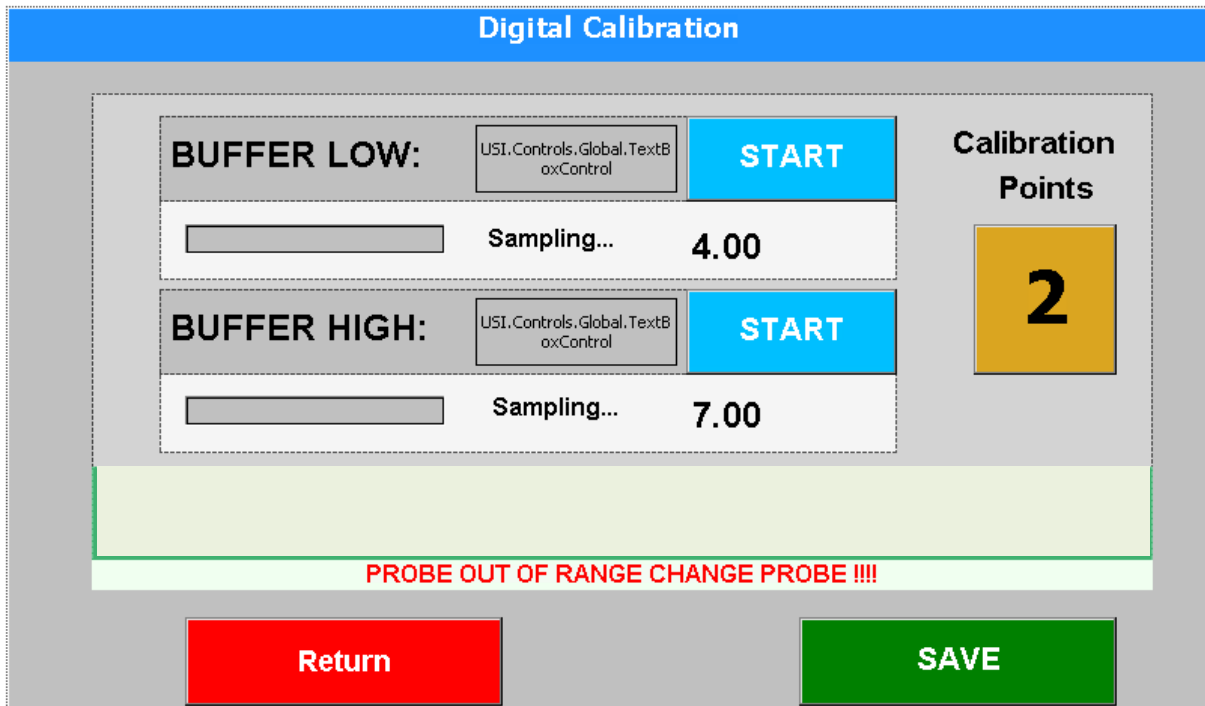
Digital Probe Calibration

Figure 3.12 Check the Digital Calibration.

Follow the same process from ANALOGUE probe to calibrate each digital probes.
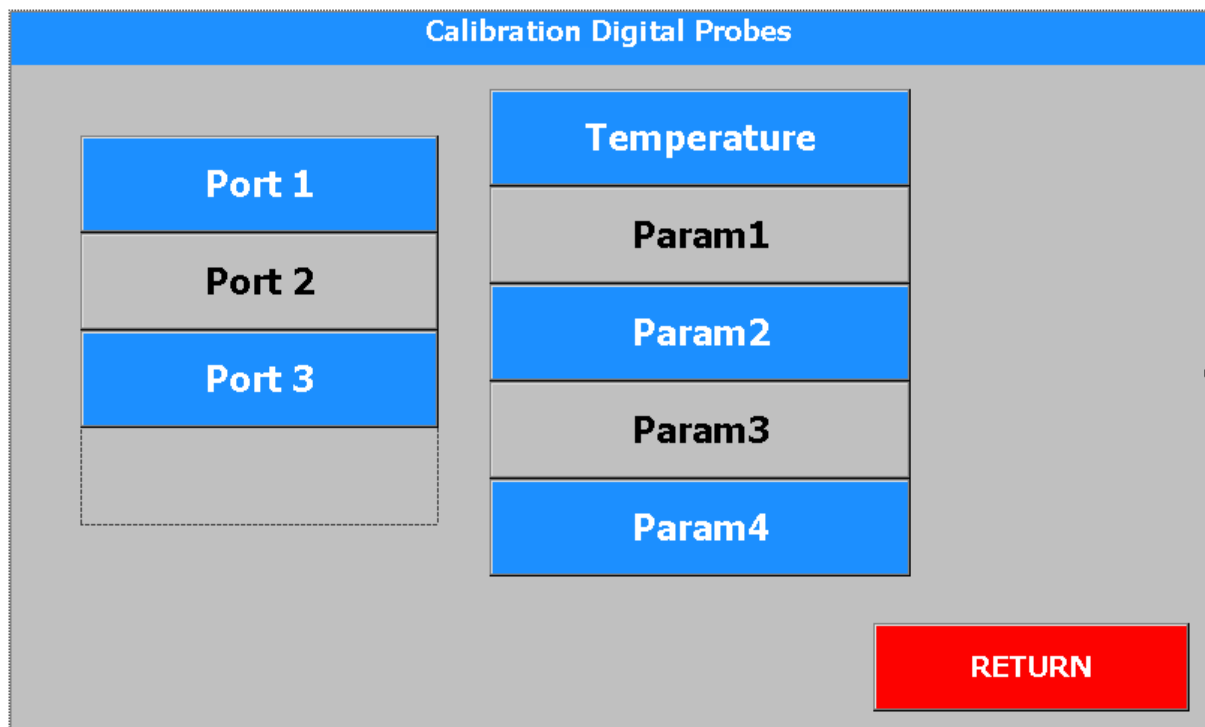
Figure 3.14 Check the Digital Probe Screen.

When digital probes are connected accurately, the probe name and params will be display here automatically after restarting or resetting the unit.

4. IP Address and Modbus interface.

4.1. IP Address.

The USI is assigned an IP address when connected to a Network.

To view the IP address, Press the Menu Button and enter the Password 0 0 0 0.

From the Menu Select Settings

Figure 4.1 Select Settings from the Menu.

The IP Address will be displayed.

Figure 4.2 IP Address.

4.2. Modbus Registers

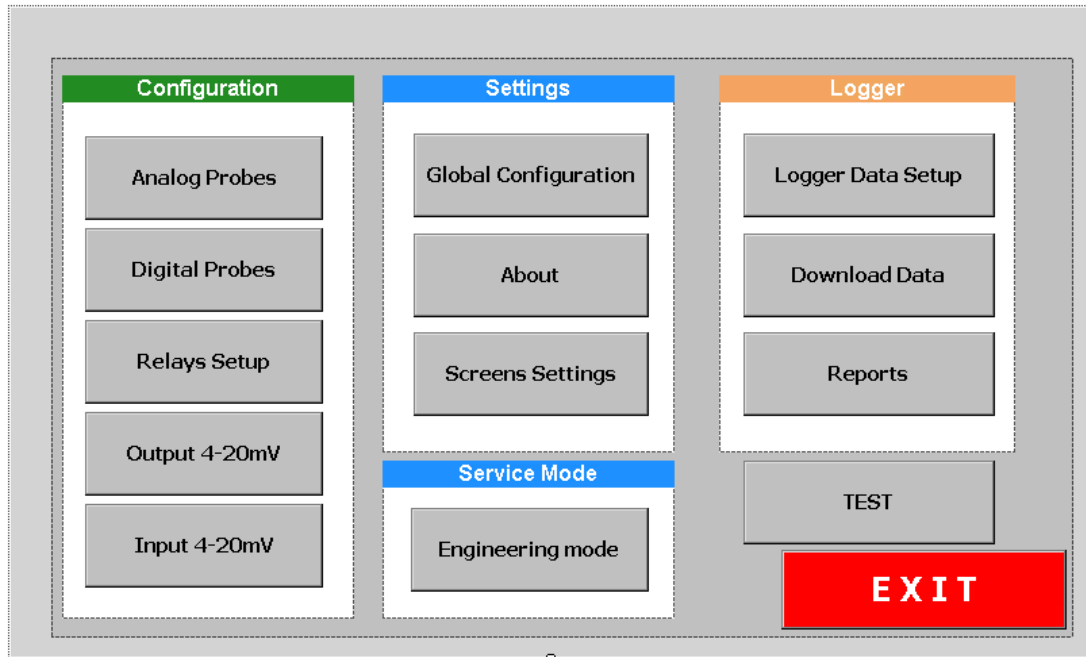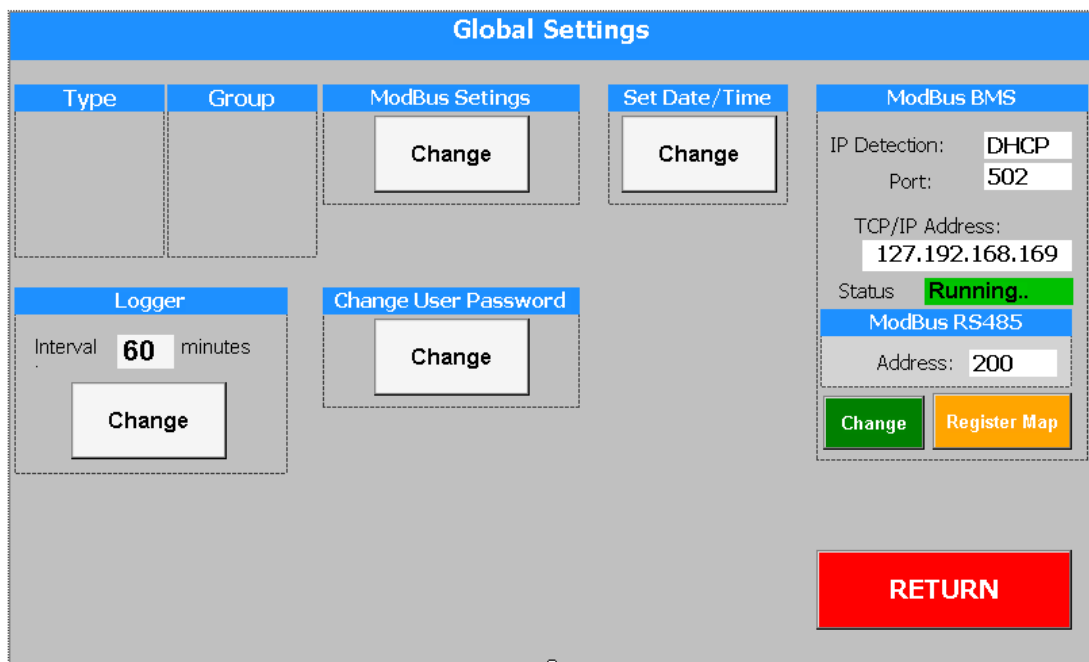| Name	Reg. HEX	Reg. DEC
Internal pH	0x006E	110
USI 4-20mA Input 1	0x0070	112
USI 4-20mA Input 2	0x0072	114
USI 4-20mA Input 3	0x0074	116
USI 4-20mA Output 1	0x0076	118
USI 4-20mA Output 2	0x0078	120
Expansion Board	-	-
ISE 1	0x00DC	220
ISE 2	0x00DE	222
ISE 3	0x00E0	224
ISE 4	0x00E2	226
Modbus 1 Parameter 1	0x014A	330
Modbus 1 Parameter 2	0x014C	332
Modbus 1 Parameter 3	0x014E	334
Modbus 1 Parameter 4	0x0150	338
Modbus 2 Parameter 1	0x01B8	440
Modbus 2 Parameter 2	0x01BA	442
Modbus 2 Parameter 3	0x01BC	444
Modbus 2 Parameter 4	0x01BE	446
Modbus 3 Parameter 1	0x0226	550
Modbus 3 Parameter 2	0x0228	552
Modbus 3 Parameter 3	0x022A	554
Modbus 3 Parameter 4	0x022C	556

Figure 1.1 Modbus Register Table.

4.3. Accessing the Modbus Registers.

The registers can be read either individually or as a block of 4 (allowing all parameters from a single probe to read).

Examples of common Modbus requests are shown in the table below:

PARAMETER	ADDRESS	COMMAND	REGISTER	no.REG	CRC
internal pH	D5	03	006E	0002	B7 C2
ISE1	D5	03	00DC	0002	17 E5
ISE2	D5	03	00DE	0002	b6 25
ISE3	D5	03	00E0	0002	d7 e9
ISE4	D5	03	00E2	0002	76 29
ISE ALL VALUES	D5	03	00DC	0008	97 E2
PROBE 1 PARA1	D5	03	014A	0002	F6 35
PROBE 1 PARA2	D5	03	014C	0002	16 34
PROBE 1 PARA3	D5	03	014E	0002	B7 F4
PROBE 1 PARA4	D5	03	0150	0002	D7 F2
PROBE1 ALL VALUES	D5	03	014A	0008	76 32

PARAMETER	ADDRESS	COMMAND	REGISTER	no.REG	CRC
PROBE 2 PARA1	D5	03	01B8	0002	57 C6
PROBE 2 PARA2	D5	03	01BA	0002	F6 06
PROBE 2 PARA3	D5	03	01BC	0002	16 07
PROBE 2 PARA4	D5	03	01BE	0002	B7 C7
PROBE2 ALL VALUES	D5	03	01B8	0008	D7 C1

PARAMETER	ADDRESS	COMMAND	REGISTER	no.REG	CRC
PROBE 3 PARA1	D5	03	0226	0002	36 6C
PROBE 3 PARA2	D5	03	0228	0002	57 AF
PROBE 3 PARA3	D5	03	022A	0002	F6 6F
PROBE 3 PARA4	D5	03	022C	0002	16 6E
PROBE1 ALL VALUES	D5	03	0226	0008	B6 6B

Figure 1.2 Common Modbus Commands.

- Relays

Objective: Configure a relay to be triggered when one of the reading cross a set point

Table 4.4 Relay Setup Table.

Description:

- You can configure up to 6 relays independently

- For each relay you need to select:

  ◦ The reading on which the relay will be triggered (or disabled if the relay is not used)

  ◦ The On and the Off-set point.

- Outputs

Objective: Configure outputs

Figure 4.5 Modbus Table.

Description:

- 4-20mA Outputs 1 and 2: Configure a 4-20mA output to be controlled by one of the readings. For each output you need to configure:

  ◦ Type: The reading which is output

  ◦ The value equivalent to 4mA and 20mA

  ◦ Test: This option can be used to test that the output is correctly configured and working.

- About

Objective: Display information relative to the equipment and Smart Storm Ltd.

Figure 4.6 About Us Screen.

- Engineer

Note: This page is only accessible when logged as an Engineer

Objective: Provide option for the engineer

Figure 4.7 Engineering Menu.

Description:

- Terminate: Close the application. The terminate password is required to terminate the application

- Cancel autostart: The next time the equipment is turned off, the application will not start. See Section VIII-C for information on how to re-install the application.

- Calibrate mA: Calibrate the mA output. See section VIII-D for information on how to calibrate the mA output.

- Test relays: Test the relays. See Section VIII-E for information on how to test the relays.

- **Logger**

Objective: Download the data logged on the internal memory, to a USB stick

Plug the memory stick on one of the USI usb port and select the relevant month needed and press download. He data will be saved in the memory stick as .USC file which can be interpreted by using inquisitor 11 downloaded on https://www.smartstormgroup.com

However, depending on the availability of data, the button will display green initiating the presence of data and gray for the absence of data during that month. Only 3 months can be downloadable at a time.
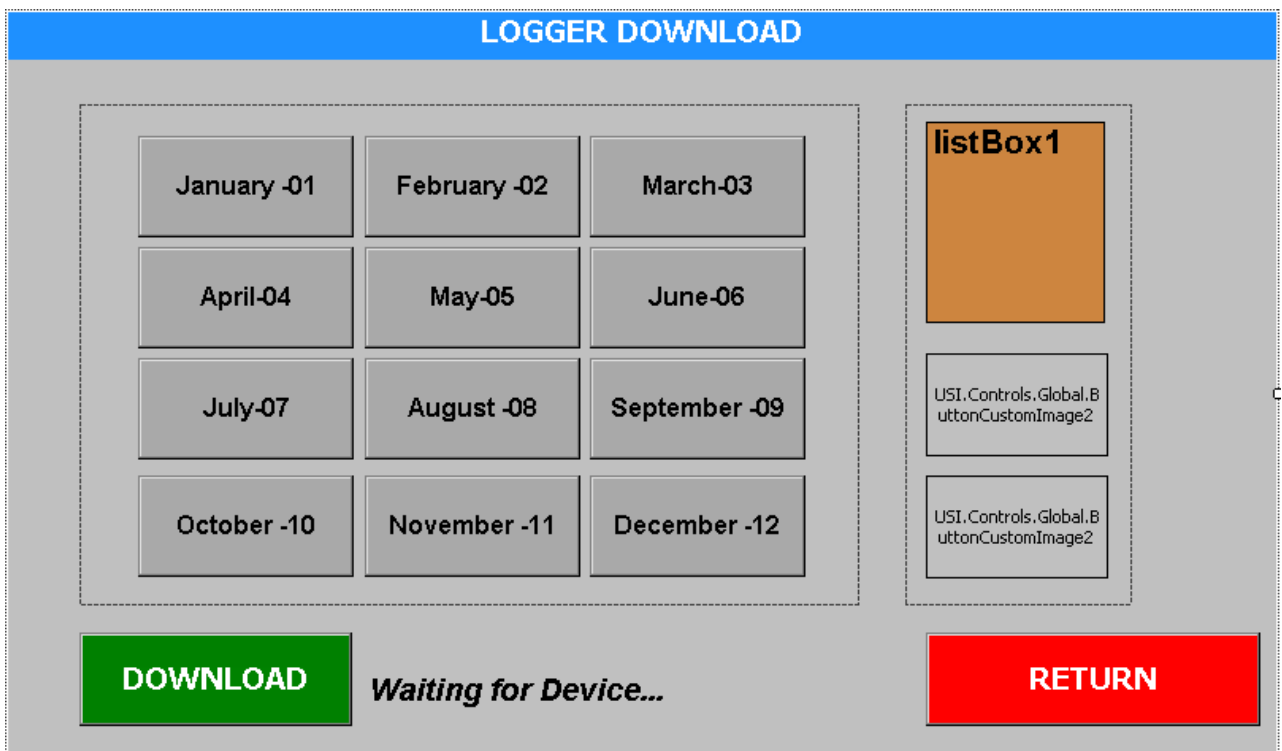
Figure 4.8 Logger Download Table.

Description:

- See section VIII-A for more information on the download process

- **Modbus Expansion Board**

+Ve	-Ve	SCR		SDI	A	B		SDI	A	B		SDI	A	B		SDI	A	B
				-Ve	+Ve	SCR		-Ve	+Ve	SCR		-Ve	+Ve	SCR		-Ve	+Ve	SCR

Vdc IN   USI IN   PROBE 1   PROBE 2   PROBE 3
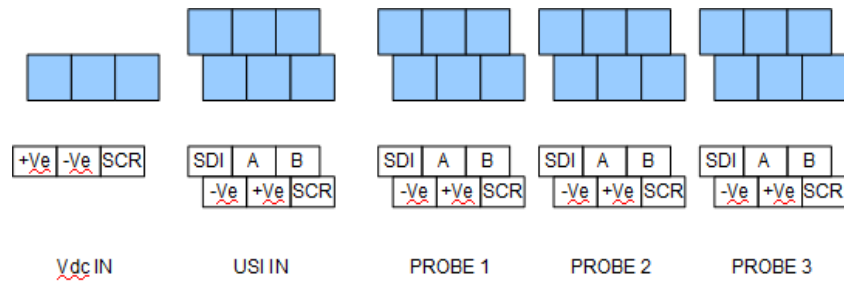
- USI

- The Red wire must connect to the "+Ve"
- The Black wire must be connected to the "-Ve"
- The White wire must be connected to the "A"
- The Green wire must be connected the "B"
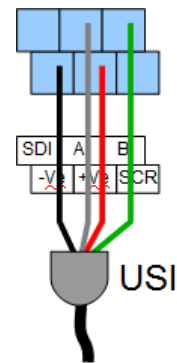
- Modbus probe

- The Red wire must connect to the "+Ve"
- The Black wire must be connected to the "-Ve"
- The White wire must be connected to the "A"
- The Green wire must be connected the "B"
- The Blue wire must be connected the "SDI"
- The Yellow/Green wire must be connected the "SCR"

- ## **How to**

  - ### **Download**

The USI store the data it logs on its internal memory. To analyse those data, it is necessary to download them, using a USB Memory Stick.

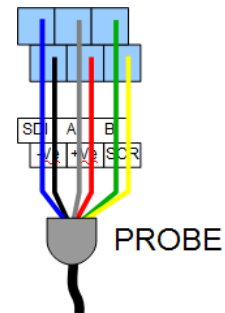| NOTICE |
|---|
| To ensure optimal performance, the USB must be formatted in the FAT file system. Any other file system (such as NTFS or FAT32), could potentially cause issue during the detection of the USB memory stick or during the download. |

The data are download on the USB Memory Stick in a folder named using the "SiteName" and "SiteID" entered on the "Setup->System" page of the application.

Each month of data is downloaded as a separate CSV file.

Existing files on the USB Memory Stick are overwritten during the download unless the size of both files is different.

To download the data, follow those instructions:

1. Press the "Logger" menu button and enter your password.

2. Insert your USB Memory Stick. The device will try to detect it.

3. If after 30 seconds, the USB Memory Stick has not been detected, you can manually restart the detection. The detection can fail if:

    1. The USB stick is not in the FAT file system.

        ▪ Insert the USB Memory Stick on a PC and format it.

    2. The USB Memory Stick has been inserted into its port late in the detection.

        ▪ Restart the detection

    3. The USB Memory Stick is not connected properly.

        ▪ Remove the USB Memory Stick, insert it back and restart the detection.

4. If the USB Memory Stick has been detected, you can now have selected the range of data to be download.

5. Once the range has been selected, press "Start Download". Do NOT remove the USB Memory Stick during the download as this could damage the USB Memory Stick.

6. You can stop the download at any time by pressing "Stop Download". Please note that the device will finish the download of the current month before stopping.

7. At the end of the download, a confirmation box will appear.

8. Close the window and remove your USB Memory Stick.

9. Press the "Run" menu button to return to the run screen.

- **Calibrate milliamp output**

Note: To calibrate the milliamp output, it is necessary to have a multimeter.

Moreover, for a precise reading, it is recommended to connect a resistor on the 4-20mA Output connector of the Relay Board and measure the voltage across that resistor.

To calibrate the milliamp output, go in Setup>Engineer (you need to use the engineer password to access this page), and press the "Calibrate mA" button. This new window will appear:

1. Select the output you want to calibrate by pressing the corresponding the radio button at the top

2. Press the field next to the 4mA

3. Measure the milliamp reading on the output

4. Enter this value in the field

5. Repeat step 2, 3 and 4 for the 20-mA field.

6. Press saves to validate the calibration.

7. You can now use the test field to verify the calibration.

    1. Press the field

    2. Enter any value

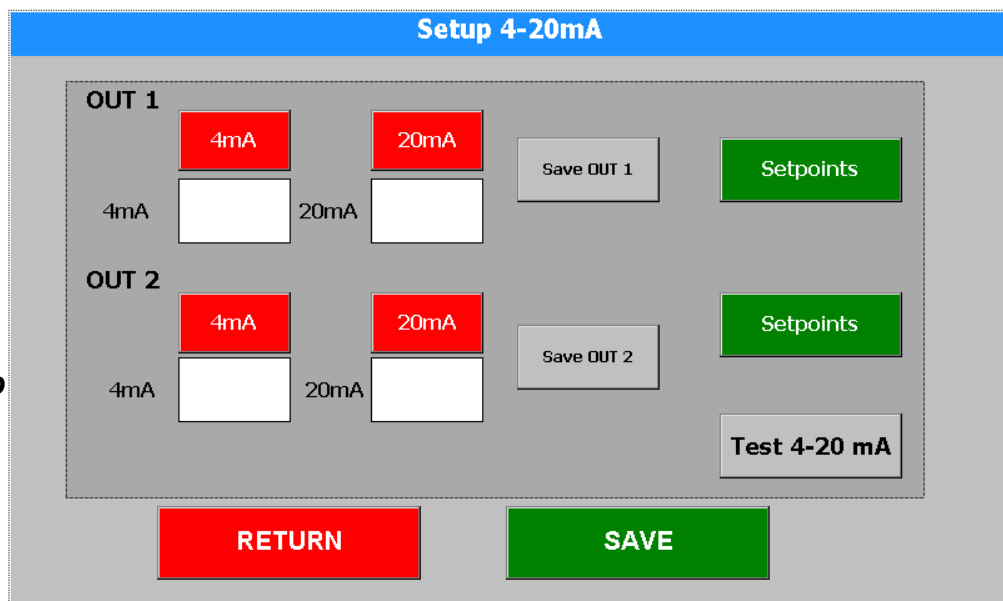   3. Compare the value entered with the value measured.

Figure 4.9 Setup 4-20mA

- **Test relays**

To test the relay, go into Setup>Engineer (you need to use the engineer password to access this page) and press the "Test Relays" button.

This new window will appear:

Each box represents a relay, in the same order as the LED on the front panel.

Press a button to change its state. If the relay is opened (off), the box will be black. Otherwise, the box will be red.
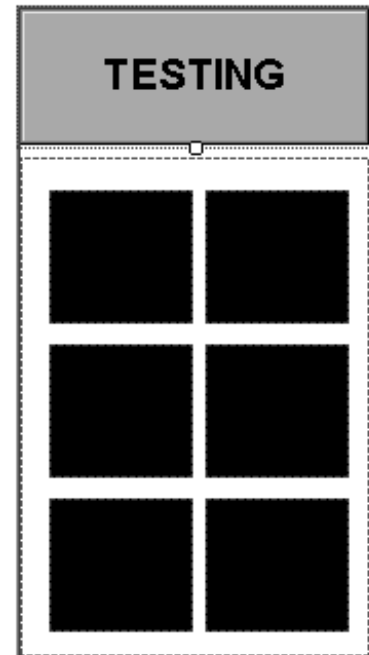

4.1. USI Enclosure

The USI enclosure is IP65 rated only with its cover fully closed. Always mount on a vertical surface and avoid mounting in direct sunlight. Ensure that the lower wiring compartment can be easily accessed.

A small number of glands are provided for cable entry. Should additional glands be required place masking tape across the bottom of the enclosure and mark their position. Drill a pilot hole first and then using a cone cutter drill the hole to accommodate the gland. This must be performed with light pressure in order to avoid the drill bit over running and damaging the circuit board. If you are in doubt remove the circuit boards from the enclosure before performing this task but be sure to place the surface boards on a conductive surface (metal, aluminium foil) whilst out of the USI enclosure to avoid static damage.

It is preferable to connect the USI through a mains isolator or a fused spur rather than direct to a mains socket. This allows the USI to be isolated whilst wiring in connectors and performing maintenance.

5. Dimensions

All dimensions are in millimetres.
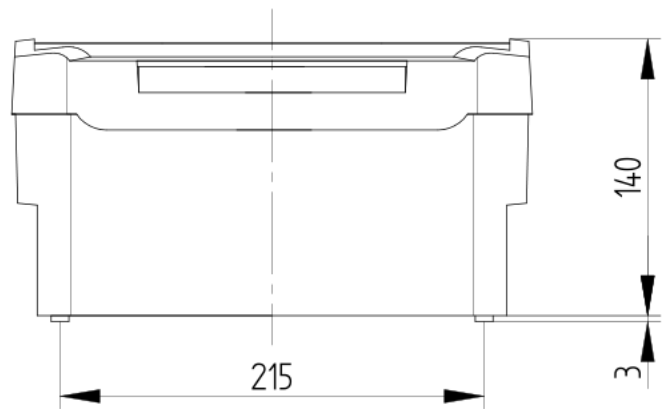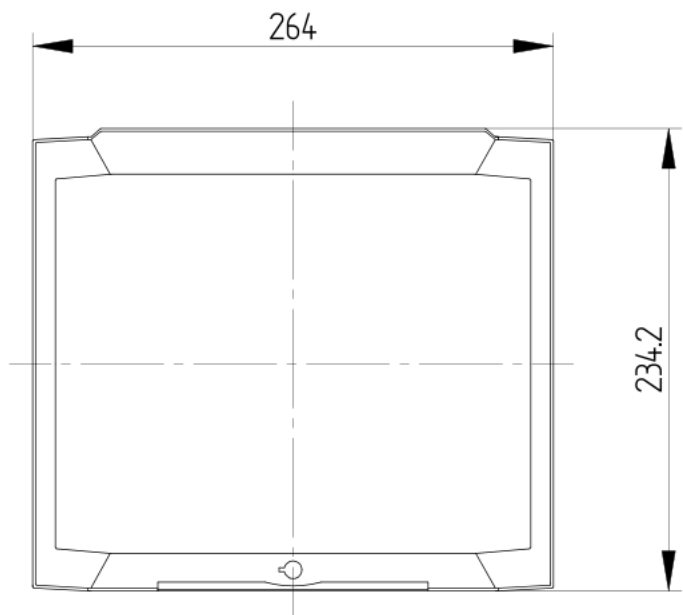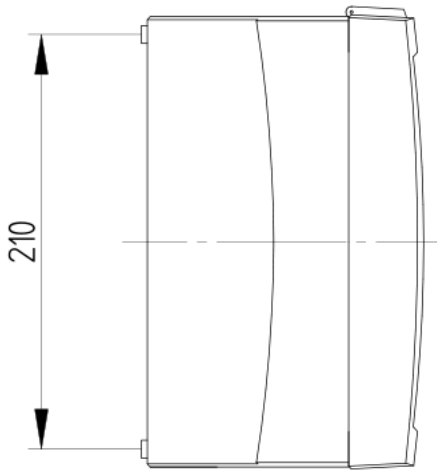
6. Declaration of Conformity

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.

Standard	Issue
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