USI Flow

USER MANUAL

Version – 2.1

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1 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

2 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.

4 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.

5 Revision History

Version	Date	Modifications	Approved by SSL
V1.0	21/09/2012	Original	V CHAPRONT
V2.0	18/03/2013	Change UI, added dimensional diagram	V CHAPRONT
V2.1	12/08/2015	Added wiring diagram for Modbus expansion board	V CHAPRONT

Welcome to the USI (Universal Smart Instrument). The USI uses intuitive programming through its touch screen display. The user will navigate through the different screen with ease to calibrate, programme and display chosen options. This largely negates the need for a detailed instruction manual and provided the user is familiar with the generic terms (see glossary) he or she should enjoy trouble-free operation.

Notes:

- **To change a programming parameter, touch/tap the relevant box and a pop-up menu option or a keypad will appear. Make your preferred choice or enter a numerical value and press enter.**
- **When you have programmed the USI you should tap the run button. The USI will ask you to either save any changes that you have made or ask you to discard them.**

6 Operation

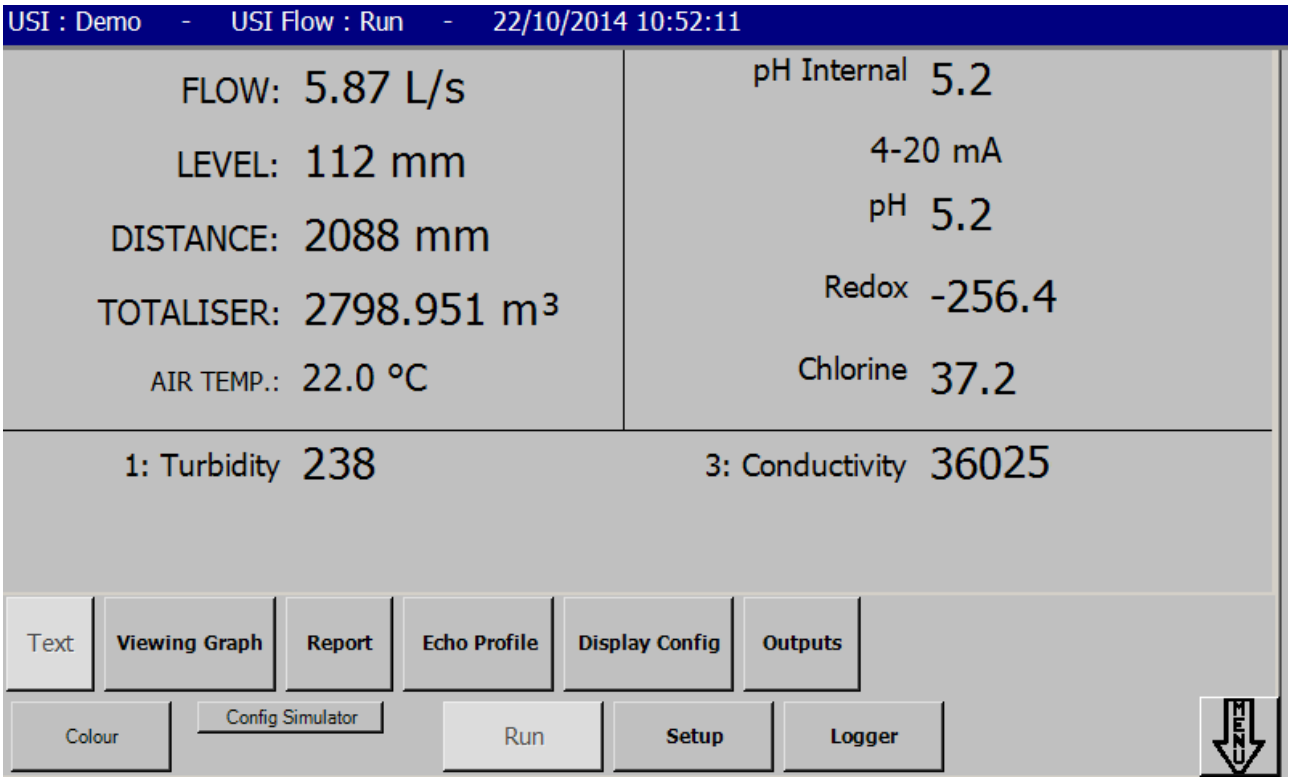
6.1 Run

When the USI is switched on it will load its current mode of operation, ie flow, level, environmental etc. It will then automatically run the programme with the factory set defaults. The user at this stage must programme the unit for his/her application.

At the bottom of the screen the user will find the touch screen menu buttons which are now described.

6.1.1 Text

What: Displays the current readings of all programmed inputs, outputs, status etc.

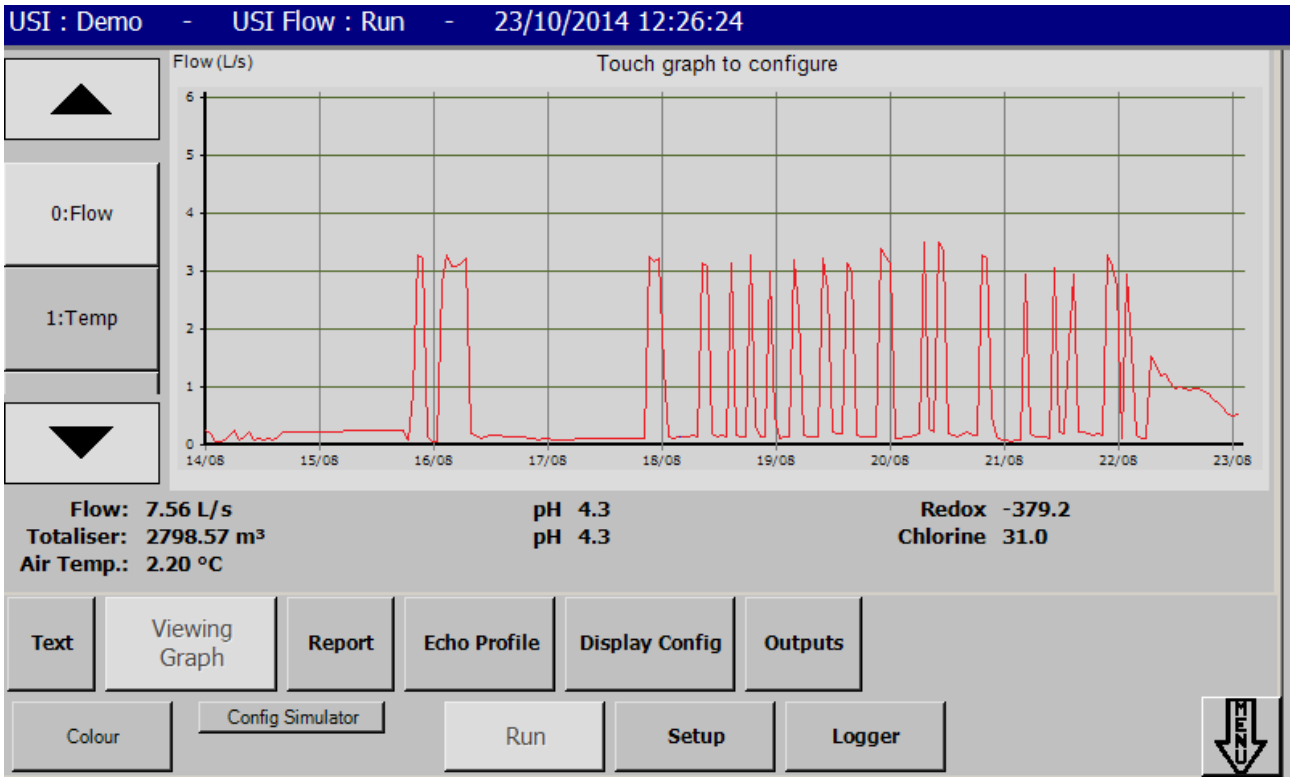


Description:

- Displays the value of Flow, Temperature, Totaliser, and all of the defined inputs.
- The box below the value displays the daily readings of the last 7 days. Scroll to view.

6.1.2 Graph

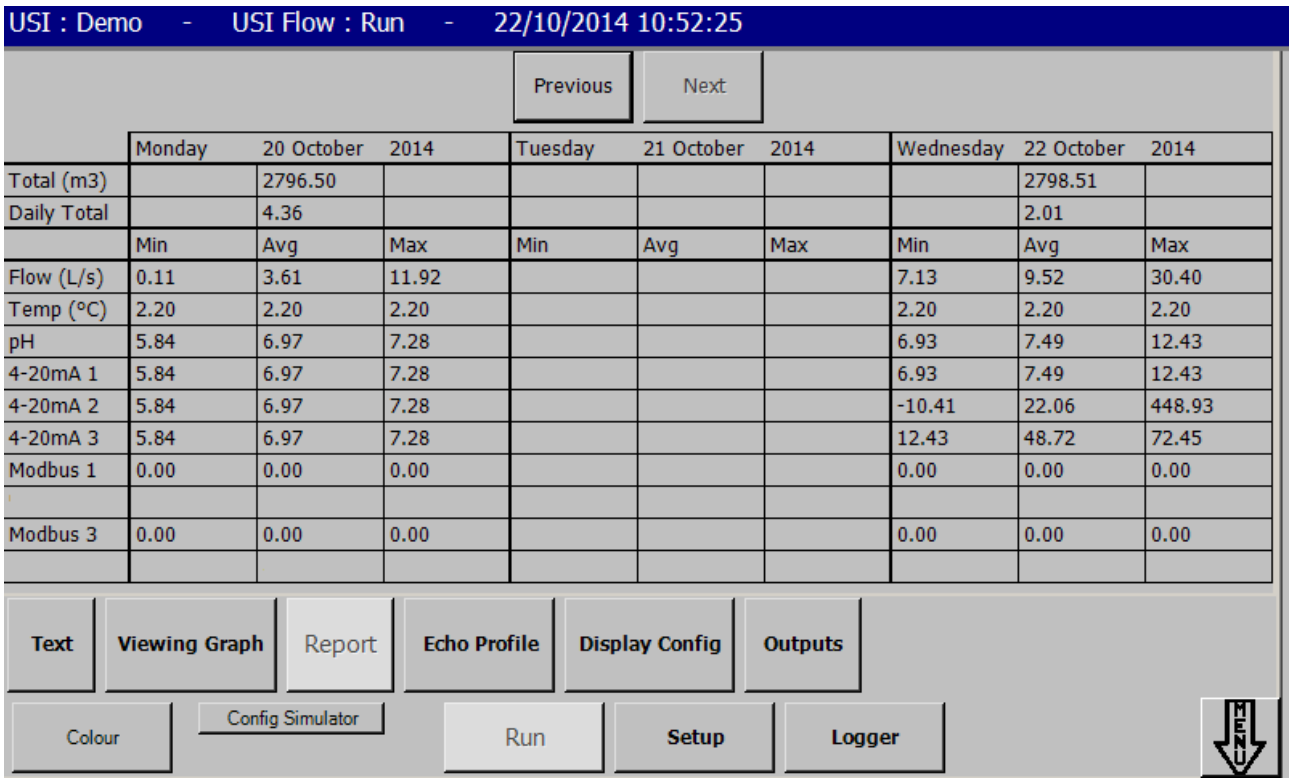
What: Shows the measured readings as a graph.



Description:

- Shows each reading as a graph. Where there is more than one measured input each will have a button allowing the user to display its associated graphical information.
- The range of the graph is defined in Setup-System (see section 2.2.1 System).
- Tapping the graph screen allows the user to adjust its scaling.

6.1.3 Report

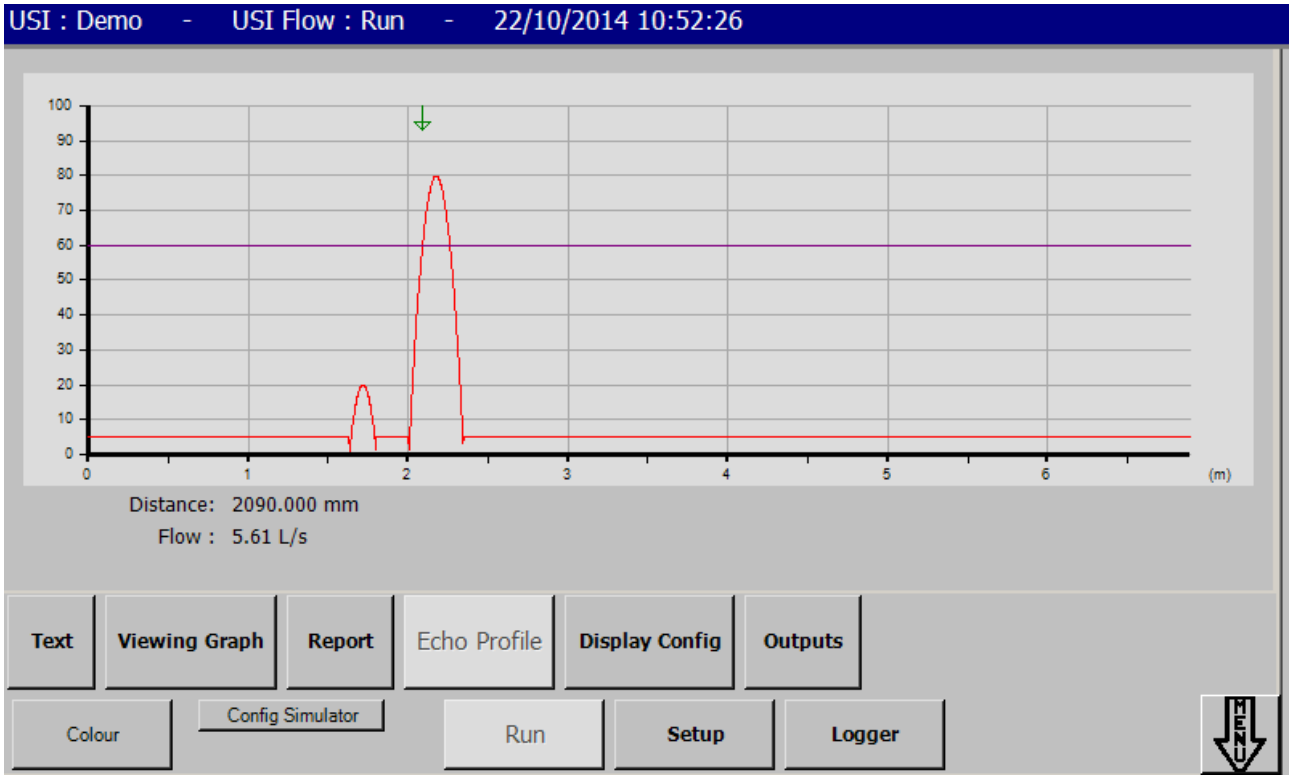


	Monday	20 October	2014	Tuesday	21 October	2014	Wednesday	22 October	2014
Total (m3)		2796.50						2798.51	
Daily Total		4.36						2.01	
	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max
Flow (L/s)	0.11	3.61	11.92				7.13	9.52	30.40
Temp (°C)	2.20	2.20	2.20				2.20	2.20	2.20
pH	5.84	6.97	7.28				6.93	7.49	12.43
4-20mA 1	5.84	6.97	7.28				6.93	7.49	12.43
4-20mA 2	5.84	6.97	7.28				-10.41	22.06	448.93
4-20mA 3	5.84	6.97	7.28				12.43	48.72	72.45
Modbus 1	0.00	0.00	0.00				0.00	0.00	0.00
Modbus 3	0.00	0.00	0.00				0.00	0.00	0.00

What: This shows the daily summary for each input, for the last 7 days.

6.1.4 Echo Profile

What: This shows the actual real time echo signal received by the ultrasonic sensor. This is only shown where airborne ultrasonic sensors are attached for either flow of level applications.

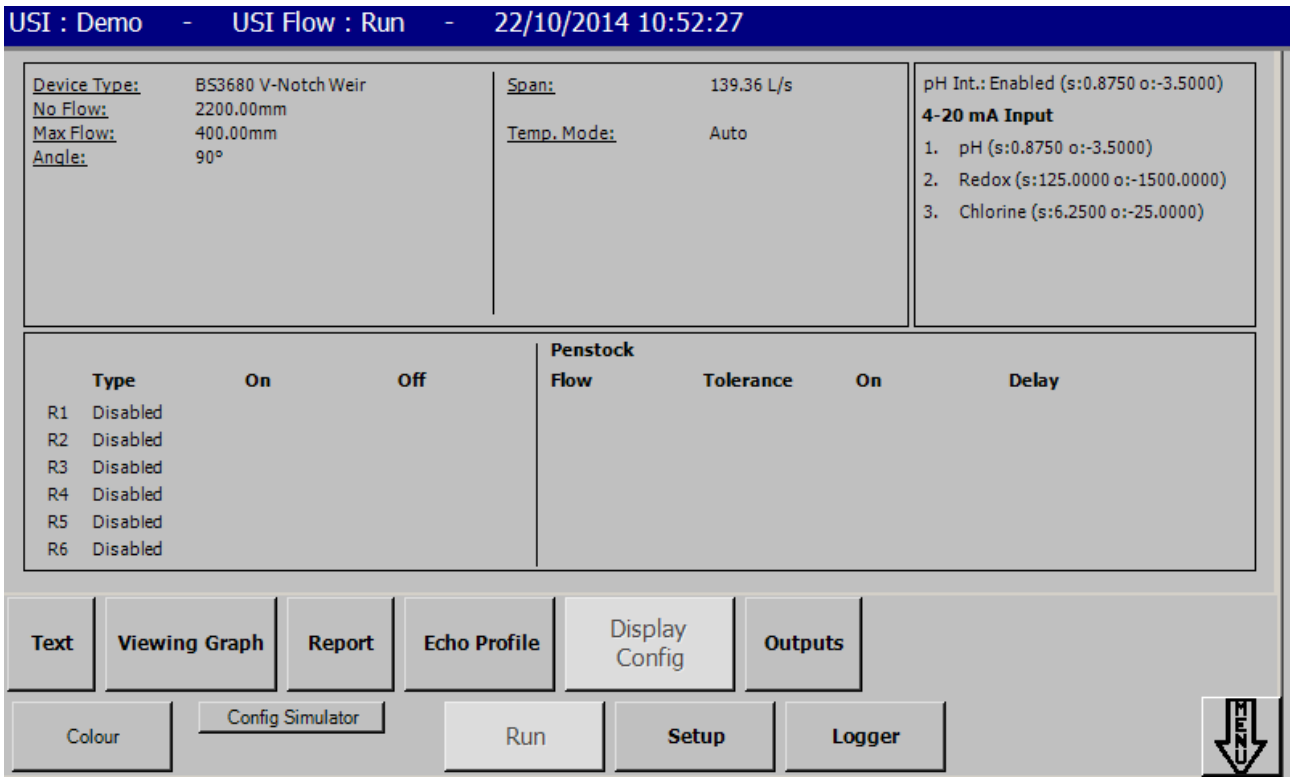


Description:

- The signal received by the sensor is displayed on the graph.
- The distance calculated is shown by a green arrow at the top of the graph.

6.1.5 Display Config

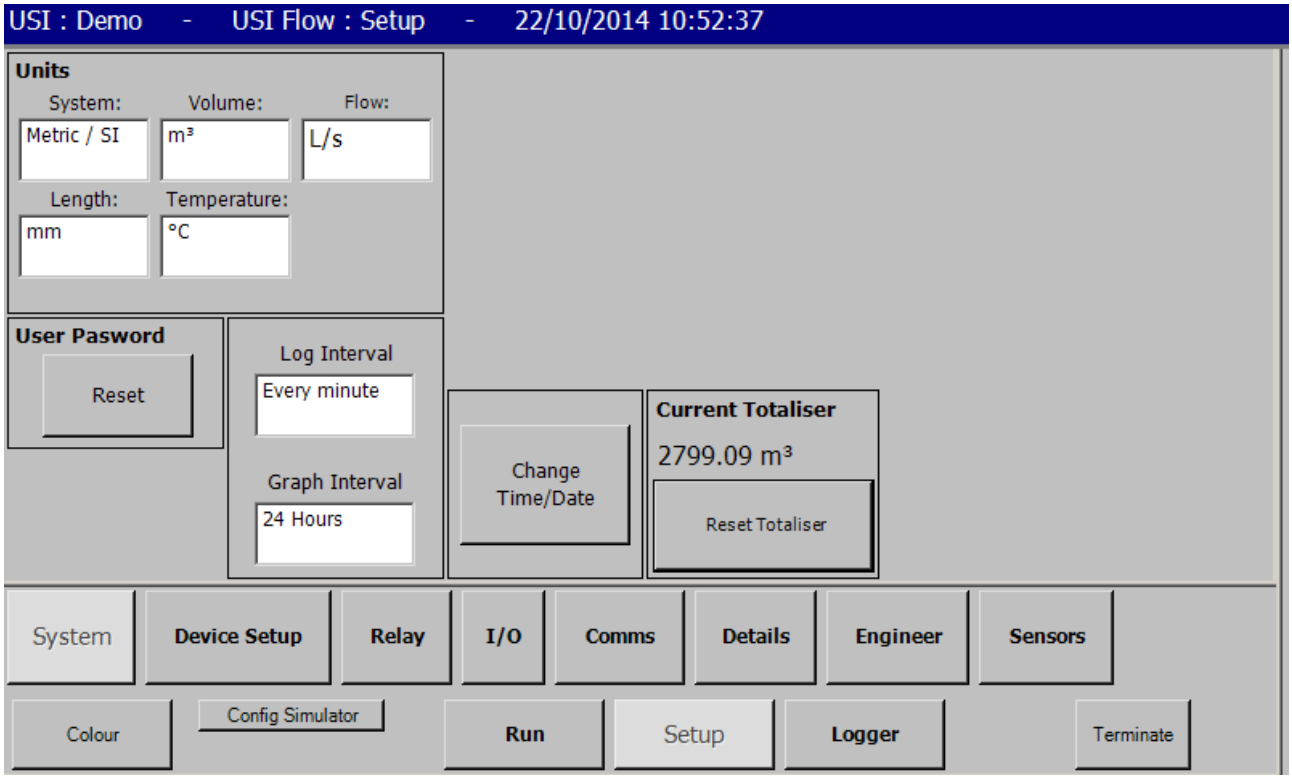
What: Shows the current programmed configuration of the USI.



6.2 Setup

6.2.1 System

What: Configure the USI for Measurement.

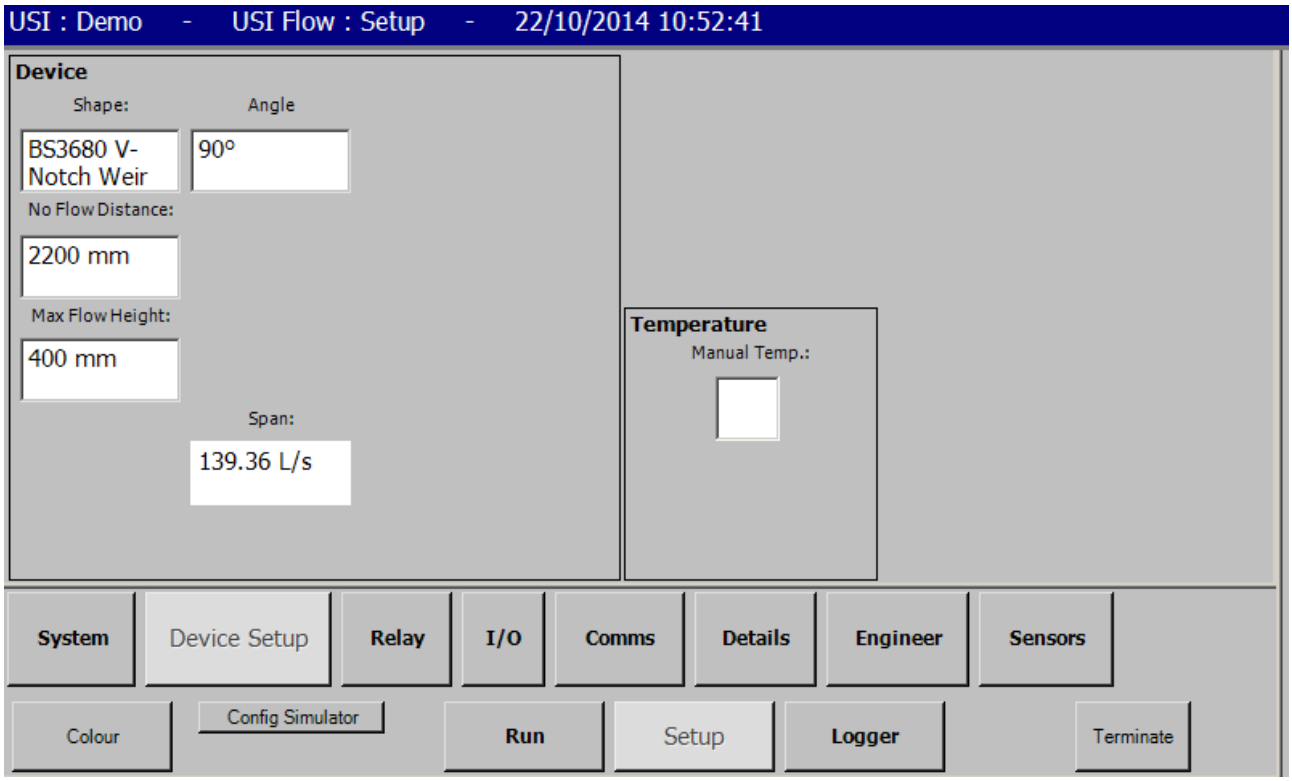


Description:

- Units: Set the units used to display value. If the system of units (Metric or Imperial) is changed, the USI will have to be reset to its factory settings. Please download any data before doing that (see section 3.1 Download on page 17);
- Log Interval: Define the time between each logged value. The USI will read value every seconds on that interval and logged the average at the end of the interval;
- Communication: Enable and configure the Ethernet capabilities. The IP address and the password will be required to connect to the USI.
- User Password: **Factory default is 0001**

6.2.2 Device

What: Defines the primary device used to measure the flow.



Description:

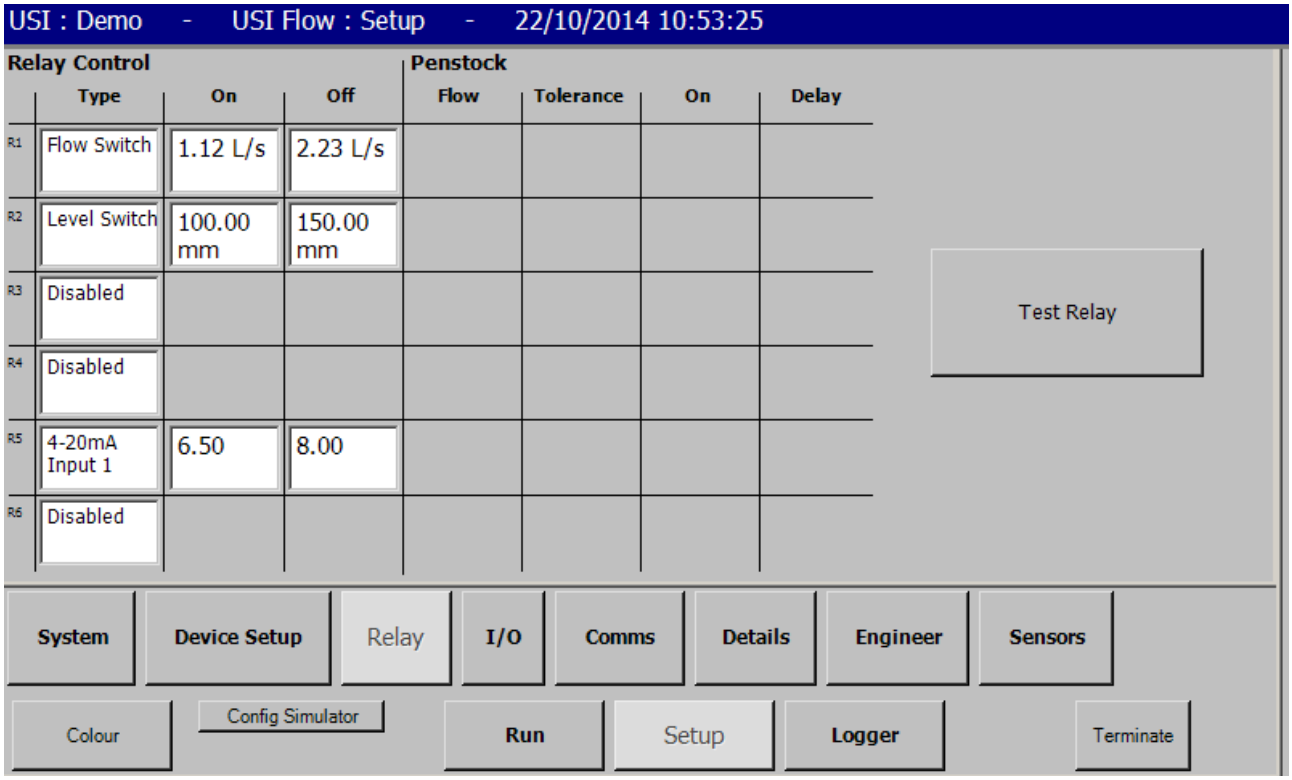
- Device: Describe the type the dimensions of the device used to measure the flow (for more details, see section 3.3 Define Device on page 17)
- Temperature: If "Manual temp." is checked, the USI will use a user defined temperature to calculate the distance, otherwise the temperature read by the sensor will be used.
- Span: The USI calculates the maximum flow span for the dimensions programmed.

Calibration

To calibrate the flow meter with the primary device you must enter the distance from the sensor to the zero flow point of the primary device. This is the bottom of the notch on V-notch weir and a rectangular flume and the bottom of the channel in a flume. **See Setup Section.**
Do not use a tape measure or rule to make this measurement.
Ensure no flow is flowing through the primary device and put the USI into run mode. Record the distance that is displayed on the USI screen. This is an accurate measurement of the zero calibration point. Enter this value as the "No Flow Distance".

6.2.3 Relay

What: Configuration screen for the relays.

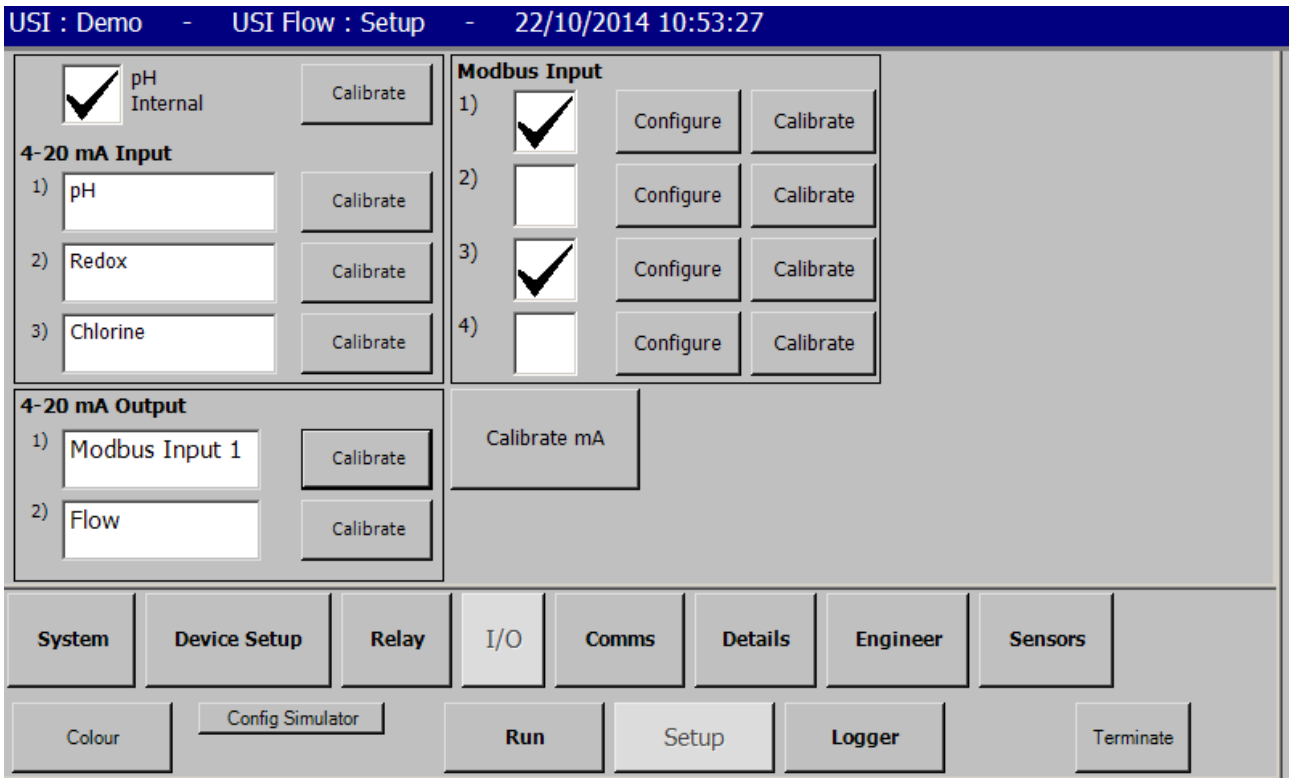


Description:

- Up to 6 relays can be configured at the same time.
- Relays can be configured as:
    - Flow switch: start when the flow goes below (or above) the defined ON, and stop when the flow goes above (or below) the defined OFF point;
    - Sampler: start for 1 second every time the flow meter record the defined volume (ON point)
    - Penstock Up and Penstock Down: Control a penstock gate
    - Parameters: Conductivity, Temperature, Turbidity, DO, pH.
    - To programme a relay simply tap the relevant box and choose from the pop-up list or enter values when a pop-up keyboard appears. Save values before proceeding.

6.2.4 I/O

What: Defines inputs and outputs.

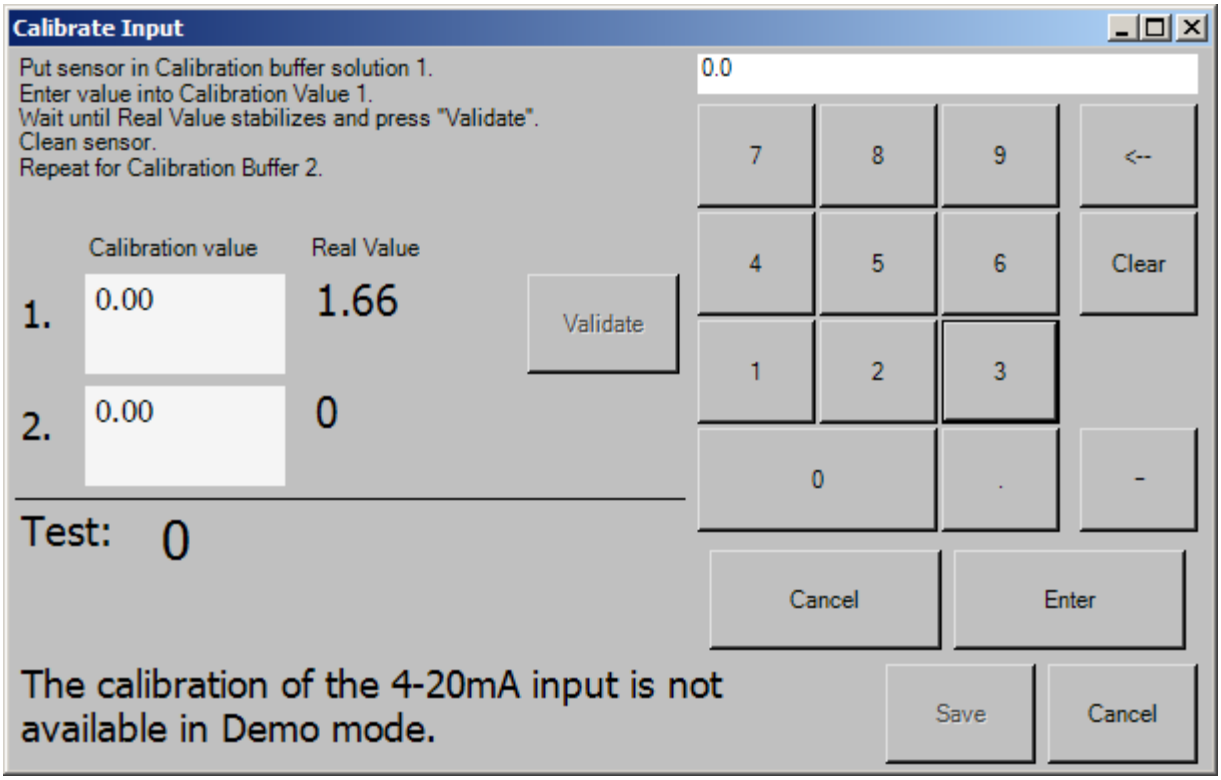


Description:

- Can read up to three 4-20mA input channel, 1 internal pH, 4 modbus environmental sensors and can write to up to 2 4-20mA output channel.
- When an input is defined, it has to be calibrated (see section 2.2.5 Calibrate Input on page 12).
- The USI has a dedicated pH input channel to which a pH probe can be connected. This is know as the pH internal.

6.2.5 Calibrate Input

What: Calibrate the 4-20mA input.

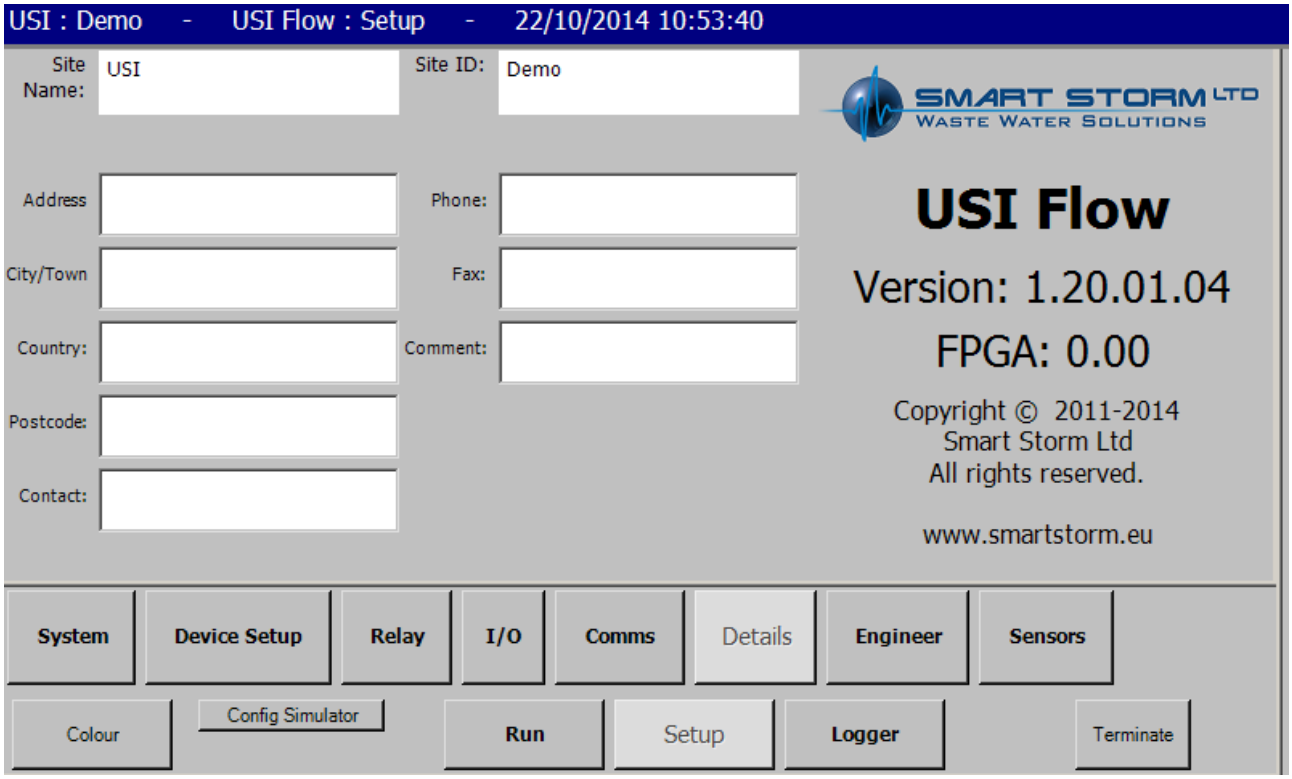


Description:

- Calibrate the 4-20mA input readings by settings two points (for more details, see section 3.2 Calibrate Input on page 17).

6.2.6 Details

What: Details of the site in which the device is installed. This information will appear on any reports generated.

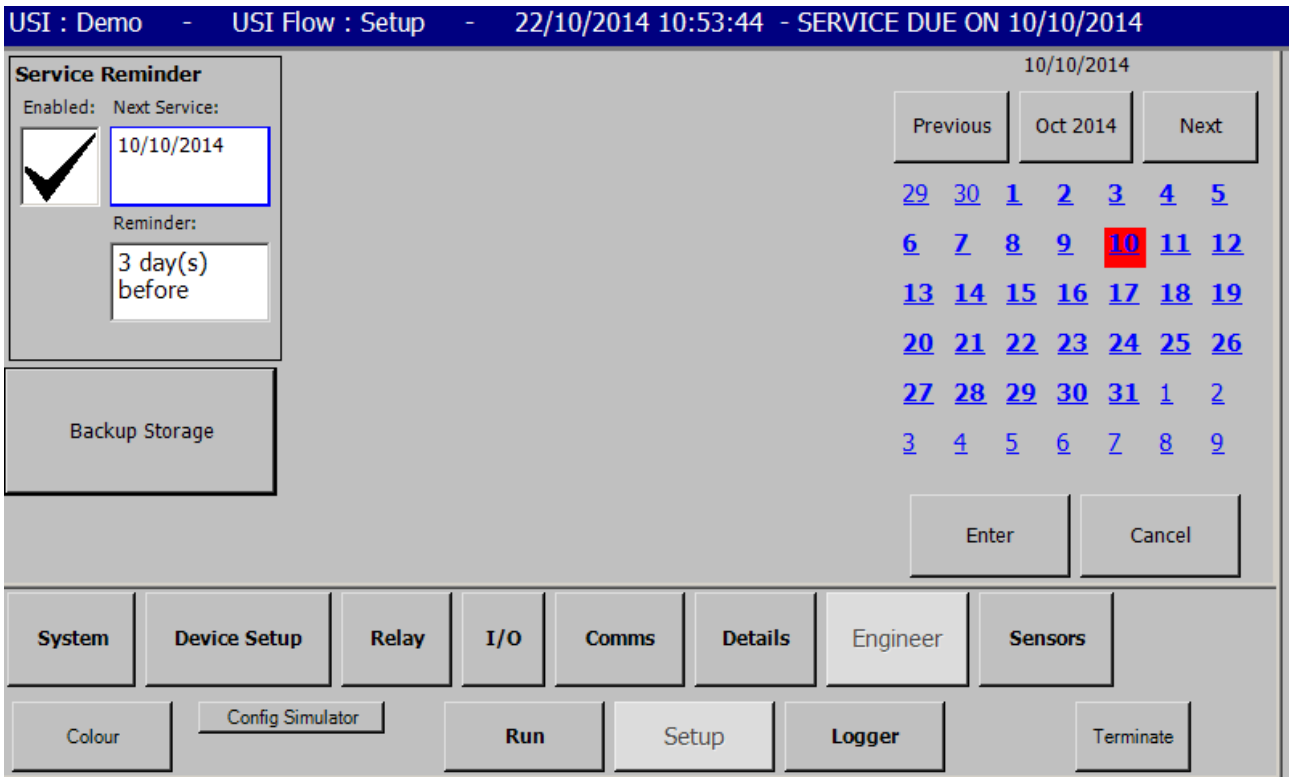


Description:

- The Name and the ID are used to name the data file. Please enter something meaningful to help recognise the file.

6.2.7 Engineer

What: Engineer option. This screen is accessible only when logged as an Engineer.

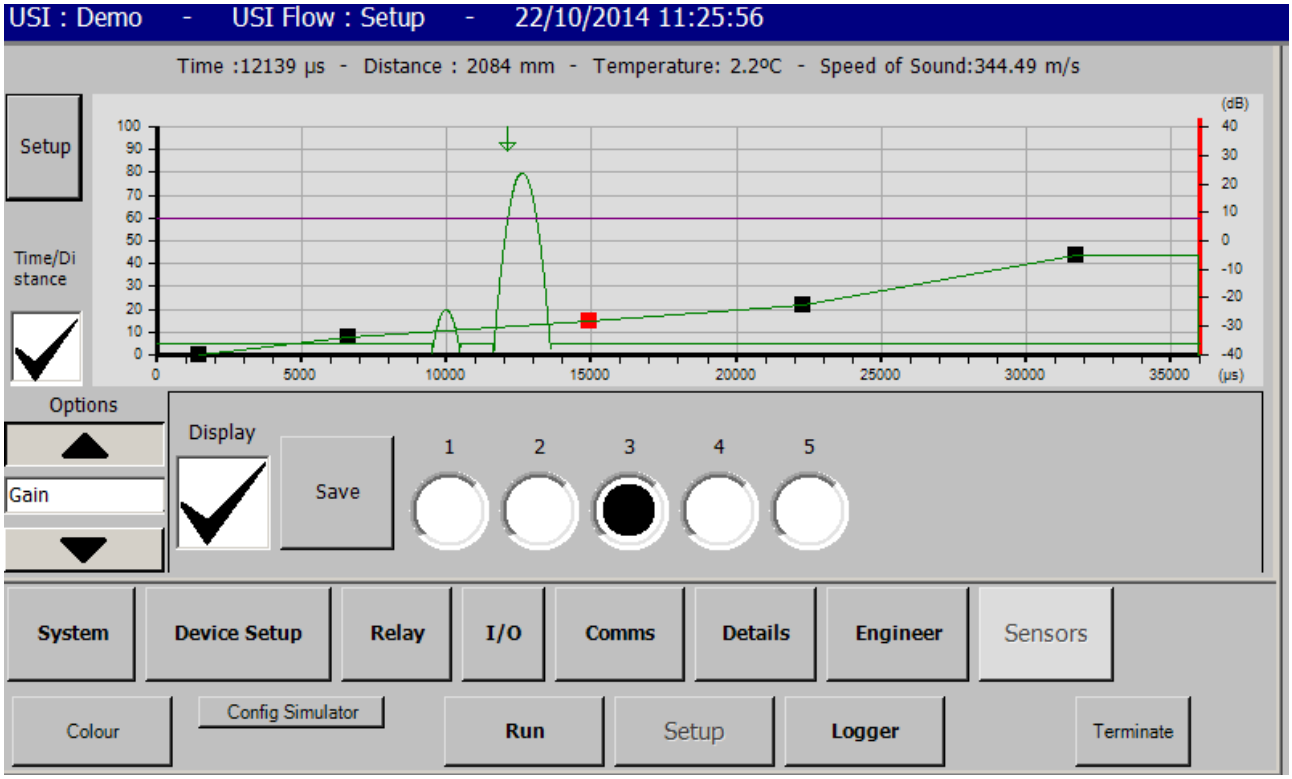


Description:

- Service Reminder: Enable an alarm that will be display when a service is due.

6.2.8 Sensors

What: Display and configure the ultrasonic sensor settings. This screen is accessible only when logged as an Engineer.



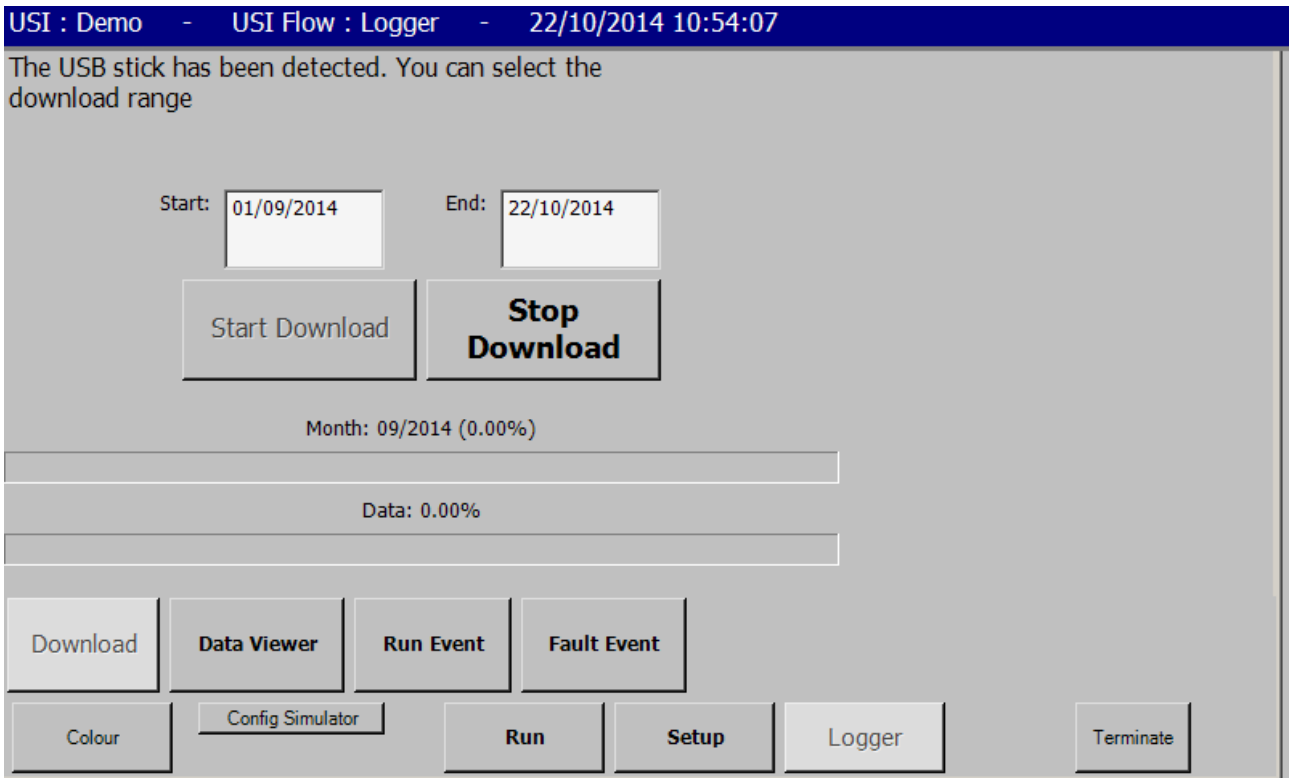
Description:

- This screen should only be used by a trained engineer. It allows the gain on the amplifiers to be changed to cope with very hostile measurement condition

6.3 Logger

6.3.1 Download

What: Enables the user to download data logged on the device onto a USB stick. For further details on how to download, see section 8.1.

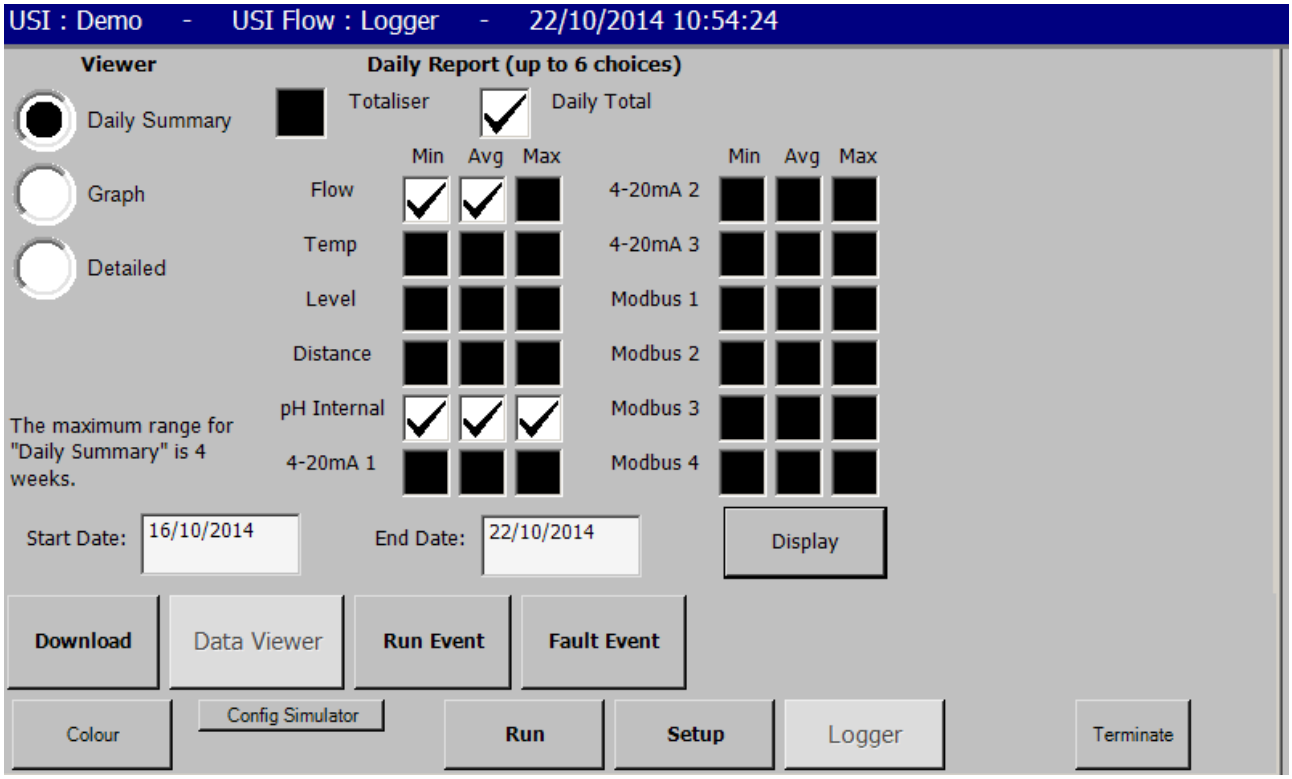


Description:

- When this screen is displayed, the software will automatically try to detect a USB stick.
- Once the USB stick has been found, options to select the start and end date of the download will appears.
- During the download, 2 progress bars will fill to show the current progress of the download.
  - The first bar represents the number of month to download.
  - The second bar represents the quantity of data per month to download.

6.3.2 Data Viewer

What: Configures a viewer to display previous logged data.



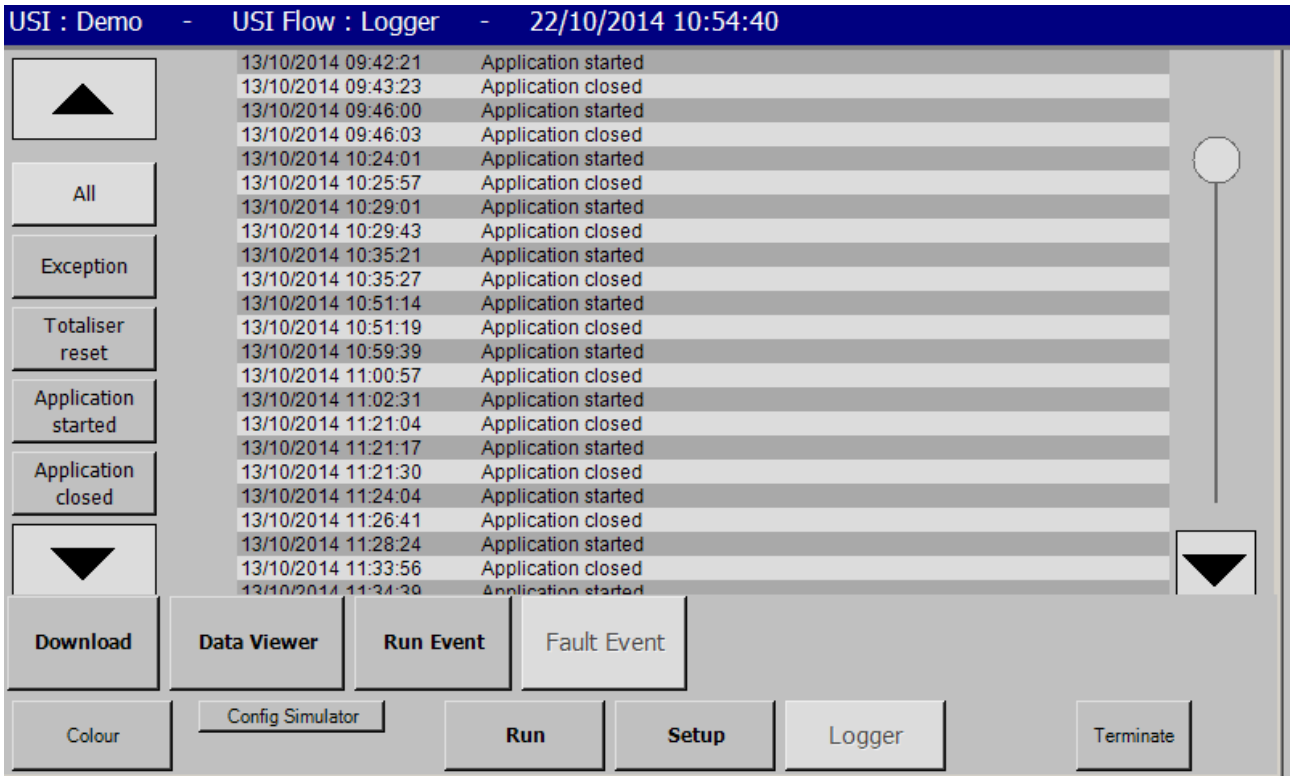
Description:

- 3 difference viewers can be used:
    - Daily: A summary of a daily readings display as a report (range: 4 weeks).
    - Detailed: Detailed readings display as a report (range: 1 day).
    - Graph: Detailed readings display as a graph (range: 4 weeks).

- The range is the maximum amount of data that can be displayed by the viewer. That range can be picked at any point in the logged data.

6.3.3 Run and Fault Event

What: Displays any event logged by the USI.



7 Modbus Registry

The USI can input environmental parameters from its dedicated range of Modbus sensor. The following protocols apply.

	Modbus address	Read/Write		Type	memory box number	
1	0x0001	r	Flow	float	2	
3	0x0003	r	Totaliser	float	2	
5	0x0005	r	Temperature	float	2	
7	0x0007	r	Level	float	2	
9	0x0009	r	Distance	float	2	
11	0x000B	r	ph Internal	float	2	
13	0x000D	r	4-20mA Input 1	float	2	
15	0x000F	r	4-20mA Input 2	float	2	
17	0x0011	r	4-20mA Input 3	float	2	
19	0x0013	r	4-20mA Output 1	float	2	mA generated by the output
21	0x0015	r	4-20mA Output 2	float	2	mA generated by the output
23	0x0017	r	Status	float	2	

STATUS (0x0017)

Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1
Mode		Relay 6	Relay 5	Relay 4	Relay 3	Relay 2	Relay 1
4-20mA Input 1 Type				4-20mA Input 2 Type			
4-20mA Input 3 Type				pH	Data received	Good echo	

Mode	0: Run	1: Setup	2:Logger				
Relay 6	0:Off	1:On					
Relay 5	0:Off	1:On					
Relay 4	0:Off	1:On					
Relay 3	0:Off	1:On					
Relay 2	0:Off	1:On					
Relay 1	0:Off	1:On					
pH Internal	0:Disabled	1:On					
4-20mA Input 3 Type	0: Disabled	1: pH	2:D.O.	3:Chlorine	4:Temperature	5:Redox	6:ADC
4-20mA Input 2 Type							
4-20mA Input 1 Type							

8 How To?

8.1 Download

To download the data logged by the USI:

1. Connect a USB stick to one of the front USB port.
2. Wait approximately 30 seconds for the USI to recognise the USB stick. The USI will only recognise a preferred USB stick and the user should where possible use a USB stick supplied by Smart Storm.
3. Go into the Logger menu. If you were in the Run menu, you will have to enter your password;
4. Go into the Download sub-menu (see section 2.3.1 Download on page 15 for the interface)
5. Press the “Download” button
   - If you have an existing file on your USB stick, the USI will automatically transfer any new data to the file;
   - If you do not have an existing file, you will be asked if you want to download all of the data stored on the USI, or just the one in a time range.
6. Wait until the download is complete;
7. Go back to the Run menu;
8. Remove your USB Stick (it is not necessary to disconnect as in other versions of Windows)

8.2 Calibrate Input

After you have selected a type of value to read from a 4-20mA input channel, you need to calibrate it:

1. On the “IO” sub-menu (see section 6.2.4 IO), press the “Calibrate” button corresponding to your Input.
2. On the “Calibrate Input” window (see section 6.2.5), for each button under “New Value” do the following:

   - Press the button, next to it will be displayed the value read by the 4-20mA using the previous calibration (if the input has never been calibrated before, the previous value will be measured using a default calibration setting)
   - Once the Previous Value is stable, enter the value of the solution using the keypad and press “Enter”.

3. Once both calibration points are set, press “Save”.
4. On the IO sub-menu, press “Read Value” to check the readings with the new calibration setting. You might have to press the button multiple times as the readings are processed

through a moving average filter.

8.3 Programme Device

To configure your device in the USI:

1. Go into the “Setup” menu;
2. Go into the “Device Setup” sub-menu;
3. In “No Flow Distance” enter the distance between the sensor and the bottom of your device;
4. In “Max Flow Height” enter the height of your device;
5. The “Dead-band” is a space that will be invisible to the sensor.
6. In “Shapes” select the correct shape of your device. Each shape will require specific dimension to calculate the flow correctly;
7. The “Span” is the maximum flow that can be measured by the device, and is updated in real time when you change the dimension of your device

Definitions:

No Flow distance: This is the distance from the ultrasonic sensor to the no flow point. For a Weir it is to the bottom of the notch and for a flume it is to the floor of the flume approach channel. Both distances can only be measured when no flow is passing through the primary device.

Max Flow height: This is the distance from the zero flow point up to the maximum permitted height of flow. It may be to the top of the v-notch or the top of the flume throat. Alternatively, the user may define it at any point that he defines maximum flow. About the point, the USI will clamp the flow figure as a maximum even if the level exceeds this point.

Dead Band: This has a minimum value depending on the sensor type. For example the Digison 8 has a minimum deadband of 250mm. This means the sensor is blind and will not measure distances below 250mm. However, the deadband can be extended by the user. This is often used if the sensor sees a false echo from an interfering obstruction such as the edge of the flume. In this case the blanking distance can be extended beyond this point in order to ignore the false echo.

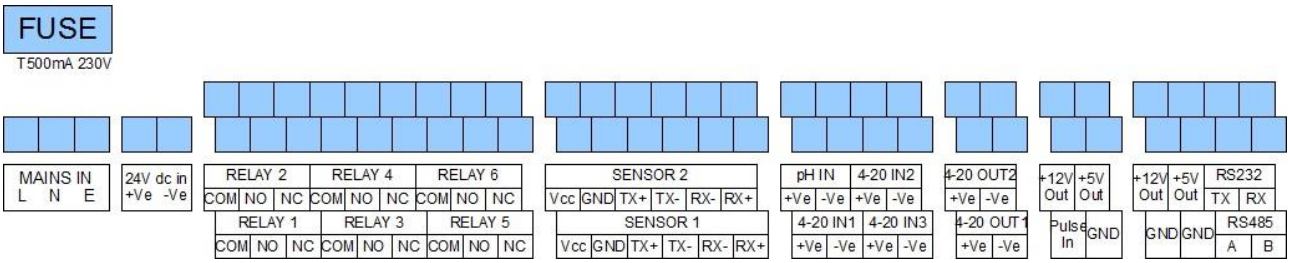
8.4 Updating Software

1. Read the instructions entirely before starting
2. Write down the current readings and settings
3. Insert USB stick
4. Tap “Setup” and enter password 2010
5. Tap “Terminate” and enter password 4279
6. Double tap “My Device”

7. Double tap “Hard Disk”
8. If “Hard Disk” is not present
9. Try to disconnect and reconnect the USB stick
10. Leave the USB stick inserted, turn the power off and turn it back on.
11. Double tap “USI Installer”
12. Double tap “0-Updater.exe”
13. Tap “Update”
14. Wait a few seconds while the unit is updated
15. When the screen turns black, remove the USB stick
16. If you remove it before, the update will fail
17. If you remove it after, the USI software might not autostart. In that case, turn the power off and back on.
18. The unit will automatically restart with the new version of the software
19. Check that the settings and readings are still correct

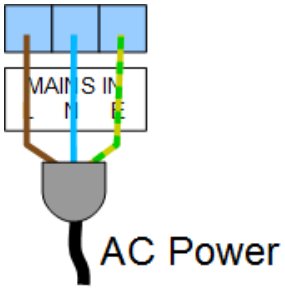
9 Wiring Diagram

9.1 Relay board



9.1.1 AC Power Input

- The Live (typically Red or Brown) must be connected to “L”
- The Neutral (typically Black or Blue) must be connected to “N”
- The Earth (typically Yellow/Green) must be connected to “E”



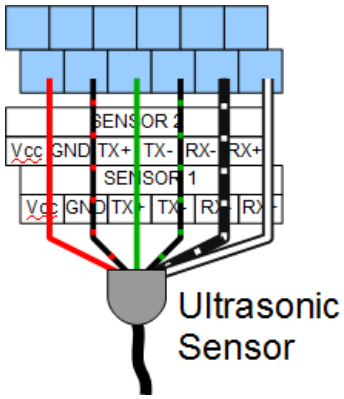
9.1.2 Sensor wiring

The sensor cable consist of three pairs of wires:

Red/Black: Vcc/GND

Green/Black: TX+/TX-

Black/White: Rx-/Rx+



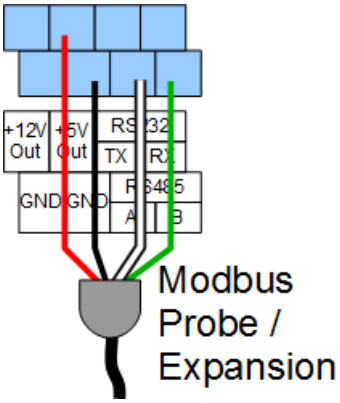
9.1.3 PH Input

Negative: normally screen

Positive: normally core

9.1.4 Modbus probes / Expansion

- The Red wire must connected to the “+5 V out”
- The Black wire must be connected to the “GND”
- The White wire must be connected to the “RS485 A”
- The Green wire must be connected the “RS485 B”

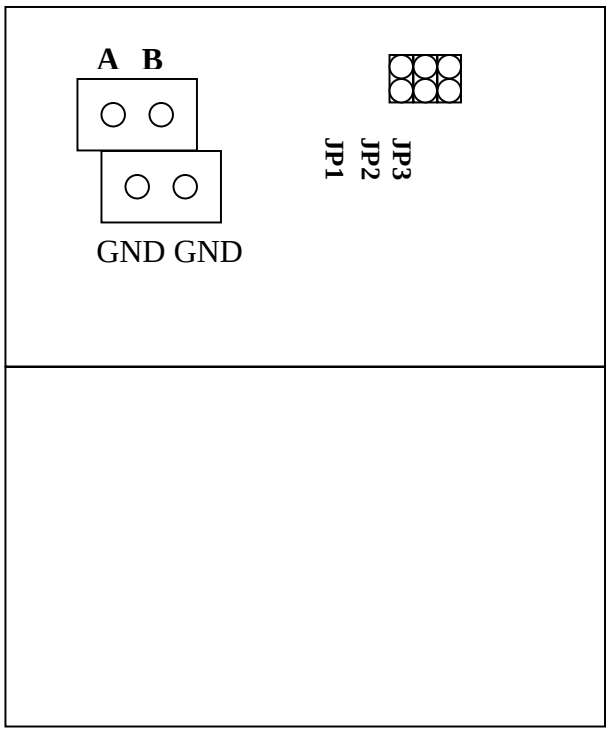


9.1.5 Modbus connection

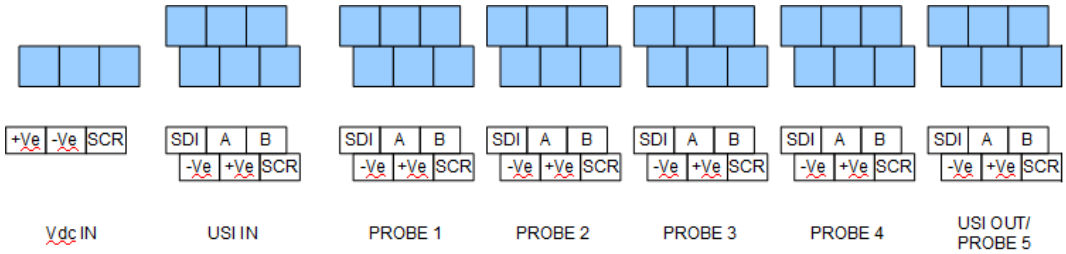
JP1 – 680 OHM LINE A PULL UP

JP2 – 680 OHM LINE B PULL DOWN

JP3 – 120 OHM LINE TERMINATION

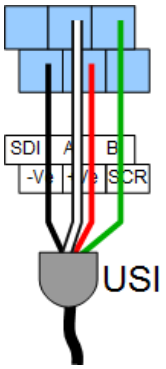


9.2 Modbus Expansion Board



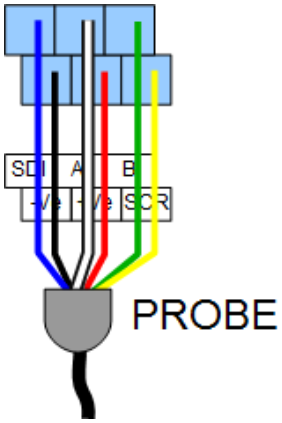
9.2.1 USI IN

- The Red wire must connected to the “+5 V out”
- The Black wire must be connected to the “GND”
- The White wire must be connected to the “RS485 A”
- The Green wire must be connected the “RS485 B”



9.2.2 Probe

- The Red wire must connected to the “+5 V out”
- The Black wire must be connected to the “GND”
- The White wire must be connected to the “RS485 A”
- The Green wire must be connected the “RS485 B”
- The Blue wire must be connected the “SDI”
- The Yellow wire must be connected the “SCR”



10 Installation

10.1 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.

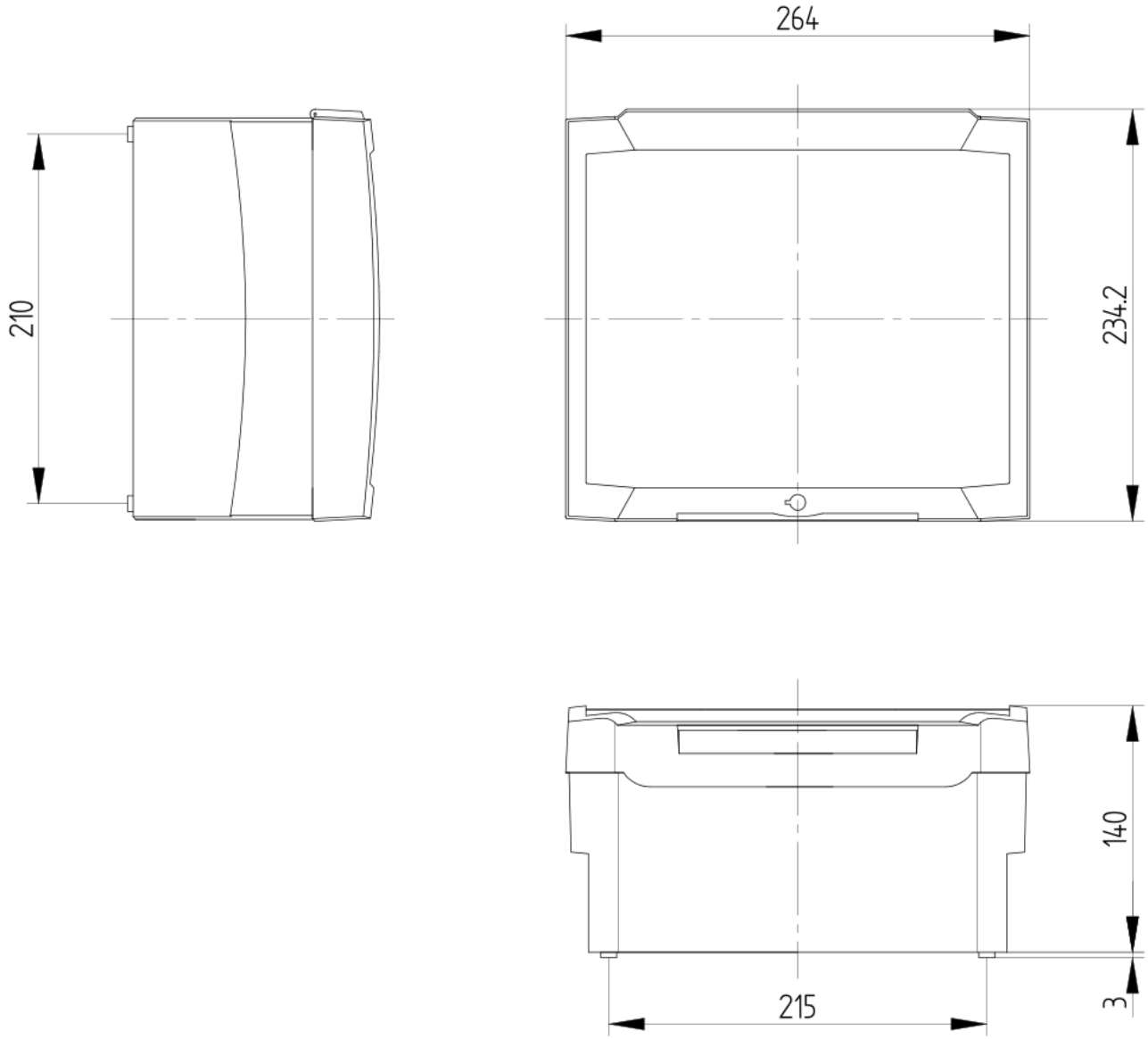
A small number of glands are provided for cable entry. Should additional glands be required place masking tape across the bottom of the enclosure and mark their position. Drill a pilot hole first and then using a cone cutter drill the hole to accommodate the gland. This must be performed with light pressure in order to avoid the drill bit over running and damaging the circuit board. If you are in doubt remove the circuit baords 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.

10.2 Sensors

11 Dimensions

All dimensions are in millimetres.



12 Glossary of Terms

- **Angle** – this is the angle of the V-notch.
- **Dead Band** – this is a distance from the front face of the sensor which the instrument is blind to any echoes. It has a minimum depending on the sensor model but can be extended to overcome false echoes such as the lip of a flume.
- **Echo profile** – the USI can display directly the echo received from the sensor.
- **Max Flow Height** – The maximum height of liquid flow through the primary device that can be measured. This gives the flow span.
- **No Flow Distance** – The distance from the sensor to the surface when no flow is current
- **Penstock** – a penstock is a mechanised gate that can be lowered into a flow channel to regulate flow volumes.
- **pH external** – a 4-20mA input signal from an external pH meter can be calibrated and logged by the USI.
- **pH internal** – the USI has an integrated pH meter which can be calibrated directly with a pH sensor.
- **Primary Device** – Either a Flume or Weir through which the flow is to be measured
- **Rectangular Flume** – most common flume found in Europe
- **Rectangular Weir** – a square notch weir used for high flows
- **Totaliser** – the totaliser is the cumulated volume that has flowed through the device from the start of measurement.
- **USI** – Universal Smart Instrument