USM FLOW METER

INSTRUCTION MANUAL

Version : 1.0

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Contents

1. Specifications

Specifications	Universal Smart Meter – Flow Meter
Input	DIGISENS UltraSonic Sensor
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
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 Specifications

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, the 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.

3. Turning On the USM

3.1. General Product Information

The instrument is configured to measure Flow using a DIGISENS Sensor. The DIGISENS sensor is an intelligent sensor which measures time of flight of an ultrasonic echo and communicates to the USM using RS422.

The USM can interface with other instruments (e.g. Data Logger) through a galvanic isolated 4-20mA output.

Three configurable relays are provided for control, alarm and monitoring.

3.2. 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 or 9-24Vdc input.

The DIGISENS Sensor is supplied with clearly paired wires and should be connected as follows.

Green	TX+
Black (with green)	TX-

White	RX+
Black (with white)	RX-

Red	15V
Black (with red)	GND

Some DIGISENS Sensors are supplied with an additional pair of wires which should be connected as follows:

Blue	15V
Black (with blue)	GND

Relays can be connected as COM & NO (connection made when relay ON) or COM & NC (connection made when relay OFF).

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.

Figure 4.1 – Smart Storm Screen

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

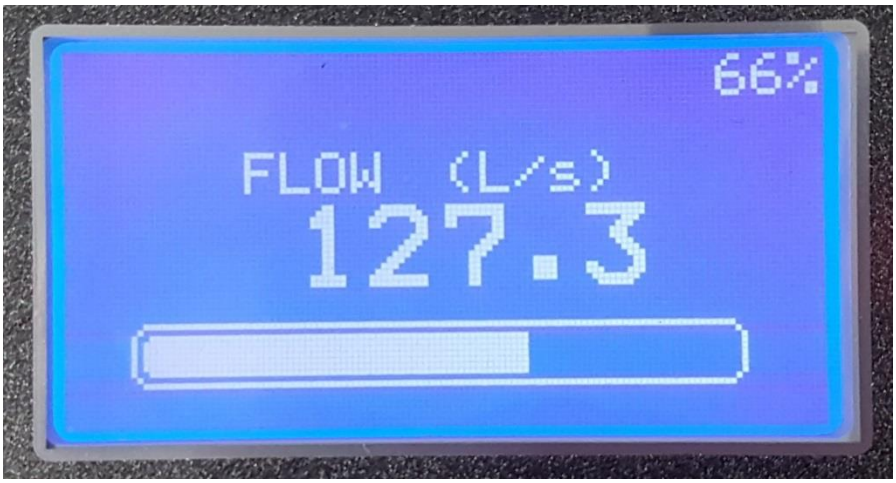

Figure 4.2 – Home Screen

The Home Screen shows the flow (in the selected units) with a bar graph and percentage indicating the 4-20mA output. When the unit is first turned on the flow will be inaccurate as flow parameters will not have been set. Further display options are outlined in Section 5. If a DIGISENS sensor is connected the red LED at the side of the display will flash.

4. Configuring the USM.

The unit is configured using 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 5.1 – Keys' Functionalities

The unit is configured through the MENU page which is password protected. From the Home Screen, press  button to access the PASSWORD page.

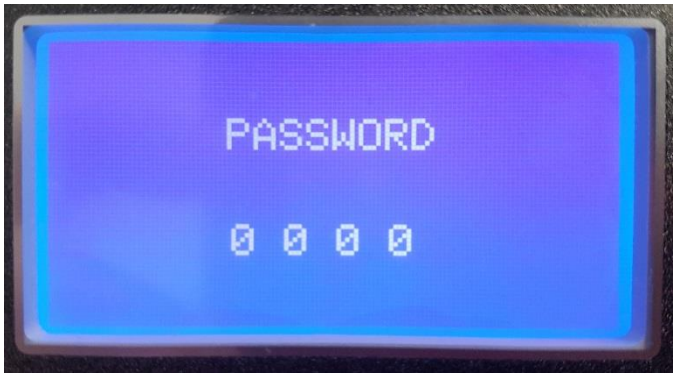

Figure 5.1 – Password Screen

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

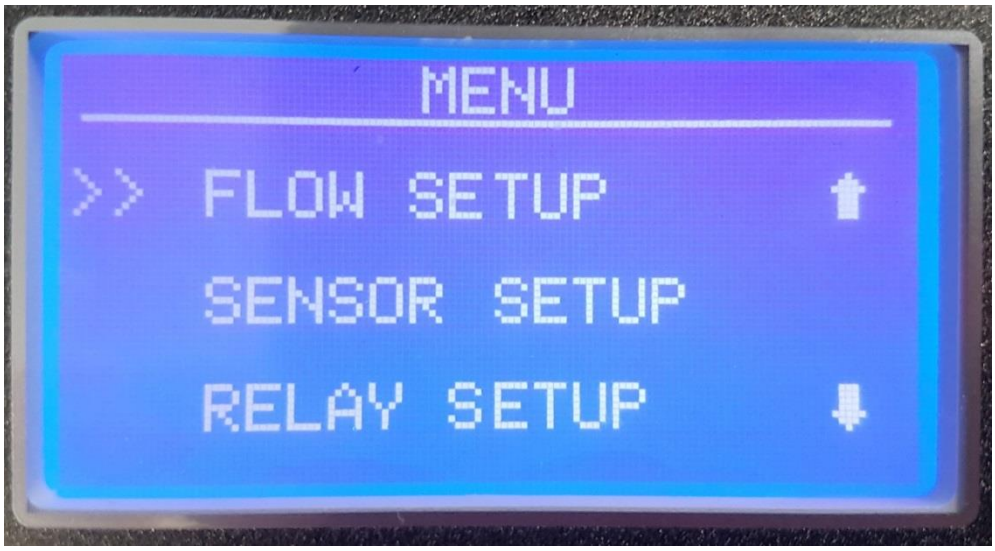

Figure 5.2 – Configuration Menu Screen

There are 8 sub menus to the Configuration menu:

1. FLOW SETUP
2. SENSOR SETUP
3. RELAY SETUP
4. 4 – 20 mA SETUP
5. RELAY TEST
5. 4-20mA TEST
6. CHANGE PASSWORD
7. ENGINEER
8. RESET TOTALISER.

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

The ENGINEER menu contains settings which should only be changed by Smart Storm and requires an additional password. Similarly, SENSOR SET UP and RESET TOTALISER should not be used and instructions are therefore omitted from the manual.

N.B. When the Configuration Menu is entered all relays are frozen in their current state and not updated. It is important that the USM is not left in the Configuration Menus for extended periods.

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4.1. Configuring the Flow Parameters.

Select **FLOW SETUP** on the MENU page and press ▶ button.

Figure 5.3 – Flow Set Up Screen

4.1.1. Device Set Up.

Select **Device SET UP** on the MENU page and press ▶ button.

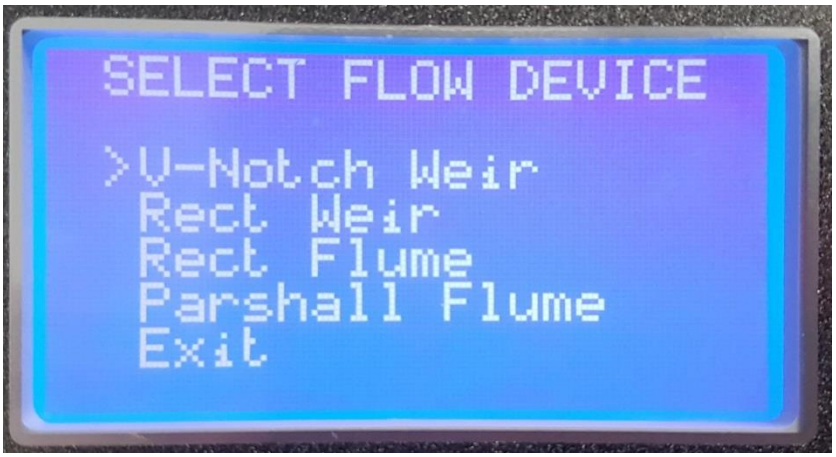


Figure 5.4 – Flow Device Screen

There are currently 4 Default Flow Devices available on the USM Flow Meter. Others are available on request from Smart Storm.

4.1.1.1. V Notch Weir

Move the Cursor to V-Notch Weir and press the ▶ button.

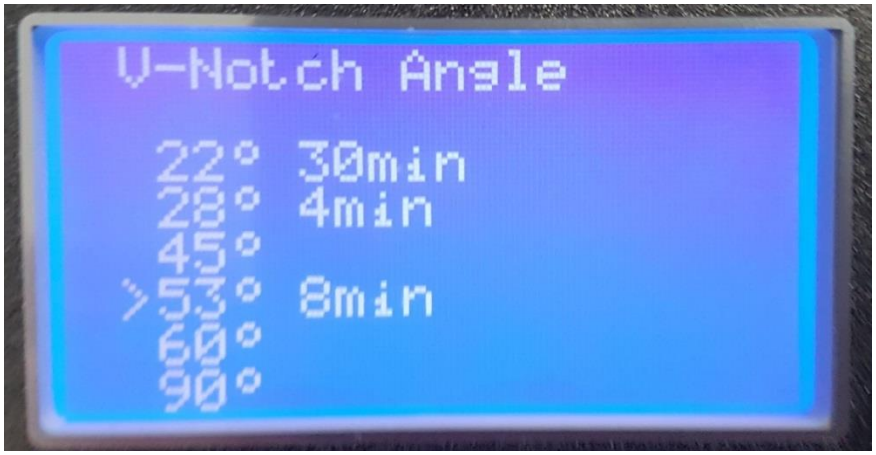


Figure 5.5 – V-Notch Angle Screen

Use the ↑ or ↓ to select the required V-Notch Angle and press the ▶ button. This will take you to the Max Flow Height Screen.

4.1.1.2. Max Flow Height.

The Max Flow Height is required on all Flow Devices. It is used to calculate the span of the device (maximum Flow Rate). This is often used for setting features such as the 4-20mA.

Figure 5.6 – Maximum Flow Height Screen

Use the ↑ or ↓ to change the value to the maximum height and press the ▶ button. This will return you to the **FLOW SETUP** menu.

4.1.1.3. Rectangular Weir and Rectangular Flume.

The Parameters for Rectangular Flumes and rectangular Weirs and entered in the same way as the No flow Height. After pressing the ▶ button you will be passed automatically to the next parameter.

The input parameters are:

Rectangular Weir –

Sill Height
Sill Width
Approach Width
Max Height

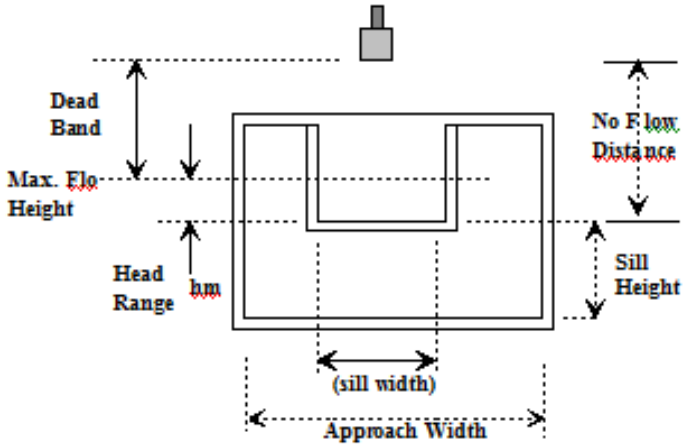


Figure 5.7 – Rectangular Weir Parameters

Rectangular Flume –

Channel Width
Throat Width
Throat Length
Max Height

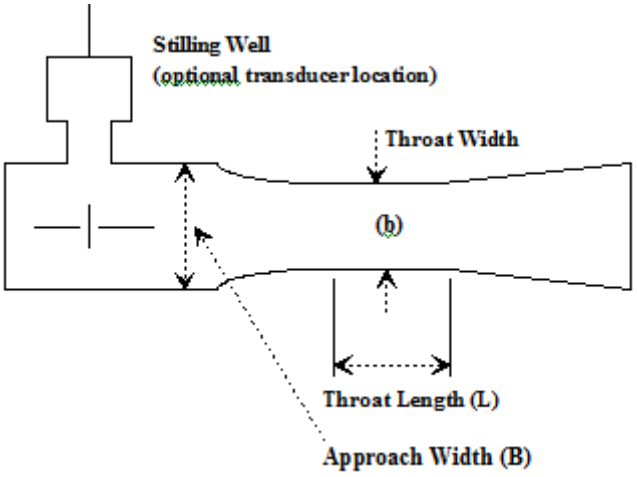


Figure 5.8 -Rectangular Weir Parameters

4.1.1.4. Parshall Flume.

The required Parshall Flume can be selected from a rotating list

Figure 5.9 – Rectangular Weir Parameters

The default types of Parshall Flume are:

3 inch (74 mm)	2 feet (610 mm)
6 inch (152 mm)	3 feet (914 mm)
9 inch (229 mm)	4 feet (1220 mm)
1 foot (305 mm)	5 feet (1520 mm)
1.5 feet (457 mm)	6 feet (1830 mm)

For other types contact Smart Storm.

N.B. THE VALUES ENTERED WILL NOT BE SAVED UNTIL THE FLOW SET UP MENU IS EXITED AND SAVE SELECTED.

4.1.2. No Flow Distance.

The No Flow Distance is the distance measured by the USM when there is no flow. For accurate measure the flow through the device should be stopped and a reading taken from the USI when there is no Flow.

The USM calculates the head of the liquid through the device as the No Flow Distance minus the measured distance – So incorrect entry of the No Flow Distance will result in all subsequent readings being incorrect!

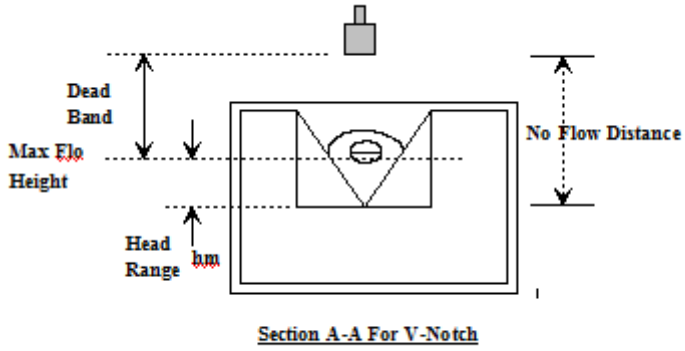


Figure 5.10 – No Flow Distance

The No Flow Distance parameter is accessed from the Flow SET Up Menu and entered using the ⬆ or ⬇ to change the value. Pressing the ▶ button will accept the value and return to the **FLOW SETUP** menu.

Figure 5.11 – No Flow Distance Entry.

N.B. THE VALUES ENTERED WILL NOT BE SAVED UNTIL THE FLOW SET UP MENU IS EXITED AND SAVE SELECTED.

4.1.3. Flow Units.

The Flow measurement units input screen is accessed from the Flow Set Up Menu. The units are selected from a rotating list using the ⬆ or ⬇ keys. When the correct units are selected the ▶ button will accept the value and return to the **FLOW SETUP** menu.

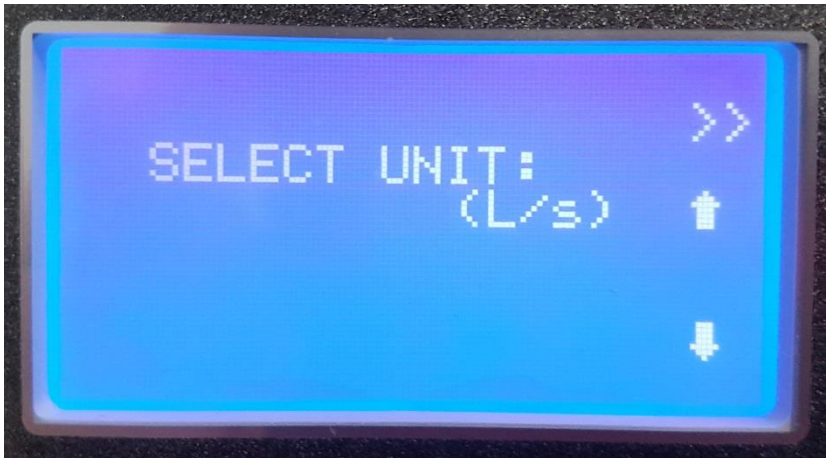


Figure 5.12 – Flow Unit Selection.

The current list of flow units available on the USM are:

L/s (litres per second)

L/Hr (litres per hour)

m3/s (cubic meters per second)

m3/min (cubic meters per minute)

m3/hr (cubic meters per hour)

m3/d (cubic meters per day)

N.B. THE VALUES ENTERED WILL NOT BE SAVED UNTIL THE FLOW SET UP MENU IS EXITED AND SAVE SELECTED.

4.1.4. Saving the Settings.

Parameters are not saved to the USM until a correct exit from the Flow Set Up Menu is performed.

If at any time the USM is returned to the Home Screen without saving the parameters must be re-entered.

From the Flow Set Up Menu, use the ⬆ ⬇ and ▶ buttons to select Save & Exit.

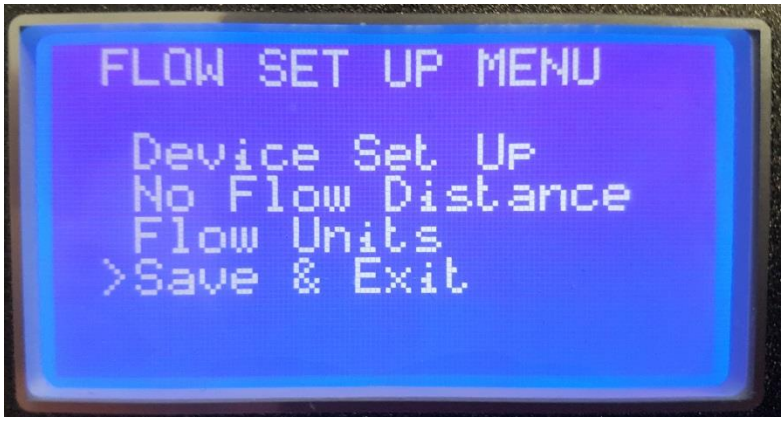


Figure 5.13 Selecting Save and Exit

On the Save Settings use the ⬆ to select YES and press the ▶ button to confirm

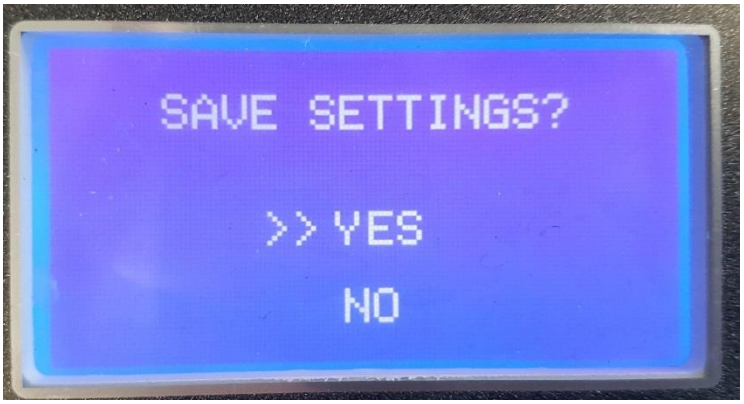


Figure 5.14 – Save Screen

The Flow Parameters will now have been saved to memory and a confirmation message will flash on the screen.

4.2. Relay Setup

The USM has three programmable relays. These are configurable as ON/OFF flow switches or as LOST ECHO (no distance returned from the DIGISENS sensor).

The RELAY SETUP is accessed from the Configuration MENU

Figure 5.15 – Relays Setup Screen

Use the ⬆ or ⬇ buttons to select the relay to be configured. and select by pushing the ▶ button, the program returns to the MENU page.

Figure 5.16 – Relay 1 Setup Screen 1

Use the ⬆ ⬇ keys to move the cursor to the setting to be changed.
When the Status field is selected pressing the ▶ button toggles the selection between ENABLED and DISABLED.

When the Mode field is selected pressing the ▶ button toggles the selection between LOST ECHO and Flow Switch.

When LOST ECHO is selected, no further input is required and Exit should be selected and the parameters saved. This relay will now turn on when either there are 5 consecutive readings from the DIGISENS sensor with zero distance returned or no communication from the DIGISENS sensor for 10 seconds.

When Flow Switch is selected the ON and OFF parameters are visible. These are configurable by moving the cursor to the required field and pressing the ▶ button. An arrow will appear next to the parameter to show it as selected.

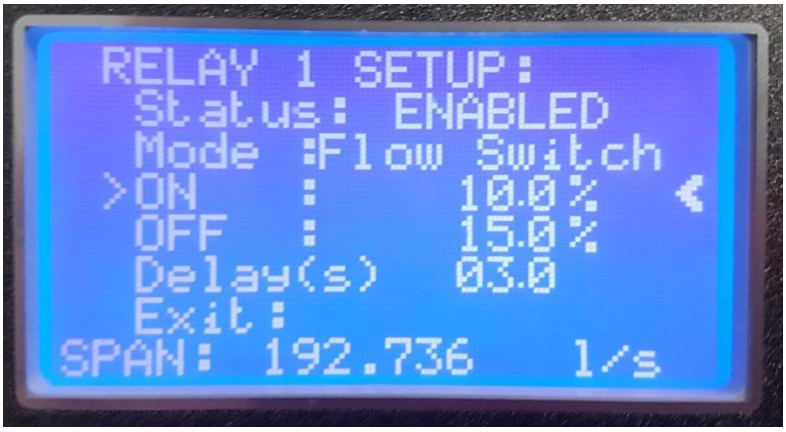


Figure 5.17 – Relay 1 Setup Screen 2

The Parameter can then be changed using the ⬆ ⬇ keys and the value entered using the ▶ button.

The ON/OFF values are entered as a percentage of the SPAN (the maximum flow through the device).

In the above example the relay would turn on at 10% of 192.736l/s -

(10 x 192.736 / 100 = 19.3 l/s)

and turn off at 15% of 192.736 l/s - (15 x 192.736 / 100 = 28.9 l/s).

If a High Flow alarm was required at say 50 l/s the ON value should be entered as –

100 x 50/192.736 = 25.9 %

and the OFF value at a level below e.g. 20% to add hysteresis and avoid the relay switching repeatedly.

If a Low Flow alarm was required at say 1.0 l/s the ON value should be entered as –

100 x 1/192.736 = 0.5 %

and the OFF value at a level above e.g. 0.7% (to give a value a flow of 1.35 l/s)

The Delay functionality is currently not implemented.

N.B. THE VALUES ENTERED WILL NOT BE SAVED UNTIL THE RELAY SET UP MENU IS EXITED AND SAVE SELECTED.

4.3. 4-20mA Setup

The USM has a 4-20 mA output which can be configured to represent flow through the device

The 4-20mA SETUP is accessed from the Configuration MENU

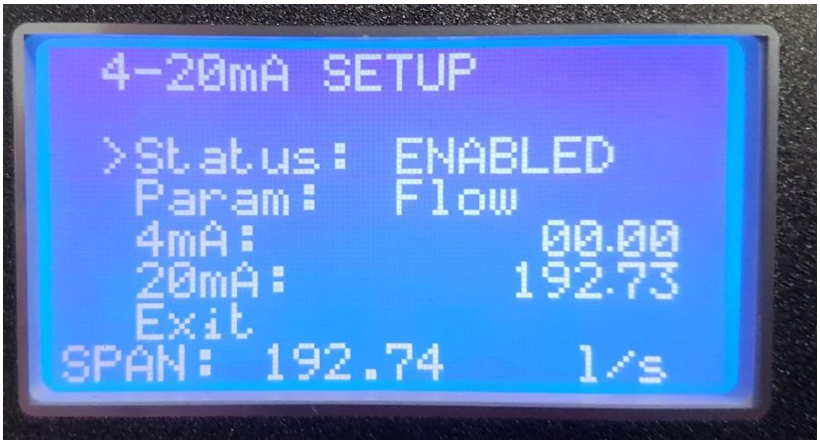


Figure 5.18 – 4-20 mA Setup Screen

When the cursor is on the Status field the ▶ button toggles the Status between ENABLED and DISABLED.

Moving the cursor to 4mA field and pressing the ▶ button allows the value to be entered at which the USM will output 4mA (use ↑ ↓ to change the value ▶ to accept).

Similarly, the 20mA field represents the value at which the USM outputs 20mA.

The values are entered in the flow units to which the USM is set. The SPAN is shown for information.

The above example shows the USM set for full scale – typically this would be used for interfacing to a data logger. The 20mA value will be seen by the unit as the SPAN as it is within 1%.

The settings are saved with a correct exit from the Set Up and save selected.

If the USM detects a LOST ECHO or LOST COMMs from the DIGISENS sensor, the 4-20mA will be zero regardless of these settings.

4.4. Change Password

The default password can be changed from 0000. On selecting this option the user will be required to enter the current password and then the new password.

Caution is advised as the new password is saved immediately after the last digit is entered. The new password will appear temporarily after it is input.

4.5. Sensor Set Up

The Sensor Set Up Menu allows the Frequency, Firing rate and blanking period of the DIGISENS sensor to be changed. Please contact Smart Storm for further information on changing these settings.

4.6. Engineering

The Engineer Menu is password protected and not available for general use.

4.7. Totaliser Reset.

A facility is provided to reset the totaliser (accumulated flow) to zero. Caution is advised as this cannot be undone and will lead to a discontinuity in recorded values.

5. Test Screens

Two Test screens are provided to check the functionality of the unit. Both are selectable from the Configuration Menu.

5.1. Relays Test

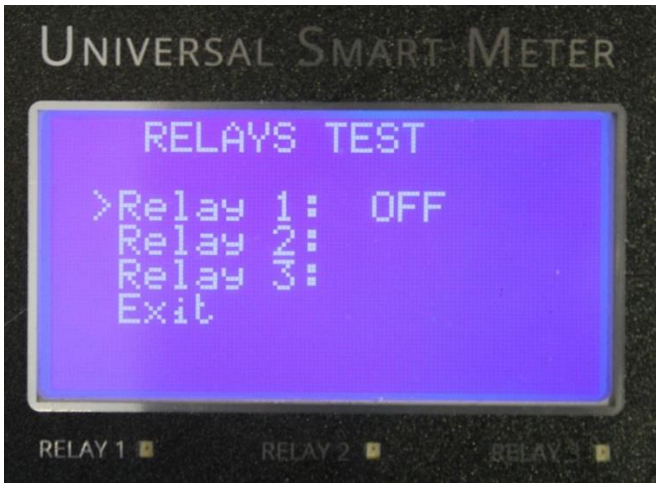


Figure 6.1 – Relays Test Screen 1

Move the cursor to the required relay using ⬆ or ⬇ buttons. Pressing the ▶ button will toggle the relay state. The appropriate LED should light.

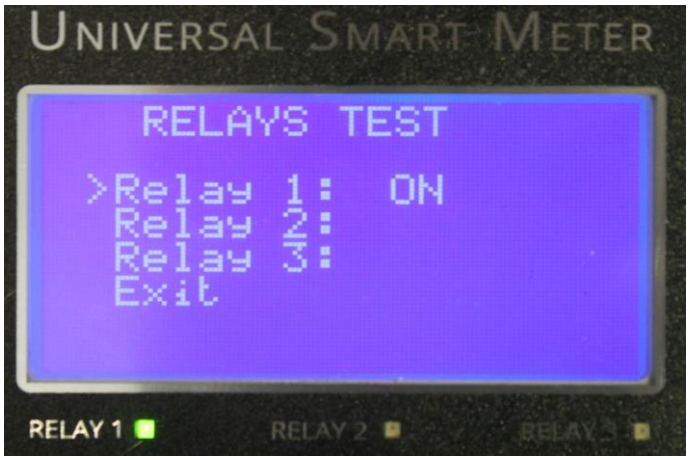


Figure 6.2 – Relays Test Screen 2

This can be used to test the functionality of peripheral equipment connected to the USM, such as alarms and beacons.

5.2. 4-20mA Test

The 4-20mA test selects fixed value for the 4-20mA output circuit. The output value can be changed using the ⬆ or ⬇ buttons. Pressing ⌂ or ▶ will exit to the Configuration MENU

Figure 6.3 – 4-20 mA Test Screen

The output can be checked by measuring the voltage generated across a 100 ohm resistor on the output (current = voltage/100) or by direct measurement using the current input on a suitable multi-meter.

N.B. In both cases any other connections from the 4-20mA output circuit should be removed.

5.2.1. Integrating a Data Logger

The 4-20mA test can be used for calibration to other equipment.

To integrate to a data logger, configure the 4mA output to 0.0 flow and the 20 mA to the span as explained in Section 5.3.

In the 4-20mA Test, set the output to 4mA and enter 0.0 as the 4mA value on the data logger.

Set the output to 20mA and enter the Span as the 20mA value on the data logger.

This will calibrate the USM to the data logger. Refer to the data logger instruction manual for details of calibrating the values.

6. 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.

6.1. Home Screen

The Home Screen shows the flow (in the selected units) with a bar graph and percentage indicating the 4-20mA output.

If the DIGISENS reports LOST ECHO or there are no communications with the sensor an error message will display and the 4-20mA will be zeroed.

Figure 7.1 Home Screen with LOST ECHO

6.2. Totaliser Screen

Shows the cumulative flow through the unit since the last reset. This is shown in m3. For alternative units contact Smart Storm.

6.3. Distance and Level Screen

Shows the distance measured by the USM from the sensor to the liquid and the level of the liquid above the No Flow height. If LOST ECHO or LOST COMMS an error message will be displayed.

6.4. Calc Parameters Screen

Displays the data used by the USM to calculate the height of the flow.

ToF – Time of flight measured by the DIGISENS sensor. 5600us equates to approximately 1 metre.

Temp – The temperature returned from the DIGISENS senor when Temp mode is AUTO or the pre-set temperature in Manual Mode.

Temp Mode – this should always be AUTO (can be overridden in ENGINEERING).

SOS – Speed of Sound used to calculate distance

No Flow – The entered value of No Flow Distance.

6.5. Device Parameters. Screen

Displays the values entered to define the flow device (Flume or Weir).

N.B. After any changes to the flow Parameters, The Calc Parameters and Device Parameters should be checked to ensure the correct values have been saved.

6.6. Sensor Info

Displays the values set in the Sensor Set Up.

Blanking distance – the distance from the Sensor in which no measurement is taken. The sensor should be placed at least this distance above the Max flow height.

Threshold- the % of maximum return echo height which must be exceeded for the unit to trigger.

6.7. Relay Configuration

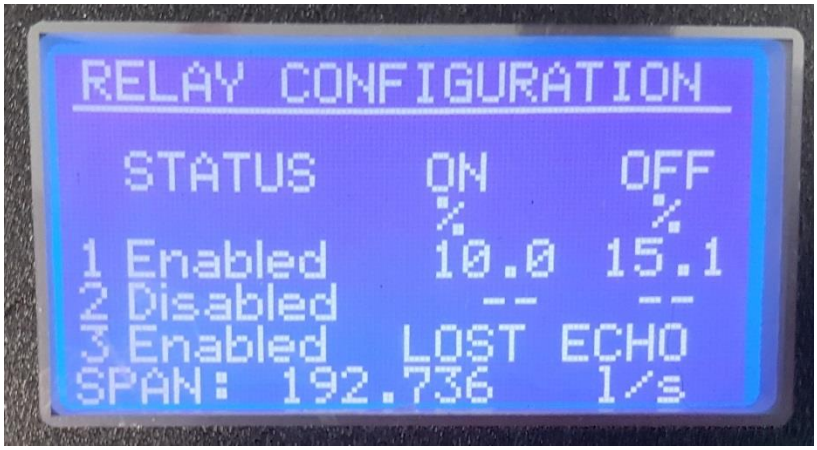


Figure 7.2 Relay Configuration

Displays the relay set up information
If the relay is configured as a flow switch the ON and OFF values are shown. If a relay is configured as LOST ECHO this will be indicated across the ON OFF values.

6.8. 4-20mA Set Up

Displays the settings entered for the 4-20mA output parameters.

N.B. After any changes to the control Parameters, the Relay and 4-20mA Set Up screens should be checked to ensure the correct values have been saved.

6.9. About USM

Displays Information about the USM including Software Version and Serial Number.

7. 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
Lost Comms	Sensor wiring incorrect	Check Wiring of DIGISENS sensor. Check Power to Senor is 15V
Flow reading not stable Or LOST ECHO displays continuously	DIGISENS sensor incorrectly mounted	Check and ensure the DIGISENS sensor is positioned correctly and parallel to the liquid. Ensure there are no obstructions between the sensor and the liquid
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 8.1 – Fault Finding

8. Appendix A. Positioning the DIGISENS Sensor.

Correct positioning and mounting of the sensor is vital if accurate results are to be obtained.

8.1. Mounting

- Locate the sensor at least 600mm above the maximum level (see below)
- Ensure the ultrasonic beam has a clear path to its target and will not strike obstructions
- The sensor should be held rigid over the channel in a vertical position directed at the liquid face
- Avoid the temperature sensor being exposed to sunlight
- Ensure the sensor Fascia is parallel to the liquid surface.

8.2. Positioning

The sensor should be placed such that the ultrasonic beam does not reflect from interfering structures during its flight path. The table below gives the beam spread for the ultrasonic wave form the DIGISENS sensor. Ensure for the maximum distance to be measured the beam does not collide with any obstructions.

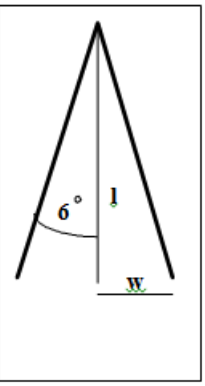
Tank Height l (metres)	Beam Half Width w (metres)	
1	0.11	
2	0.21	
3	0.32	
4	0.42	
5	0.53	
6	0.63	
7	0.74	
8	0.84	
9	0.95	
10	1.05	

Table 9.1 Beam Angle.

The Ultrasonic sensor has a deadband in which they can trigger on false ‘resonant’ echos. To avoid this a blanking distance is set such that echoes are ignored in this window. Ideally, for safety, the blanking distance is set 200mm beyond the deadband meaning that no echoes are processed within deadband +200mm of the sensor. The sensor should therefore ideally be placed 600mm above the maximum height of the liquid.

The sensor should be placed at the mid-point of the width of the approach channel of the flume or in line with the mid- point of the weir.

If possible the sensor should be place at 4-5 times the maximum flow height for any weir or flume.

9. Safety Information

9.1. General 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's products 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.

9.2. 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.

9.3. 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.