# Royce Aqua 22 Manual

May 2022

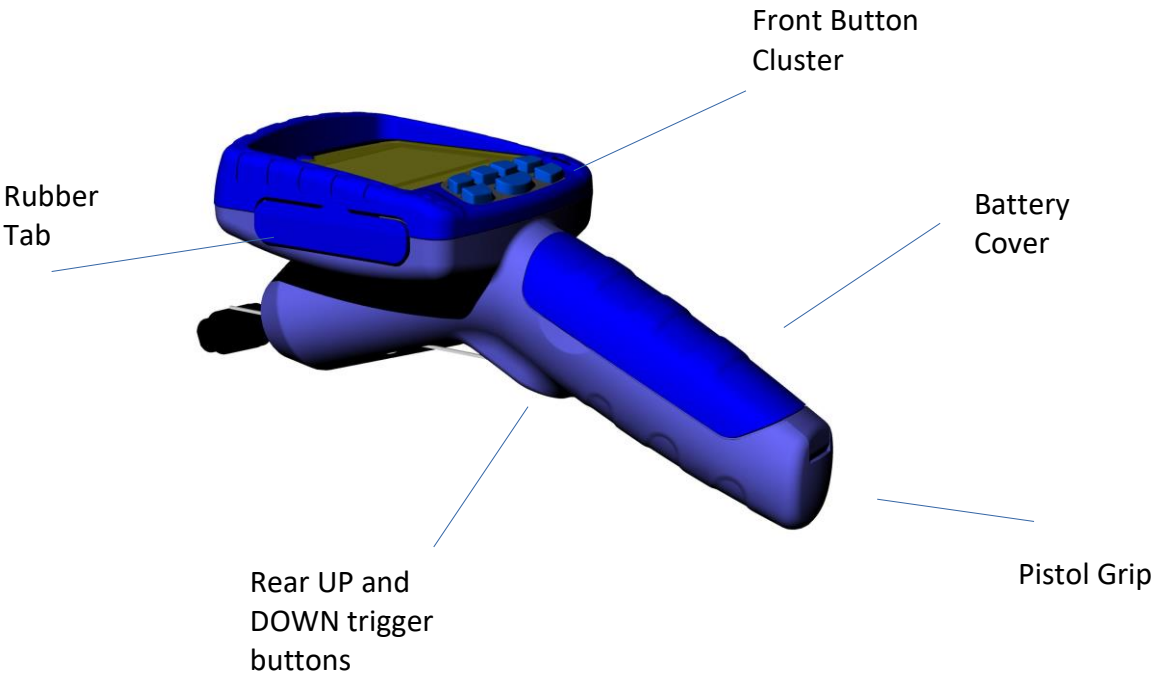
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# 1 Specifications

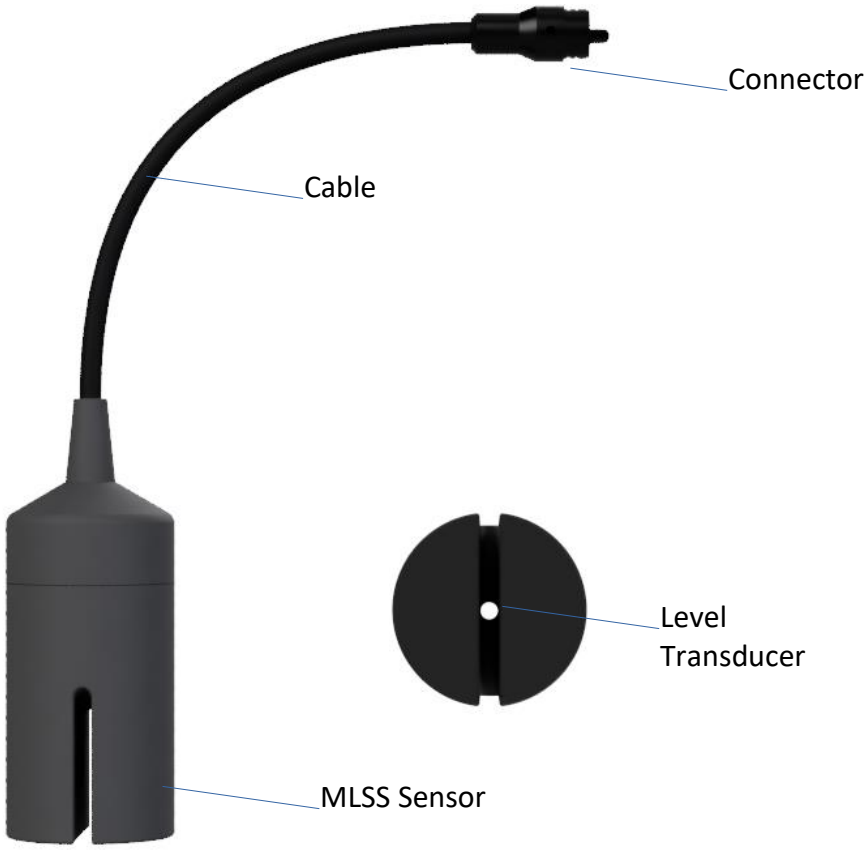
## 1.1 Handheld Analyser




**Technical Specifications**

| | |
|---|---|
| Protection | IP65 |
| Body materials | ABS/Polycarbonate/Acrylic |
| Weight | 320g |
| Width | 110mm |
| Length | 240mm |

## 1.2 Sensor




**Technical Specifications**

| | |
|---|---|
| Cable Material | Polyurethane |
| Cable length | 10M |
| Body materials | UPVC/Nylon |
| Protection | IP68 |
| Diameter | 60mm |
| Overall length | 180mm |
| Weight | 450g |

## 1.3 Overall Specifications

**Technical Specifications**

| | | |
|---|---|---|
| Measuring | Total Suspended Solids<br>Interface layer analysis | |
| Sensing technology | TSS – Absorption | Depth - Hydrostatic level sensor |
| TSS Range | 0 – 20,000mg/l | |
| Depth Range | 10m | |
| Accuracy | +- 5% | |
| Repeatability | 1% | |

# 2 Features

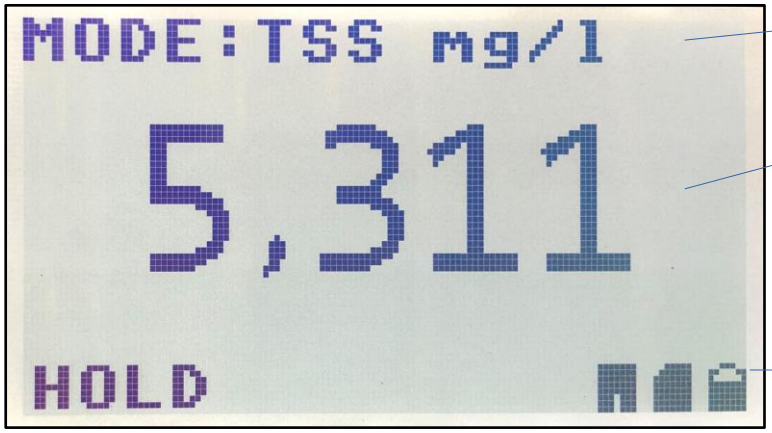
## 2.1 Key features

- A hydrostatic level sensor is used to provide easy depth measurement of the interface layer.
- Smart serialised sensors holds calibration data internally. This means that sensor can be interchanged between handhelds without the requirement to be calibrated.
- Light, ergonomically designed handheld with a pistol grip to facilitate one handed operations.
- Front cluster buttons in easy reach of a thumb resulting in easy selection of functions.
- The LCD display is optimised to provide excellent clarity in bright sunlight with or without Polaroid glasses.
- Readings can be save to one of 9 locations as well as a micro SD card.

## 2.2 Handheld Display

The main TSS and LEVEL screens use large digits to facilitate readability.
A configurable back light is provided to enhance the clarity of the display in poor lighting conditions.

The main operation screens are divided into 3 sections.




**Top line**
Displays current operational mode. Toggle mode TSS or LEVEL using the MODE button

**Mid section**
Displays TSS readings in mg/l in TSS mode and Absorption % and depth in m in LEVEL mode

**Bottom line**
This is split in two sections

**Bottom Line LHS**
Displays the current function.
When one of the trigger buttons are pressed the display will change from HOLD to READ. In SAVE or RECALL this will display the current memory location number.

**Bottom line RHS**
Displays a range of ICONS. ICONS are described below.

## 2.3 Status Icons



**Micro SD Icon**
This icon will be displayed if USE SD CARD has been configured in the units setup.
If configured, a flashing icon indicates that a SD is not present in the unit. This will result in an ERROR message being displayed if a SAVE is initiated.
This icon is not displayed if USE SD CARD is set to OFF.



**Sensor Icon**
This Icon is always displayed. This icon will flash if a sensor is not connected, or if an error has been detected in the sensor.



**Charging Icon**
This icon is displayed when the unit has been connected to a 5V supply using a USB C plug. The charging port is found on the left hand side of the unit under the rubber tab.



**Battery Status Icon**
This icon displays the battery voltage level in 25% increments.
A flashing icon indicates that the battery voltage is very low and that the unit is about to power down

## 2.4 Rubber Tab

The rubber tab on the left hand side of the unit covers the USB C charging port and the micro SD card port.
To access these ports pull the tab to the left.
NOTE: This tab protects the unit from water ingress and must always be plugged in.

## 2.5 Front button cluster (from left to right)

| | |
|---|---|
| MENU | Enters the Main Menu screen. |
| LEFT and RIGHT arrows | These two buttons provide a number of functions depending on the screen being displayed.<br>In MENU items, these can the used to scroll up and down the menu options.<br>When entering numbers, these are used to select the digit that will be edited. Use the UP and DOWN trigger keys to edit the nominated digit.<br><br>When in the TSS or LEVEL recall screen, pressing any on of these keys will display the DATE and TIME associated with a saved reading. |
| ON/OFF | Used to switch the unit ON and OFF.<br>**NOTE that the button must be held down for at least 6 seconds to switch the unit OFF.** |
| MODE | Used to switch operational modes between TSS and LEVEL mode |
| ENTER | Use to accept an entry or to select a menu item. |
| EXIT | Abort the current operation and return to the previous screen |

## 2.6 Trigger buttons (located on the rear of the unit)

| | |
|---|---|
| UPPER and LOWER buttons | These button provide a number of function depending on which screen is being displayed.<br>In the main TSS and LEVEL screens either one of these button can be pressed to start taking a reading.<br>In menu screens the UP will step up through the menu options and the DOWN will step down.<br>When entering numbers, these buttons will increment/decrement the nominated digit.<br>**Note: These button will NOT auto scroll.** |

## 2.7 Battery Cover and compartment

The battery compartment can be assessed by pulling up on the battery compartment lid located on the top of the pistol grip.
Note that the battery is covered with a water proof seal. This seal must be replaced by a new seal when the battery is replaced. (Available as a consumable part from Royce Water Technologies).
The battery is a Lithium-Ion rechargeable battery. Size 18650 3.7V 2.6Ah. Recommended replacement is a TB-18650IC26.

## 2.8 Micro SD card

The micro-SD card port is located on the left hand side of the handheld under the rubber tab.
The following is required of the SD card.
1. The SD card must be formatted. (FAT32)
2. SD cards must have a capacity less <= **32GB. SD cards over 32GB are NOT supported.**

To insert the SD card, remove the rubber tab. Carefully slide the SD into the slot ensuring that the contacts of the SD card are pointed down. Remove the SD card by slightly pushing it in and the releasing the pressure. The card will pop out and then can be withdrawn.

## 2.9 SD files and file format

| | |
|---|---|
| TSSSAVED | This file holds saved TSS data.<br>File format: CSV<br>DATE TIME(yyyy/mm/dd HH:MM),TSS VALUE mg/l,LOCATION |
| LEVSAVED | This file holds LEVEL data.<br>File format:CSV<br>DATE TIME(yyyy/mm/dd HH:MM),TSS %.DEPTH m,LOCATION |
| TSSREAD | This file holds the TSS data after a READ has been performed. No location data is recorded against this transaction. (Note the LOG TSS READINGS option needs to be switched ON in the SD CARD setup for this function to work.)<br>File format:CSV<br>DATE TIME(yyyy/mm/dd HH:MM),TSS VALUE mg/l |

# 3 Operation

## 3.1 The sensor

All calibration data is stored in the sensor

Each sensor has a unique serial number that enables it to be tracked.

This means that the sensor may be used with a different handhelds or more than one sensor can be used with a particular handheld.

This may be useful if a number of tanks have significantly different properties.

## 3.2 Connecting the sensor to the handheld.

The system uses a propriety coupling system that ensures a secure and watertight coupling between the handheld and the sensor.
Each connector has a patterned or knurled section machined on its surface that should be held by hand.

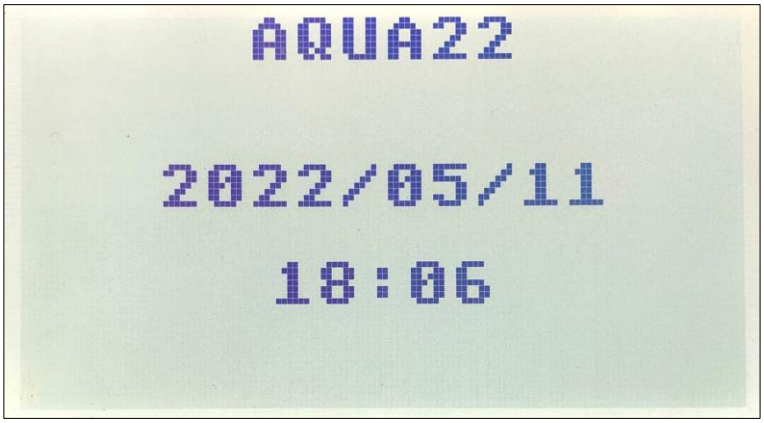
*(It is recommended to hold the connector and not to hold the handheld by the pistol grip while performing this operation)*

Line up the protruding tong on the sensor connector with the recess found on the top of the handheld's connector. Gently push the connectors together until fully seated. Slide the Screw cap on the handheld connector forward onto the sensor connector and screw it on until it covers the O-ring seal on the sensor connector.

Power up the handheld and check that the sensor icon is not flashing. Press one of the trigger buttons and ensure that some sort of reading is displayed.

## 3.3 Power Up – (the handheld will not power up while connected to a charger.)

Press and hold the power button until the display lights up.
The display will come on and display the date and time in the unit for a couple of seconds.




Check the date and time and update if required.
The date and time is used to time stamp readings.
(Note that the date and time will have to be reset if the battery is replaced)
By default the unit will start in TSS mode.
Check the status bar at the bottom of the display. Any flashing icon indicates that some user action is required.

## 3.4 Power Down

Press and hold the Power button for 6 seconds.
if the Auto Timeout feature has been set, the unit will power down automatically after 5 minutes.

The unit will power down if a low battery voltage has been detected. (The battery Icon on the status display will start to flash when low battery power has been detected.

**The Aqua22 has two operation modes:**
TSS mode – Measuring Total Suspended Solids (TSS)
LEVEL mode – Interface Layer Analysis

## 3.5 Safety note when taking a reading in the field

It is highly recommended that the sensor cable is wrapped around a rail (if available) prior to submerging the sensor. This will provide protection if the handheld is dropped.

***Note: A wrist strap has not been added to the handheld. This is a safety precaution for if the submerged sensor gets trapped in a moving mechanism.***

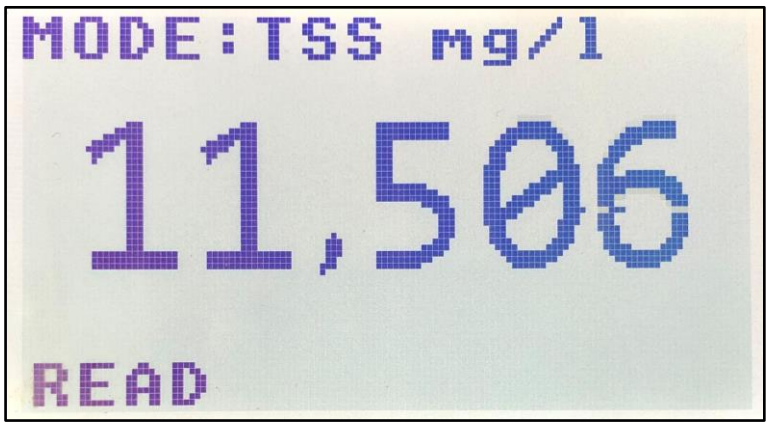
## 3.6 TSS Measurement

### 3.6.1 Taking a TSS reading

Lower the sensor into the process.
Press one of the trigger buttons on the bottom of the unit.
The HOLD indicator on the bottom left hand side of the display will change to READ.
A reading from the sensor will be displayed.
Release the trigger button.
The READ indicator will change back to HOLD and the reading will be held on the display.
If there is a problem with the sensor or it is not connected a ERROR message will be displayed.

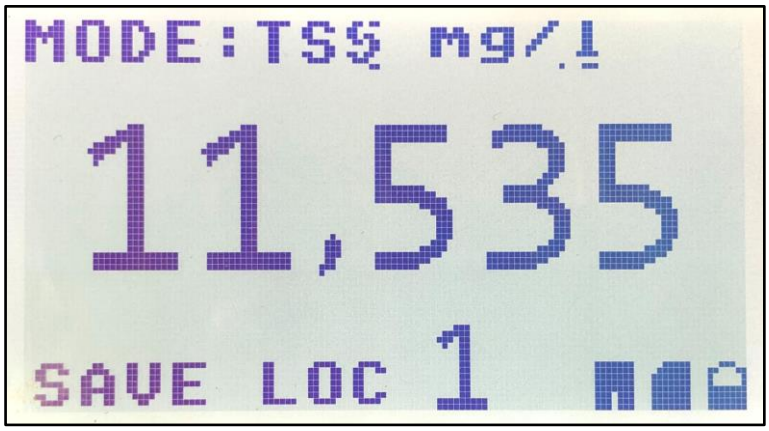
If USE SD CARD and LOG TSS readings option has been setup, the unit will write this reading to the SD card.

A decision can be made at this time to log the reading to one of the 9 memory locations in the unit.



### 3.6.2 Saving a TSS reading to the units memory location and SD card.

A reading can be saved from the main screen by pressing the ENTER button.
The status on the bottom left hand side of the display will change to SAVE. To the right of the SAVE a location number will be displayed.




You can save the reading to one of 9 locations. (A location references the location where the reading was taken.)

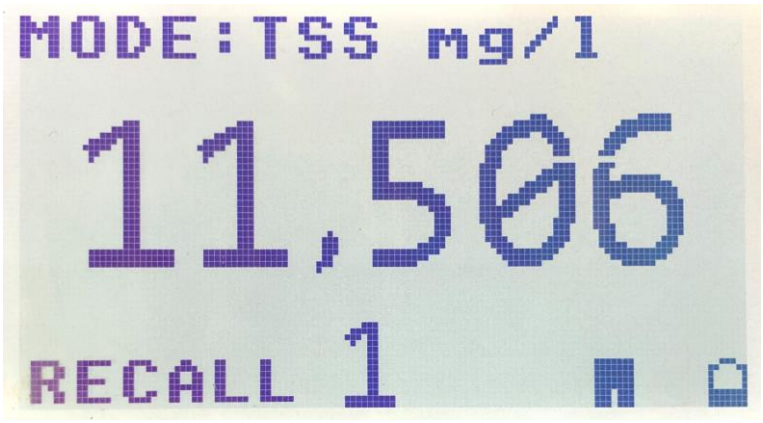
Use the < > or UP and DOWN trigger buttons to select the location number.
Press ENTER to save the reading to the nominated location.
At this point the reading in conjunction with the location number, date and time will be written into the unit's internal memory, If USE SD CARD has been set, the reading and location number, date and time will also be written to the SD card.

The screen will return to the main TSS screen.

**Note:**
When saving a reading to a Location, the reading is saved to the internal memory of the unit. This memory records the LAST readings that was saved to a location and does not retrieve readings from the SD.
If USE SD CARD has been configured, then in addition to saving the reading to the internal memory the reading is also saved to the SD card.

### 3.6.3 Recall TSS readings from internal memory

Press the < or > while in the **main TSS screen** to enter the Recall screen.




The reading for Location 1 will be displayed. Use the < > or trigger buttons to display readings for the other locations. To view the Date and time stamp associated with the reading press the ENTER key. The date and time will be displayed for a couple of seconds.

### 3.6.4 Clearing TSS readings from the internal memory

Go to Menu –> Reset –> Handheld TSS memory clear and press ENTER.

## 3.7 Sludge level Measurement

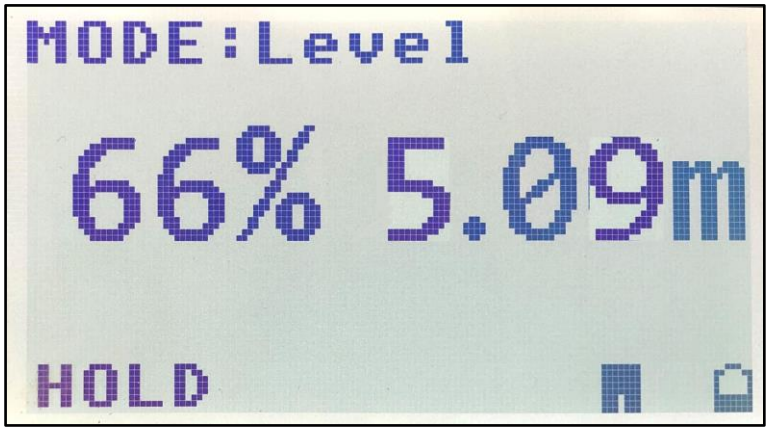
### 3.7.1 Before taking a LEVEL reading

Prior to taking a reading ensure that the meter has been calibrated for the tank.
Refer to LEVEL Span in the Calibration menu.

### 3.7.2 Overview of the LEVEL operation.

The sensor at this stage should have had its Span calibrated by lowering the sensor to the bottom of the tank and the calibration routine performed. In this step the TSS value at the bottom of the tank is associated with 100%. The sensor has a built-in hydrostatic level sensor, as the sensor is lowered into the tank, the sensor will detect that it has entered the process and will automatically take a TSS reading at the top of the process. This TSS value is then associated with 0%.

As the sensor is lowly lowered into the tank, the operator needs to observe the change in %. A sudden change in % would indicate that the sensor has entered the interface layer. When the trigger button is released. The unit will hold the % value and the depth in m.




### 3.7.3 To take a reading

Press and hold one of the trigger buttons prior to lowering the sensor into the tank.
Continue holding down the trigger button until the interface layer has been identified.
Release the trigger button so that the sensor can hold the current reading.
Retrieve the sensor from the process.

### 3.7.4 Saving LEVEL readings

A reading can be saved from the main screen by pressing the ENTER button.
The status on the bottom left hand side of the display will change to SAVE. To the right of the SAVE a location number will be displayed.

You can save the reading to one of 9 locations. (A location references the location where the reading was taken.)

Use the < > or UP and DOWN trigger buttons to select the location number.
Press ENTER to save the reading to the nominated location.

The screen will return to the main TSS screen.

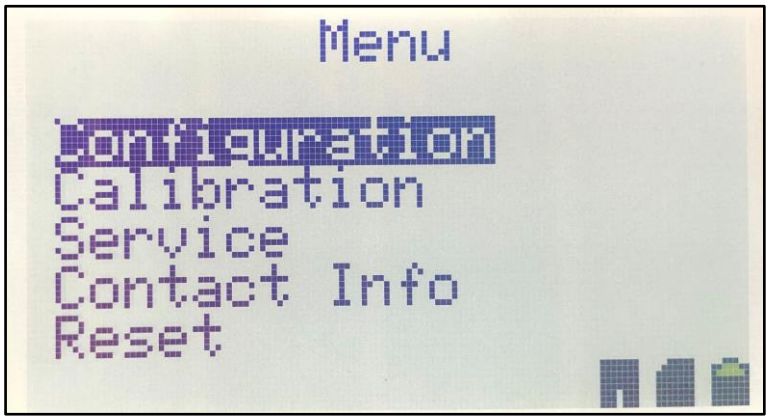
### 3.7.5 Recalling a LEVEL reading

Press the < or > while in the **main LEVEL screen** to enter the Recall screen.

The reading for Location 1 will be displayed. Use the < > or trigger buttons to display readings for the other locations. To view the Date and time stamp associated with the reading press the ENTER key. The date and time will be displayed for a couple of seconds.

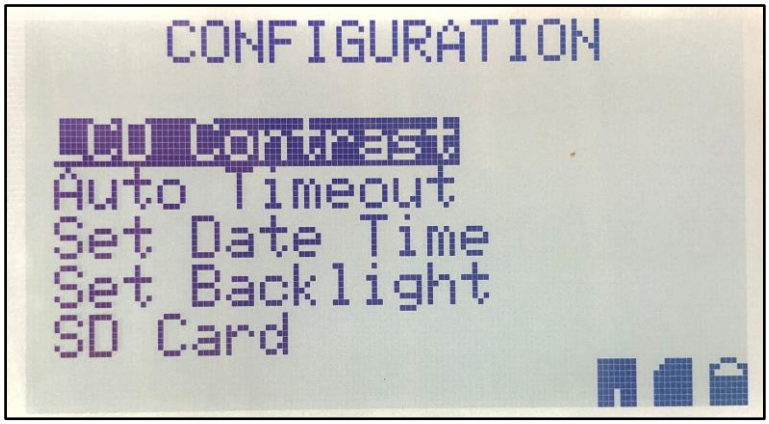
## 3.8 Menu operations

The following shows the items displayed in the main menu

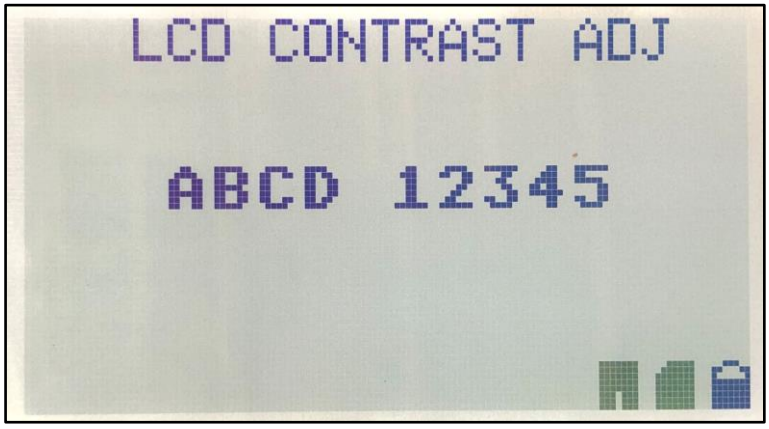



## 3.9 Configuration menu

The following shows the items displayed in the configuration menu

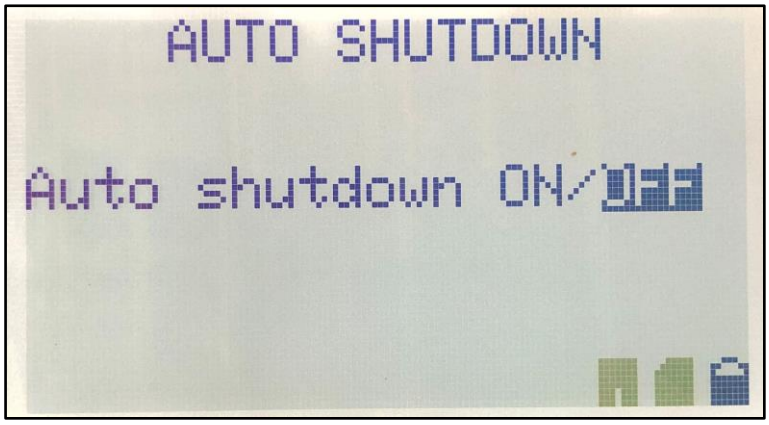


### 3.9.1 LCD Contrast



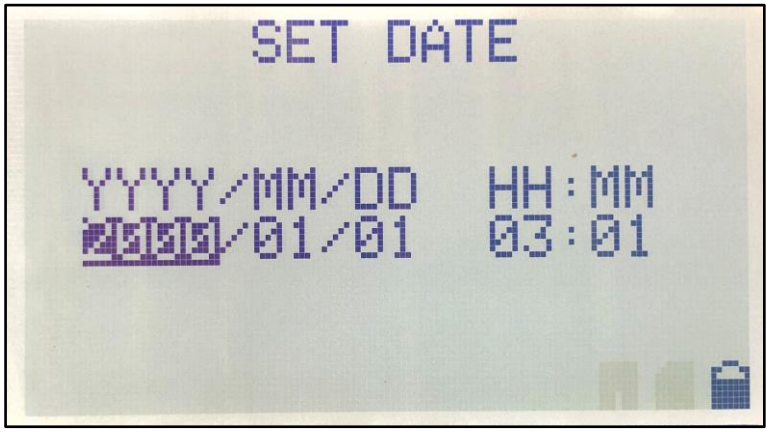

The LCD contrast screen displays a sequence of letters and numbers in the middle of the screen.
Use the < and > or trigger buttons to adjust the contrast of the screen.
Limits are imposed on being too bright or too dark.
Use the ENTER to save the setting, Exit to abort to the previous menu.

### 3.9.2 Auto Timeout




When this option is set ON the unit will automatically power off after 5 minutes in the absence of any buttons being pressed. The timer is restarted every time a button is pressed
This is the default setting for the unit since it prolongs battery life.

### 3.9.3 Set Date and Time




Date and time is displayed in the following format
YYYY/MM/DD HH:MM
Use the < and > buttons to select the digit to edit.

Use the UP and Down trigger buttons to edit the digit value.
ENTER to save the date and time.

**Note: Date and time will have to be reset if the battery has been disconnected.**

### 3.9.4 Backlight menu

The following shows the items displayed in the backlight menu



### 3.9.5 Use Backlight




Set this to ON or OFF.  Battery life can be extended by having it OFF. The default setting is ON.
Use the < and > or UP and DOWN trigger keys to select.

ENTER to save the selection.

### 3.9.6 Backlight level




The brightness of the backlight can be selected by using the < and > or trigger buttons.
A bright backlight setting will consume more battery power.
Press ENTER to save.

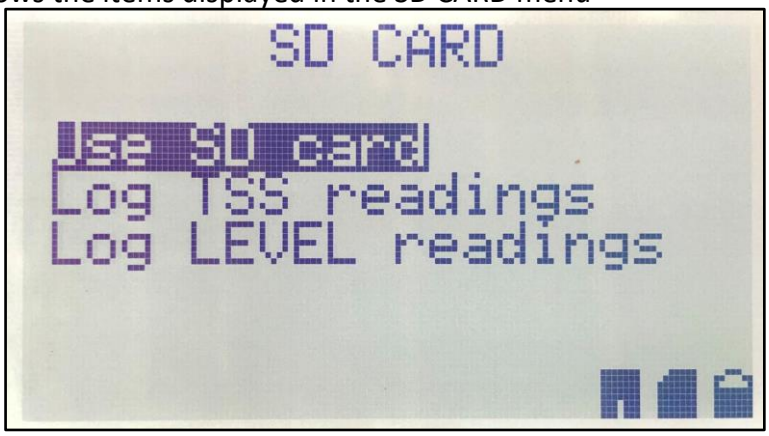
## 3.9.7 Backlight time



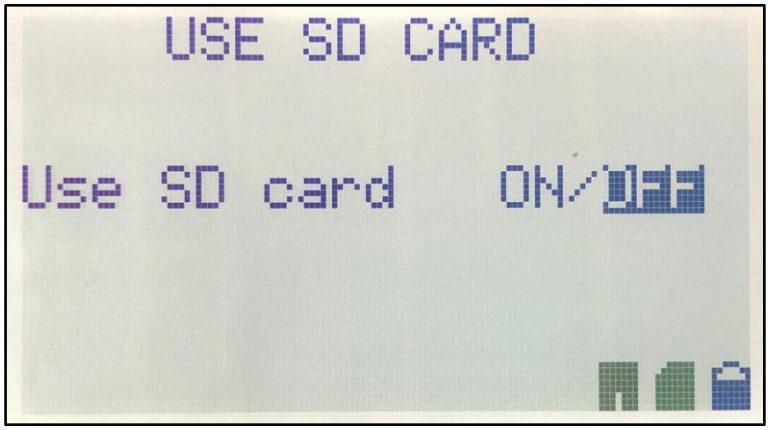

The duration of the backlight can be set by nomination one of the 4 options.
If enabled, the backlight will come on for the nominated period whenever a button is pressed.
The default is 5 seconds.
Use < and > or trigger button to select.
ENTER to save.

## 3.9.8 SD card menu

The following shows the items displayed in the SD CARD menu



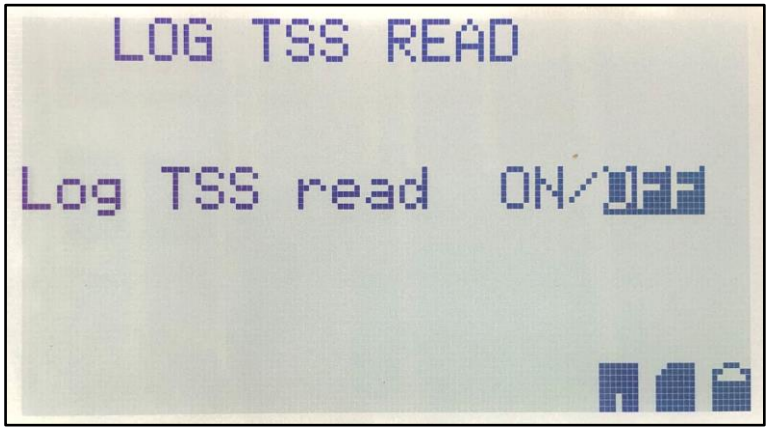

## 3.9.9 Use SD card




Set ON to log readings to a micro SD card. The SD card icon will appear on the status line.

If the SD card option is not used, TSS and LEVEL readings can be saved and recalled from the units internal memory.

## 3.9.10 Log TSS readings

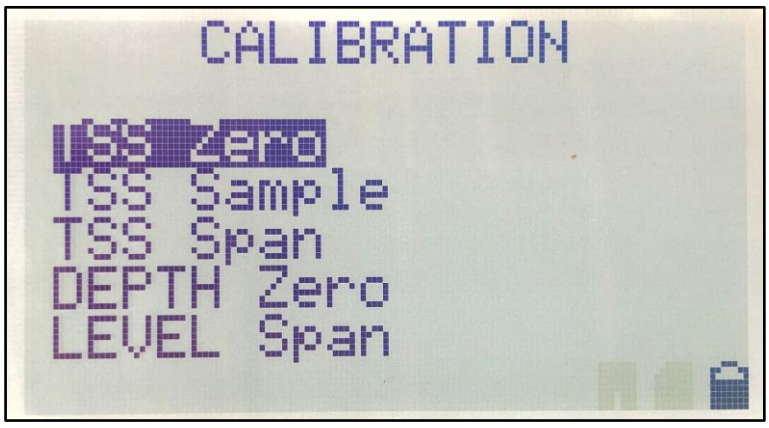



This option will log every TSS read operation that is performed to the SD card.

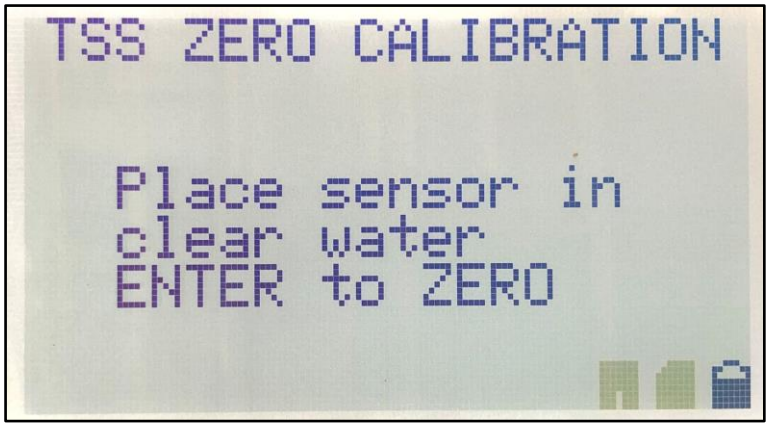
The default setting for this is OFF.
Note: that it does not save a location.
Use this option only if Use SD card has been set to ON.

# 4 Calibration

**Calibration menu** **NOTE: Calibration data is stored in the sensor and not in the handheld.**
The following shows the items displayed in the calibration menu

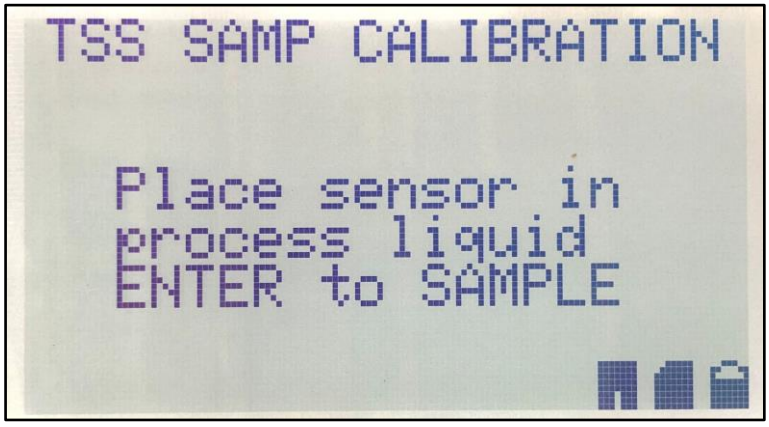



## 4.1 TSS Zero




The sensor can be calibrated to zero TSS by submerging the sensor in clear water and pressing ENTER.
A CALIBRATING message will appear on the display.
An error message will be generated if the sensor detects that the water is not sufficiently clear.
Note: that the sensor will return a non-zero value when a reading is taken in air.

## 4.2 TSS Sample




Calibrating the sensor for SPAN TSS is a two stage process.
Step 1 is to take a reading of the process liquid. A sample of the process liquid is taken and analysed to establish the weight of the total suspended solids after the liquid has been evaporated.
The weight of the TSS in mg/l is entered as step 2 using the TSS SPAN option. Ensure that Step2 is performed on the **same sensor** used in step 1.

Lower the sensor into the process. Press ENTER to take a sample reading.
The Serial number of the sensor will be displayed.
Note the serial number and associate it with the sample to be processed.
Press ENTER again to complete the sampling process.
Once the sample has been analysed and the concentration of TSS determined. Complete the calibration by going TSS Span in the calibration menu



## 4.3 TSS Span

In the TSS Sample procedure a sample of the process was taken for analysis. The analysis is a result that quantifies the weight of total suspended solids found and is represented in mg/l. This weight needs to be entered into the sensor so that the sensor can associate it with the reading it took during the sample process. The sensor uses this result in combination with the TSS zero to establish a result for different levels of TSS in a process with similar characteristics.

The unit will poll the sensor and return serial number of the sensor connected. Ensure that the serial number associated with the initial sample and the connected sensor match.
The display will display the last TSS span value recorded in the sensor. Use the < and > buttons to nominate the digits that need to be edited. Use the UP and DOWN trigger buttons to edit the digits.

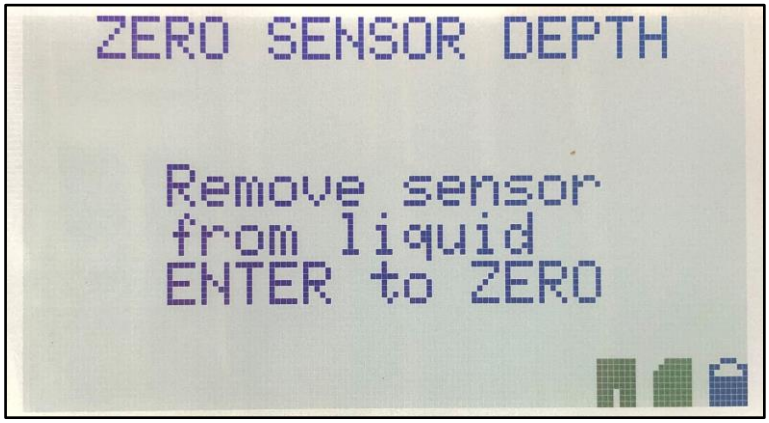



When complete, press the ENTER button and a CALIBRATING message should display.

The sensor will check the entered value and if an error is detected the ERROR message will be displayed.

In the event of an ERROR use the MENU – SERVICE – SENSOR INFO option to display the sensors diagnostics. A negative number in the operation or calibration field will indicate the issue. Refer to the troubleshooting section of this manual for more information

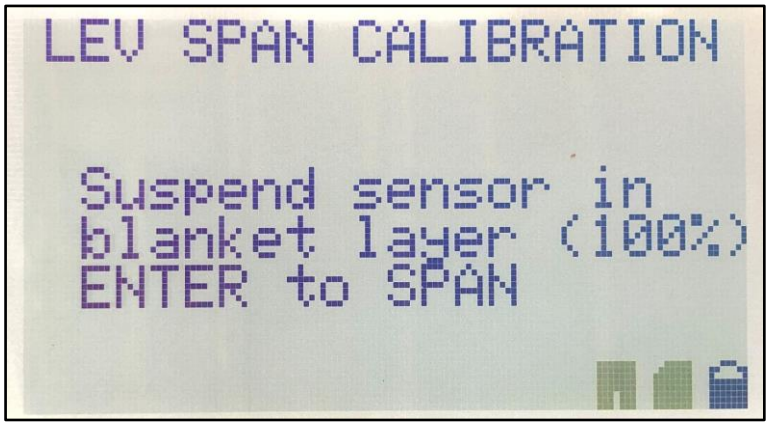
## 4.4 DEPTH Zero




This is used to calibrate the depth sensor so that it displays a value of zero when out of the process.
Remove the sensor from the process and press ENTER. The level sensor will be calibrated to display Zero.
The depth sensor is used to establish the depth of the interface layer in LEVEL mode.

## 4.5 LEVEL Span

Prior to performing a LEVEL reading, the sensor should be calibrated to the tank that the interface analysis is going to be performed on.




Lower the sensor to the bottom of the tank and press ENTER. The span for this tank has now been calibrated and stored to the sensor.

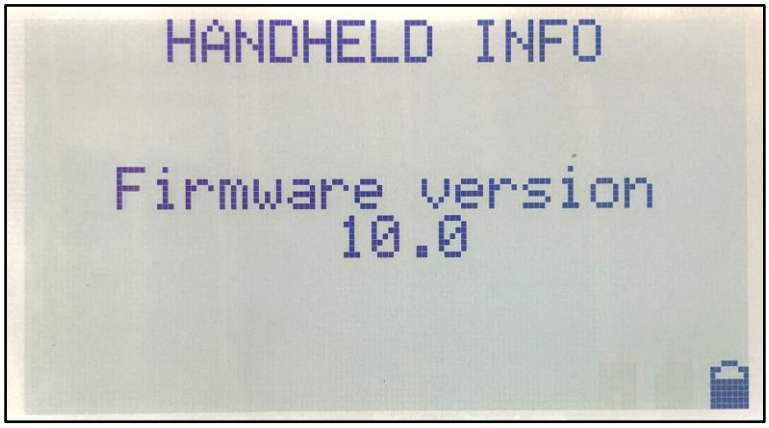
# 5 Troubleshooting

## 5.1 Service menu

The following shows the items displayed in SERVICE menu



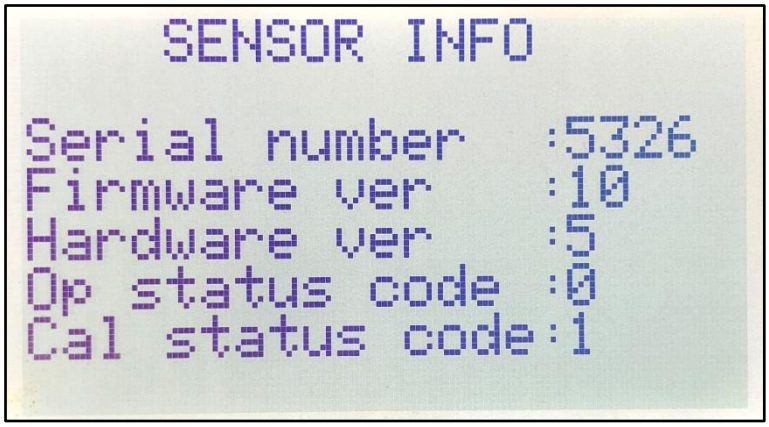

## 5.2 Handheld info

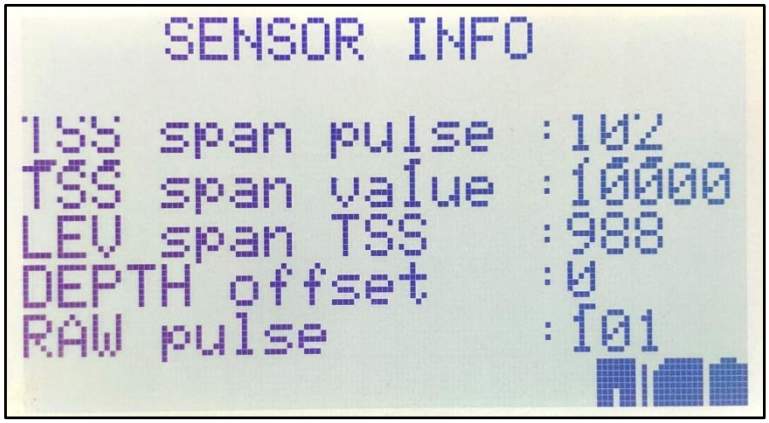



This screen displays the current firmware version used in the unit.
This number may be required when requesting support.

## 5.3 Sensor info

This feature will interrogate a sensor that is currently connected and display some of its vital statistics.
Press ENTER and the handheld will poll the sensor for information.
Use the < and > or UP and DOWN trigger keys to scroll the display.




This is a very useful feature when diagnosing any issues with the system.
Of prime importance is the Op and Cal status codes. These should always have a positive value.
Any negative numbers indicate a problem.

### 5.3.1 Status codes

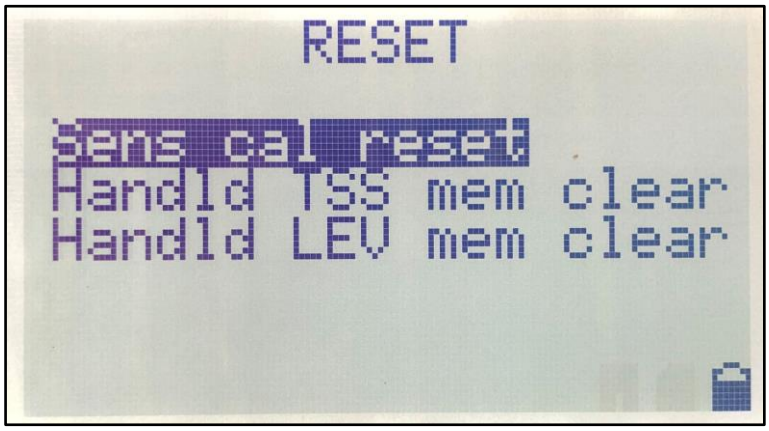
| | |
|---|---|
| 0 | No errors |
| -2 | Sensor is recording a very low reading from the light sensor. Sensor fault. |
| -4 | TSS reading very low for a Span sample to be performed. |
| -7 | Invalid Span TSS low value |
| -14 | TSS reported from sensor is over range. |
| -19 | Light sensor is reporting an over range condition. |
| -20 | Light sensor is reporting an under range condition. Fault. |
| -23 | Level Span Error |
| -24 | Depth Zero  Error - The sensor is not out of the process |

## 5.4 Contact info

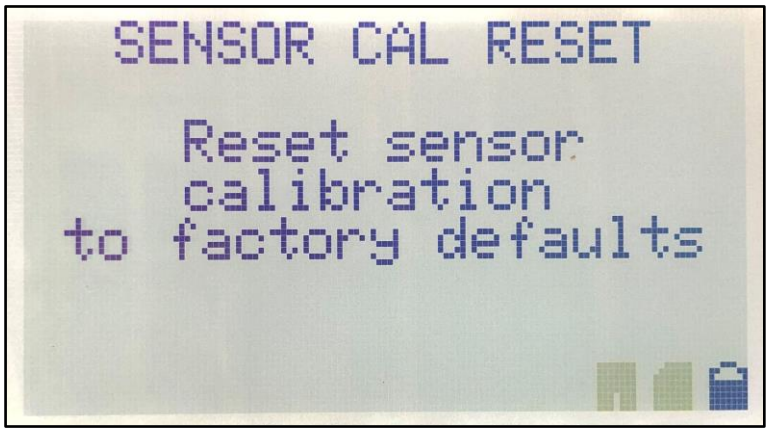
This screen shows the contact details for support

## 5.5 Reset menu

The following shows the items displayed in the RESET menu




### 5.5.1 Sensor calibration reset




This option can be used at any time to reset the sensor back to the default factory calibration values. For accurate results the sensor should be re calibrated.

### 5.5.2 Handheld TSS location memory clear

Use this option to clear the handhelds internal location memory of past TSS readings.
**Note: This does not clear data from the SD card.**

### 5.5.3 Handheld LEVEL location memory clear

Use this option to clear the handhelds internal location memory of past LEVEL readings.
**Note: This does not clear data from the SD card.**

## 5.6 Cleaning the Handheld

Use a damp cloth and wipe the outer case.
(do not use solvents)

## 5.7 Sensor maintenance

Clean the sensor using warm soapy water.
Use a soft fabric and clean the sensor slot.

Do not use any solvents. This will damage the sensor.
Do not insert any object up into the sensor. This will damage the pressure sensor diaphragm.

## 5.8 Resolving problems

| | |
|---|---|
| Unit will not switch on | 1. Check that the battery is installed<br>2. Disconnect the unit from a charger if plugged in. (the unit will not power up while being charged). Wait 10 second before attempting to power up after disconnecting.<br>3. Disconnect the sensor<br>4. Press and hold the power button for a count of 15.<br>5. Release and press the power button again.<br>If the unit does not power up, connect it to a charger for a couple of hours and retry. |
| Sensor error | Ensure that the sensor is securely plugged in. Hold down on of the trigger buttons and look in between the sensors sensing gap and see if a red glow can be observed. If no red glow can be see, may indicate that the sensor is faulty.<br><br>Go to Manu-Service-Sensor Info and press ENTER.<br>Check for any negative codes or No response from sensor error code. |
| Error on SD card | Check that a SD card is in the unit<br>Ensure that the SD card has a capacity of <= 32GB<br>Ensure the SD card has been formatted<br>Check for any damage to the SD contact pins |

## 5.9 The unit has been submerged

The handheld has a IP65 rating and should not be submerged. If this has occurred, do not switch the unit on. Remove the battery, clean and return the unit to the supplier for repair.