Monitoring a Boat with an ORB-X1

Introduction

Boats that are moored or berthed need constant monitoring to ensure that they remain on the mooring, that the water level in the bilge is low, that the engine and house batteries are charged and that there is no unauthorised entry to the cabin. Where the owner lives remotely, this can be time-consuming, and expensive. The ORB-X1 will allow remote monitoring of all these features, remotely, at low cost.

This application note describes an example of how an ORB could be installed to monitor the position, pitch, roll, sea-state, utilisation, bilge level, intruder detection, sea temperature, engine batteries, and house batteries. The sensors used are widely available and are low cost.

Hardware Interconnect

An ORB-X1-G has been chosen in this application as it has integrated GPS for location, GSM for communications and a thermocouple input to measure sea-water temperature. The ORB should be mounted in a location where the GPS and GSM antennas have a view of the sky that is not obscured by metal.

Figure 1 - ORB-X1-G Installed in the Engine Bay

For level measurement, a simple float switch is used. The Normally Closed (NC) terminal will be used so that if a wire breaks, the circuit will be broken (as if the switch is opened), and a notification will be received. If real-time bilge level measurement is required, a 4-20mA submersible depth sensor could be used.

Figure 2 - Float Switch (Cynergy RSF78YNP)

For the door switch, a simple reed switch is chosen. Again, the NC terminal is used to make the system fail safe. If additional doors, or an engine hatch also need to be monitored, multiple switches could be connected in series. If any of the switches is opened, or a wire fails, the circuit will break, and an alarm will be received. Keep in mind that not all reed switches ship with an included magnet. If preferred a mechanical door switch could be substituted.

Figure 3 - Door Switch (Littlefuse 59135-030)

Sea water temperature is measured using a K-Type thermocouple. A thermocouple with a bolt hole is chosen for easy install, where the thermocouple can be attached to a bolt on one of the water inlets. In some installs, the thermocouple is clamped to a fitting that is in contact with the sea water using a hose clamp. If sea water temperature is not of interest, the thermocouple could be used to measure engine or exhaust temperature.

Figure 4 - Thermocouple (Labfacility FW-K-2M)

A siren is connected and can be configured to activate if an intruder alert is generated or additionally if the bilge level rises or if the engine temperature rises. Some users are setting the buzzer to sound periodically to scare away birds. The buzzer used is rated at 12V. If the vessel uses 24V power, a higher voltage alarm should be chosen. A light or beacon could be substituted for the siren, but a relay may be needed to supply the high current required.

Figure 5 - Piezo Siren (Imo 41.P47L120GLF)

Figure 6 shows a typical connection diagram. In the figure, the ORB is powered by the house battery, with power being applied to pin 1 and ground to pin 2. The house battery is chosen to power the ORB in case, in an extreme case, the power drawn by the ORB causes the battery to drain, in which case the engine can still be started. The voltage of the power connected to pin 1 is monitored by the ORB and so the house battery voltage will be monitored and reported. It is assumed that the house battery is charged by a solar panel, if not, the interval at which the ORB reports may need to be reduced, to minimise power consumption. It is recommended that a 1A fuse be inserted between the solar panel and the power connection of the ORB. The fuse protects the battery in the unlikely event that the ORB fails, or if the positive wire comes loose and touches ground.

The thermocouple is connected to the dedicated thermocouple input on the ORB on pins 11 and 12. Note that with most thermocouples, the red wire is negative and goes to pin 11.

The positive wire of the siren is connected to the house battery and the siren turns on when the negative wire, connected to pin 10, is pulled low on alert. The ORB can be configured to activate the output on alert, warning, or alarm, and can be configured to stay on for a selected time.

The engine battery positive is connected to Input 2, pin 9 on the ORB, and will be monitored and reported upon. An alert can be generated if the voltage falls below a critical level. Only micro-amps will be drawn from the engine battery.

The intruder detection switch is connected between supply and Input 1 on the ORB. The input will be selected to alarm if a low voltage is detected on the input. A change on Input 1 can wake the ORB immediately and so even if the ORB is sleeping to reduce power, an instant alert will be received if the intruder circuit is broken.

Optionally, a weather station, or other serial device can be connected to the serial port. Many wind speed sensors are available with serial MODBUS output and can report wind speed, direction, and other environmental parameters.

The current sources on the ORB can be set to act as inputs, and in this application, source 1 is set to be an input and is used to monitor the bilge level.

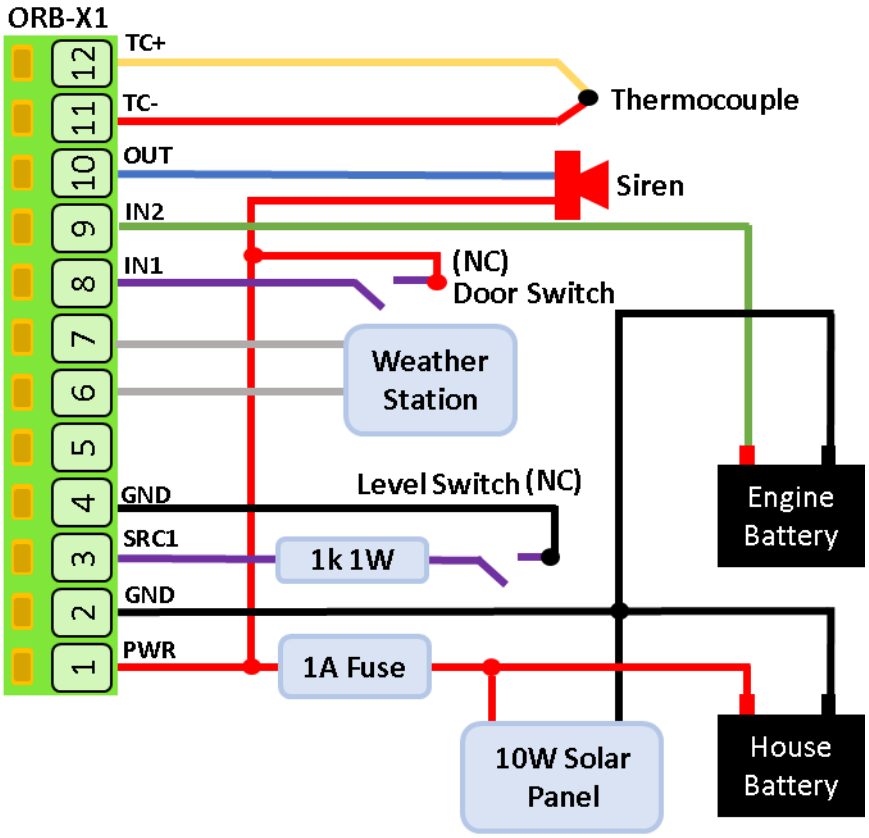


Figure 6 - Example Wiring Guide

ORB Configuration

If you are configuring the ORB for the first time, use a phone, tablet, or laptop to access the ORB's integrated webserver. To activate the webserver, press the setup key on the ORB for 2 seconds and then connect to the ORB's Wi-Fi on your phone, tablet, or laptop. Passwords for the ORB's Wi-Fi and webserver can be found on a tear-off sticker under the lid of the ORB. For further details on how to access the webserver, please see the "ORB-X1 User Guide". If the ORB is already available on the Senquip Portal, simply login to the portal and make the required changes remotely.

The ORB can be set to transmit via either Wi-Fi or GSM. The configuration of the transmission is not covered in this application note but GSM at least should be selected so that the ORB can be used to track the boat when it leaves the mooring.

Note that only settings used in connecting the ORB as a boat monitor are discussed in this application note.

General Setup

For general setup, use the ***General*** tab on the ORB webserver or Senquip Portal as shown in Figure 7. Remember to save when complete.

Give the ORB a name that is meaningful to the user, in this case, the name of the boat "Moonshine."

To save energy, the ORB is set to wake up every 6 minutes (360 seconds), report the position and all measurements and then return to sleep. If the house battery is connected to solar, the measurement interval could be reduced to receive faster notification if the boat leaves the mooring position.

Set the Transmit Interval to 1 so that the position is sent each time it is measured.

There are no warnings or alarms used in this application that require faster updates be sent and so the Exception Interval is set to be the same as the transit interval.

The *Device Always On,* and *Web Server Always On* options are both not ticked to save power.

Power Loss Alert and *Hibernate on Powe Loss* are both ticked so that an alert will be sent if power is lost and so that the ORB will then enter a low power hibernate mode, running off internal batteries and reporting only every 6 hours.

If AA batteries are being used as a backup to power the ORB, then an alert should be set for when the batteries are low. This is not normally required as the ORB has an internal LiPo battery that will power it if power is lost.

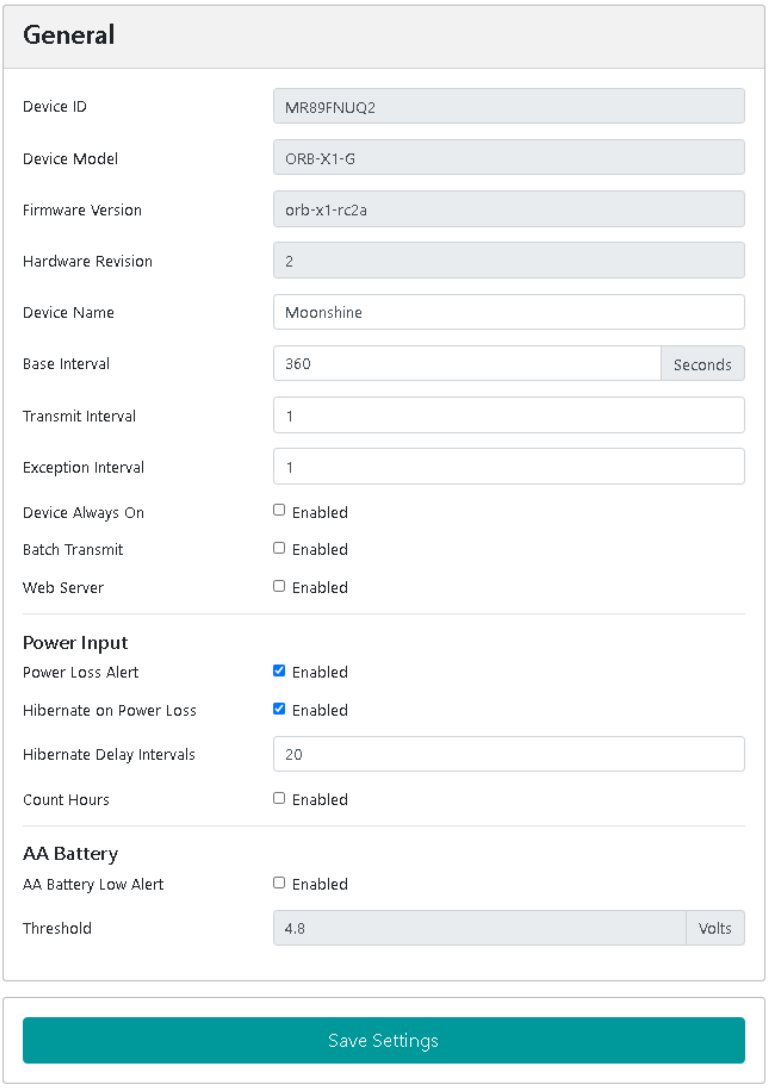


Figure 7 - General Setup

Internal Sensor Configuration

This section discusses all the setting of sensors internal to the ORB and can be found using the ***Internal*** tab on the ORB webserver or Senquip Portal.

The ORB contains a tamper alert that is activated if the ORB is opened.

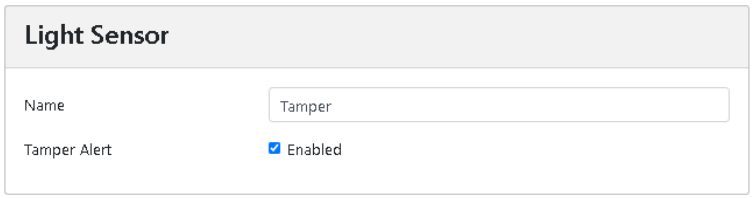


Figure 8 - Tamper Alert

The ORB has been mounted in the engine compartment and the temperature sensor in the ORB is being used to measure the ambient temperature. A warning is configured to be raised if the temperature exceeds 40°C.

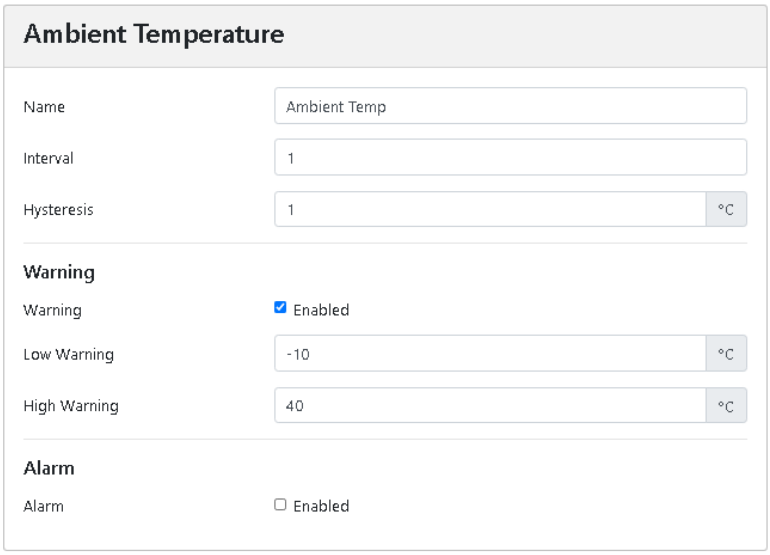


Figure 9 - Ambient Temperature Monitoring

The 3-axis accelerometer in the ORB is used to measure the pitch and roll of the boat as well as the sea state. An alert is generated if the boat experiences motion exceeding 100mG. In this case, the owner may elect to check the condition of the mooring lines as it is likely that the boat is experiencing rough conditions on the mooring. Excessive pitch or roll could be an indication that the boat is filling with water.

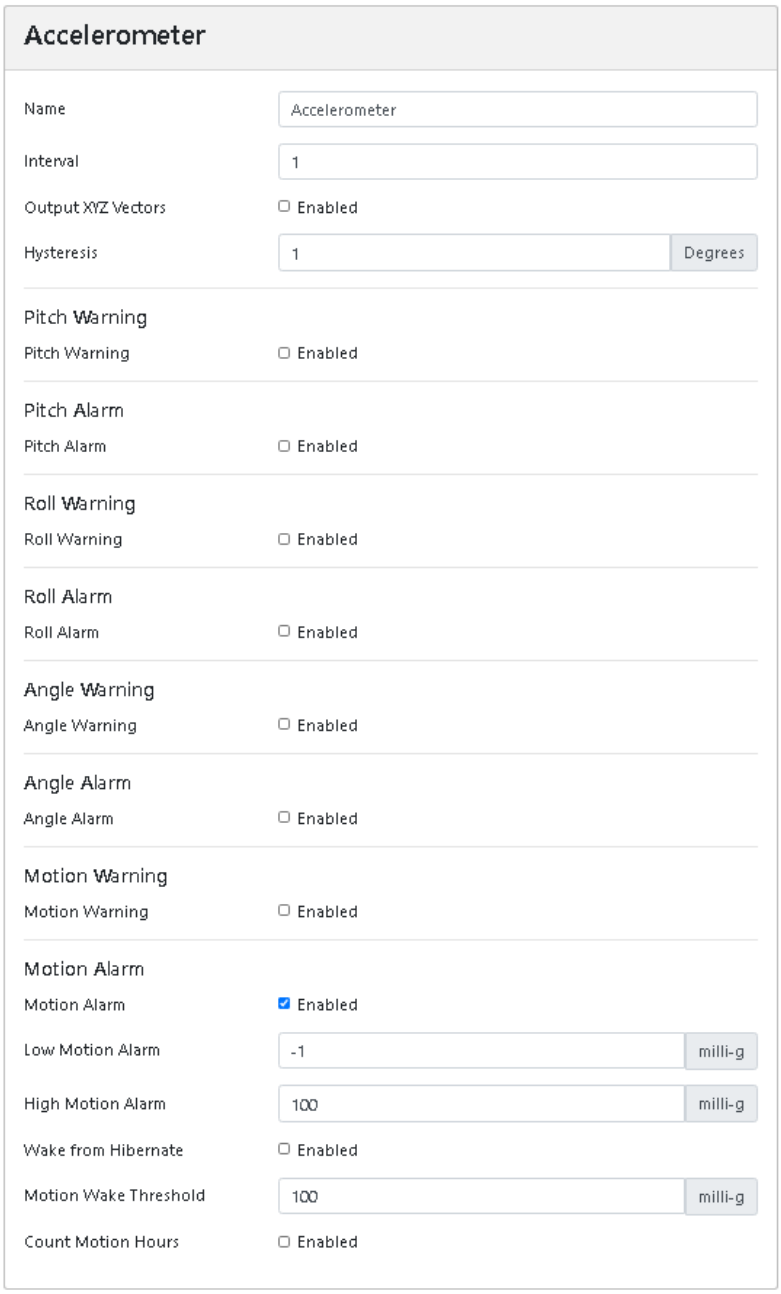
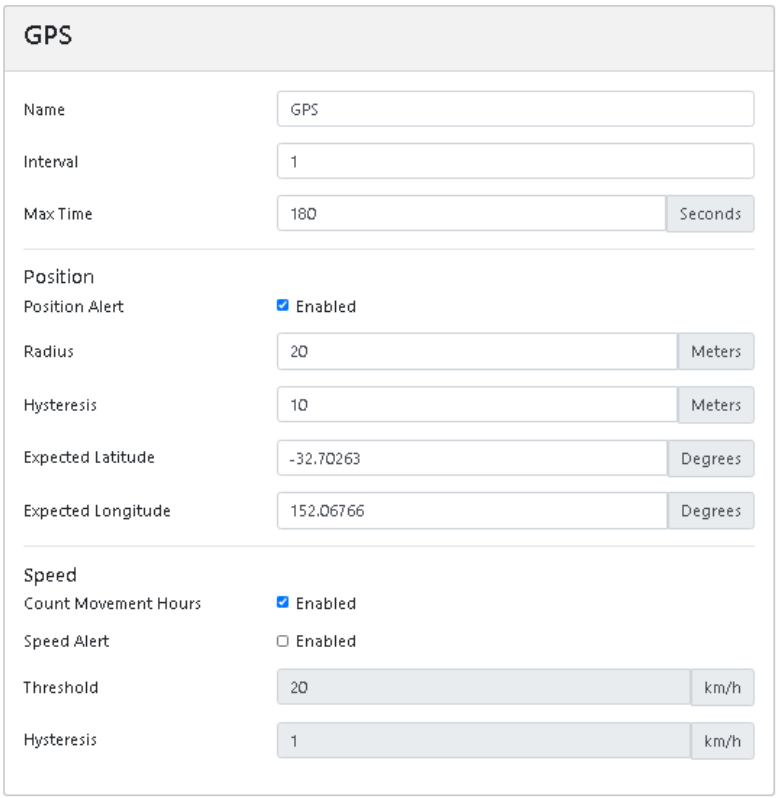


Figure 10 - Accelerometer configuration

The GPS is used to monitor the location and speed of the boat and to measure utilisation. A position alert has been set to create an event if the boat moves more than 20m from its expected location on the mooring. The expected location is copied from the GPS Info on the main page of the Senquip Portal. Hysteresis prevents multiple alerts if the boat is on the edge of the allowed 20m radius. Movement hours are used to determine how often the boat is used. An hour counter is incremented when the boat speed exceeds 2km/h. Alternatively, motion or an ignition feed could be used to measure utilisation.



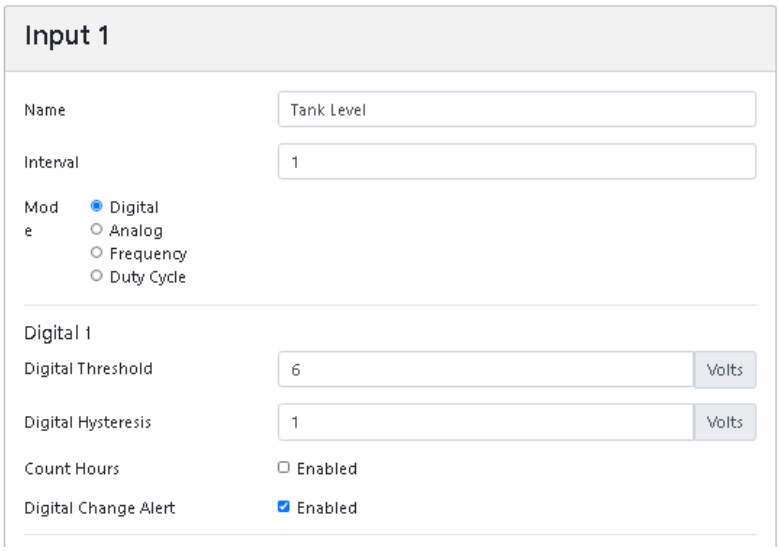
External Sensor Configuration

This section discusses all the setting of sensors internal to the ORB and can be found using the ***External*** tab on the ORB webserver or Senquip Portal.

Input 1 is used to monitor for intruder detection. The input is set in *Digital* mode and the threshold is set to 6V. When the switch is closed, the house battery voltage will be measured and when the switch is open, 0 volts will be measured. Hysteresis of 1V is applied to prevent multiple alerts as the voltage crosses 6V.

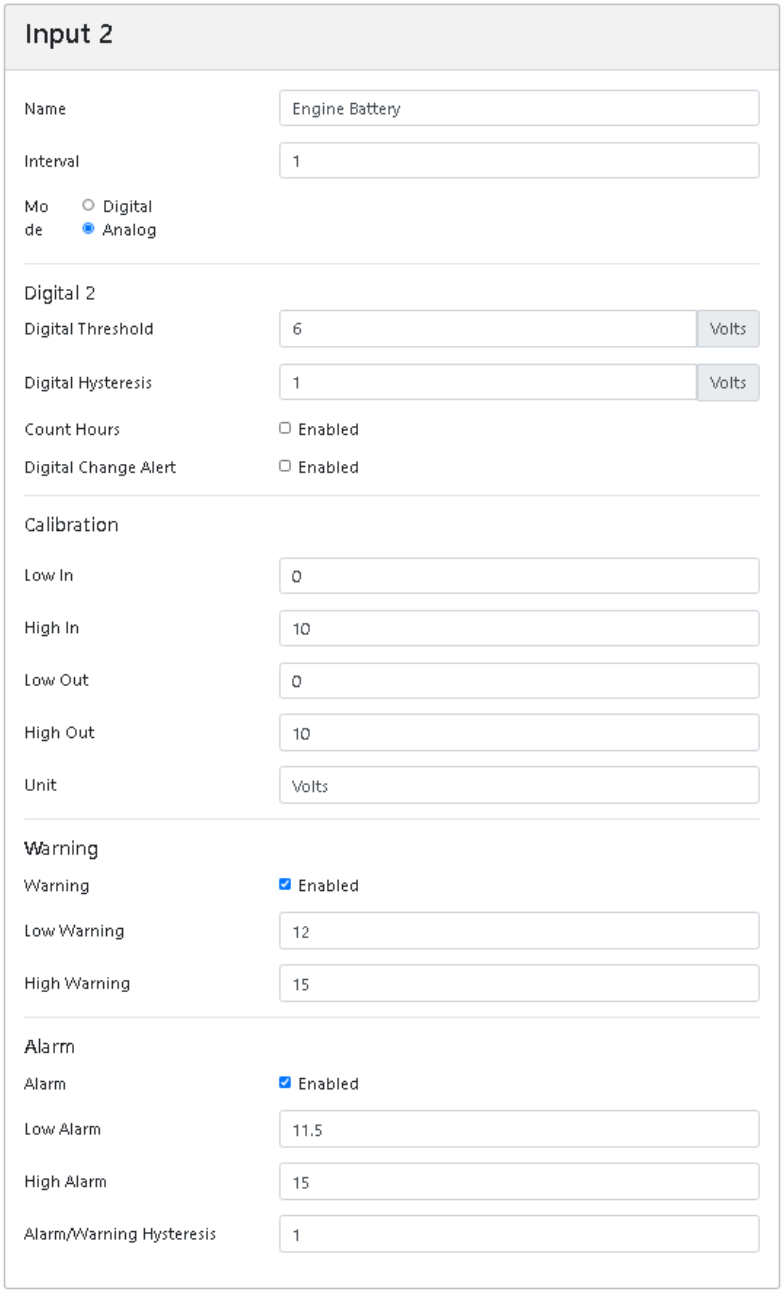
An alert is set to happen when the switch position changes due to the circuit being opened or closed. If the ORB is sleeping when the change happens, it will immediately exit sleep and report the change. The output will be configured to turn on when a change is detected.

None of the settings associated with the analog functions of the pin, such as calibration and warning and alarm levels are used.

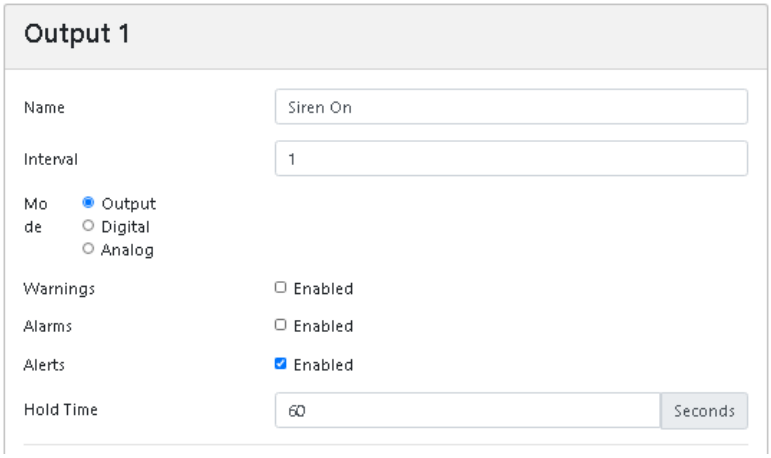


Input 2 is used to measure the engine battery voltage and so has been named “Engine Battery” and is set to *Analog* mode. A warning is set if the voltage drops below 12V and an alarm if it further drops below 11.5V.

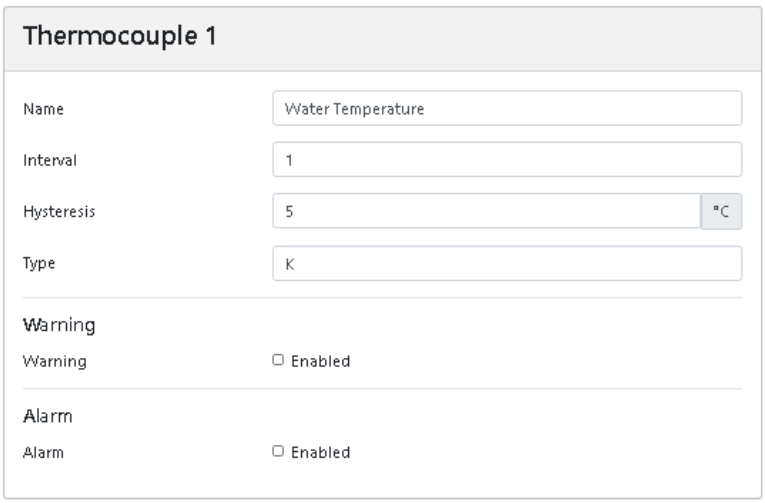
Calibration is not used.



The Output is used to turn on a siren in the event of an intruder detection. The siren could also be made to turn on when the battery is low, the temperature reaches a threshold, the bilge level rises, the boat moves off the mooring etc.



A type “K” thermocouple is used to measure water temperature. No warnings or alarms are raised because of sea temperature changes.

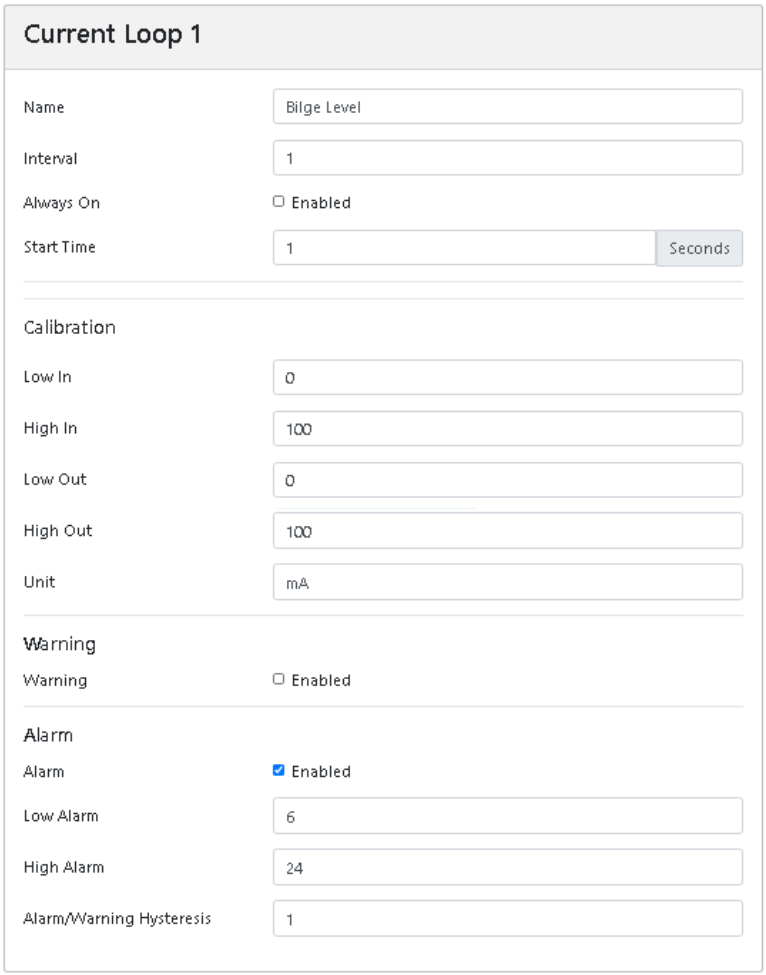


The Current Source peripheral is used to trigger an alarm when the bilge level exceeds a threshold that is set by the mounting position of the level switch.

The current sources turn on and deliver 12V to an externally connected sensor. The current drawn by the sensor, typically a 4-20mA or other current output sensor is then measured. By adding a 1000 Ohm resistor in series with a switch, a current can be created that changes in response to the switch position. When the switch is closed, 12mA will flow and when open, no current will flow.

Since the switch is normally closed when the water level is low, under normal circumstances, 12mA will be measured. An alarm is set to occur if the current drops below 6mA.

The Current sources can also be configured to measure voltage directly, but the method described allows a simple change to a 4-20mA depth sensor if required.



Current Source 2 is unused and could be used to monitor another switch or sensor such as an oil pressure, water level, temperature, or other sensor.

The Serial peripheral could be connected to a weather station or anemometer, many of which operate over serial and use a protocol called MODBUS that is supported by the ORB.

Viewing Data and Receiving Alerts

Now that your Senquip™ ORB is connected and configured, the information associated with your boat can be monitored online using the Senquip Portal.

Figure 11shows a subset of the data measured for a boat being monitored with an ORB.

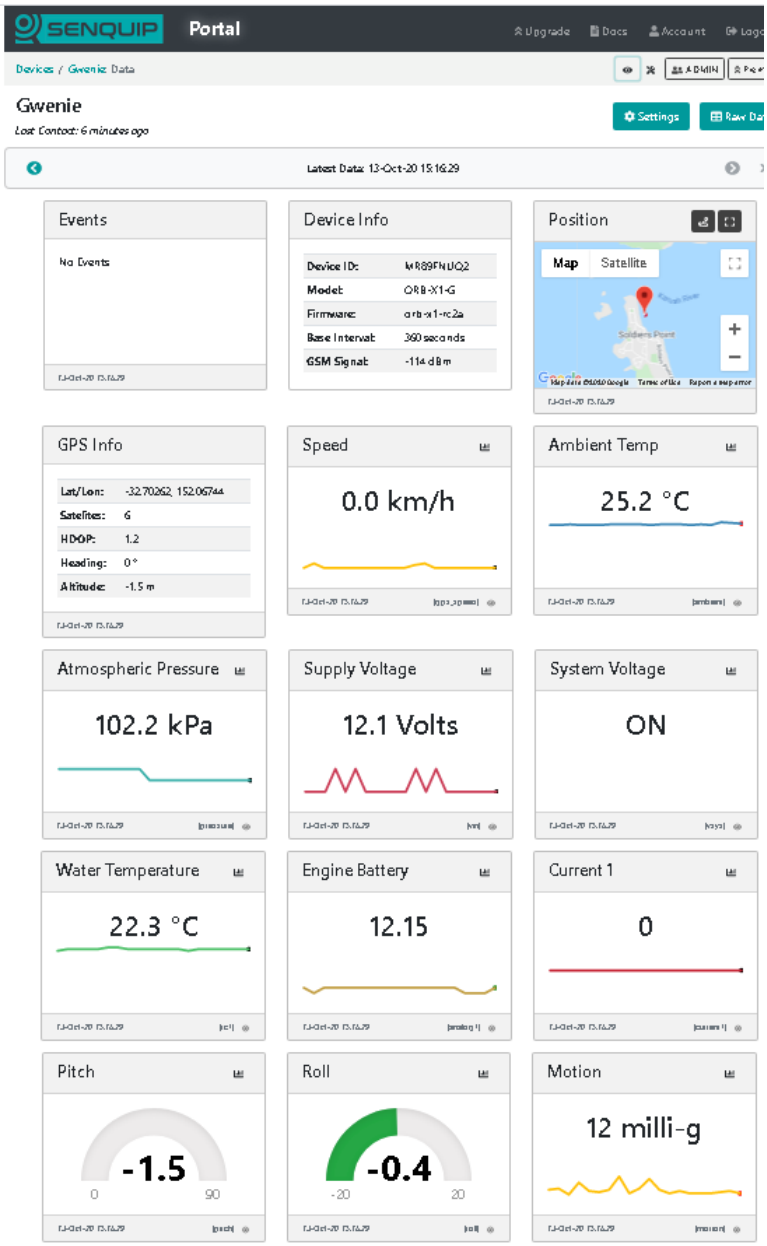


Figure 11 - Senquip Portal

Email and SMS alerts can be configured on the Senquip Portal to be sent in response to alerts, warnings, and alarms.

Conclusion

The physical connection and setup required to allow an ORB to monitor a boat on a mooring is quick and simple. Once connected, the position, speed, pitch, roll, sea-state, utilisation, bilge level, intruder detection, sea temperature, engine and house battery voltage can be viewed anywhere in the world on the internet. Email and SMS alerts can be configured to warn if the boat leaves the mooring, there is an intruder detection, or the bilge level rises.