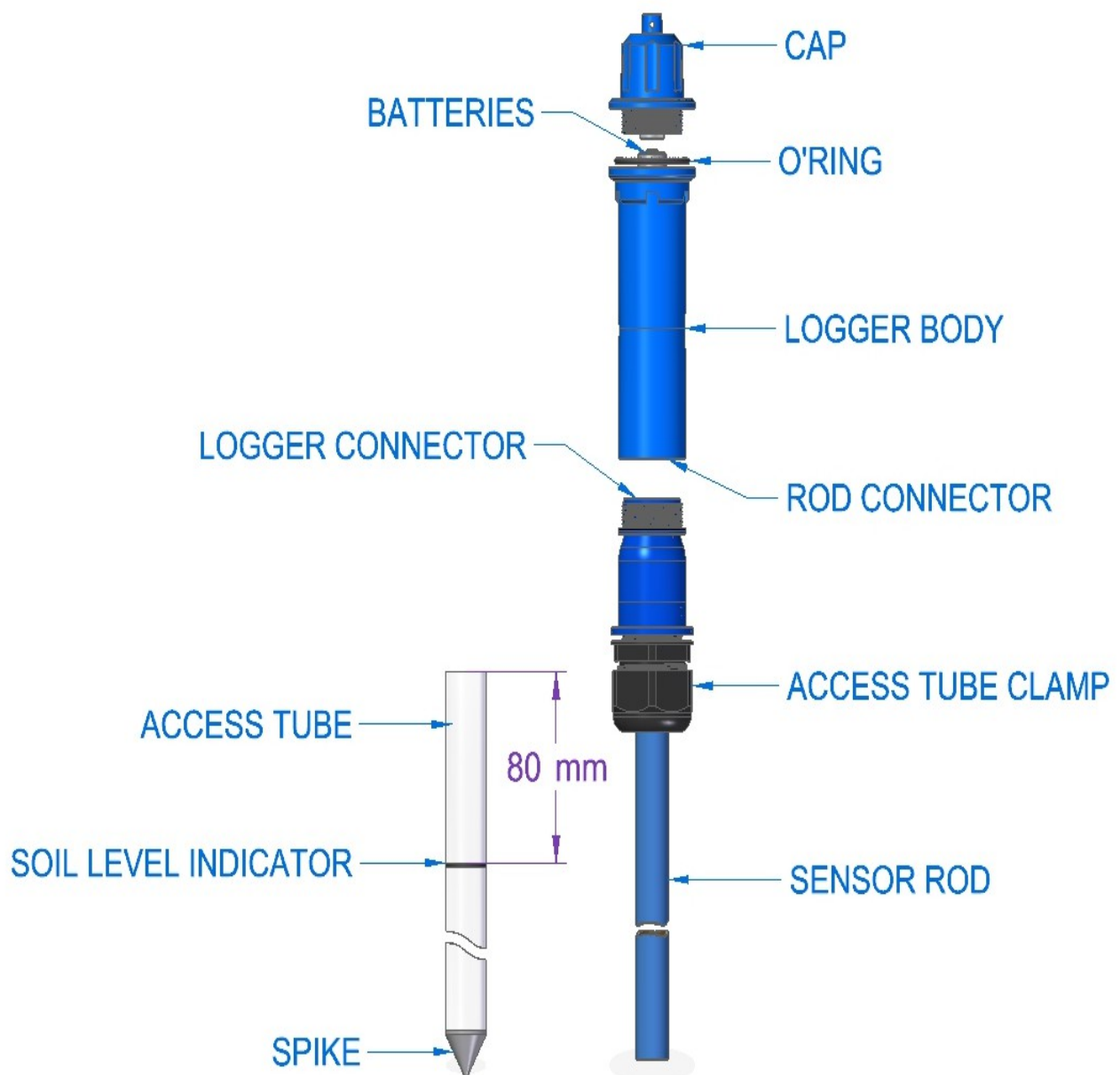


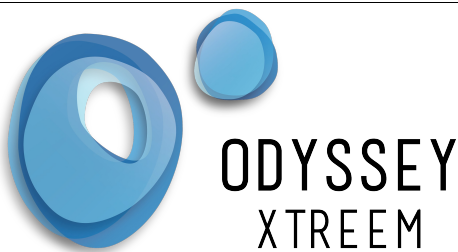


ODYSSEY
XTREAM

Odyssey® Xtream Multi-Profile Soil Moisture Logger User Manual

Xtream Multi-Profile Soil Moisture Logger User Diagram

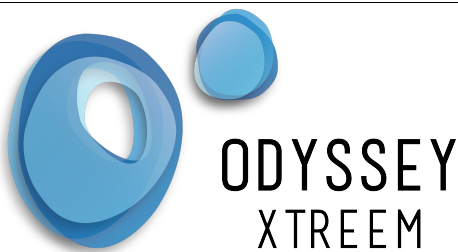




Odyssey® Xtream Multi-Profile Soil Moisture Logger User Manual

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Principal of Operation

The multi-profile soil moisture logger is non contact and measures both the soil moisture and temperature at multiple (up to 5) discrete points along the length of the rod with sensor spacings as low as 100mm.

The sensor in the rod consists of two metal plates connected to a proprietary oscillator circuit. As the moisture of the soil seen in the electric field between the plates increases, the capacitance also increases which reduces the frequency of the oscillator. This frequency is then measured by the sensor over a fixed time period. The sensor measurement diameter is up to 170mm in soil.

The temperature at each profile level is measured through a thermal bond to the moisture measurement plates which are in close proximity to the soil.

Measurement of each sensor down the rod occurs sequentially and the resultant digital data is sent to the Odyssey® Xtream logger attached to the top of the rod. The logger stores the data in its memory along with the time of the measurement.

When uploading the data via Bluetooth to a tablet / phone the soil moisture data is compensated for variations due to soil temperature using the stored factory calibration.

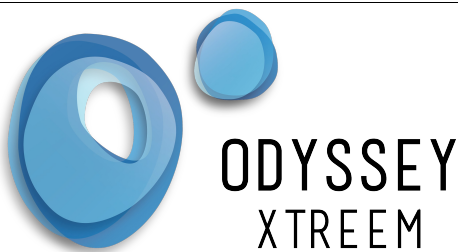
Installation Methods

The Xtream multi-profile soil moisture must be installed into an access tube available from Odyssey®.

Access Tube

The access tube must be inserted into the ground and there are many methods to do this depending on the soil type and situation. The aim is to insert the access tube with as little effect as possible on the surrounding soil. Note, access tubes used with the older Classic multi-profile system must be replaced with new access tubes.

- 1) **Impact Driven from the top** using the impact plug also available from Odyssey®. This method is best suited for softer soils with no stones. First soak the ground, see section below. Place the impact plug on top of the access tube and with a mallet gently tap the impact plug driving the access tube into the ground. If too much force is applied the access tube could bend preventing the sensor rod being inserted. If it gets too hard soak the ground again. All access tubes are supplied with a black line near the top. Insert the tube until this line is level with the ground surface.
- 2) **Impact Driven from the bottom** using the impact rods, available from Odyssey®. This method is best suited for most soils types with no stones. It is better than top driven as the access tube does not bend which reduces the soil movement. First soak the ground, see section below. For tubes longer than 0.5m use both rods by screwing them together. With a mallet gently tap the impact rod driving the access tube into the ground. If too much force is applied the access



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tube could bend preventing the sensor rod being inserted. If it gets too hard soak the ground again. All access tubes are supplied with a black line near the top. Insert the tube until this line is level with the ground surface.

- 3) **Auger undersized hole** using a 20mm drill fitted to a long shaft. We still suggest the ground is soaked first as this will make it easier. This method is suitable for firmer soils with small stones. Once bored use either of the 2 methods above to tap the access tube into the ground.
- 4) **Auger oversized hole** using a 25mm drill (or larger) fitted to a long shaft. We still suggest the ground is soaked first as this will make it easier. This method is suitable for firmer soils with stones. Auger 100mm at a time and place the soil in numbered piles. Sift through each pile and remove the stones. Pack the soil back in the hole so that it is mostly in the same place it came from. Use either method 1 or 2 above to tap the access tube into the ground.

Soaking the ground:

To soften the soil it may be necessary to soak it with water for 24 to 48 hours. Do this by placing a cylinder (300mm diameter minimum) on the ground at the site with the access tube gently pushed into the ground in the middle. Note a 20 litre bucket with the bottom cut out can be used as the cylinder. Fill this cylinder with 250mm of water. Once it has emptied refill it several times over 24-48 hours until the soil is soft.

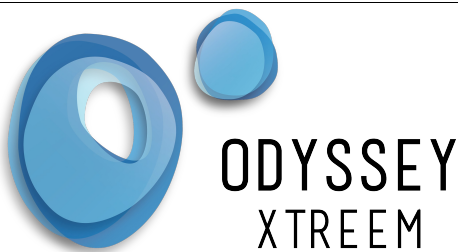
Installing the Sensor Rod

Slide the sensor rod into the access tube that has previously been installed into the ground. The sensor rod must go all the way into the access tube. In this position the access tube clamp will cover the access tube by about 30mm. Hold the blue sensor rod body and tighten the access tube clamp nut by hand (Do not use a spanner for this). It is important that this is tightened firmly to prevent moisture entering the tube. Do not tighten the clamp when the access tube is not in the clamp as this will prevent the sensor rod from being installed correctly requiring the sensor rod to be returned for repair.

Installing the Logger

Looking up into the body of the logger the sensor rod connector can be seen. There are 4 small gold probes which must be kept clean at all times. Do not press these probes as this may damage them. These gold probes connect to the gold rings on the top of the sensor rod. Make sure there is no moisture or dirt on these rings. To prevent contamination of these probes always keep a logger connected to the sensor rod.

Screw the logger onto the sensor rod. Again this must be hand tightened to prevent moisture entering the logger. Rotate the logger until it is just touching the seal, then tighten it with another quarter turn. It is important that this is tight as there is a seal beside the logger connector, to prevent moisture ingress.



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Getting the best Performance

These loggers and sensors rods are very sensitive. To get the best performance out of the system follow these simple procedures.

1. The sensor rods are sensitive to rotation so if a rod is to be removed for any reason then mark a vertical line on the access tube and the sensor rod body using a pen. When putting the sensor rod back into the access tube, align these two marks again.
2. Moisture in the access tube will prevent the system measuring correctly. Remove the sensor rod and inspect for any sign of moisture. If there is, dry the inside of the access tube. This can be done with a 16mm diameter rod (impact Rod available from Odyssey®) and a small cloth. Whenever a sensor rod is removed from the access tube remember to put the access tube cap on to prevent water getting in.
3. The sensor rods are sensitive to movement. Which may be indicated by small unexplained jumps of a couple of percent in the data. Check that the sensor rod clamp is tight on the access tube and that the logger is tight on the sensor rod. Also check that the access tube is firmly anchored in the ground. If an extension rod is being used wind may cause small movements. In this case anchor the top of the logger with some string to the ground with pegs.

Installing the Xtract Application

Search Google Play Store or Apple App Store for the Odyssey® Xtract application and install as usual. The application must have access to Bluetooth communications and GPS location services. In the Settings screen enter your username and password provided by Dataflow Systems.

Press the green **SERVER SYNC** button to load the Odyssey® Xtream logger(s) and configuration(s) from the Xpert Web Portal.

The latest Odyssey® Xtract user manual and other user manuals are available on Xpert once you have logged in.

Identifying the Logger

By default the Odyssey® Xtream logger will arrive with its name being a hexadecimal representation of its serial number. In the Xtract Application press the View button. Once scanned, the Odyssey® Xtream logger located will be shown in the list. The Xtream logger with the highest signal (also coloured green if it is very close) is the logger that is closest to the tablet / phone.

Setting Up the Logger

The first time the logger is used, unscrew the top cap and remove the battery insulation disc. All user configuration is carried out in the Xpert Web portal. The tablet / phone running the Xtract application transfers the logged data from the Odyssey® Xtream logger to the Xpert web portal and transfers the configuration into the Odyssey® Xtream logger. Using a web browser (Firefox is preferred) navigate to www.xpert.nz, then enter your username and password provided by Dataflow Systems. On the Map page (default), select Home from the drop down selection box, then select a logger from the logger selection drop down box. An icon for the selected logger will display on the Map. Click on this



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icon and an information box above it will pop up. To locate the icon for the first time, it may be necessary to zoom the Map out to find the logger.

Download the full Odyssey® Xpert user manual from Xpert web portal.

Logger Configuration

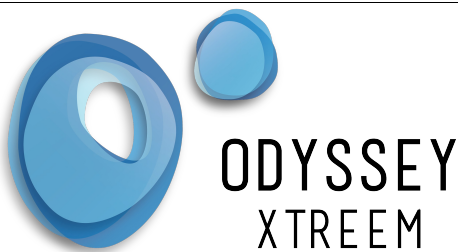
1. Select the Logger Config Tab. Enter a Logger Name that will be used to Identify the Logger from now on. The serial number can be used however this is very long and difficult to remember.
2. For most situations use continuous logging. This means once the memory is full it will start overwriting the oldest data first. Start and stop times can also be entered.
3. Choose a logging Interval in Hours, Minutes and Seconds. Intervals selected below 1 minute will force continuous logging to be disabled. At an interval of 30 minutes the logger will not overwrite data for more than a year.
4. In the Site box, add some brief location information to help locate the logger in the future. In the Notes box add any information that may be of use.
5. Select the Time Zone the Logger is deployed at. This is important as it may be different from the time zone where the data is viewed.
6. Press the Submit button to apply the Logger Configuration.

Sensor Configuration

1. Select the Sensor Config Tab.
2. From the drop down box select the number of sensors in the sensor rod.
3. Press the Submit button to apply the Sensor Configuration.

Calibration

1. Select the Calibration Tab.
2. Choose the Calibration type either percentage of Saturation or Volumetric percentage.
3. For each of the soil profile levels select from one the standard soil types in the drop down box. *The standard soil types are only a starting point and these should be changed once the values are known for your soils.* If the soil type is unknown, select the custom option and enter the values for dry soil and the field capacity. Follow the field capacity measurement in the section below. For more information on Soil types see the section below on Soil Types. The Soil Type can be changed at any time as these values only affect the displayed Soil moisture not the raw values that are stored in the database. To see the raw values select the Soil Test option.
4. If the soil type for each level is the same, select it for the first sensor, then press the "Apply to All" button.
5. Enter a wilt point % which is a user defined line that will be displayed on the chart.



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6. If Volumetric Calibration has been selected, enter the three values, Saturated Soil Weight, Dry Soil Weight & Saturated Volume.
7. Slope and Offset will be automatically calculated and shown on each profile line in the second section. You can also enter your own slope and offset by changing the Calibration Method from Calculated to User Defined.
8. Press the Submit button to apply the Calibration.

Transfer Configuration to Logger

The configuration will be sent to the logger automatically (typically less than 10 minutes) through the tablet / phone running the Xtract Application. To apply this immediately, press the '**SERVER SYNC**' button in the Settings screen. Once the button has been pressed the time below the button will display the word 'Never', then once synced, it will change to a valid time.

Select the History screen in the Xtract Application to view the logger name(s) entered for the Odyssey® Xtream logger(s).

The next time the tablet / phone sees the logger, it will connect to it and automatically apply the settings.

Soil Types

Soil types can be characterised by the size of its particle. Gravel or stones are larger than 2mm in size. Sand ranges from 2mm down to 0.05mm in diameter while Silt ranges from 0.05mm down to 0.002mm in diameter. Clay particles are flat shaped (not round) and are less than 0.002mm in size.

Using the soil triangle, scientists have created classes which break the distribution of particle sizes into 12 categories: clay, sandy clay, silty clay, sandy clay loam, clay loam, silty clay loam, sand, loamy sand, sandy loam, loam, silt loam, silt.

Basically the larger the soil particle size is the less moisture the soil can hold.

Dataflow have characterised the soil moisture logger for these 12 types of soil to help in initial setup. Once you know the dry point and field capacity of your soils select the custom to enter these manually. Also most soil types change with depth, therefore a soil type selection is required for each sensor depth.

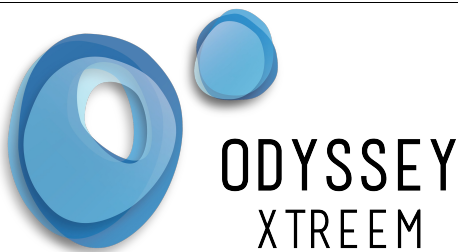
Field Capacity Measurement

Field capacity is the amount of water that can be held in the soil against gravity. The Xtream logger system can be used to measure this value.

In the calibration tab select the soil type as Soil Test for all levels and press the submit button. We suggest the logging interval is set to 1 minute for this test.

Place a 250mm diameter cylinder (a 20 litre bucket with the bottom cut out) around the logger and fill with water. The water will slowly empty from the bucket into the soil. This may have to be repeated several times depending on the soil type and the depth of the bottom sensor.

Using the Xpert portal select the chart page for this logger. It can be clearly seen that the moisture value increases soon after the water is applied around the logger. The moisture value should rise to a



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peak value then drop back a small amount and level out. The measured field capacity from the chart page must be multiplied by 100 when entering it into the 'Field Cap' box on the Calibration page. Find a soil type on the Calibration page where the field capacity is similar to the measured field capacity (x 100) and the drypoint value for this soil type should be the drypoint needed. Note the values entered on this calibration page do not affect the factory calibration of the logger, just the displayed and exported data. Choose the Custom Soil type from the drop down box and enter the drypoint value and field capacity value. Do this for each level in the soil.

Volumetric Measurement

There are three more parameters required for Xpert to calculate the parameters to give volumetric soil moisture percentage.

These measurements are normally carried out by a qualified technician following a test Standard like ASTM D2216 there the following is only an overview to aid in the understanding of the process.

Using a soil corer collect a saturated soil sample and place this sample into a plastic bag. The volume of soil the corer collects is the **Saturated Volume**.

Accurately weigh the soil sample, this is the **Saturated Soil weight**.

Dry the soil, this is normally done in an oven over several days.

Accurately weigh the dry soil, this is the **Dry Soil weight**.

Calculations

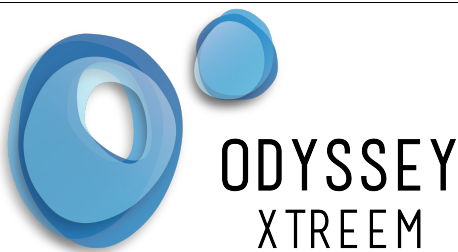
For either Percentage of Saturation or Volumetric Percentage the calculation is the same.

The slope and offset parameters are used as follows to calculate soil moisture.

$$\text{Soil Moisture (\%)} = \left(\left(\frac{\text{Logger Reading (\%)}}{100} \times \text{Slope} \right) + \text{Offset} \right) \times 100$$

For a logger reading of 60.00% with calculated scale of 1.4815 and an offset of -0.3704.

$$\left(\left(\frac{60.00}{100} \times 1.4815 \right) - 0.3704 \right) \times 100 = 51.85\%$$



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Collecting Data

Bring the tablet / phone with the Xtract application running within range of the logger and the application will automatically find, connect and collect the logs from the logger. This can be seen happening on the main screen of the Xtract application. If any configuration changes have been made since the logger was last connected, these will be applied at this time. If there is a firmware update for the logger this will also be sent (this takes several minutes to complete) to the logger if automatic firmware updates have been enabled (Contact Dataflow Systems to enable Automatic firmware updates).

To confirm the date of the last log that has been collected, select the History screen then tap on the logger name.

Viewing Data

Using a web browser (Firefox is preferred) navigate to www.xpert.nz then enter your username and password provided by Dataflow Systems. On the Map page (default) select Home from the drop down box then select a logger to be configured. An Icon for the logger will display on the Map. Click on the icon. (It may be necessary to Zoom the Map out to find the Logger).

ICON pop-up

This pop up shows brief data on the selected logger

Selected Logger Box

This shows the logger which has been selected on the Map tab.

Latest Information Box

This shows the latest known information about the logger.

Chart

Once the logger has been selected choose the chart option from the menu.

To view a graph of the logged data select a date range, then press the Go button. For a quick view press one of the Last Day, Last 7 Days, or Last 30 Days buttons. To export the data right mouse click on the graph then select the export format required. Alternately, enter a date range then press the Send Report button. A link to download the file will be sent to the registered email address. To view other data collected from the logger, in the drop down box showing 'Primary Data', select 'Diagnostic Data', then select a date range or press one of the quick Day buttons.

Errors

The Odyssey® multi-profile soil measuring system is very sensitive but sometimes issues may be

noticed.

Reading at 100% on Chart

Go to the Calibration page and check that the soil types are set correctly. If they are, note down the soil types for each level. If using custom soil types note down the two custom values also. Change the Soil type to Soil Test then press submit. Back on the Chart page check the value of the soil Moisture. Values greater than 10000 may indicate moisture inside the access tube. Very large values 32700 or greater indicate a communications error with the sensor rod.

Reading at 0% on Chart

Go to the Calibration page and check that the soil types are set correctly. If they are, note down the soil types for each level. If using custom soil types note down the two custom values also. Change the Soil type to Soil Test then press submit. Back on the Chart page check the value of the soil Moisture. A reading below 0 indicates the sensor rod is not in an access tube in the ground.

Memory Storage Capacity

The memory is capable of recording at least 125000 records. The number of recording days before the memory is full can be calculated using the following formulae. If continuous logging is enabled the oldest will overwritten first. If continuous logging is disabled no more data will be collected.

$$\text{Recording Days} = \frac{125000}{\text{Records per day} \times (\text{No of Sensors} + 2)}$$

The extra two are for the logger temperature and time record.

Examples.

Interval (mins)	Records per Day	No of Sensors	Recording Days
60	24	5	744
30	48	5	372
15	96	5	186
15	96	3	260
15	96	1	434
10	144	5	124

It is recommended to use the longest scan time required as this reduces the collection time and speeds up the graphing process.



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Batteries

Life

The battery life is dependant on a number of variables, including the sampling interval and operating temperature. The remaining battery life is indicated in the Xpert web portal. In typical conditions (25°C), battery life is expected to be approximately 2 years.

Replacement

To replace the batteries, unscrew the cap and lift out the 2 batteries. Over time the cap can become very tight, so use the special Odyssey® spanner for opening the cap which is available from www.OdysseyDataRecoding.com. As the batteries are non-hazardous, disposal is with your normal rubbish. We recommend with temperatures greater than 0°C to use the Energizer Max E91 with PowerSeal Technology batteries as these have been tested in our Xtream products to give the best life and are least likely to leak. At 0°C the battery life is reduced to half of its calculated life and it further reduces to 1/8th of its life at -20°C.

For temperatures below 0°C we recommend Energizer Lithium L91 batteries and these will have a life of greater than 2 years even at -20°C. Replace the batteries in the logger in the indicated orientation in the battery holder. (Note the unit will not be damaged if the batteries are inserted incorrectly). Before replacing the cap check the O-Ring seal is present, clean and free from dirt. If required apply some silicon grease (available from www.OdysseyDataRecoding.com). Replace the cap and tighten by hand. Do Not use any tools to tighten the cap.

If the logger is not to be used for more than a year, then remove the batteries to prevent any chance of leaking.

Specifications

	Description
Radio	NRF52832 Bluetooth SOC from Nordic Semiconductor
Frequencies	2402 – 2480MHz
Modulation	GFSK
Bandwidth	1MHz
Output Power	+4.0dBm max
Antenna	Ceramic Chip with 0.5dB gain.Return Loss -9.5dB UFL (external)
Operating Temperature	-20 to 55°C (standard)
Relative Humidity	0% to 100%
Water Proof	IP67 (30 mins @ 1m)
Dimensions	Logger 46mm OD, 160mm Length Sensor 17.5mm OD, 1.25m long (max) / 21.5mm OD, 1.4m long (max)



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Intellectual Properties

- Bluetooth® is a registered trademark owned by Bluetooth SIG Inc.
- Odyssey® is a registered trademark of Dataflow System Limited.

Legal Information

FCC

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. this device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Radiation Exposure Statement

This equipment complies with FCC and IC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 20cm between the radiator and your body.

Japan (MIC)

The Xtream loggers are approved for use in the Japanese market.
In Japan, certification is valid for 80 channels between 2402...2481 MHz

CE Warning

This device has been tested for compliance with the relevant standards for the EU market.
A copy of the Declaration of Conformity is available upon request to the manufacturer.
Dataflow Systems, PO Box 13672, Christchurch 8023, New Zealand

Radiation Exposure Information

This equipment complies with EU radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 20cm between the radiator and your body.

Industry Canada

This device complies with ISSED's licence-exempt RSSs. Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. this device must accept any interference received, including interference that may cause undesired operation.

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be chosen so that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

Radiation Exposure Statement

This equipment complies with ISSED radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 20cm between the radiator and your body.