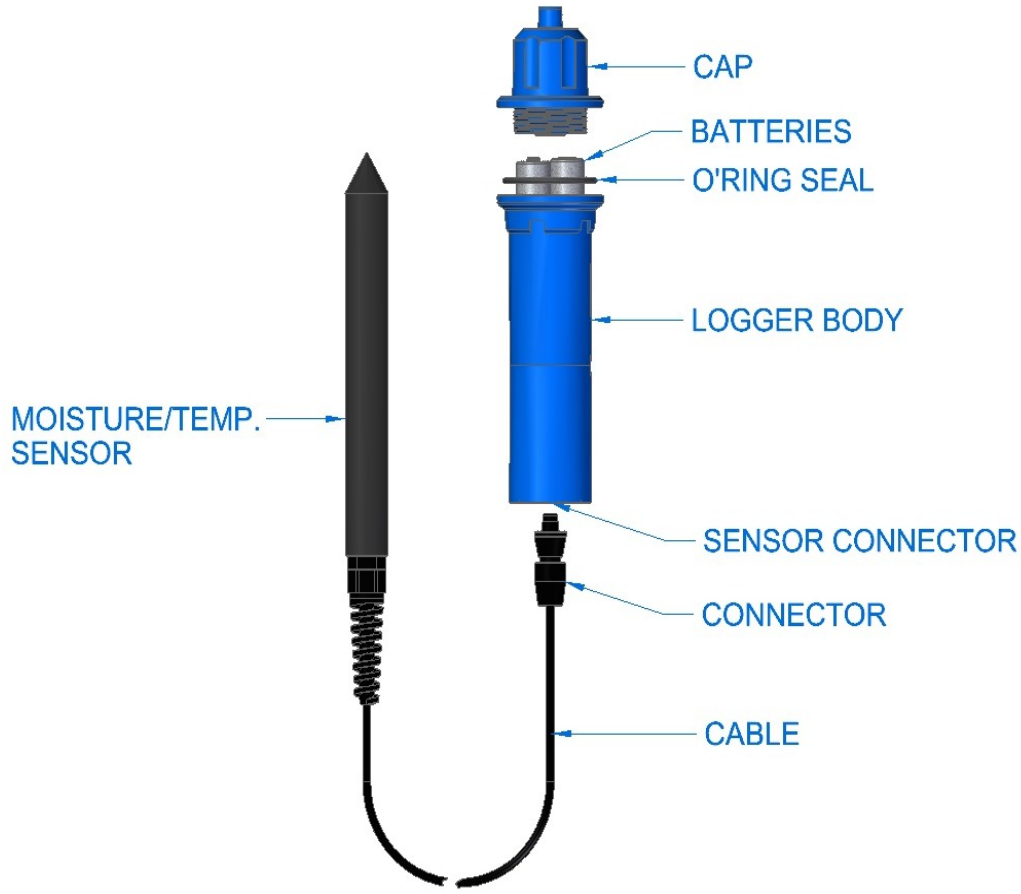
Odyssey® Xtreem
Single Soil Moisture Logger
User Manual

Xtreem Single Soil Moisture Logger User Diagram



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Principal of Operation

The soil moisture logger is non contact and measures both the soil moisture and temperature at the depth the sensor is buried.

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

The sensor measurements are converted to digital in the sensor and the resultant digital data is sent to the Odyssey® Xtreem logger at the end of the cable. 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

The soil moisture sensor cable must be plugged into the logger. The connector is keyed so once this is lined up push the connector in as far as it goes and then rotate the top of the connector until it locks into place. The sensor should not come out when light downward pressure is applied to the sensor connector. Do not pull on the sensor cable.
The black sensor must be fully buried to get the best performance. Excavating a hole is one method or for lighter soils it may be possible just to push the sensor into the soil. Never force the sensor into the soil with a tool.

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® logger 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® Xtreem logger will arrive with its name being a hexidecimal representation of its serial number. In the Xtract Application press the View button. Once scanned, the Odyssey®

Xtreem logger located will be shown in the list. The Xtreem 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® Xtreem logger to the Xpert web portal and transfers the configuration into the Odyssey® Xtreem 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 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 installed sensors to 1.
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. 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. Enter a wilt point % which is a user defined line that will be displayed on the chart.
5. If Volumetric Calibration has been selected, enter the three values, Saturated Soil Weight, Dry Soil Weight & Saturated Volume.
6. Slope and Offset will be automatically calculated and shown on the 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.
7. 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® Xtreem 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.
Field capacity is the amount of water that can be held in the soil against gravity. The Xtreem 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 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.

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.

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

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

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

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® 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 type. If using a custom soil type 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 sensor. Very large values 32700 or greater indicate a communications error with the sensor.

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 type. 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.

Memory Storage Capacity

The memory is capable of recording at least 60000 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.

$$Recording\ Days = \frac{60000}{Records\ per\ day}$$

Examples.

Interval (mins)	Records per Day	Recording Days
60	24	2500
30	48	1250
15	96	625
10	144	416.67
5	288	208.33

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

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 (25ºC), 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 0ºC to use the Energizer Max E91 with PowerSeal Technology batteries as these have been tested in our Xtreem products to give the best life and are least likely to leak. At 0ºC the battery life is reduced to half of its calculated life and it further reduces to 1/8th of its life at -20ºC.
For temperatures below 0ºC we recommend Energizer Lithium L91 batteries and these will have a life of greater than 2 years even at -20ºC. 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 55ºC (standard)
Relative Hunidity	0% to 100%
Water Proof	IP67 (30mins submersion to 1m), IP68 on request
Dimensions	46mm Diameter, 160mm Length Sensor Length 1m

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 Xtreem 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 ISED'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 ISED 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.