



# Wintersense

An IoT Solution for  
RWIS Network Densification



# Please read first

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## About this manual

Please note that this manual was originally produced by Campbell Scientific Inc. primarily for the North American market. Some spellings, weights and measures may reflect this origin.

Some useful conversion factors:

**Area:** 1 in<sup>2</sup> (square inch) = 645 mm<sup>2</sup>

**Length:** 1 in. (inch) = 25.4 mm

1 ft (foot) = 304.8 mm

1 yard = 0.914 m

1 mile = 1.609 km

**Mass:** 1 oz. (ounce) = 28.35 g

1 lb (pound weight) = 0.454 kg

**Pressure:** 1 psi (lb/in<sup>2</sup>) = 68.95 mb

**Volume:** 1 UK pint = 568.3 ml

1 UK gallon = 4.546 litres

1 US gallon = 3.785 litres

In addition, while most of the information in the manual is correct for all countries, certain information is specific to the North American market and so may not be applicable to European users.

Differences include the U.S standard external power supply details where some information (for example the AC transformer input voltage) will not be applicable for British/European use. Please note, however, *that when a power supply adapter is ordered it will be suitable for use in your country.*

Reference to some radio transmitters, digital cell phones and aerials may also not be applicable according to your locality. Some brackets, shields and enclosure options, including wiring, are not sold as standard items in the European market; in some cases alternatives are offered. Details of the alternatives will be covered in separate manuals.

Part numbers prefixed with a “#” symbol are special order parts for use with non-EU variants or for special installations. Please quote the full part number with the # when ordering.

## Recycling information



At the end of this product's life it should not be put in commercial or domestic refuse but sent for recycling. Any batteries contained within the product or used during the products life should be removed from the product and also be sent to an appropriate recycling facility.

Campbell Scientific Ltd can advise on the recycling of the equipment and in some cases arrange collection and the correct disposal of it, although charges may apply for some items or territories.

For further advice or support, please contact Campbell Scientific Ltd, or your local agent.

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# 1. About Wintersense

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Wintersense™ is an easy-to-deploy, smart, non-invasive sensor for road temperature monitoring. Using the latest generation, low-power wide-area network (LPWAN) communications, Wintersense provides a fully integrated smart sensor. Power and communications are integrated in the sensor. The sensor is compact and light enough to be easily mounted onto existing roadside columns (such as street lighting columns), significantly reducing the costs of installation.

Data from a Wintersense smart sensor is delivered wirelessly to a secure cloud data platform (software) that provides the user with network management capabilities, data analysis tools, and data export capabilities via FTP and email. For clients wanting to import Wintersense data into their own software application, Wintersense provides a web API

<https://docs.wintersense.com/api/v1/#introduction> and supports data polling via Datex2 (see [Wintersense Datex2 support documentation](#) (p. 30).

## 1.1 Technical specifications

### Road surface temperature

Measurement range:	-40 to 70 °C (-40 to 160 °F)
Accuracy <sup>1</sup> -40 to 60 °C:	±0.5 °C
Resolution:	0.01 °C

### Air temperature

Measurement range:	-40 to 70 °C (-40 to 160 °F)
Accuracy <sup>2</sup> :	±0.4 °C
Resolution:	0.01 °C

### Relative humidity

Measurement range:	0 to 100%
Accuracy:	< ±3%
Resolution:	0.1%

### Dew point temperature (calculated)

Measurement range:	-40 to 70 °C (-40 to 160 °F)
Accuracy <sup>3</sup> -35 to 50 °C:	±1 °C

<b>Resolution:</b>	0.1 °C
<b>Field of view (FOV):</b>	10° (at 50% normalized signal) See <a href="#">Installation height and angle</a> (p. 12) for more information.
<b>Distance to target</b>	
<b>Minimum:</b>	2 m (6 ft)
<b>Maximum:</b>	15 m (50 ft)
<b>Dimensions, excluding band clamp (length x height x depth):</b>	350 x 200 x 100 mm (13.8 x 7.9 x 4.0 in)
<b>Weight:</b>	1.4 kg (3 lb)
<b>Power</b>	
<b>Replaceable internal battery:</b>	3.6 V 19 Ahr non-rechargeable Lithium Thionyl Chloride D-cell
<b>Recommended replacement battery:</b>	Tadiran SL-2780/TL-5930, available from Campbell Scientific. Any alternative battery must comply with IEC 60086-4 to ensure safe operation.
<b>Average power consumption:</b>	<1 mA typical
<b>Data transmission frequency:</b>	15 minutes
<b>Radio communications</b>	
<b>Network:</b>	Compatible with the Sigfox Network. Works in Sigfox region: RC1. Covers operation in: Austria, Belgium, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, United Kingdom.
<b>Transmission frequency:</b>	868.130 MHz
<b>Transmission power:</b>	25 mW ERP
<b>Antenna:</b>	The antenna supplied has a nominal gain of 4 dBi at 868 MHz.

Contact Campbell Scientific for applications requiring NB-IoT communications.

**Operating temperature:** -40 to 70 °C (-40 to 160 °F)

**Operating humidity:** 0 to 100%

**Internal enclosure sealing:** IP65 (minimum)

**EU declaration of compliance:** Hereby, Campbell Scientific Ltd. declares that the radio equipment type Wintersense-SF, is in compliance with Directive 2014/53/EU. The full text of the EU declaration of conformity is available at:

<http://www.campbellsci.eu/wintersense> 

<sup>1</sup> Temperature dependent – quoted accuracy is against a blackbody source within ambient temperature range of -20 to 50 °C and object temperature range of -40 to 60 °C.

<sup>2</sup> Accuracy may be reduced under low wind-speed and moderate to high snow-albedo conditions.

<sup>3</sup> Calculated dew point temperature found from Tetens' equation solved for dew point with coefficients optimized for the temperature range -35 to 50 °C.

## 2. Software setup

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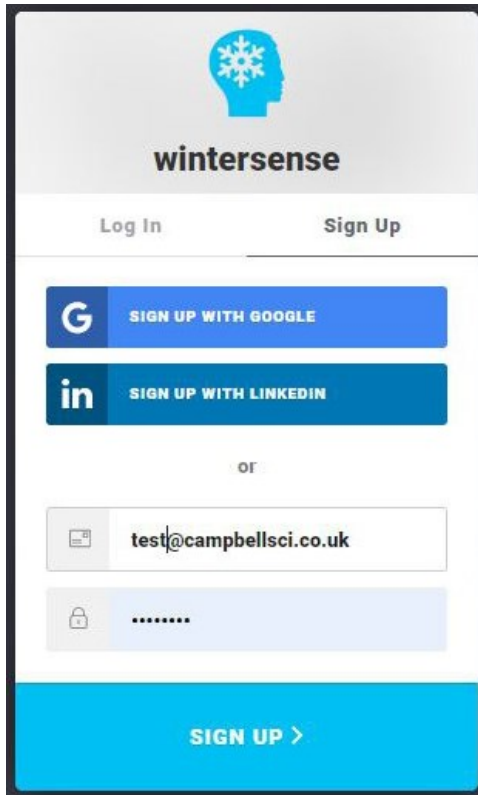
In the Wintersense architecture, users create a network, and within a network they create multiple sites, then one or more smart sensors are linked to a site. All data is stored to a site in the software. When a sensor is unlinked from a site, the data remains with the site and the sensor is then available to bind to another site within the network.

**NOTE:**

Once a sensor is linked (bind) to a site, it cannot be added to another site until it has been unlinked (unbind) from the current site.

## 2.1 Get started

1. Enter [user.wintersense.com](http://user.wintersense.com) into a web browser.
2. Click **Log In**.
3. Click the **Sign Up** tab to set up an account. Enter your email address and create a password. Click **SIGN UP >**.



4. Click **LOG IN >**.

## 2.2 Create a network

1. The home screen shows a list of options under **What would you like to do?** Click **Create a new Network**.



## What would you like to do?

- View this Network's [Sensors](#).
- View this Network's [Sites](#).
- Plot data from this Network on a [Map](#) or as a [Line Chart](#).
- [Export](#) the data for use in your own application.
- View and edit your [Account](#).
- [Create a new Network](#) or edit existing [Networks](#).


2. Enter the **Name** of the Network to add.
3. (Optional) Enter a **Description**.
4. Click **Add**.

### Add a New Network

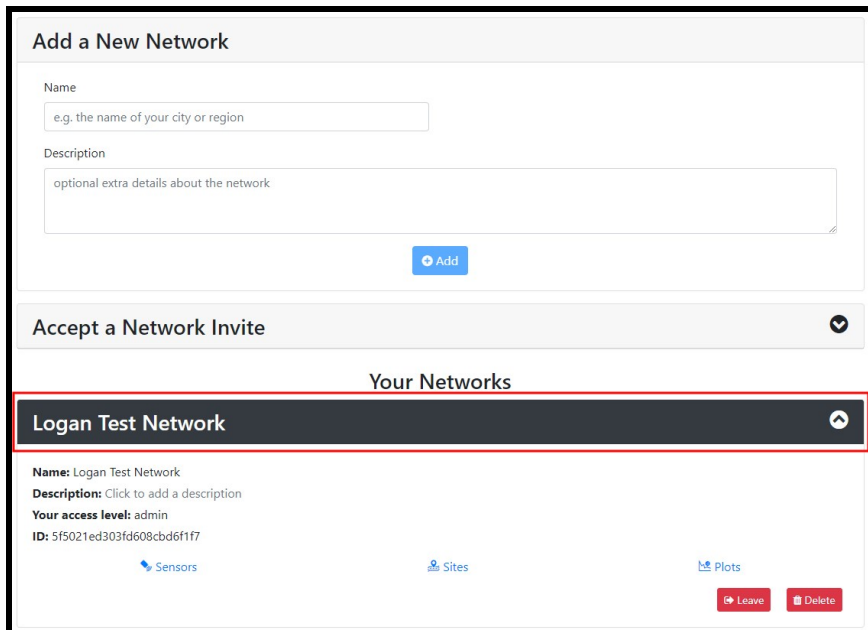
Name

Description


[Add](#)

Accept a Network Invite 

5. The new network will appear at the bottom of the page. Click the network name to expand for more details.



## 2.3 Add sites

1. Once in the network, click the **Sites**  link or go to the **Sites** tab at the top of the page.
2. The first time to this page will automatically present **Add a new site**.
3. Enter the name of the site.
4. (Optional) Enter a description.

5. Input the location of the site. Either click **Use Current Location**, enter the **Latitude** and **Longitude**, or adjust the cursor on the map to the precise location.

The screenshot shows a web form titled "Add a new site". It has a close button in the top right corner. The form contains the following fields:

- Name:** Campbell Scientific Bldg, 1
- Description:** Near electronic sign.
- Latitude:** 41.818522
- Longitude:** -111.83063

Below the form is a map showing a street view with a red location pin. A button labeled "Use Current Location" is positioned below the map. At the bottom of the form is a search bar with the text "search for address" and an "Add" button.

6. Click **Add**.
7. Repeat the process to add as many sites as required.

## 2.4 Add sensors

1. Go to the **Sensors**  tab.
2. Enter the key written on the sensor or scan the QR code on the unit.

**NOTE:**  
The sensor key is case sensitive.

3. Click **Add Sensor**.

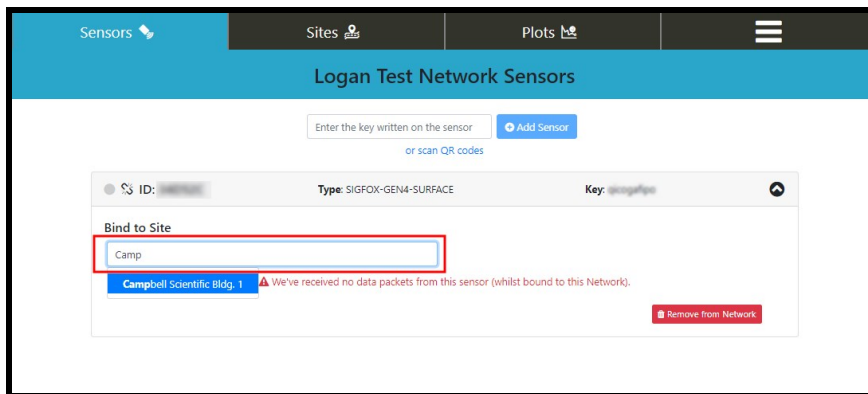
The screenshot shows the "Logan Test Network Sensors" page. The navigation bar includes "Sensors", "Sites", and "Plots" tabs. The main content area has a text input field with the placeholder text "Enter the key written on the sensor" and an "Add Sensor" button. Below the input field is a note: "This Network doesn't currently have any sensors bound to it. Once you add a sensor you can then link it to a site and start ingesting data. Each sensor has a key written on it. Enter this key above to add the sensor to the Network. Note that once the sensor is added, it cannot be added to any other Networks."

4. A sensor will automatically be added to the network but not bound to a site; this is done manually.

## 2.5 Bind (link) sensors to sites

Campbell Scientific recommends binding the sensor on site to verify the sensor is installed in the correct location. However, this can be done in advance.

1. Expand the sensor.
2. In the **Bind to Site** field, start typing the name of the site to bind the sensor to.
3. Select the site from the drop-down menu; this will bind the sensor to the site.



## 3. Sensor activation

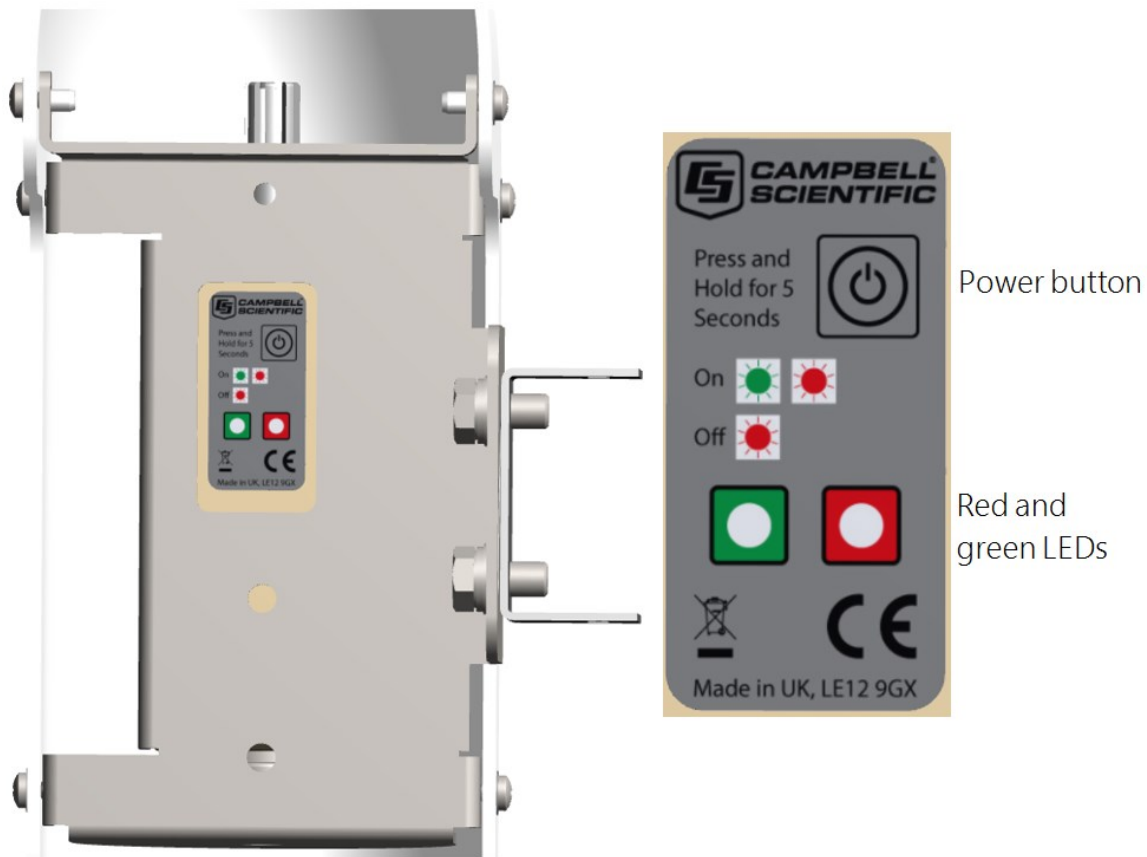
Each Wintersense smart sensor has two modes, **Sleep Mode** (off) and **Active Mode** (on). All sensors are shipped in **Sleep Mode** and must be set to **Active Mode** to enable automated measurement and data collection. These modes persist through power cycles and battery replacement.

### CAUTION:

Ensure the sensor is in **Active Mode** before leaving the site by following the activation procedure. See [Sensor activation](#) (p. 8) for more information. If the sensor is installed and left in **Sleep Mode**, no measurement or communications will occur.

## 3.1 Activate sensor

1. Press and hold the **Power** button on the underside of the sensor for 5 seconds, until the red and green LEDs flash.
2. To indicate **Active Mode**, the red and green LEDs will flash alternately 10 times, followed by a solid green LED for approximately 10 more seconds. It is important to observe this red and green LED sequence.



### NOTE:

When the sensor is in **Active Mode**, pressing and holding the **Power** button for 5 seconds will return the sensor to **Sleep Mode**. This is indicated by the red LED flashing 10 times. When the sensor is in **Sleep Mode**, pressing and holding the **Power** button for 1 second will not trigger a manual measurement and data upload.

### NOTE:

When the sensor is in **Sleep Mode**, it will transmit a GPS signal once per day to indicate its location (GPS signal required).

## 3.2 End-to-end data test

With the sensor in **Active Mode**, a measurement and data upload can be manually triggered for test purposes. This will perform an on-site end-to-end data test to the software. This test is recommended to ensure signal coverage at the installation location.

**To perform a manual data test:** Press and hold the **Power** button for 1 second.

When a measurement has been successfully triggered, a solid green LED (approximately 3 seconds) will be followed by a flashing green LED for several more seconds. If the site has network coverage, and the sensor and software platform are configured correctly, data should appear in the software within 30 seconds.

### NOTE:

A data test will only work when the sensor is in **Active Mode** and there is network coverage. Once successful, do not repeat this test too often to avoid exceeding the limit of the number of daily messages allowed under the Sigfox contract (nominally 140 per day).

# 4. Site installation

Select a site away from intersections and where there is not regularly stopped traffic.

Tools required:

- Band clamp of suitable size for the vertical pole the sensor will be installed on. 70 to 120 mm (3 to 5 in) and 110 to 170 mm (4 to 7 in) band clamps are supplied with the sensor.
- 8 mm (5/16 in) hex tool or slotted screwdriver (not supplied) for adjusting band clamp
- 13 mm (1/2 in) spanner, wrench, or socket to allow sensor angle adjustment
- tin snips
- gloves

## 4.1 Temperature and humidity cover

Wintersense ships with a small protective cover over the temperature and relative humidity sensor. While at ground level, gently pull the cover off. The white filter cap will be exposed; do not remove it.

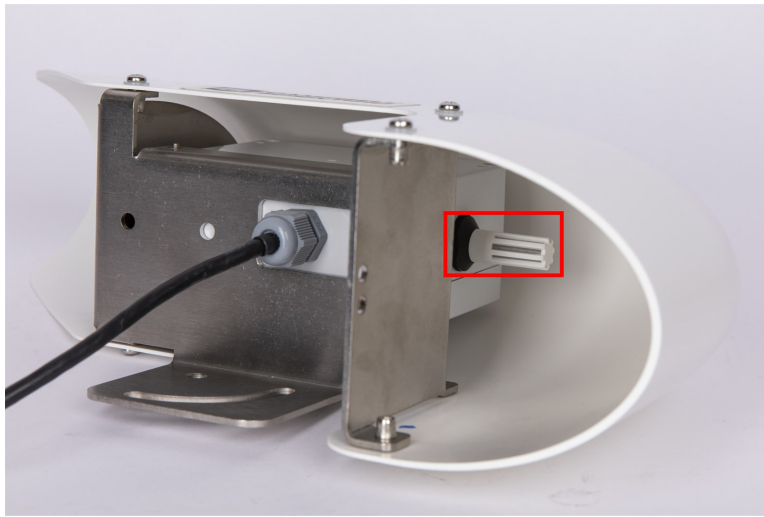
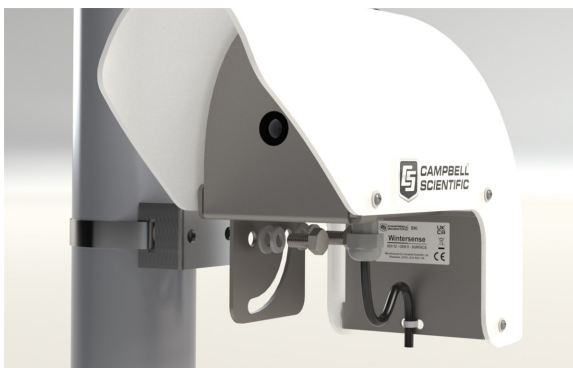


Figure 4-1. Sensor exposed after protective cover is removed

## 4.2 Install bracket

The included C-bracket, used for angle adjustment, attaches to the main sensor bracket.

1. Locate installation hardware which includes two bolts, spring (split) washers, and flat washers.
2. Slide one spring (split) washer onto each bolt.
3. Slide one flat washer, next to the spring washer, onto each bolt.
4. Insert one bolt through the main sensor bracket hole and screw into hole on C-bracket, ensuring the C-bracket tabs that accept the band-strap are pointing away from the sensor bracket.



5. Insert the other bolt through the slot on the main sensor bracket and screw into other hole on the C-bracket.



6. Secure C-bracket to main sensor bracket using a 13 mm (0.5 in) spanner, wrench, or socket.

## 4.3 Installation height and angle

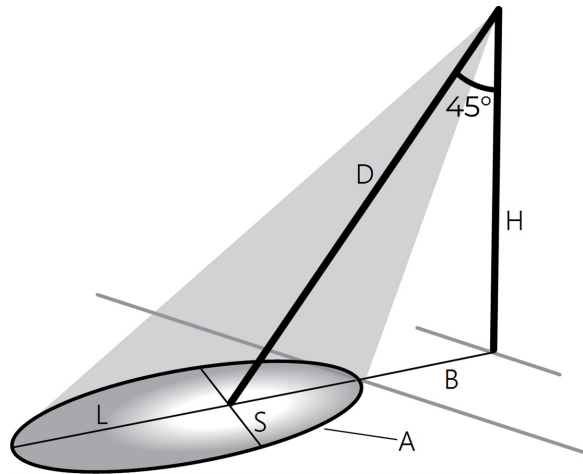
Installation height and angle affect the surface measurement area. Use an online field of view tool <https://docs.wintersense.com/field-of-view/> to see how these factors affect the field of view, and consequently the section of road surface being measured.

The recommended installation height for a Wintersense smart sensor is 3 to 5 meters (10 to 16 feet). Sensors can be installed higher if required. However, the higher the sensor is installed, the larger the surface measurement area will be. This increases the risk of sensing the temperature of unwanted objects. In addition, a large measuring distance may result in reduced accuracy under certain atmospheric conditions.

The following table and figure show typical installation parameters and resulting target dimensions.



Installation parameters:	
Angle	45°
Sensor setback (B)	3 m (10 ft)
Sensor height (H)	4.6 m (15 ft)
Lane width	3 m (10 ft)
Calculated target dimensions:	
Distance to target (D)	6.5 m (21.4 ft)
Target coverage area (A)	6 m <sup>2</sup> (66 ft <sup>2</sup> )
Major (long) diameter (L)	3.4 m (11.2 ft)
Minor (short) diameter (S)	2.3 m (7.7 ft)



The recommended installation angle of a Wintersense sensor is 30 to 60° (from vertical). The following figure shows it at 45° from vertical.



Wintersense smart sensors contain a thermopile sensor which detects the presence of thermal radiation emitted from the target surface. With non-contact infrared thermopile sensors, the greater the installation angle of the sensor from vertical, the greater the risk of sensing reflected radiation from other sources (such as long-wave infrared or reflected sunlight), which can affect sensor accuracy. The Wintersense unit contains an integrated optical filter (long-wave pass) that cuts off the visible and near-infrared radiant flux to provide optimum ambient and sunlight immunity. The wavelength pass band of this optical filter is from 5.5 to 14  $\mu\text{m}$ . Therefore, if site restrictions dictate that an installation angle of greater than 45° is required, the Wintersense

sensor will be less prone to errors from reflected radiation than other non-invasive sensors without these optical filters.

To adjust the sensor angle, slightly loosen both bolts in the bracket to allow rotation of the sensor around the bolt that is fitted in the round hole towards the front of the sensor. Once at the correct angle, tighten the bolts by hand until the spring washers are fully compressed.

Adjust the angle of the hood antenna so it is as close to vertical as possible.

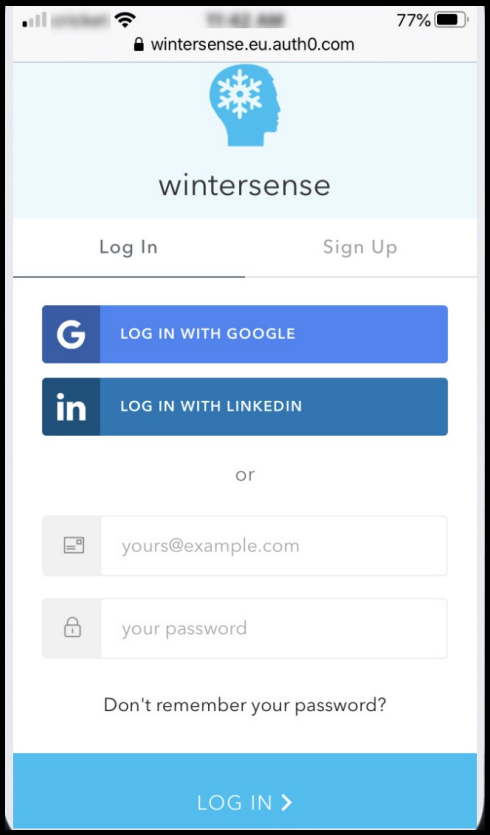
## 4.4 Sensor and location check

The following assumes that the steps in [Software setup](#) (p. 3) have been completed prior to visiting the sensor site.

Before physically installing the sensor at the site, confirm that the location is accurately represented on the site map in the software.

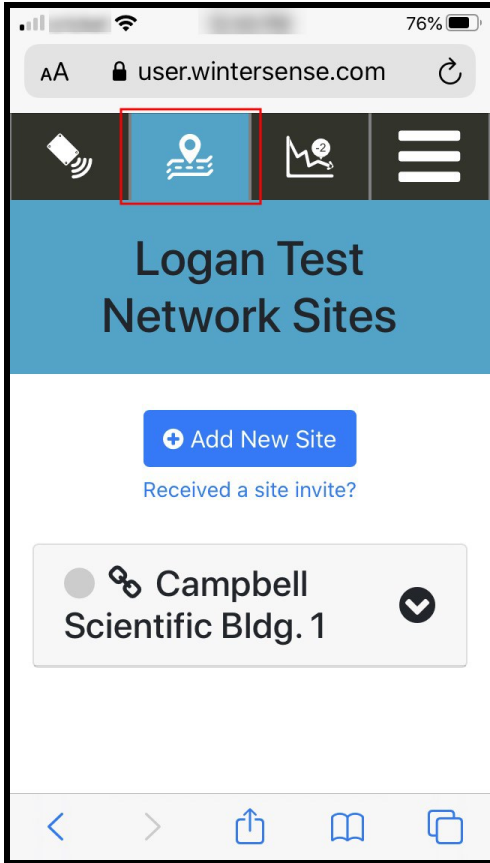
1. Arrive at the site with equipment.
2. Enter [user.wintersense.com](http://user.wintersense.com) into a web browser.
3. Click **Log In**.

4. Enter your email address and password. Click **LOG IN >**.

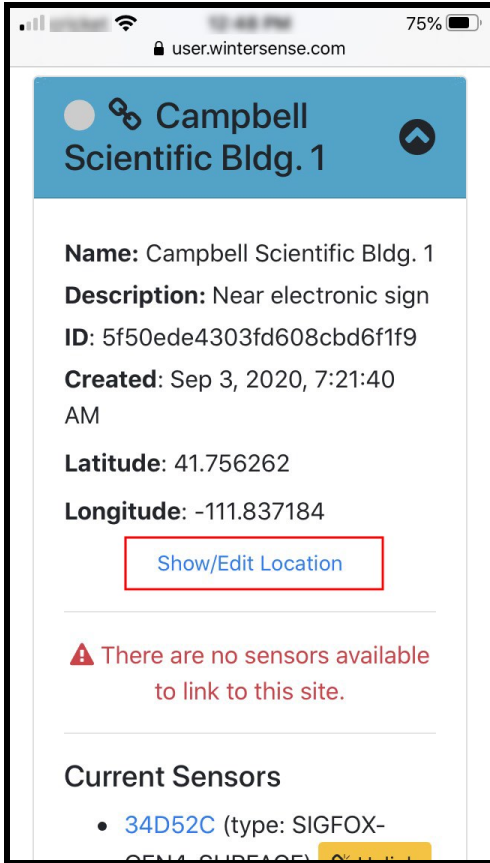


5. Go to the **Sites**  tab.

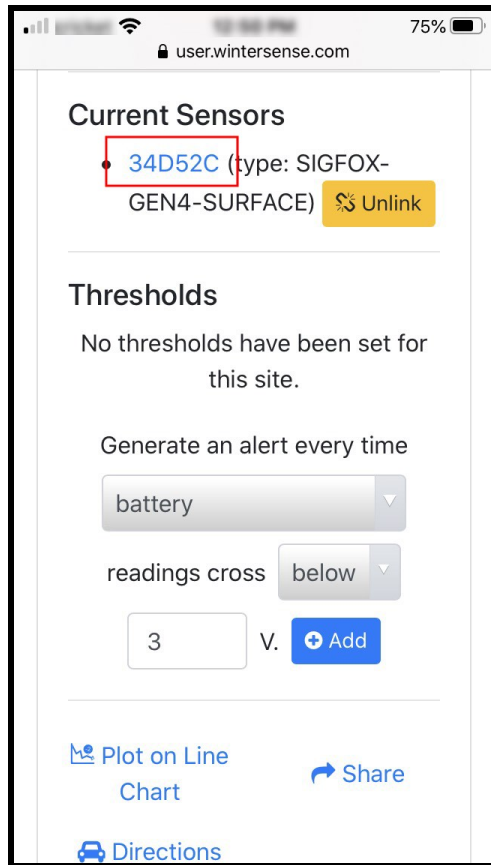
6. Select the site where the sensor is to be installed.



7. Click **Show/Edit Location** to confirm the location on the map. Adjust location if required.

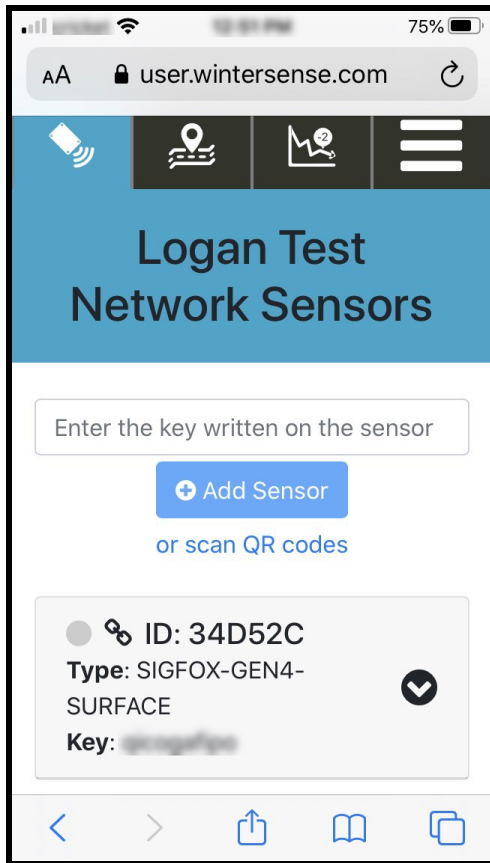


8. Confirm that the unique key of the sensor about to be installed matches the key of the sensor linked to this site in the software.
  - a. Under **Current Sensors** select the sensor ID.

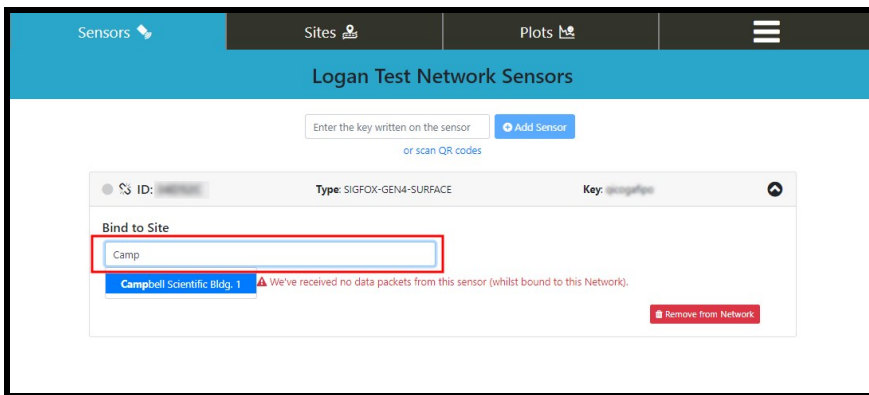


- b. Compare the Wintersense sensor key on the label to be installed to the key in the software.

If the sensor needs to be bound (linked) to a site in the software, follow steps 9 through 11.



- 9. Expand the sensor.
- 10. In the **Bind to Site** field, start typing the name of the site to bind the sensor to.
- 11. Select the site from the drop-down menu; this will bind the sensor to the site.



Follow the activation procedure to ensure the sensor is active and data is being received by the software prior to leaving the site. See [Sensor activation](#) (p. 8) for more information.

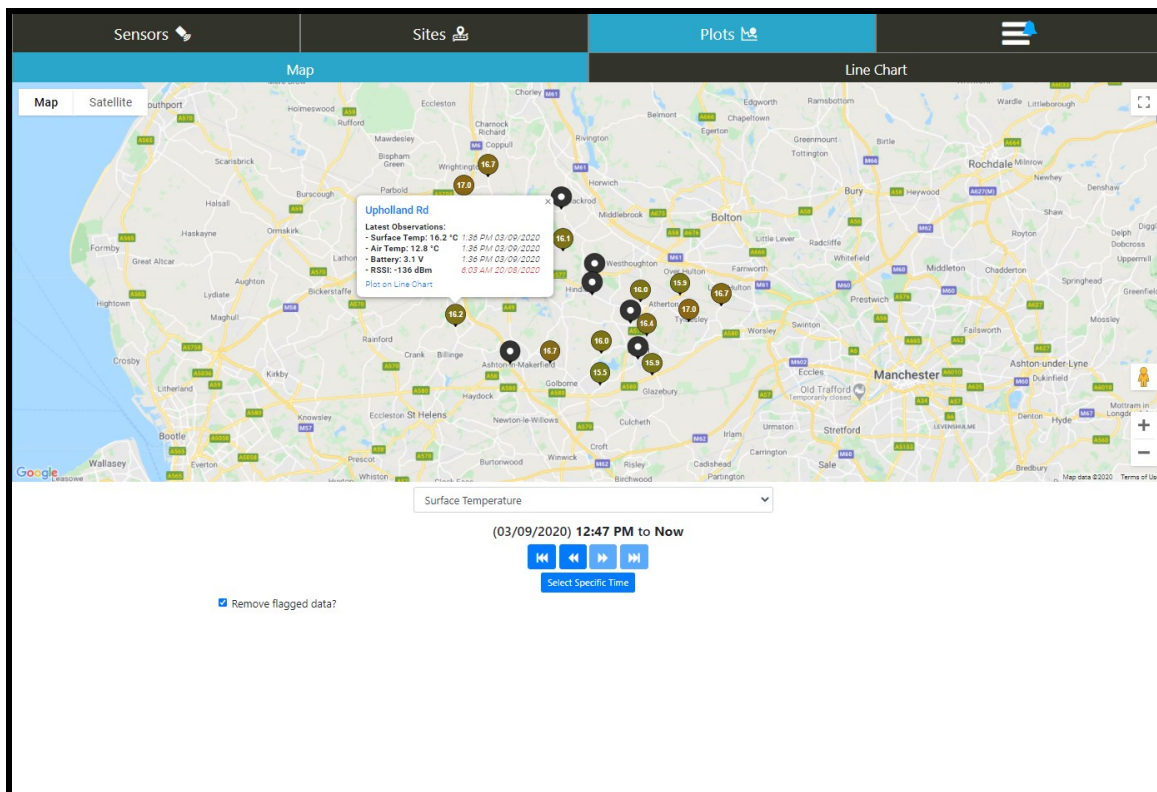
**CAUTION:**

Ensure the sensor is in **Active Mode** before leaving the site by following the activation procedure. See [Sensor activation](#) (p. 8) for more information. If the sensor is installed and left in **Sleep Mode**, no measurement or communications will occur.

# 5. View data

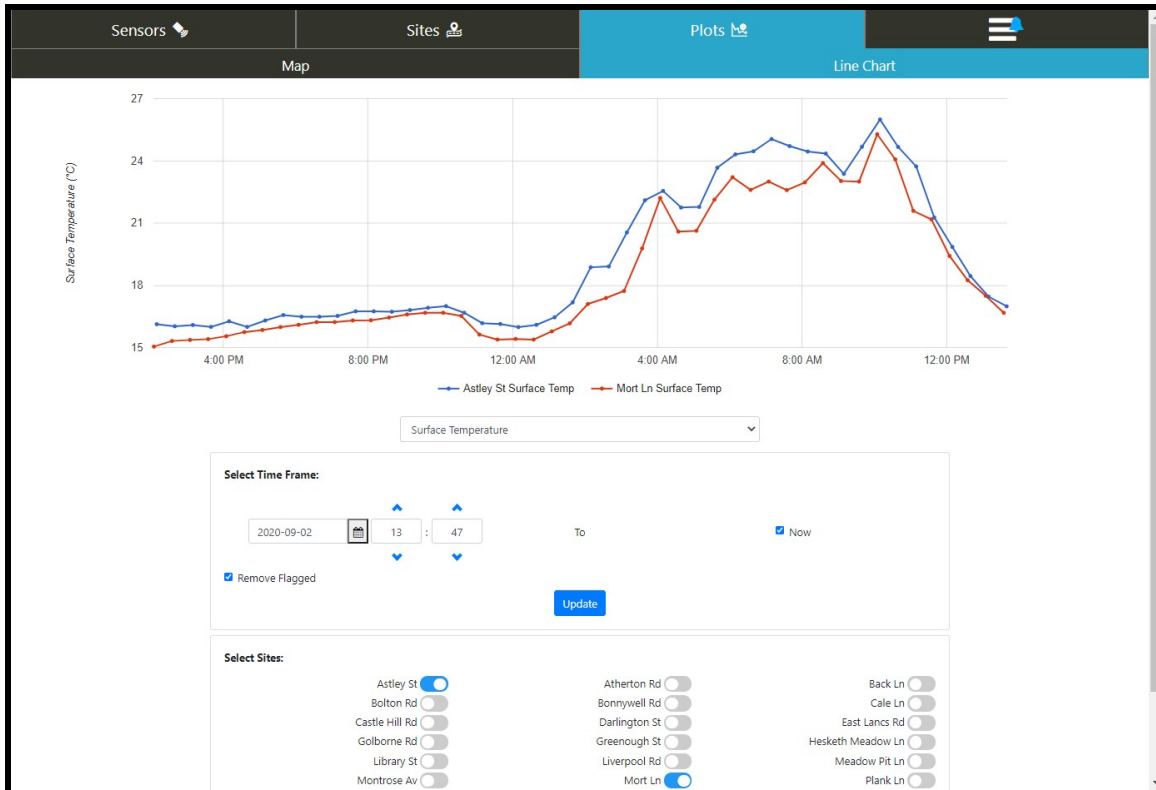
View real-time and historic data from the **Plots**  tab.

The **Map** view shows site locations. Click on a site pin to see current data.





Configure the **Line Chart** tab to display historic data from several sites at a time.



## 6. Maintenance

### DANGER:

Before attempting any maintenance on the sensor, refer to the [Safety](#) section. Study the sections on working at height, use of batteries, and exposure to radio transmitters.

Recommended equipment and supplies:

- 8 mm (5/16 in) hex tool or slotted screwdriver (not supplied) for adjusting band clamp
- 13 mm (1/2 in) spanner, wrench, or socket to allow sensor angle adjustment
- Clean lint-free cloths
- Air duster
- Cotton buds or swabs
- Electronics-grade alcohol

## 6.1 Clean the sensor

Wintersense smart sensors are designed to be low maintenance. Like any non-invasive sensor, however, objects in front of the sensing element can influence readings. Regularly check, and when necessary, clean the sensor to remove any dirt, insects, or spider webs that may block the sensing element.

To clean the sensor:

1. Remove the Wintersense unit from the mounting pole and take it down to ground level.
2. Remove the six screws attaching the sensor hood to the mounting bracket.
3. Lift the sensor hood up and off the mounting bracket, leaving the antenna mounted on the electronics box.
4. Wipe down the hood to remove any dirt.
5. Use a clean cloth to wipe down the internal box, bracket, and front metal plate.
6. Use an air duster to clean dirt from within the sensing element. If there appears to be any deposits on the detector window, use a cotton bud (swab) dipped in electronics-grade alcohol to gently clean the detector window.
7. Replace old desiccant bags with new.
8. Check that the antenna is still tightly attached to its connector on the top of the electronics box.
9. Replace the hood by sliding it down over the antenna with the antenna fed through the hole in the top of the hood.
10. Reattach the hood with the six mounting screws, making sure the anti-vibration spring washers are still in place.
11. Adjust the angle of the hood antenna so it is as close to vertical as possible.

## 6.2 Replace battery and desiccant

Campbell Scientific recommends replacing the internal battery and desiccant every year as part of an annual maintenance program.

To access the internal box to replace battery and desiccant, remove the Wintersense from the mounting pole and take it down to ground level.

Each Wintersense unit contains a user-replaceable 3.6 V, 19 Ahr D-cell battery. Campbell Scientific recommends Tadiran batteries which offer better performance at colder temperatures than other batteries (see [Technical specifications](#) (p. 1), **Power** specification).

**NOTE:**

The sensor mode will be retained through battery replacement. A sensor in **Active Mode** (on) will remain in **Active Mode**.

To replace the battery:

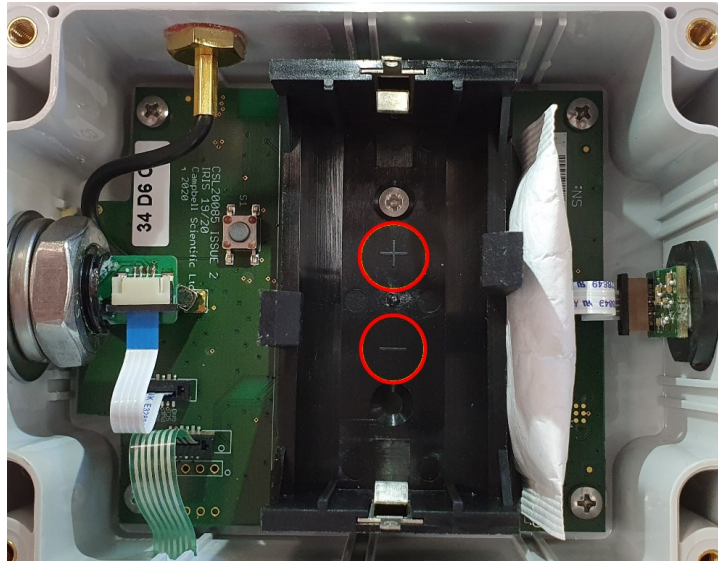
1. Adjust the antenna so it is perpendicular to the top surface of the hood.
2. Remove the six screws attaching the sensor hood to the mounting bracket.
3. Lift the sensor hood up and off the mounting bracket, leaving the antenna mounted on the electronics box.
4. Loosen the four screws attaching the lid of the internal box housing the sensor electronics.
5. Gently remove the lid by pulling it off the box. Do not use a screwdriver to lever off the lid as this may damage its seal.
6. Note the orientation of the existing battery in the centre of the board, and in particular, the position of the positive end of the battery, identified by a "+" symbol on the battery.



*Figure 6-1. Position and orientation of internal battery*

7. Remove the existing battery by gently pulling it out of the battery carrier.

8. Before installing the new battery, look at the black battery carrier and find the "+" and "-" symbols printed on the plastic in the bottom of the carrier. These indicate which way the battery should be fitted.



*Figure 6-2. Battery polarity indicators*

9. Install the new battery ensuring the "+" symbol printed on the battery, near one end, is at the same end of the carrier as the "+" symbol printed in the carrier. This should match the orientation of the battery that has just been removed. When pushing the battery in, it should "pop" into place and be firmly held in place by the clips on the side of the carrier.
10. Replace old desiccant bags with new.
11. Inspect the seal around the lid of the box. Clean off dirt that may cause leaks.
12. Reattach the lid to the box and hand tighten the four screws.
13. Check that the antenna is still tightly attached to its connector on the top of the electronics box.
14. Replace the hood by sliding it down over the antenna with the antenna fed through the hole in the top of the hood.
15. Reattach the hood with the six mounting screws, making sure the anti-vibration spring washers are still in place.
16. Reinstall the sensor on its mounting pole.
17. Adjust the angle of the hood antenna so it is as close to vertical as possible.

After replacing the battery, conduct a manual data test to ensure correct operation of the sensor. See [End-to-end data test](#) (p. 10) for more information.

**To perform a manual data test:** Press and hold the **Power** button for 1 second.

When a measurement has been successfully triggered, a solid green LED (approximately 3 seconds) will be followed by a flashing green LED for several more seconds. If the site has network coverage, and the sensor and software platform are configured correctly, data should appear in the software within 30 seconds.

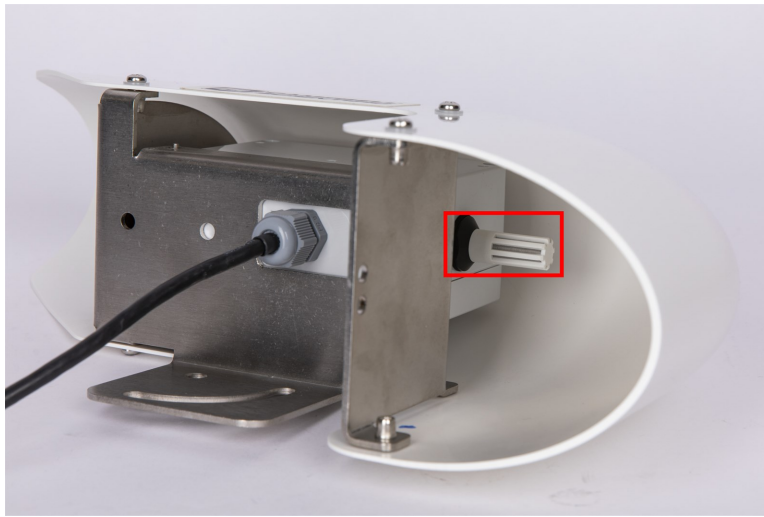
**NOTE:**

A data test will only work when the sensor is in **Active Mode** and there is network coverage. Once successful, do not repeat this test too often to avoid exceeding the limit of the number of daily messages allowed under the Sigfox contract (nominally 140 per day).

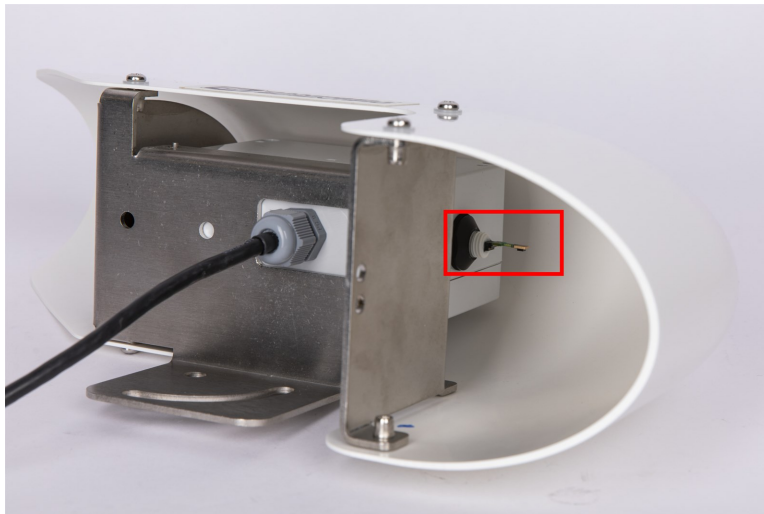
## 6.3 Replace the temperature and humidity element

Replace the temperature and humidity element every 1 to 2 years to ensure accurate measurements. The element is pre-calibrated; so, changing the element will return the system to factory calibration accuracy. A replacement filter cap is supplied with the element; fit it to ensure adequate air flow to the sensor element.

To replace the element, the Wintersense unit must be brought down to ground level and the outer hood removed as discussed in [Clean the sensor](#) (p. 22). The temperature and humidity element is on the opposite end of the electronics box as the infrared sensor, which normally points down to the road. Unscrew the filter cap in an anticlockwise direction, by hand, to expose the sensor element.



*Figure 6-3. Sensor element with filter cap on*



*Figure 6-4. Sensor after filter cap has been removed*

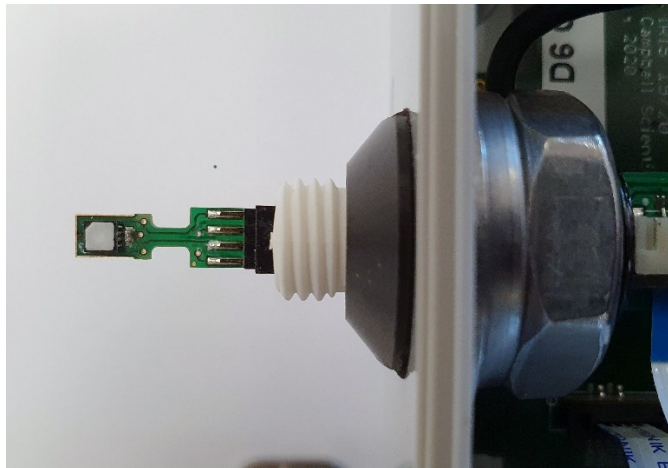


Figure 6-5. Exposed sensor element after filter cap has been removed

## 6.4 Replace sensor element

Campbell Scientific offers a replacement temperature/RH element and cap for the Wintersense. The replacement element is only available from Campbell Scientific. It includes a small circuit board that is coated to ensure longer life at high humidity. A single row of four gold pins inserts into one side of an eight-way socket at the end of the sensor.

The replacement element must be correctly installed for the sensor to work properly. Follow these steps to correctly replace the element:

1. Wash your hands to avoid getting dirt or grease on the element. If possible, use cotton gloves and handle the element by the edges of the small circuit board. Avoid touching the square white filter on the surface of the small, black component on top of the circuit board.

**CAUTION:**

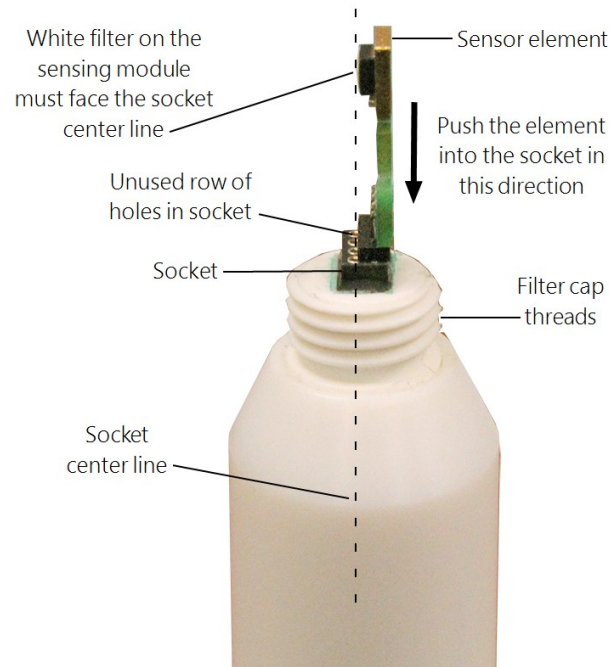
If dirt, salt, or grease are left on the face of the sensor element during the process of handling the element, it may influence the measurements made.

2. Disconnect the Wintersense battery. See [Replace battery and desiccant](#) (p. 22).
3. Remove the filter cap by unscrewing it counter clockwise when looking towards the tip of the sensor.

**CAUTION:**

Only unscrew the filter cap. Attempting to pull the filter cap off the sensor may damage the filter cap.

- Identify the sensor element. The element plugs into the black plastic socket that protrudes by about 2 mm from the end of the body of the sensor.



*Figure 6-6. Correct fit of the 4-pin sensor element (side view)*

- Grasp the sensor body to ensure you are at the same electrical potential as the element. Hold the edge of the circuit board between your fingertips and pull the element out of the socket. Store the old element in electrostatic protective packaging if you wish to retain it.

**CAUTION:**

Avoid pink-colored electrostatic bags as they can emit chemicals which change the calibration of the sensor.

- With the element removed, check for dirt and corrosion around the socket. Use a damp cloth to remove dirt or salts that might be there.
- Hold the replacement element by the sides of the circuit board. The element has four gold pins. Carefully match the gold pins to a row of holes in the socket with the sensing module facing the socket center towards the empty row of holes (see [Figure 6-6](#) [p. 28]). Gently push the pins down into the socket until they will not go in any further.



8. Before replacing the filter cap and connecting the sensor to a data logger, double-check that the element is seated correctly with the sensing module facing the socket center, towards the empty row of holes (see [Figure 6-6](#) [p. 28]).

**CAUTION:**

Conditions that will cause the sensor to not work include an improperly oriented element, contamination, or water bridging the connections. The element may draw excessive power, possibly damaging the element, when powered under these conditions for more than a few seconds.

9. Screw the filter cap onto the sensor, ensuring it clears the sensor element. If the element appears too close to the filter cap, the element likely has been inserted in the incorrect orientation or the element gold pins are bent. Screw the filter onto the thread and gently finger tighten.

**CAUTION:**

Only finger tighten the filter approximately 1/8th of a turn after the filter is fully screwed onto the thread. Over-tightening the filter will damage it and cause problems in inserting and removing the sensor from some shields.

# Appendix A. Wintersense Datex2 support documentation

---

## A.1 Introduction

Datex2 or Datex II is a data exchange standard for exchanging traffic information such as road weather information.

The Wintersense API has endpoints capable of serving Wintersense data in Datex2 format (specifically **Datex2 v2.2**) so that it can be ingested into other systems such as Highways England SWIS system.

## A.2 Endpoints

Datex2 endpoints are available at the path `/datex2/`, of which there are two main endpoints:

1. <https://api.wintersense.com/datex2/mst.xml> See [Site data](#) (p. 32).
2. <https://api.wintersense.com/datex2/content.xml> See [Observation data](#) (p. 32).

## A.3 Authentication

Clients need to provide authentication to request data from the Datex2 endpoints. Typically Datex2 uses the [HTTP Basic Authentication Scheme](#). A username and password are provided in the **Authorization** header of the HTTP request.

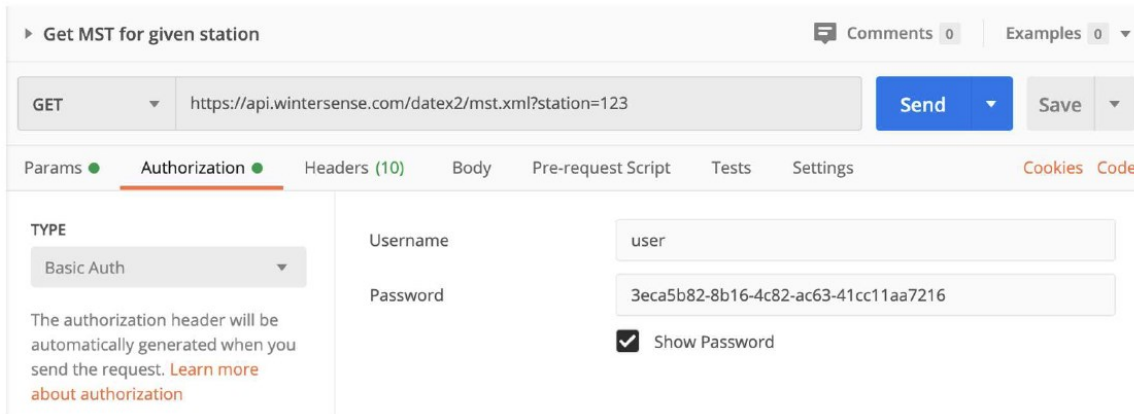
The rest of the Wintersense API does not support this form of authentication, favouring a JSON Web Token or API Key instead. However, the Datex2 endpoints have been modified so that they can support HTTP Basic Authentication.

### NOTE:

The username and password are **NOT** the same as those used by a client when logging in to the [Wintersense Web Application](#). Instead the username is ignored, and the password is the client's API Key.

## A.3.1 Example in Postman

This example shows a Site Data request made in [Postman](#). Note that the username is simply set as **user**, because its value is not important. The password is the API Key (a v4 UUID) copied from the [Wintersense Web Application](#).



## A.3.2 Example in curl

The same request using a **curl** request from the command line would look similar to:

```
curl --user user 'https://api.wintersense.com/datex2/mst.xml?station=123'
```

Paste the Wintersense API Key when asked for a password.

The client will be able to get Site and Observation data from any stations or sites within the Wintersense Networks they have rights to.

## A.3.3 Getting a Wintersense API Key

To generate or refresh an API Key, log in to the [Wintersense Web Application](#) > [Account](#) > [Your API Key](#). Copy this API Key.

## A.3.4 Alternative authentication approaches

When HTTP **Basic Auth** is not needed, then it may be easier to simply provide the API Key as a URL querystring parameter. An example URL would look like:

```
https://api.wintersense.com/datex2/content.xml?station=123&apiKey=3eca5b82-8b16-4c82-ac63-41cc11aa7216
```

The API Key can also be entered in the **Authorization** header preceded by the word **apiKey**. For example:

```
curl -H "Authorization: apiKey 3eca5b82-8b16-4c82-ac63-41cc11aa7216"  
"https://api.wintersense.com/datex2/mst.xml?station=123"
```

## A.4 Site data

To get the Measurement Site Table (MST) for a Site, use the `/datex2/mst.xml` endpoint.

Provide the integer ID (**Station Number**) of the given Site using the **station** query parameter.

For example, the request URL with an integer ID of **123** would look like:

```
https://api.wintersense.com/datex2/mst.xml?station=123
```

The response is in XML format compliant with Datex2 standards.

Note the following:

- The `<publicationTime>` value is set as the time of the request.
- The **version** attribute of the `<measurementSiteTable>` element is a 30-character long hash, e.g. `cd19926d4ebbd0712984f3fab3e7dd`, auto generated from the date the Wintersense Site was last updated and the variables measured by that Site. It will update if the Site metadata, such as its location, changes or the Site starts measuring different variables (both of which will happen rarely).
- If a station has no observations yet, then the response will not include the `<measurementSiteRecordExtension>` element, but everything else will be present.

## A.5 Observation data

To get actual observations from a Wintersense Site, use the `/datex2/content.xml` endpoint.

Provide the integer ID (**Station Number**) of the given Site using the **station** query parameter.

For example, the request URL with an integer ID of **123** would look like:

```
https://api.wintersense.com/datex2/content.xml?station=123
```

The response is in XML format compliant with Datex2 standards.

An **If-Modified-Since** request header is used to limit the data returned to just observations between the date specified and the most recent observation. Example value: **Wed, 21 Jan 2015 15:33:59 GMT**. If this header is omitted, then only the most recent observation from the given Site will be returned.

The **Last-Modified** response header is set as the time of the request and can be used as the **If-Modified-Since** request header in the next request.

Note the following:

- The **version** attribute of **measurementSiteTableReference** is auto generated based upon the date the Wintersense Site was last updated and the variables measured by that Site. It will update if the Site metadata, such as its location, changes or the Site starts measuring different variables (both of which will happen rarely).
- `<d21m:publicationTime>` is set as the time of the request.
- If a station has no observations yet, then the response status code will be 304.
- If an observation is deemed faulty by the Wintersense quality control system, then it will add a `<fault>` element to the `<d21m:metData>` element, whilst still including the faulty reading. For example, **airTemperature**, **dewPointTemperature**, and **surfaceTemperature** readings are all routinely checked and will be flagged if values persist at the same value for too long or if they fall outside of the expected upper and lower limits.
- New data from a Wintersense sensor is typically available every 30 minutes.

## A.6 Getting a list of sites

To retrieve a list of all available Sites, use the `/datex2/stations.csv` or `/datex2/stations.json` endpoints, depending on the data format needed, CSV or JSON format.

An example CSV response:

```
"Station Number","Station Name","Easting","Northing","Network Name"  
235817385,"Bythorn",503985,276683,"Cambridgeshire"
```

A JSON response contains the same information:

```
[  
  {  
    "stationNumber": 235817385,  
    "stationName": "Bythorn",  
    "eastings": 503985,  
    "northing": 276683,  
    "networkName": "Cambridgeshire"  
  }  
]
```

The list includes Sites from all your Networks. Use the **Station Number**, an integer, for the **station** querystring parameter when making Site and Observation data requests.

### NOTE:

This station number differs from the string **id** assigned to each Wintersense Site.

The **eastings** and **northing** are given in the Ordnance Survey National Grid datum (OSGB36).

# Guarantee

---

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# Safety

---

**DANGER** — MANY HAZARDS ARE ASSOCIATED WITH INSTALLING, USING, MAINTAINING, AND WORKING ON OR AROUND TRIPODS, TOWERS, AND ANY ATTACHMENTS TO TRIPODS AND TOWERS SUCH AS SENSORS, CROSSARMS, ENCLOSURES, ANTENNAS, ETC. FAILURE TO PROPERLY AND COMPLETELY ASSEMBLE, INSTALL, OPERATE, USE, AND MAINTAIN TRIPODS, TOWERS, AND ATTACHMENTS, AND FAILURE TO HEED WARNINGS, INCREASES THE RISK OF DEATH, ACCIDENT, SERIOUS INJURY, PROPERTY DAMAGE, AND PRODUCT FAILURE. TAKE ALL REASONABLE PRECAUTIONS TO AVOID THESE HAZARDS. CHECK WITH YOUR ORGANIZATION'S SAFETY COORDINATOR (OR POLICY) FOR PROCEDURES AND REQUIRED PROTECTIVE EQUIPMENT PRIOR TO PERFORMING ANY WORK.

Use tripods, towers, and attachments to tripods and towers only for purposes for which they are designed. Do not exceed design limits. Be familiar and comply with all instructions provided in product manuals. Manuals are available at [www.campbellsci.eu](http://www.campbellsci.eu) or by telephoning +44(0) 1509 828 888 (UK). You are responsible for conformance with governing codes and regulations, including safety regulations, and the integrity and location of structures or land to which towers, tripods, and any attachments are attached. Installation sites should be evaluated and approved by a qualified engineer. If questions or concerns arise regarding installation, use, or maintenance of tripods, towers, attachments, or electrical connections, consult with a licensed and qualified engineer or electrician.

## General

- Prior to performing site or installation work, obtain required approvals and permits. Comply with all governing structure-height regulations, such as those of the FAA in the USA.
- Use only qualified personnel for installation, use, and maintenance of tripods and towers, and any attachments to tripods and towers. The use of licensed and qualified contractors is highly recommended.
- Read all applicable instructions carefully and understand procedures thoroughly before beginning work.
- Wear a hardhat and eye protection, and take other appropriate safety precautions while working on or around tripods and towers.
- Do not climb tripods or towers at any time, and prohibit climbing by other persons. Take reasonable precautions to secure tripod and tower sites from trespassers.
- Use only manufacturer recommended parts, materials, and tools.

## Utility and Electrical

- You can be killed or sustain serious bodily injury if the tripod, tower, or attachments you are installing, constructing, using, or maintaining, or a tool, stake, or anchor, come in contact with overhead or underground utility lines.
- Maintain a distance of at least one-and-one-half times structure height, or 20 feet, or the distance required by applicable law, whichever is greater, between overhead utility lines and the structure (tripod, tower, attachments, or tools).
- Prior to performing site or installation work, inform all utility companies and have all underground utilities marked.
- Comply with all electrical codes. Electrical equipment and related grounding devices should be installed by a licensed and qualified electrician.

## Elevated Work and Weather

- Exercise extreme caution when performing elevated work.
- Use appropriate equipment and safety practices.
- During installation and maintenance, keep tower and tripod sites clear of un-trained or non-essential personnel. Take precautions to prevent elevated tools and objects from dropping.
- Do not perform any work in inclement weather, including wind, rain, snow, lightning, etc.

## Use and disposal of batteries

- Where batteries need to be transported to the installation site, ensure they are packed to prevent the battery terminals shorting which could cause a fire or explosion. Especially in the case of lithium batteries, ensure they are packed and transported in a way that complies with local shipping regulations and the safety requirements of the carriers involved.
- When installing the batteries follow the installation instructions very carefully. This is to avoid risk of damage to the equipment caused by installing the wrong type of battery or reverse connections.
- When disposing of used batteries, it is still important to avoid the risk of shorting. Do not dispose of the batteries in a fire as there is risk of explosion and leakage of harmful chemicals into the environment. Batteries should be disposed of at registered recycling facilities.

## Avoiding unnecessary exposure to radio transmitter radiation

- Where the equipment includes a radio transmitter, precautions should be taken to avoid unnecessary exposure to radiation from the antenna. The degree of caution required varies with the power of the transmitter, but as a rule it is best to avoid getting closer to the antenna than 20 cm (8 inches) when the antenna is active. In particular keep your head away from the antenna. For higher power radios (in excess of 1 W ERP) turn the radio off when servicing the system, unless the antenna is installed away from the station, e.g. it is mounted above the system on an arm or pole.

## Maintenance

- Periodically (at least yearly) check for wear and damage, including corrosion, stress cracks, frayed cables, loose cable clamps, cable tightness, etc. and take necessary corrective actions.
- Periodically (at least yearly) check electrical ground connections.

WHILE EVERY ATTEMPT IS MADE TO EMBODY THE HIGHEST DEGREE OF SAFETY IN ALL CAMPBELL SCIENTIFIC PRODUCTS, THE CUSTOMER ASSUMES ALL RISK FROM ANY INJURY RESULTING FROM IMPROPER INSTALLATION, USE, OR MAINTENANCE OF TRIPODS, TOWERS, OR ATTACHMENTS TO TRIPODS AND TOWERS SUCH AS SENSORS, CROSSARMS, ENCLOSURES, ANTENNAS, ETC.

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