



1250 - Wireless Charge Sensor

Revision: 0 | DS179

Table of contents

Introduction	3
Pack Contents	4
Operational Overview	5
Connectivity	7
Charging the Sensor	8
Firmware Updates	9
Usage Information	10
Practical Investigations	12
Sensor Specifications	14
Limited Warranty	15
Compliance	16
Troubleshooting	17
Notices	18
Contact Information	19
PDF Translations	20

Introduction

Thank you for purchasing the Smart Wireless Charge Sensor. We pride ourselves on producing high quality products that meet with the demands of the busy classroom environment. If you have any problems using this sensor, please read this documentation in full before contacting the Data Harvest support team.



Overview

The Smart Wireless Charge Sensor is USB and Bluetooth compatible. Using Bluetooth, a sensor can connect to mobile devices, tablets, laptops, and desktops.

The Charge sensor can measure the amount of charge on a source where the charge available is very small e.g. as in many electrostatic experiments. It can replace a traditional gold leaf electroscope by showing not only the polarity of the charge but also performing quantitative measurements. It can also measure the potential difference between two points.

The Charge sensor has an input capacitor connected in parallel across the input terminals to a voltage amplifier. An applied charge will charge the input capacitor resulting in a rise in the magnitude of the voltage across the capacitor. The sensor will use the value of the potential difference across the capacitor to calculate the charge (nC) or voltage (V).

The Charge sensor is, additionally, a very high impedance voltage sensor, (at least 1 tera ohms (10^{12} ohms)), which will draw practically no current whilst measuring the potential difference between the ends of an electrical component.

The sensor is supplied with a shielded BNC to crocodile lead. This lead should not be substituted by another manufacturer's lead, which could give false results. The lead ends with a red and black (earth) crocodile clip.

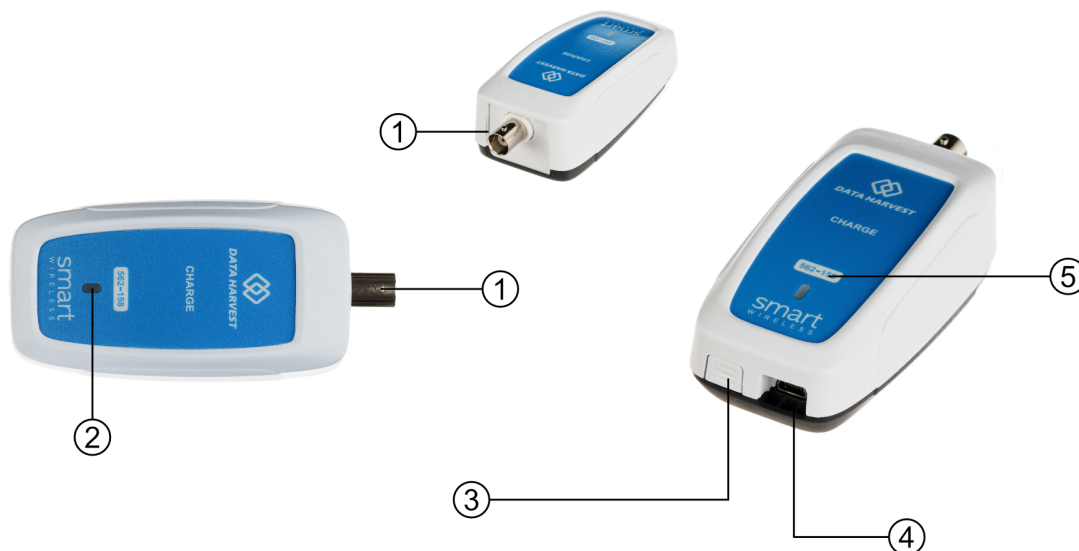
Pack Contents

This product is supplied with the following items:

- 1 x Smart Wireless Charge Sensor
 - 1 x USB Connecting lead
 - 1 x BNC – crocodile clip lead set
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Operational Overview

The diagram below shows the specific parts of the sensor. Read further to explore the functionality of each part of the sensor.



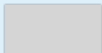



1. Sensor End Cap
2. Status Indicator
3. On/Off Switch
4. USB Port
5. Unique ID Number





Sensor End Cap (1)

Most Smart Wireless Sensors feature an end cap that is specific to the requirements of the device's internal sensor. The sensor's end cap is the direct interface between the device's internal sensor and your experiment.

The Status Indicators (2)

The sensor features a single status indicator that changes colour and flashes. See the table below for further information.

Status Light		Indicates
No light		Sensor is Off. Short press the On/Off switch
Blue flashing		Sensor is On and Bluetooth advertising
White flashing		Charging via USB mains charger or USB port, Sensor is On and Bluetooth advertising
Red, Green, Blue Flashing		Charging via USB mains charger or USB port, Sensor is Off

Green flashing		Communication with the EasySense2 app (via USB or Bluetooth) has been established
Solid Green		Fully charged
Orange flashing		Recording data
Red flashing		Battery is low

On/Off Switch (3)

The sensor's on/off switch allows you to turn the sensor on, off or perform a hard reset.

To switch the sensor off

- Press and hold down the On/Off switch until the white light shows, then release.
- If not communicating with the EasySense2 app, the sensor will turn off after a period of one hour of inactivity.

Hard resetting the sensor

- If necessary, attach the sensor to power.
- Press and hold down the On/Off button for at least 8 seconds until the status LED gives a flash of blue light, then release.
- If the sensor fails to respond, contact Product Support at Data Harvest. Please provide details of:
 - The computer platform it is being used with and the EasySense2 app's version number.
 - A description of the problem being encountered.

USB Port (4)

Use to connect to a computer or a charging unit.

For specific USB or Bluetooth connectivity instructions, please see the 'Connectivity' section of this documentation.

For instructions on charging your device, see the section on 'Charging the Sensor'.

Unique ID Number (5)

All Smart Wireless Sensors are labelled with a unique ID number. This number is used in the EasySense2 app, so that you can identify each sensor when making a connection wirelessly.

Connectivity

The sensor is both USB and Bluetooth compatible. Install the EasySense2 app, if it is not already on your device. For details of how to operate the EasySense2 app, please refer to the EasySense2 documentation.

USB Connectivity

Quick Steps

1. Connect the sensor to the computer's USB port using the USB cable supplied.
2. The computer will automatically detect a new device and depending on your operating system, will install any applicable device drivers.
3. Start EasySense 2 app.
4. Within the EasySense2 app, the Devices icon will change to green to show that the sensor is connected, and the status light on the sensor will also turn green.
5. Begin your practical investigations.

Bluetooth Connectivity

Using Bluetooth, the sensor can wirelessly connect to mobile devices such tablets and mobile phones, as well as desktop or laptop computers, giving students the ability to run experiments independently without being tethered to a device.

See the EasySense2 app user manual system requirements for further details.

Quick Notes on Bluetooth Connectivity

Only use with the EasySense2 app, you do not need to pair the device. If paired, the sensor will not be available to the EasySense2 app.

Computers or devices will need to support Bluetooth Low Energy (BLE). For further information refer to the instructions provided for the EasySense2 app.

Quick Steps

1. Short press the on/off switch to turn the sensor on, blue LED will flash.
 2. Open the EasySense2 app.
 3. Select the Devices icon.
 4. Select your sensor from the list of available sensors to connect to the device. Your sensor is identified by its unique ID in the list.
 5. Click on connect at the side of your sensor in the list.
 6. The Devices icon will change to green and the status light on the sensor will flash green to indicate a connection has been established.
 7. Begin your practical investigations.
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Charging the Sensor

The Smart Wireless sensors are fitted with a rechargeable lithium-ion battery and can be charged via the USB port. Use the supplied USB lead to connect the sensor either directly to a USB port on your computer, a powered USB hub or a USB mains charger that outputs 5 V at 500 mA or more.

A full charge can take up to 4 hours.

Additional Information

Whenever the sensor is connected to the USB port on the computer or to a USB mains charger (output 5 V at 500 mA or more), it will automatically recharge the battery (LED status flashing white).

When connected to a computer, the computer should be turned on and not in sleep or standby mode, as the battery may drain instead of charge.

The sensor will stay awake for 5 minutes when Bluetooth advertising (LED status flashing blue).

Lithium-ion batteries are 'memory-free' and prefer a partial rather than a full discharge. Constant partial discharges with frequent recharges will not cause any harm. Frequent full discharges should be avoided whenever possible. Ideally the sensor should be stored at about 40% or more charge.

The speed at which a lithium-ion battery will age is governed by both its storage temperature (preferably less than 40 C) and state-of-charge.

Firmware Updates

Occasionally Data Harvest may release updated firmware which will contain improvements or new features.

Updates will take place when you connect your sensor to the EasySense2 app. You will be given the option to decline an update.

Updates can be performed over USB or Bluetooth and will typically take less than one minute. Updating firmware over USB will be quicker than Bluetooth.

Do not disconnect the sensor, or power off during the update.

If you have a wireless connection to the EasySense2 app, the sensor will have to be reconnected after performing the update.

Usage Information

- The extremely high input resistance of this sensor also makes it sensitive to stray electrostatic fields in its immediate vicinity. To minimize the influence of static fields, follow these guidelines:
 1. Before taking measurements short the crocodile clips together to remove any held charge, and if necessary, link the black lead to a good earth point and short.
 2. Better results are obtained if, whilst conducting the investigation, the user is connected to a good ground or earth point. The electrostatic discharge apparatus (e.g. wrist band, grounding cord and earth bonding plug) used by circuit board assemblers will provide a good link to earth. Be careful not to touch any voltage sources while you are grounded.
 3. If it isn't possible for the user to connect to an earth point, then they should keep as still as possible with their feet on the floor.
 4. Movement from people or equipment in the locality can produce static, which will disrupt readings.
 5. When conducting investigations where the quantity of charge needs to be measured accurately (and not comparatively) mount the Charge sensor, so it won't be moved during an investigation e.g. in a retort stand and clamp.
 6. The Charge sensor is sufficiently sensitive to detect charge accumulation on the leads. Leave the crocodile clips at the end of the lead set connected together, so they are shorted out.
 7. In some circumstances wrapping the sensor in aluminium foil may help stabilise readings.
 8. Weather conditions can have an effect on readings. In dry weather keep body movement to a minimum to reduce the effect of stray static charge. In humid weather the charge may leak too rapidly to get reasonable results from some investigations.
- Equipment used for static investigations must be clean and dry. It must be kept dry even whilst working under humid conditions. Putting the cloths, rods, and other equipment on a metal plate above a radiator works well. A warm air blower (e.g. a hairdryer) can be very useful.
- If the equipment being used proves difficult to discharge, breathe gently over it. The moisture and heat in the breath will be enough to carry any remaining charge away. A yellow Bunsen flame will discharge insulators very effectively, when used with care. The hot gases rising from the flame are ionised and will neutralise surface charge on insulators.
- The Charge sensor will be affected by devices that use electromagnetic fields. The equipment that can produce interference includes computer monitors, mobile phones, televisions, switching power supplies, electric motors, etc.
- Even after shorting out the terminals, there can be a small offset voltage recorded, the reading may not be exactly at zero. This offset can be subtracted using a calculation function or using the tare function in the software.
- High frequency fluctuating fields (such as 50 Hz or above) will usually not be detectable. The sensor has a low pass filter to ensure that any 50/60 Hz mains signal is attenuated. Input signals with a rise/fall time quicker than approximately 80 ms will be significantly reduced in value.
- When used to measure the potential difference between the ends of an electrical component the Charge sensor should be connected in parallel i.e. across the component.
- For reasons of accuracy, if the Charge sensor is used with another Charge or Voltage sensor in a circuit, ensure they share a common earth (the same black lead).
- The Charge sensor can be used to measure d.c. circuits, or potentials of half cells.

SAFETY: Never use with high voltages.

- The Charge sensor can be used to look at low-voltage a.c. signals if the following is followed:-
 - The maximum voltage is 5.5 Vpp (peak to peak) i.e. low voltage, low frequency a.c. signals. It is not suitable for looking at mains supply voltages.
 - The signal frequency is recommended to be below 12Hz.

- When measuring the charge on a capacitor, it is necessary to use capacitor values significantly less than 33 nF. For good results use low current leakage capacitors below 1 nF. The error in this case will be less than 3%. The lower the value capacitor the more accurate the results.
 - Do not connect the charge sensor to high voltage static generators such as Van der Graaf generators or similar apparatus.
 - The SI unit of electric charge is the Coulomb. It is equal to the amount of charge which passes a point in a conductor if one ampere flows through the conductor for one second.
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Practical Investigations

The Smart Wireless Charge Sensor can be used to investigate a number of scientific experiments such as:

- Magnitude and sign of the charge on different objects
- Electrostatic phenomena
- Simple demonstrations of sign of charge
- Charge sharing between conductors
- Faraday's ice pail investigations
- Electrostatic shielding
- Induced charge
- Charging by induction
- Density of charge on the surface of a conductor
- Investigating the relationship 'Voltage is proportional to the charge on an object' by adding charges
- Discharge of a capacitor
- Use as a high impedance voltmeter e.g. measuring the voltage of chemical half cells
- Measuring the emf of cells

Online Videos

Learn how to use data logging in the classroom with our Secondary Science Academy demonstration videos, which will walk you through using the new EasySense2 app and show you how to get hands-on with the latest Bluetooth wireless sensors. The video experiments will show you how to get the best out of your science lessons.

New online content is being continuously uploaded onto our YouTube channel, including practical worksheets as well as videos.

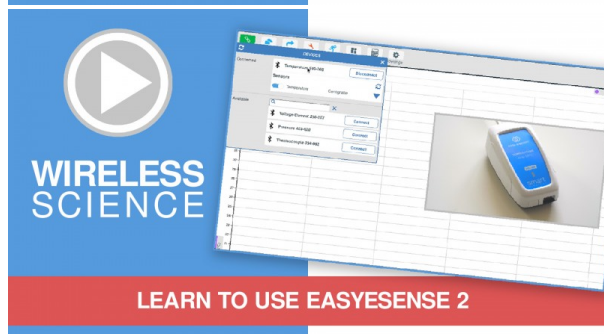
See our website for further information and links.



Explore Bluetooth Sensors

Are you looking to make the jump to our smart wireless sensors? Or have you recently purchased them and want to know more about how they work?

[View video playlist](#)



Explore EasySense2

The core of our science platform is our EasySense2 software. In these videos you will learn everything from the basics of our software to the most in-depth features.

[View video playlist](#)



Explore Science Practicals

See our Smart Wireless Sensors in action with a range of practical experiments. This is the best way to get started with the new Bluetooth sensors!

[View video playlist](#)

Sensor Specifications

Please read the following table for sensor specifications.

Feature	Detail
Measurement Ranges	Charge: $\pm 165\text{nC}$, Resolution 0.001nC Voltage: $\pm 5\text{V}$, Resolution 0.0001V Input Impedance $> 1 \times 10^{12} \text{ Ohm}$
Fastest logging speed	20ms (50Hz)
Connectivity	Wired via USB Wireless via Bluetooth
Bluetooth Specifications	Bluetooth 4.2 low energy radio, single mode compliant Transmit (TX) power: 0 dBm Receiver (RX) sensitivity: - 90 dBm Usable transmission range: up to 10 m in open air Frequency Range: 2.402 to 2.480 GHz operation
Internal Battery	Rechargeable internal lithium-ion 3.7 V Power specification: 5 V at 500 mA
Storage/Operating Temperature	0 - 40 C
Humidity	0 to 95% RH (non-condensing)
Physical Specifications	Weight: approx. 85 g External dimensions: approx. height 33 mm x width 50 mm x length 103 mm

Limited Warranty

For information about the terms of the product warranty, see the Data Harvest website at: <https://data-harvest.co.uk/warranty>

Product Repairs

When returning goods to Data Harvest, please download and complete the repair return [form](#) to ensure you have sent us all the information we require, and send it to us alongside the item to be repaired. The second page of this form includes a return address label.

If you have purchased a Data Harvest manufactured product via a different company, please also supply proof of purchase.

Postage Charges

- In the event of a fault developing, the product must be returned in suitable packaging to Data Harvest for repair or replacement at no expense to the user other than postal charges.
- There will be no postal charge for the return of repaired goods to any mainland UK address (for other areas, additional shipping charges may apply).

Out of Warranty Repairs

Please visit <https://data-harvest.co.uk/repairs> for the most up to date charges for out of warranty repairs.

Warranty on Repaired Items

Once an item has been serviced and repaired, the product will have 1 year warranty against further failure of the component repaired.

International Returns

Please contact the authorised Data Harvest representative in your country for assistance in returning equipment for repair.

Compliance

This product complies to the following standards

Waste Electrical and Electronic Equipment Legislation

Data Harvest Group Ltd is fully compliant with WEEE legislation and is pleased to provide a disposal service for any of our products when their life expires. Simply return them to us clearly identified as 'life expired' and we will dispose of them for you.

FCC Details

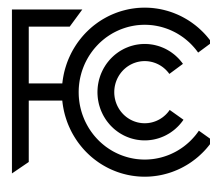
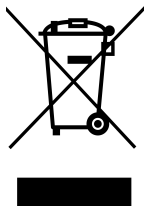
This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

CE

This product conforms to the CE specification. It has been assessed and deemed to meet EU safety, health and environmental protection requirements as required for products manufactured anywhere in the world that are then marketed within the EU.

UKCA

This product conforms to the UKCA specifications.



Troubleshooting

If you experience any problems with your product, please try the following troubleshooting tips before contacting the Data Harvest support team.

Feature	Detail
Loss of Bluetooth Connectivity	<p>If the sensor loses Bluetooth connection and will not reconnect try:</p> <p>Closing and reopening the EasySense 2 app.</p> <p>Switching the sensor Off and then On again.</p> <p>If you are using a Bluetooth Smart USB Adaptor on your computer, unplug the adaptor, plug back in again and try to reconnect.</p> <p>Hard reset the sensor and then try to reconnect.</p>

Notices

Please read the following notices with regards to using your sensor

1. The sensor is much smarter than traditional Bluetooth sensors and you are not required to pair the device. If paired, the sensor will not be available to the EasySense 2 app.
 2. When the sensor is connected to a computer, the computer should be turned on and not in sleep or standby mode or the battery may drain instead of charge.
 3. Data Harvest products are designed for educational use and are not intended for use in industrial, medical or commercial applications.
 4. The sensor is not waterproof.
 5. Plastic parts may fade or discolour over time if exposed to UV light. This is normal and will not affect the operation of the sensor.
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Contact Information

To contact Data Harvest directly, please use any of the following channels

Traditional Communications

Data Harvest Group Ltd.
1 Eden Court, Eden Way,
Leighton Buzzard,
Bedfordshire,
LU7 4FY
United Kingdom

Tel: +44 (0) 1525 373666

Fax: +44 (0) 1525 851638

Sales email: sales@data-harvest.co.uk

Support email: support@data-harvest.co.uk

Online Communications

We have active social media support channels using the following platforms

- [Facebook](#)
- [Twitter](#)
- [YouTube](#)

Office Opening Hours

Monday to Thursday - 08:30 to 16:45

Friday - 08:30 to 13:30

Saturday & Sunday & UK Bank Holidays - Closed

PDF Translations

The PDF formatted download of this manual is by default provided in the English (United Kingdom) language. If an alternative translation is available, it will be listed here.

We have for your convenience included a webpage translation feature to the online documentation which will allow you to translate and print individual pages of this documentation.
