1195 - Wireless Rotary Motion Sensor

Revision: 0 | DS174

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Introduction

Thank you for purchasing the Smart Wireless Rotary Motion 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 Rotary Motion Sensor is a multi-range sensor for studies of rotational and periodic motion. It is highly accurate, with an extremely low friction bi-directional position sensor capable of measuring a variety of motions including: - pendulum, angular, rotational, and distance moved by an object.

The sensor can measure:

- Linear displacement using the pulley ranges or optional toothed rack
- Angular displacement using the angular position or pendulum ranges
- Angular velocity using the revolutions or radians per second ranges

The Rotary Motion Sensor is especially good for work with SHM and pendulum work.

Pack Contents

This product is supplied with the following items:

- 1 x Smart Wireless Rotary Motion Sensor
- 1 x USB Connection and Charging Lead

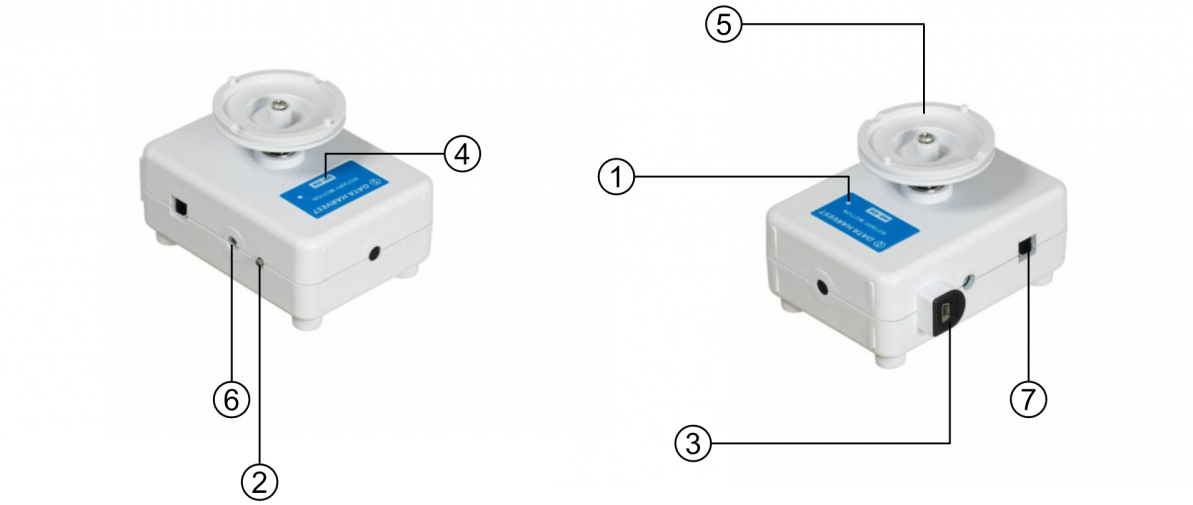
Additional Accessories

To get the most from your Smart Wireless Rotary Motion Sensor, the following items should be considered:

- Rotary Motion Accessory Kit
- Spoked Pulley

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. Status Indicator
2. On/Off & Position Reset Switch
3. USB Port
4. Unique ID Number
5. Pulley/Mounting Wheel
6. Rod Mounting Points
7. Linear Rack

The Status Indicators (1)

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 & Position Reset Switch (2)

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.

Position Reset

- During use a short press will reset the rotational position of the pulley wheel to either 0 or 180 degrees.

USB Port (3)

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 (4)

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.

Pulley/Mounting Wheel (5)

Allows for connecting additional accessories such as a pendulum rod, wire or inertia plates.

Rod Mounting Points (6)

Multiple points which allows for attaching the included metal rod to a retort stand clamp.

Linear Rack (7)

This entry point allows for the use of a linear rack.

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.

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℃) 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

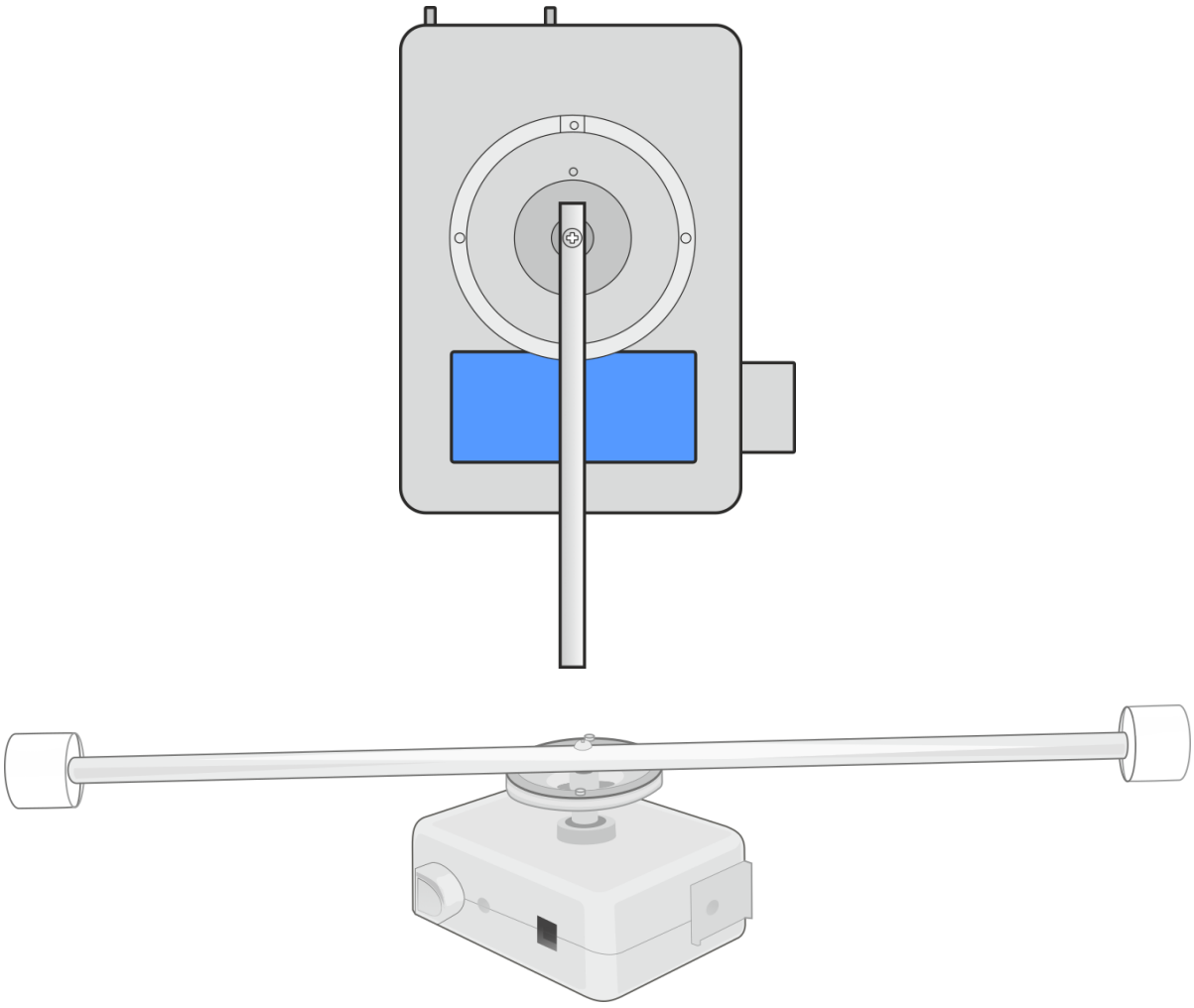
The Rotary Motion Sensor uses an optical encoder to describe the shaft position. This is a relative position indicator and will require the user to press the small zero button on the side of the sensor body to set the range to its mid-point (for example pendulum range) or its origin point (for example Distance ranges). Rotation ranges will not need to be zeroed. The encoder has a number of physical steps and an additional software tare will be required to set the exact zero.

Using the stepped pulley and ranges

The front of the sensor has a three stepped pulley. The smallest pulley is closest to the body of the sensor and has a diameter of 11 mm. The mid-range pulley has a diameter of 31 mm. The largest pulley on the outer edge of the stepped pulley wheel is 49 mm. All diameters are measured from the base of the pulley groove.

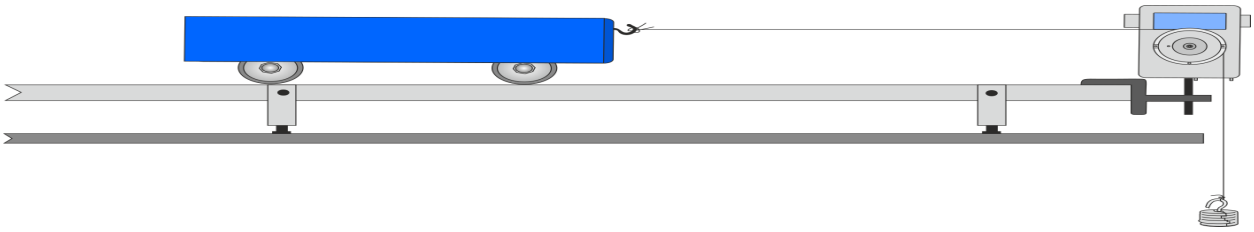
To remove the pulley, unscrew the central retaining screw and pull evenly from the shaft. The shaft is keyed and will hold the pulley securely in place.

The central retaining screw is used for additional secure attachment of the pulley, and for attachment of the included pendulum rod.



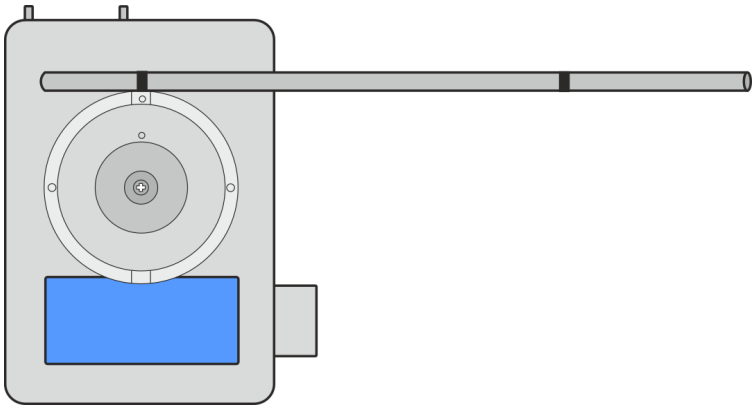
If you are using a thread to pass over the pulley and attach to something like a motion cart or spirometer, check the thread used fits into the base of the pulley and has sufficient friction to rotate the

pulley.



A small mass will need to be tied onto the thread to give tension to the thread and allow it to rotate the pulley.

If you use a rod across the pulley groove you will have to calibrate for the distance. The pulley distance is for the diameter at the base of the pulley groove. Find the distance the rod moves for one complete rotation of the pulley (use markers to identify distance and rotation points) and then use the calculate tool to apply the correction factor to the data and give true distance. Use AX – BY with A being the multiplication constant and B = 0 to cancel out the BY function.



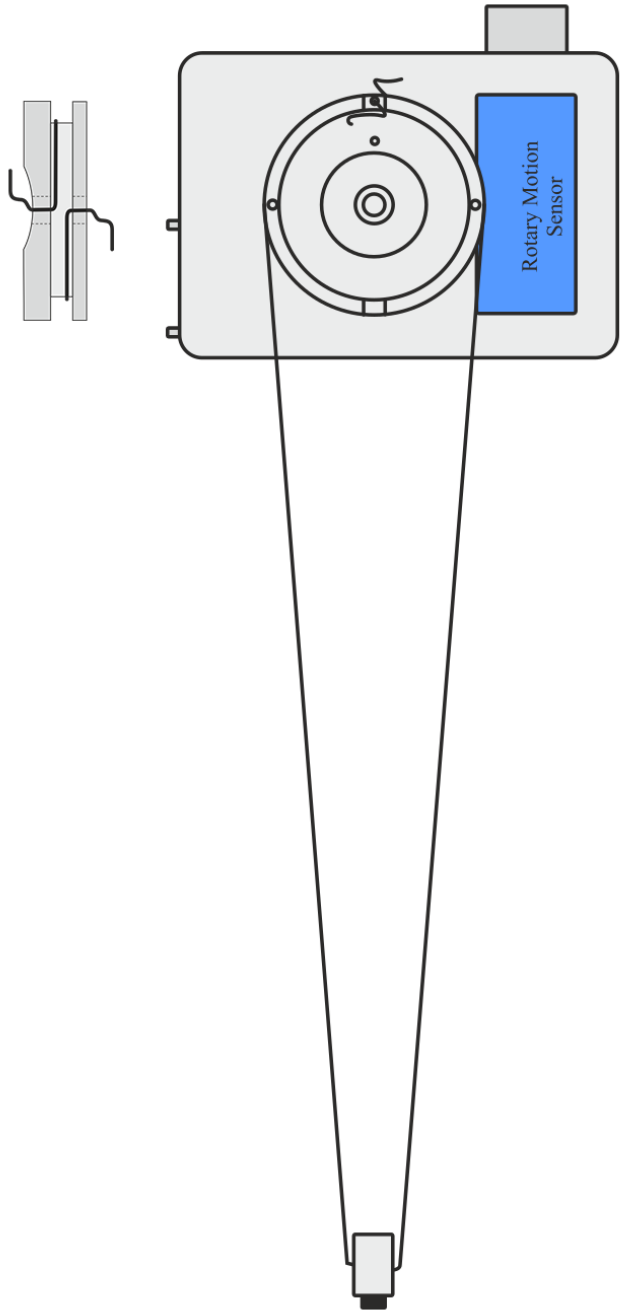
The distance between the dark lines on the rod is the distance of one rotation of the RMS pulley wheel

Using the pendulum ranges and rod

You can attach a pendulum in a variety of ways, for example:

- As a wire looped around the central securing screw
- Using the holes in the stepped pulley to attach a thread

Each has their own advantage. The pendulum rod is the simplest to use for quick studies as the masses that come with it allow you to quickly change the amplitude of the pendulum or the effective mass of the pendulum. The use of a wire or threads to create a pendulum can create very long pendulums but take longer to make changes.



Use an inter-sample period of 10 ms or greater for the best results.

The special pendulum range that is limited to 20 degrees of displacement should be used for pendulum work.

Angular Rotation Ranges

Studies of angular rotation will require the use of the optional accessory pack. Details of how to use the angular functions will be in the manual for that product.

Maintenance

If the sensor has not been used for a while it may require a few drops of light machine oil on the bearings to free them up.

If the sensor requires cleaning use a damp cloth for minor scuffs and marks. More persistent marks will require use of IMS or isopropyl alcohol.

Do not immerse the sensor body in any liquid.

Never use **Acetone (propanone)** as it will dissolve the plastic case materials. Other organic cleaners should also be treated with great care. The plastic used for the case is ABS.

Practical Investigations

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

- Study of amplitude vs period of a pendulum
- Study of length vs. period of a pendulum
- Study of Mass of pendulum bob vs. period.
- Angular momentum
- SHM – displacement > velocity > acceleration.
- Atwoods machine.
- Newtons 2nd law
- Distance moved (e.g. using kinetics trolley)
- Movement of a water spirometer.
- Distance moved by another sensor.

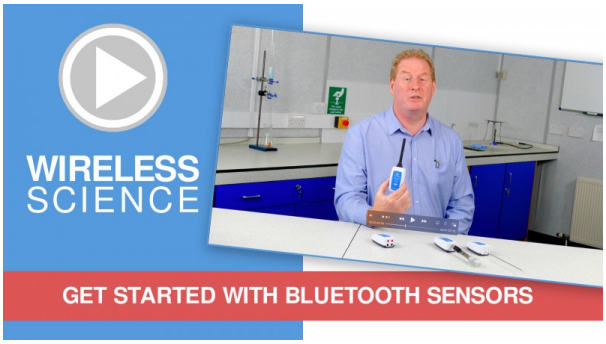
When used with the optional Rotary Motion Accessory Kit
- Conservation of angular momentum
- Moments of inertia
- Rotational inertia

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.

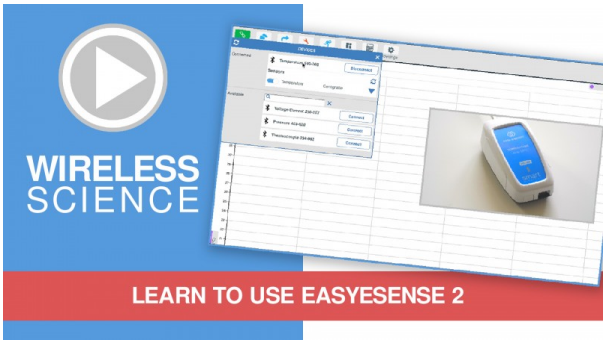
See our website for further information and links.



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	Angular Position 360 ° 0.1° Angular Velocity ±6rev/s 0.001rev/s Angular Velocity ±40rad/s 0.001rad/s Linear Rack ±400mm 0.01mm Pulley 11, 31, 49mm) >6000 rotations 0.1mm Pendulum ±20°
Accuracy	0.09°
Fastest logging speed	1ms
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℃
Humidity	0 to 95% RH (non-condensing)
Physical Specifications	Weight: approx. 170 g External dimensions: approx. height 100 mm x width 70 mm x length 83 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	**If the sensor loses Bluetooth connection and will not reconnect try:** Closing and reopening the EasySense 2 app. Switching the sensor Off and then On again. If you are using a Bluetooth Smart USB Adaptor on your computer, unplug the adaptor, plug back in again and try to reconnect. Hard reset the sensor and then try to reconnect.
The sensor has been designed to give years of trouble-free use. However, sometimes results may not appear as expected. Use the checklist for further help.	**Check:** • If using a thread on a pulley wheel and the sensor does not return to zero, it may be that the friction is insufficient between the thread and pulley wheel. If weight is not critical to the practical work, add more tension weight. • Increase friction by winding the thread once around the pulley. • Use the reset and tare to set the start to zero before each practical run. • If the data suddenly jumps from top to bottom of the EasySense 2 screen, the data being collected has fallen outside the limits of the range being used. • With slow rotation speeds and long inter-sample periods, you get stepping of data – the time taken for the encoder to move past the light source means that multiple readings of the same value for different times are occurring. Try decreasing the inter-sample period (for example from 20 ms to 10 ms inter-sample)

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.

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.
