



## 1192 - Acceleration Sensor 3 Axis

Revision: 0 | DS178

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## Introduction

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Thank you for purchasing the Smart Wireless 3 Axis Accelerometer 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 Wireless Smart 3 Axis Accelerometer Sensor is USB and Bluetooth compatible. Using Bluetooth, a sensor can connect to mobile devices, tablets, laptops, and desktops.

The Accelerometer consists of acceleration sensing circuits set at right angles to each other, each measuring acceleration along one axis.

The sensor element is a capacitive device. A central mass is held static while suspended interleaved plates are free to move relative to this mass. The result is that any movement will create a change in position of the suspended element relative to the static mass, this changes the capacitance. The change in capacitance is proportional to the force – acceleration.

With a wireless sensor any connection back to the recording device will not suffer from problems of tangled wires.

An accelerometer is an electromechanical device that will measure acceleration forces. These forces may be static, like the constant force of gravity pulling at your feet, or dynamic - caused by moving or vibrating the accelerometer. It is able to detect the magnitude and direction of the acceleration. Accelerometers are common devices but are usually unseen and unnoticed.

- A modern car's airbag system uses acceleration sensors to determine the trigger point for release.
- Seat belt tensioners in a car are often triggered by accelerometers.
- Portable computing devices e.g. laptop computers, use accelerometers to lock hard drives if the computer is dropped.
- Mobile phones use an accelerometer to determine the orientation of the screen and to adjust the screen resolution and mode.
- Gaming consoles use accelerometers in the hand controllers.

- As an accelerometer can be used to measure vibration, it can be used to detect the change in vibration signature of a machine as it starts to fail e.g. a motor bearing has a characteristic vibration pattern, smooth and quiet when in good order, gradually getting rougher and noisier as it wears out.

An accelerometer does not measure gravity - it measures the component of "total acceleration minus gravity" along its input axis as "non-gravitational" acceleration (the [acceleration](#) it experiences relative to freefall).

The term 'g - force' is normally used as shorthand to describe the force acting on a moving object relative to the force felt by an accelerating object at the earth's surface. It is not an SI unit; it is used to express the relative force experienced. To convert to a correct SI unit all g values should be multiplied by 9.81 to give the ms<sup>-2</sup> value.

Astronauts, fighter pilots, and racing drivers are often said to experience a force of so many 'g' when performing a particular manoeuvre. This force is rarely gravitational as it's a rocket, jet, or combustion engine that provides the force needed to accelerate e.g. when a pilot changes speed or direction, or a racing driver goes around a corner. The effect of high acceleration on humans can be significant as most will lose consciousness if subjected to a sustained acceleration of between 5 to 7 g. This effect is only felt if the acceleration is sustained, i.e. jumping onto a hard floor can produce a deceleration of many g but only for a fraction of a second.

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## Pack Contents

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This product is supplied with the following items:

- 3 Axis Accelerometer Sensor
  - 1 x USB Connecting Lead
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## Operational Overview

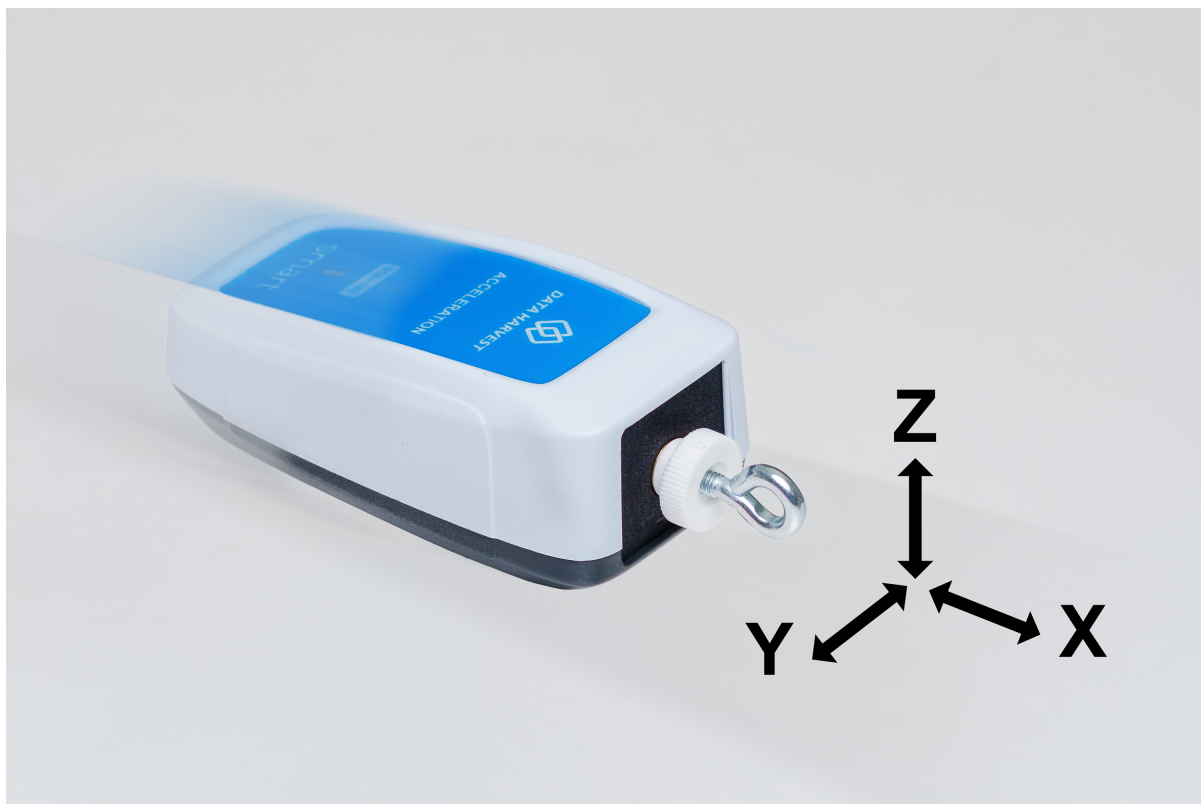
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The diagram below shows the specific parts of the sensor. Read further to explore the functionality of each part of the sensor.

The sensor measures acceleration in 3 axis (X, Y, Z).

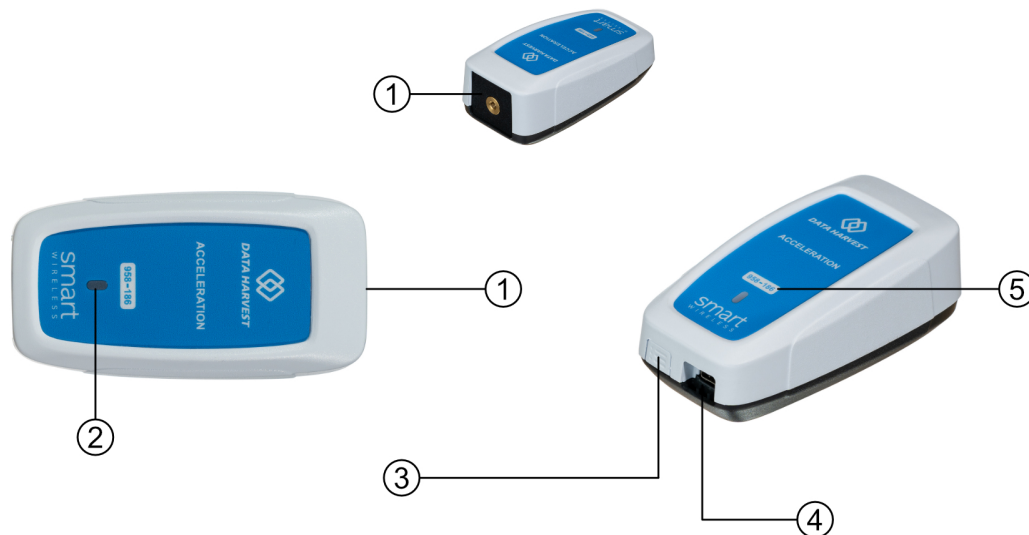
The axis are defined as -

- X runs along the long length of the sensor. If you pull the sensors from the (\*end cap) hook attachment or push towards the hook attachment you will get a +ve value returned.
- Y runs across the sensor
- Z runs vertically through the sensor (through the blue top label)



The gyro produces a +ve reading for clockwise rotation and a -ve reading for anticlockwise rotation.

\* The end cap for the Accelerometer sensor has a captive nut that accepts a 4mm threaded machine screw. A looped screw is supplied with a white plastic lock nut.



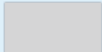






1. Sensor End Cap
2. Status Indicator
3. On/Off Switch
4. USB Port
5. Unique ID Number

## 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

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## 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

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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

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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.

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## Firmware Updates

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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.

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## Usage Information

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The accelerometer is designed to measure the force of acceleration along the selected axis. Make sure you choose the correct range and axis for the practical.

A hook / hoop is supplied to screw into the end of the sensor. Take care to not over tighten the screw or there is a possibility the end cap will split. Use the white locking nut to secure the hoop into place.

Constant rotational force is measured as the diameter of the rotation increases. If you try this practical, ensure the string is tied very securely to the hoop and rotate only with sufficient force to keep the sensor rotating parallel to the floor. If excessive rotation force is used there is a possibility the screw thread will separate from the end plate.

- Attach the sensor firmly to the object under test. Use cable ties or low tack masking tape (the tape can be removed without leaving glue residue on the sensor).
  - The accelerating object should weigh more than the Accelerometer (which weighs approximately 28 g).
  - Use no more than the sensor length to drop the sensor directly onto a solid surface, as higher drops may result in extreme jarring that could damage the sensor.
  - If the low g Accelerometer's Resultant range is selected to record a vehicle's journey, it uses data from all 3 axes; this will include any bumps or vibrations which may confuse results.
  - The sensor is not waterproof.
  - Be careful when cleaning. Use methylated spirit or isopropyl alcohol, not acetone or other solvents known to dissolve plastic.
  - If you hang items from the hoop screwed into the front plate do not exceed 2 kg.
  - If you whirl the sensor around, make sure the forces generated do not exceed the carrying capacity of the captive thread nut in the face plate, and ensure the thread connected to the sensor is securely connected.
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## Practical Investigations

The Smart Wireless 3 Axis Accelerometer Sensor can be used to investigate a number of scientific experiments such as:

In all investigations you should use the range that follows the line of acceleration forces in the motion of the object being studied.

- Acceleration of a Dynamics cart on a track
- Impulse (force change at collision)
- Collisions between carts or a cart and a surface
- Impact force on landing e.g. athlete landing on a crash mat after a jump
- Forces when ball is kicked or thrown or struck with a racquet
- Explanation of opposing forces e.g. resistive forces countering force of mass on a surface
- Bungee jump
- Pendulum
- Changes in acceleration in a golf swing
- Explanation of free fall
- Relationship between acceleration due to gravity and angle ( $\sin \theta$ )

## 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	3 Axis Acceleration ranges (X, Y and Z) : $\pm 20 \text{ m/s}^2$ ( $\pm 2g$ ), $\pm 40 \text{ m/s}^2$ ( $\pm 4g$ ), $\pm 75 \text{ m/s}^2$ ( $\pm 8g$ ), $\pm 150 \text{ m/s}^2$ ( $\pm 16g$ ),  Resultant Acceleration,  3 Axis Gyroscope ranges (X, Y and Z): $\pm 4 \text{ rad/s}$ $\pm 8 \text{ rad/s}$ $\pm 17 \text{ rad/s}$ $\pm 35 \text{ rad/s}$
Resolution	Acceleration Resolution $0.1 \text{ m/s}^2$ Gyroscope Resolution $0.001 \text{ rad/s}$
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. 68 g External dimensions: approx. height 34 mm x width 50 mm x length 91 mm

## Limited Warranty

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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.

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## Compliance

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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

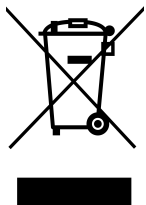
This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

### 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

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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><b>If the sensor loses Bluetooth connection and will not reconnect try:</b></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>

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## Notices

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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

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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](mailto:sales@data-harvest.co.uk)

**Support email:** [support@data-harvest.co.uk](mailto: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

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## PDF Translations

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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.

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