1155 - Wireless Blood Pressure Sensor

Revision: 0 | DS166

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 18
Sensor Specifications 19
Limited Warranty 20
Compliance 21
Troubleshooting 22
Notices 23
Contact Information 24
PDF Translations 25

Introduction

Thank you for purchasing the Smart Wireless Blood Pressure 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 Blood Pressure Sensor is an educational grade blood pressure sensor, designed to help educators explain blood pressure, and to be used for introductory lessons relating to body health, diet, exercise etc.

The EasySense2 software has a specific mode for showing blood pressure. In the display type icon (top left of each display panel) select BP to access the blood pressure measurements. In the BP mode the user can select to show mean pressure, systolic and diastolic pressure, or single values. Blood pressure is indicated as mmHg (millimetres of mercury).

Changing the display to graph and selecting pulse will reveal the graph of Blood pressure against time. This information can be used to explain the theory behind blood pressure measurements, and allow students to find the blood pressure by analysis of the raw data.

It is advised that you use a 2-pane layout in ES2 and have the BP on the upper pane and the graphical representation on the lower pane; in this layout you can easily see where problems in reading stability may be occurring. With use the graphical panel should be able to be removed.

Pack Contents

This product is supplied with the following items:

- 1 x Wireless Blood Pressure Sensor
- 1 x USB Connecting Lead
- 1 x Analogue pressure gauge
- 1 x Universal pressure cuff

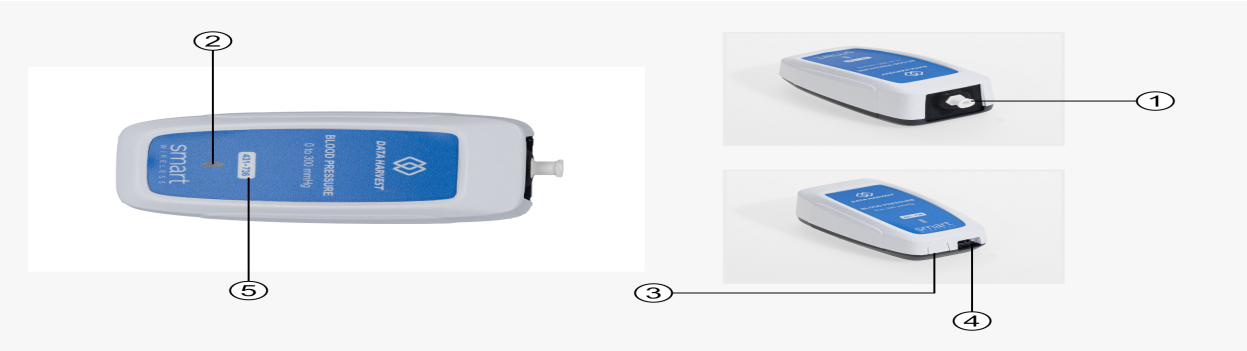
Additional Accessories

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

- Wireless Fast Temperature Sensor

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.

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

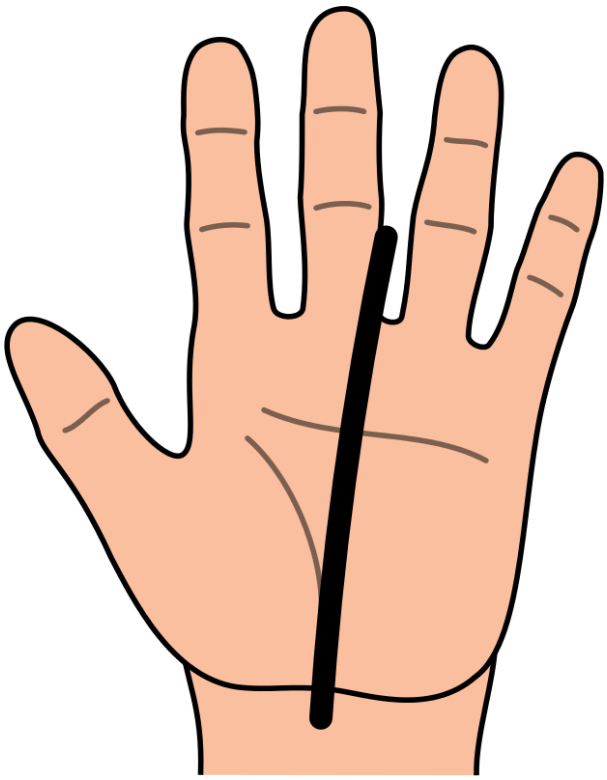
Warning: DO NOT OVER INFLATE the pressure cuff. Severe damage to major blood vessels, capillaries, and nerves is possible. Never exceed an inflation pressure in excess of 30 mmHg over expected systolic pressure. For an average teenager, a systolic pressure of 110 mmHg is expected.

The pressure cuff must be inflated to at least 110mmHg for the readings to be taken correctly.

Read the operating instructions carefully before use.

The cuff supplied is a universal cuff. When wrapped around the arm it should be tight before inflation, but not so tight that it is already creating restrictions of blood flow. We have found that the Velcro can be stiff and restrict the cuff, use the minimal Velcro overlap to be consistent with the cuff staying in position.

The position of the cuff is critical to getting consistent readings, the cuff has several markers on to help with alignment. Position the cuff so that the tube labelled “Left arm” is over the brachial artery – this is best estimated by running the tube from the cuff labelled “left arm” down the arm (with the arm orientated to give the palm up) to the space between the ring and middle finger.



The cuff should have a space equivalent to two fingers between the lower arm and the lower edge of the cuff. When you have our arm in the correct collection position the lower edge of the cuff should not be touching the lower arm (ideal).

Positioning the cuff is really a two-person job.

When sharing a pressure cuff, it is good practice to clean the surface of the cuff that contacts the skin between measurements. Alternatively, clean the skin contact area before and after use.

The sensor is not waterproof. It may be cleaned using a damp cloth. Do not immerse in water or detergent. Do not place the sensor in an environment in which high humidity levels are possible as this may result in damage or malfunction.

Blood pressure instructions:

While taking blood pressure can be an individual process, it is easier to have the assistance of another person.

For all blood pressure measurements, to get the most accurate results it is important to have the user sit down for a few minutes before having their blood pressure taken. They must be resting and not move during the measurement process.

All readings from this apparatus are indicative and not absolute; the apparatus is not medical grade or certified.

Blood pressure readings can be determined in EasySense2 by two methods. Automated where all the calculations are conducted without user intervention, and Manual where the raw data is shown and the user calculates the data.

Automated approach:

1. Attach the tube from the cuff to the Blood Pressure Sensor
2. Position the cuff on arm:
    1. Ensure the cuff is fully deflated. Open the valve on the pump bulb slightly if air needs to escape.
    2. Make sure you have minimal clothing over the arm to be used (for example shirt sleeve only not shirt and jumper). Some improvement will be seen if the cuff is placed directly to skin.
    3. Wrap the cuff around the arm so the middle of the cuff is over the brachial artery. You may need assistance for this.
    4. Position the cuff approximately 2.5cm above the elbow with the arrow on the cuff above the brachial artery.
    5. Close the valve.
3. Turn on the Wireless Blood Pressure sensor and connect the blood pressure sensor to EasySense2.
4. By default, the following ranges are turned on - this is what you need for the automated blood pressure method: ***See image 1.0 below***
5. In EasySense2, change the layout to two charts. On the top left of one of the new charts, click on the "**?**" symbol and select "**BP**".
6. EasySense2 will default the recording setup to an interval of 50ms and Continuous Mode.
7. Start recording in EasySense2.
8. Pump up the cuff (approximately one to two big pumps per second) until the cuff pressure is approximately 140 to 150 mmHg. The cuff pressure is shown on the graph and the number box on the far righthand side of EasySense2.
9. Slowly open the valve to decrease the cuff pressure. This will require a very small turn of the valve in the region of 5 to 10 degrees. The cuff should deflate at a rate of 5 to 10mmHg every 5 seconds or so, use the graph display to check the rate of deflation.
10. The experiment will automatically end once the cuff pressure gets below 35mmHg. The blood pressure results will then be displayed in the ‘BP’ chart as shown below: ***See image 1.1 below***
11. Multiple runs can be performed by simply pressing Start again.

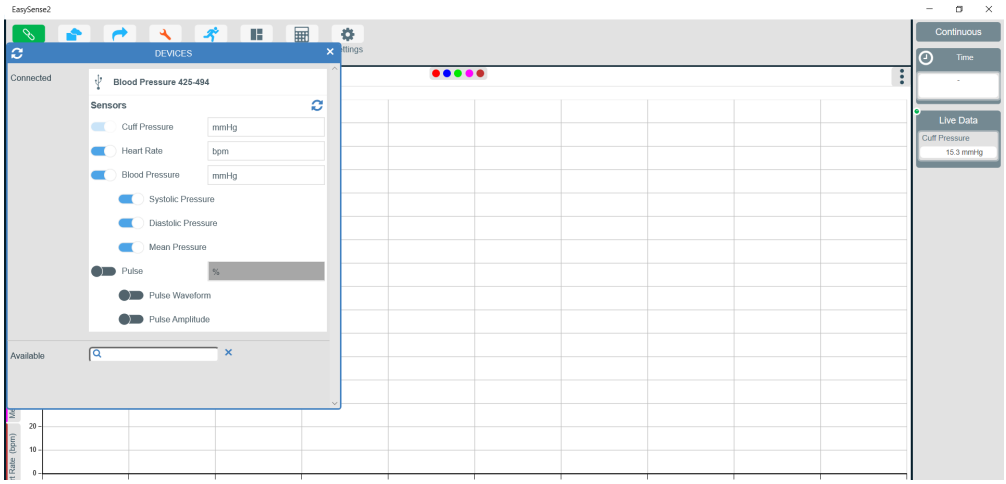


Image 1.0

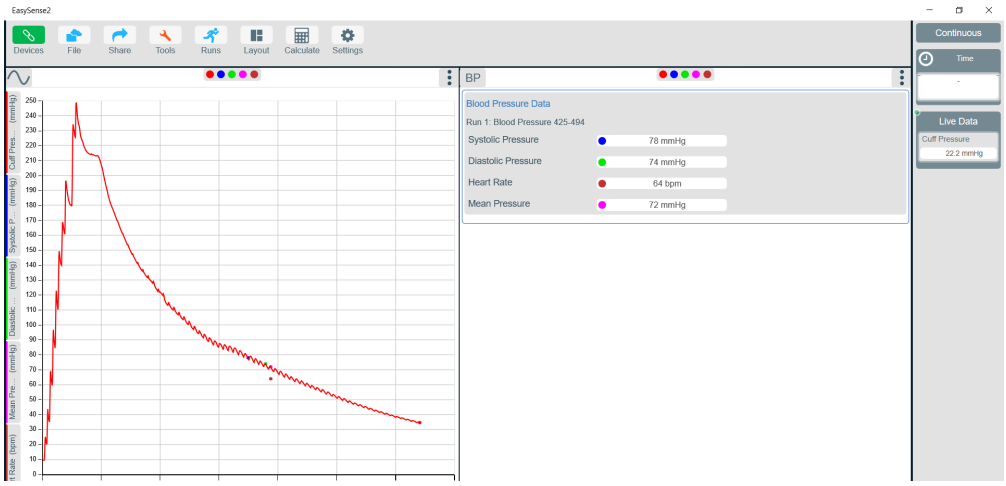


Image 1.1

Manual approach (gives an understanding of how an automated blood pressure monitor works):

1. Follow instructions form the Automated section for fitting the cuff and installing the sensor.
2. Connect the Blood Pressure Sensor to EasySense2.
3. In Devices, turn on both pulse ranges in the devices menu. The Blood pressure and Heart Rate ranges should be turned off. ***See image 2.0 below***
4. The default setting of EasySense 2 for a single panel with a graph is required.
5. EasySense2 will default the recording setup to an interval of 50ms and Continuous Mode. For this experiment, it is best to use setup to change the sampling interval to 10ms although it will still work at the 50ms default.
6. Start recording in EasySense2.
7. Pump up the cuff (approximately one to two big pumps per second) until the cuff pressure is approximately 140 to 150 mmHg. The cuff pressure is shown on the graph and the number box on the far righthand side of EasySense2.
8. Slowly open the valve to decrease the cuff pressure. This will require a very small turn of the valve in the region of 5 to 10 degrees. The cuff should deflate at a rate of 5 to 10mmHg every 5 seconds or so.
9. The experiment will automatically end once the cuff pressure gets to below 35mmHg. Results

similar to those below will be recorded: ***See image 2.1 below***

10. Use the Data Selection tool (Tools -> Select Data) to select just the portion when the green 'Pulse Amplitude' data is plotted – i.e. between about 10s and 50s. ***See image 2.2 below***
11. Meaning of the signals:
    1. **RED** = Cuff pressure. This shows the small bumps of the pulse caused by the blood flow returning to the arm.
    2. **BLUE** = Pulse Waveform. This is an amplified version of just the bumps from the cuff pressure that shows more detail of the pulse and heart beats.
    3. **GREEN** = Pulse Amplitude. This is the amplitude of the Pulse Waveform (i.e. from min to max).
12. Data analysis:
    1. Use the Crosshair values tool to find the maximum point on the Pulse Amplitude signal. Once this is found, record this value (in the above example this is approximately 31 read off the Y axis for the green trace) and read off the corresponding Pressure from the Cuff Pressure signal. This is known as the Mean Pressure (also known as the Mean Arterial Pressure or MAP). In this example the Mean Pressure is approximately 104mmHg.
    2. Systolic Pressure – This is calculated as a percentage of the peak value of the Pulse Amplitude trace. Typical values for the Systolic percentage are between 55% to 70%. Each Blood pressure monitor has a different measurement method and derived percentage. Calculate the Systolic percentage of the Pulse Amplitude signal, use the Crosshair values tool to find this value to the left of the peak on the Pulse Amplitude trace and again read off the actual pressure at this point on the Cuff Pressure trace – this is the Systolic Pressure.
        1. Example: If the max value of the green Pulse Amplitude trace is 31 and I use 70% as the Systolic percentage, then 0.70*31 = 21.7 -> find this value on the green trace to the left of the max value on pulse amplitude and read off the corresponding red Cuff Pressure at this point – in this example this equates to 128mmHg.

    3. Diastolic Pressure – this follows the same approach as Systolic. The typical percentage range for Diastolic Pressure is 70 to 85% of the peak Pulse Amplitude. Calculate the Diastolic percentage and find this point to the right of peak on the Pulse Amplitude trace. Again, read off the cuff pressure at the point -this is the Diastolic Pressure.
        1. Example: 75% of 31 = 23.25. This equates to a cuff pressure of 81mmHg

    4. You will now have the Systolic/Diastolic values that are associated with Blood pressure readings. For the above example this is 128 / 81.

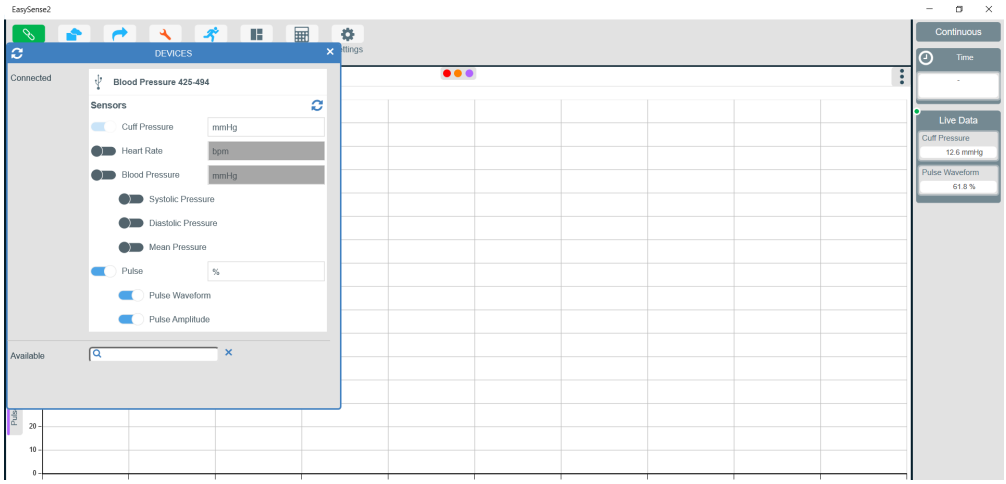


Image 2.0

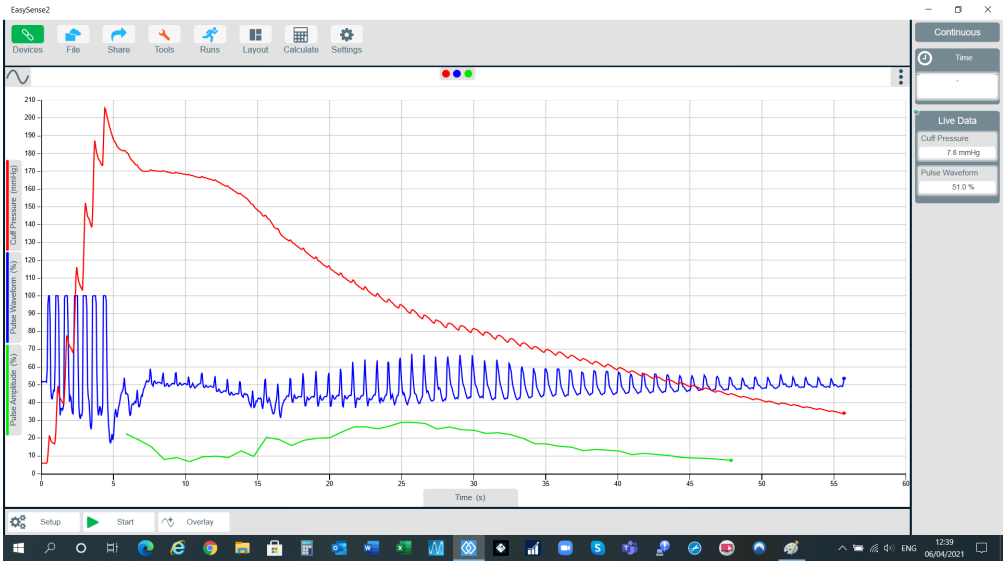


Image 2.1

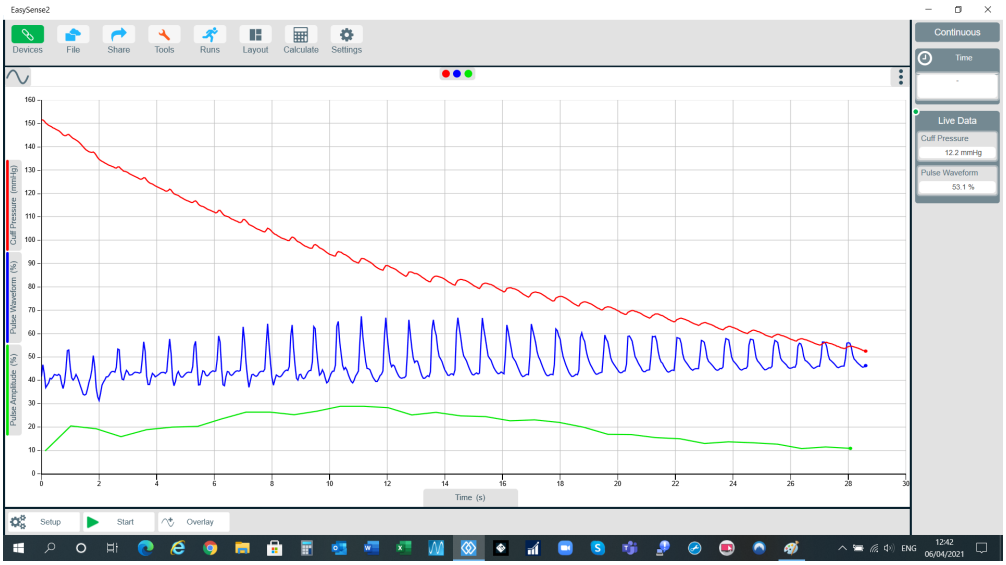


Image 2.2

Traditional Approach:

1. An analogue pressure gauge is also included with Blood Pressure kit. This can be attached to the cuff instead of the Blood Pressure sensor. By using an additional Stethoscope (product code 3178) and listening for the Korotkoff sounds whilst deflating the cuff, blood pressure values can be determined. You can use the data from the Blood Pressure sensor to confirm the auditory signal. This is how a doctor traditionally performs blood pressure readings if not using an automated system.
2. This approach just requires a graph.
3. EasySense2 will default the recording setup to an interval of 50ms and Continuous Mode. For this experiment it is best to change the sampling interval to 10ms although it will still work at the 50ms default.
4. Start recording in EasySense2.
5. Pump up the cuff (approximately one to two big pumps per second) until the cuff pressure is approximately 170 to 180mmHg. The cuff pressure is shown on the graph and the number box on the far righthand side of EasySense2.
6. Slowly open the valve to decrease the cuff pressure. This will require a very small turn of the valve in the region of 5 to 10 degrees. The cuff should deflate at a rate of 5 to 10mmHg every 5 seconds or so.
7. The experiment will automatically end once the cuff pressure gets to below 35mmHg. Results similar to those below will be recorded:

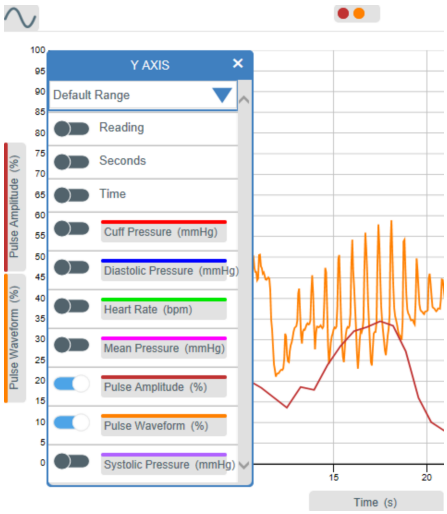
Additional Help & Guidance

Sometimes, despite your best attempts the BP will not be giving a sensible value. This is almost certainly down to technique; the following information can help you diagnose why results are erratic.

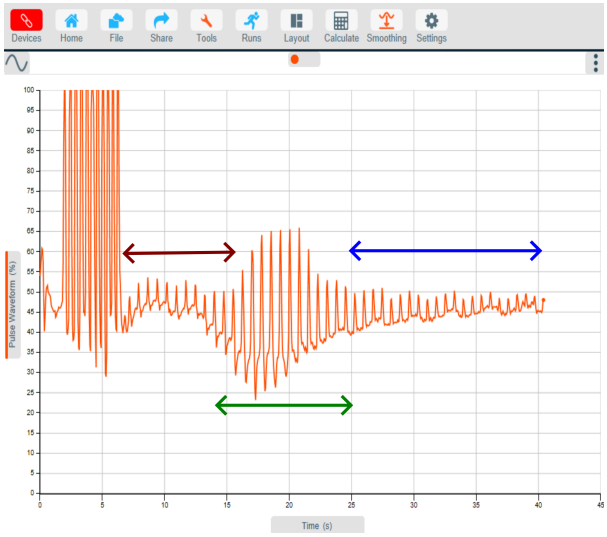
The BP calculation listens for a period of quiet after the deflation starts and then waits for “noise” in the form of a pulsed pressure wave; if you introduce noise into the period after you start deflation of the cuff the algorithm will get a false start. Typically, you would notice diastolic and systolic data being very similar or even the systolic reading higher than the diastolic – which is plainly not true.

Try the following:

1. Connect the BP sensor by a good long USB cable to a PC (preferred).
2. Open the software; the USB connection will automatically connect the sensor to the software.
3. In devices, turn on the item called Pulse.
4. Use the Layout (top centre of icons) and select two panels one on top of the other.
5. Make the top Panel the BP.
6. Make the lower panel graph. On this one, turn off everything except Pulse Waveform.



7. Click start, pump up the cuff to about 160mmHg, use the live data boxes to the right to view.
8. Unscrew the silver thumb screw. Do not move or joggle the pump. Watch the Pulse; you are looking to get a graphical pattern to data as shown below.



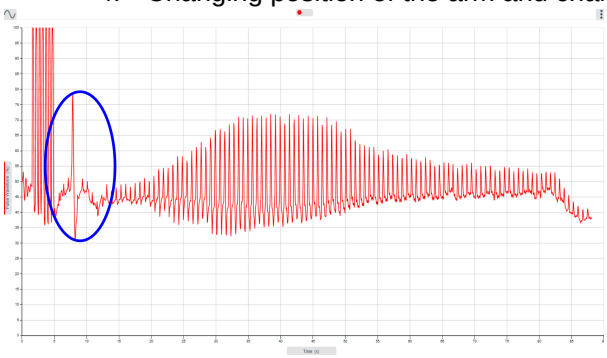
The annotations indicate the areas of a good set of data.

Red = a clean, “even” set of pulses immediately after the tall inflation pulses.
Green = the change in pulse amplitude the algorithm that produces the BP is looking for.
Blue = the “normal pulse” being recorded by changes in the cuff pressure, you can fully deflate the cuff at this point.

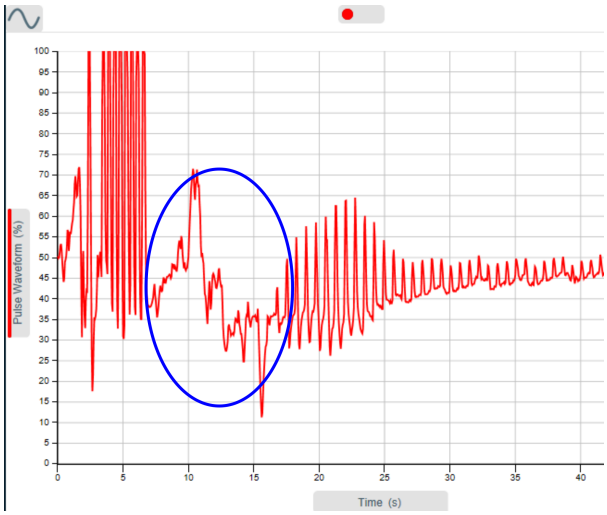
The recording below shows a “bad set of data”.

The section ringed shows how a large pressure artifact has been created – in this case it was by dropping the pressure bulb onto the tabletop; it could equally be created by;

1. Wiggling fingers.
2. Flexing hand.
3. Holding onto the pump bulb.
4. Changing position of the arm and changing the pressure in the cuff



The large pressure peak will trigger the BP algorithm, in this case looking at the BP data panel you will see that the Systolic pressure has not been recorded.



In this example the many pressure peaks in the period ringed have prevented any meaningful values (diastolic and systolic data are virtually the same).

Normally you will find after a few attempts that you will quickly develop a good collection protocol and you will be able to remove the graphical representation of the data. This is not unusual – use of BP meters is not just a simply matter of placing the cuff, inflating, and getting an answer – it does require a period of training and understanding why you may not get results.

Note:

The sensor collects data independently of the software – the software is just a view into the data. The sensor stores the data within the sensor. At your chosen intersample period, values are sent to the software to view in graph – this is why BP suddenly appears. The calculation in the sensor derives the value and sends back BP once;

1. Cuff pressure has Fallen below (approx.) 35mmHG
2. The data store is full – this is about 90 seconds after start.
3. If there has been a long pump-up time to too high a pressure the sensor memory store will fill quicker.

So, in summary, quick inflate, good steady deflate, no movement of the bulb or you.

Practical Investigations

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

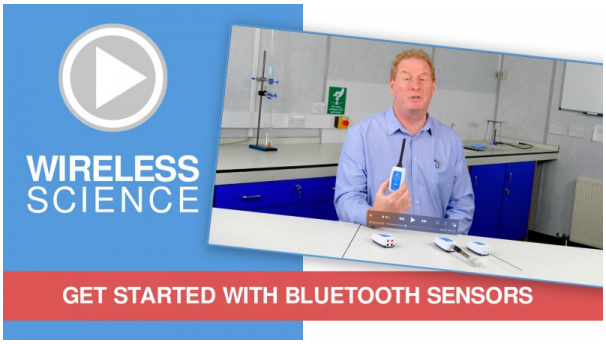
- Blood Pressure

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.

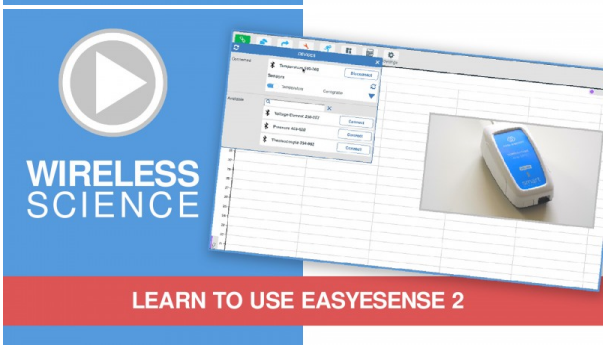
See our website for further information and links.



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	0 to 300mmHg
Accuracy	±3% of pressure reading
Resolution	0.1mmHg
Fastest logging speed	10ms (100 samples per second)
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. 80 g External dimensions: approx. height 33 mm x width 50 mm x length 98 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.

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.
