



Alpha AgTech LLC

# USER MANUAL

## Berry Impact Recorder

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# 1 Introduction

## 1.1 Product Overview

Berry Impact Recorder is an electronic sensor that is designed to measure mechanical impacts for small fruits and vegetables. It has the following features:

- Smaller size. The diameter of the sensor sphere is one inch (25.4 mm).
- Light weight.
- Large sensing range. The sensor has three single axial accelerometers, and each accelerometer can measure acceleration up to 500 **g**.
- High recording frequency. The sensor can take 4000 measurements per second.
- Long operation hours. The sensor can operate for up to 4 hours at a full battery charge.
- Large memory. The sensor has 2 MB flash memory that can record 174762 data points, equivalent to 6990 impacts.

## 1.2 Working Principle

The bruise damage of fruits and vegetables caused by mechanical impacts is greatly influenced by the force of impact and the physical properties of the produce. However, directly measuring the force acting on fruits or vegetables in industrial settings can be challenging. To overcome this, engineers have developed a sensor known as "pseudo fruits" or instrumented spheres. These miniature wireless data loggers are shaped like spheres to mimic real fruits or vegetables on packing lines. The instrumented sphere is designed to have similar weight, size, and surface properties as the produce, allowing it to experience similar impact forces.

One such sensor, the Berry Impact Recorder, encapsulates all its electronic components into a one-inch sphere to mimic the weight and size of small fruits and vegetables. The outer surface is made of customizable silicone rubber to mimic different fruit textures.

According to Newton's second law, the acceleration of an object is directly proportional to the net force applied to it and inversely proportional to its mass. By measuring acceleration, we can indirectly determine the force acting on a body, as long as the mass remains constant. Since the mass of the Berry Impact Recorder is known and constant, measuring its acceleration is equivalent to measuring the force acting on it. The Berry Impact Recorder utilizes three single axial accelerometers mounted at orthogonal angles to measure acceleration in the x, y, and z directions. The sensor uses a microcontroller to record the acceleration data, which is saved on an onboard flash memory. The recorded acceleration is measured in units of g, where 1 g is equal to  $9.8 \text{ m/s}^2$ .

During an impact, the acceleration change measured by the Berry Impact Recorder typically follows a bell curve shape. Two metrics are commonly used to quantify the impact: PeakG and Velocity Change (VC). PeakG refers to the maximum value of acceleration during the impact (Figure 1). Velocity Change represents the area under the acceleration curve, calculated by integrating the acceleration over time, and signifies the difference between the initial and final velocities during an impact (Figure 1).

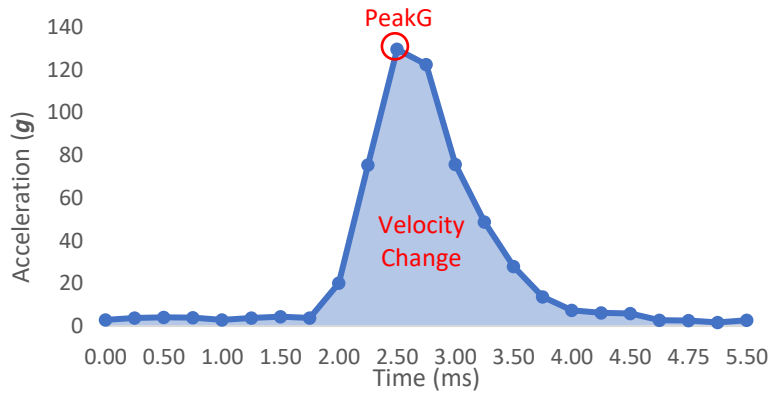


Figure 1 Illustration of PeakG and Velocity Change.

PeakG and VC serve as indicators of the hardness of the impact surface (Figure 2). When other factors remain constant, softer surfaces tend to exhibit smaller PeakG values and larger VC values compared to harder surfaces. These metrics provide valuable insights into the impact characteristics and can help evaluate the potential damage caused by different surface hardness levels.

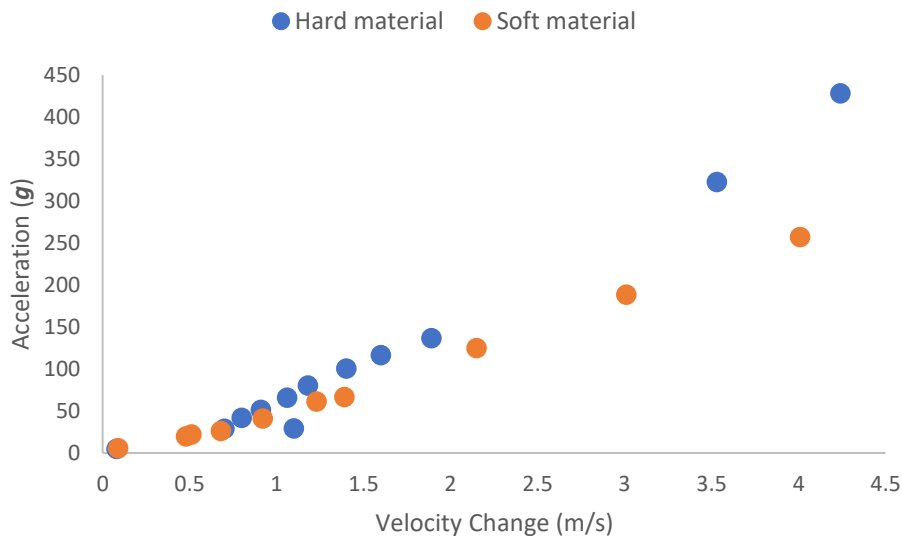
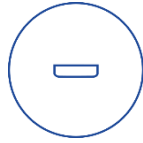


Figure 2 Impact surface hardness comparison based on PeakG and Velocity Change.

### 1.3 Package Contents

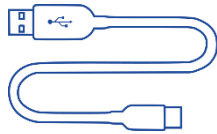
Berry Impact Recorder



USB C to USB adapter



Micro USB cable



Quick start manual



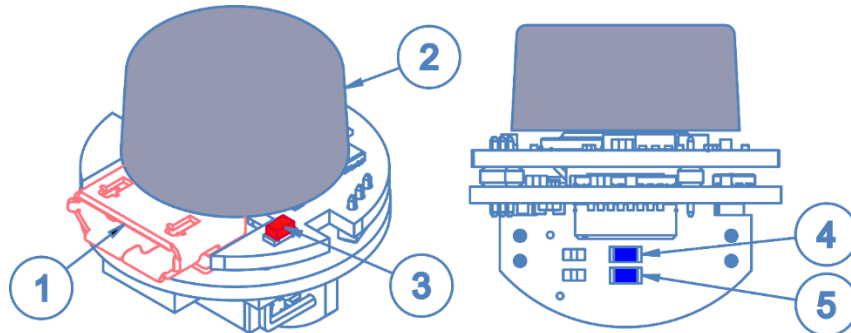
### 1.4 Important Safety Information

Please read the quick start manual before using the sensor.

Do not use a power source higher than 5 V to charge the sensor.

## 2 Getting Started

### 2.1 Sensor Components



1. Micro USB Port
2. Rechargeable Battery
3. Charge Indicator (Red)

4. Sensor Light (Blue)
5. Sensor Light (Blue)

### 2.2 Charging Sensor

The sensor can be charged through the USB port. Connect the sensor to any USB port using the micro-USB cable to charge the sensor.

### 2.3 Powering On/Off

The sensor will automatically power on once it is fully charged and connected to a computer or a mobile device. The sensor will automatically enter sleep when it is not connected to a computer or recording.

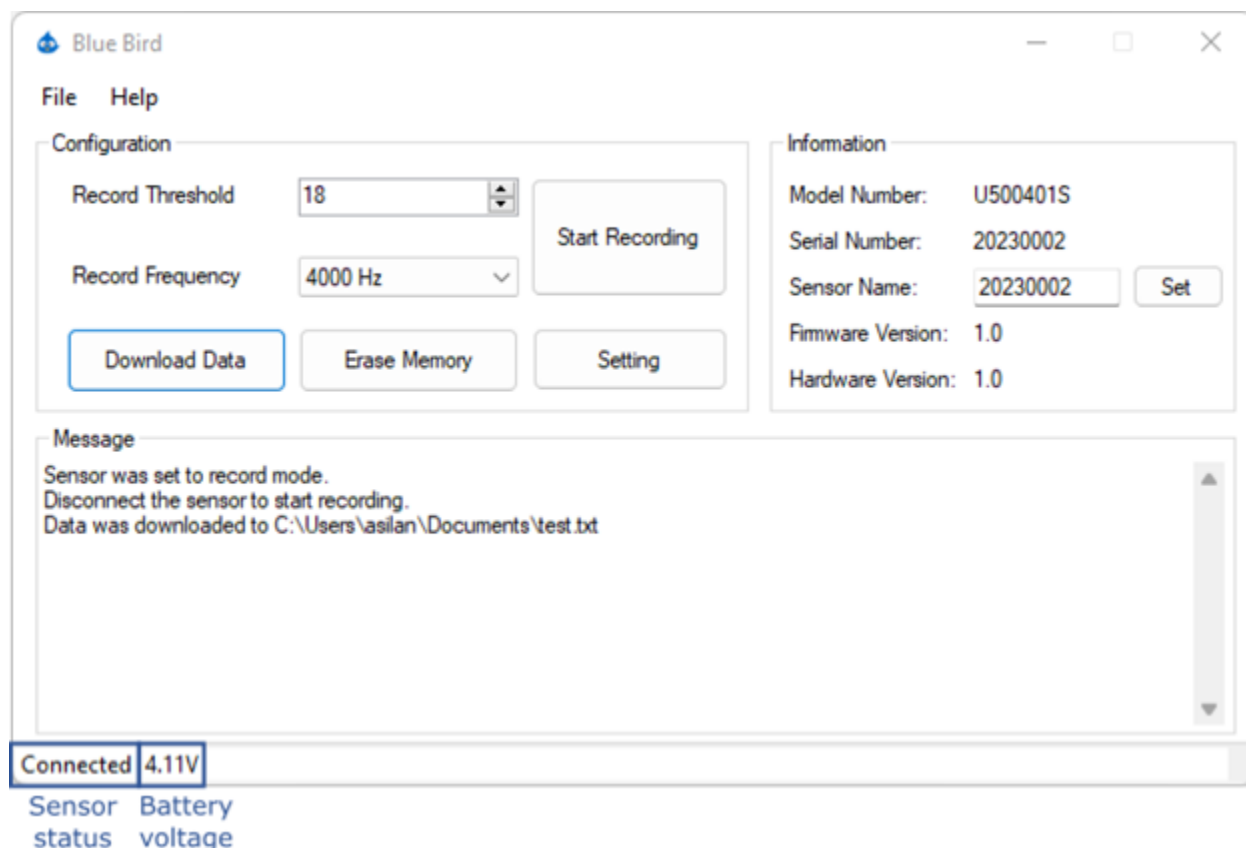
### 2.4 Software Installation

BlueBird software is available on Windows, MacOS and Android system. The software can be downloaded from <https://alphaagtech.com/berry-impact-recorder/>.

## 3 Using the Berry Impact Recorder

### 3.1 Setup the sensor for recording

Connect the sensor to a computer or a mobile device to wake up the sensor. Use BlueBird software to set up the sensor.



1. Connect the sensor to a computer or an Android device. If using the sensor with an Android device, you may need a USB C to USB adaptor.  
**At present, BlueBird has a limitation where it only supports one sensor at a time. If multiple sensors are connected to the same computer, BlueBird will only recognize the first sensor that is connected. Future update of the software will add support for multiple sensors.**
2. Select the record threshold. The sensor will only record impacts that exceed the set threshold. Adjust the threshold to customize the sensitivity levels of the sensor. Keep in mind that a lower threshold will result in more recorded impacts, filling up the memory more quickly. The recommended value is 18.
3. Choose the record frequency. The maximum record frequency determines the number of measurements taken per second. A higher frequency allows for more detailed recording of impacts (see Figure 3). However, higher record frequencies require more memory for storage. The recommended value is 4000 Hz.

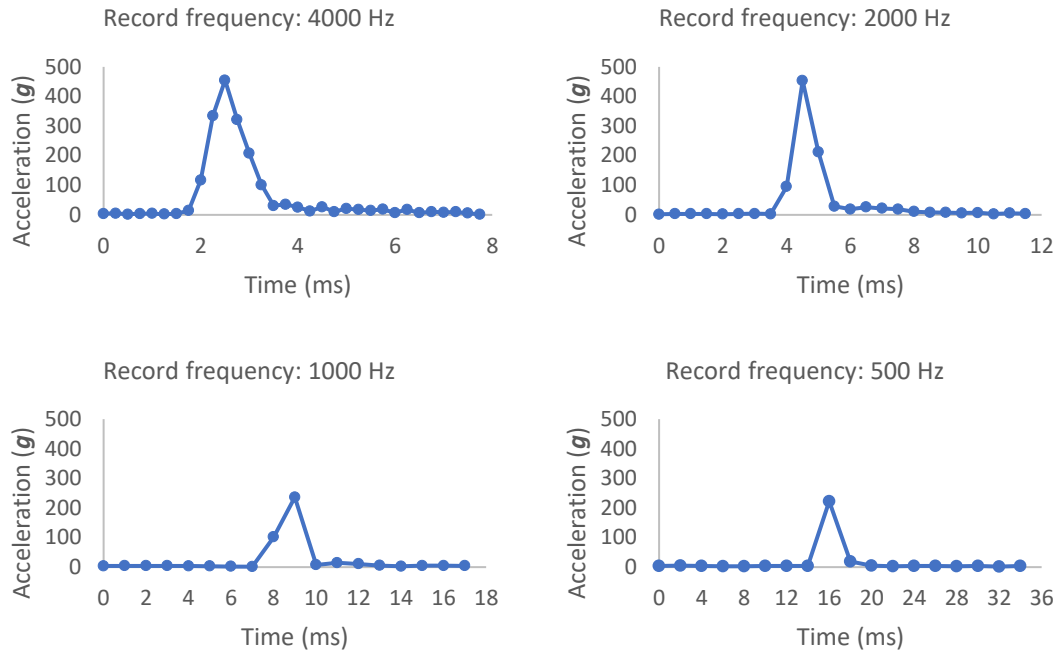


Figure 3 Recorded impacts at different record frequencies.

4. Start recording. Click the "Start Recording" button to initiate the recording process. Once you disconnect the sensor from the computer or Android device, it will begin recording impacts automatically.

### 3.2 Retrieving data from the sensor

After the recording is complete, connect the sensor to a computer or mobile device to download the recorded data. Click the "Download Data" button to begin the download process. The progress of the download will be displayed on the download progress bar. If needed, users can stop the download by clicking the "Stop Download" button.

### 3.3 Interpreting data

The downloaded data is saved in a text file with three columns. Each row represents a single data point. The columns are structured as follows:

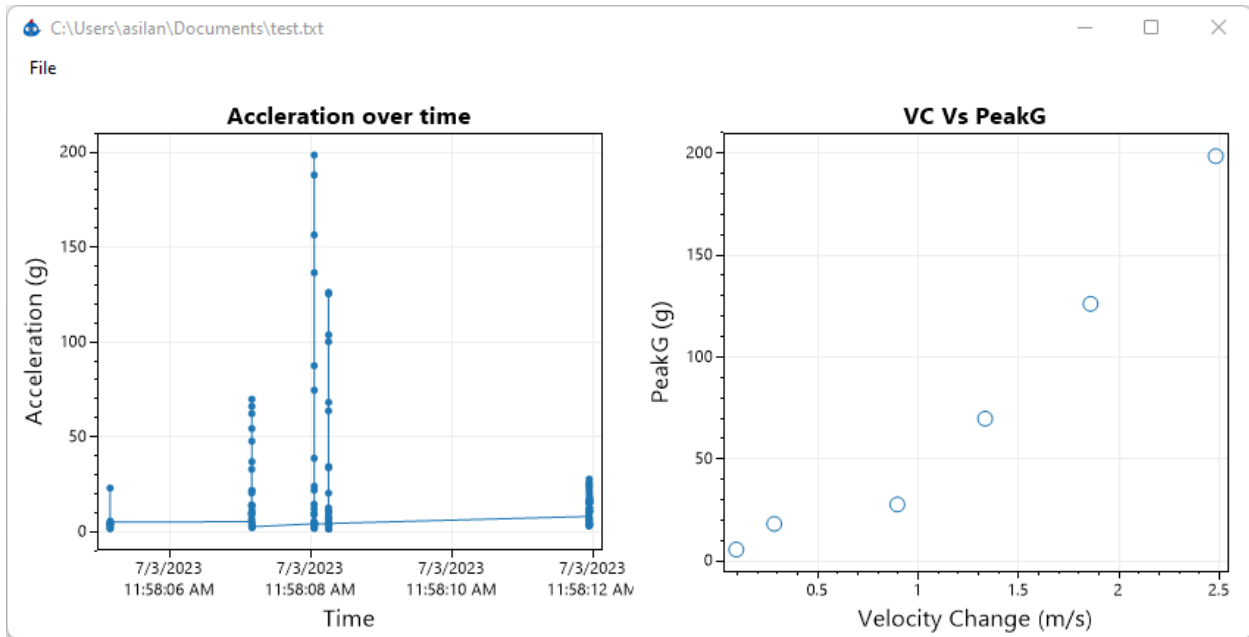
- Impact Index: This column indicates the impact of the data point.
- UNIX Timestamp: The second column contains the UNIX timestamp of the data point, representing the time of recording.
- Acceleration: The third column represents the recorded acceleration.
- PeakG: The fourth column displays the PeakG value corresponding to the data point.
- Velocity Change (VC): The fifth column provides the Velocity Change (VC) value associated with the data point.



ImpactIndex	Timestamp(s)	Acceleration(g)	PeakG(g)	VelocityChange(m/s)
0001	1688399885.15454	22.99	5.59	0.09
0001	1688399885.15479	3.19	69.80	1.33
0001	1688399885.15504	1.86	198.61	2.48
0001	1688399885.15529	1.58	126.16	1.86
0001	1688399885.15554	3.87	27.73	0.90
0001	1688399885.15579	3.67	18.22	0.28
0001	1688399885.15604	4.64		
0001	1688399885.15629	5.59		
0001	1688399885.15654	4.97		
0002	1688399887.15954	5.29		
0002	1688399887.15979	6.77		
0002	1688399887.16004	9.84		
0002	1688399887.16029	9.37		
0002	1688399887.16054	9.13		
0002	1688399887.16079	13.38		
0002	1688399887.16104	14.00		
0002	1688399887.16129	14.01		
0002	1688399887.16154	20.34		
0002	1688399887.16179	21.63		
0002	1688399887.16204	32.94		
0002	1688399887.16229	47.73		
0002	1688399887.16254	62.26		
0002	1688399887.16279	69.80		
0002	1688399887.16304	66.05		
0002	1688399887.16329	54.33		
0002	1688399887.16354	26.80		

BlueBird offers two plots for users to visualize the data.

- Acceleration over time plot: This plot displays the acceleration values recorded over time. The x-axis represents the time, while the y-axis represents the acceleration. By examining this plot, users can observe the variations in acceleration during different periods or events.
- Velocity Change (VC) vs. PeakG plot: This plot illustrates the relationship between Velocity Change and PeakG values. The x-axis represents the Velocity Change (VC), and the y-axis represents the PeakG. By analyzing this plot, users can understand the correlation between the two metrics and identify patterns or trends related to impact hardness or surface characteristics.



## 4 Troubleshooting

1. Sensor is not recognized by BlueBird software.  
Make sure the sensor is charged and powered on. The red LED is on when the battery is charging. The blue LED is on when the sensor is connected to a computer.

## 5 Technical Specifications

Diameter	25.4 mm (1 inch)
Weight	< 15 g
Sensing range	500 <b>g</b> each axis
Accuracy	-1 <b>g</b> – 1 <b>g</b>
Precision	< 1 <b>g</b>
Connectivity	USB 2.0
Recording frequency	100 Hz, 500 Hz, 1000 Hz, 2000 Hz, 4000 Hz
Battery capacity	45 mAh
Operation time	3 h
Charging time	1 h
Memory capacity	2 MB
Operation temperature	0°C – 50°C
Operation humidity	0 – 100%

## 6 Warranty

### 6.1 Warranty Period

The warranty period for the Berry Impact Recorder starts from the date of purchase and extends for a period of **one year** from that date.

### 6.2 Coverage

Our warranty covers defects in materials and workmanship that may arise during normal use of the Berry Impact Recorder.

The warranty provides for repairs, replacements, or refunds at our discretion, depending on the nature of the defect and the available options.

The warranty is applicable only to the original purchaser and is not transferable.

### 6.3 Exclusions

The warranty does not cover damage or defects resulting from improper installation, misuse, neglect, accidents, unauthorized repairs, modifications, or any other cause beyond normal and intended use.

The warranty does not cover damage caused by environmental factors such as extreme temperatures, humidity, or exposure to liquids.

Consumable parts, such as cables, are not covered under the warranty.

### 6.4 Claim Process

In the event of a defect covered by the warranty, please contact our customer support within the warranty period to initiate the claim process.

Provide the necessary proof of purchase, a detailed description of the issue, and any supporting documentation requested by our customer support team.

We may require the return of the defective product for inspection or ask you to perform troubleshooting steps under our guidance.

If the defect is confirmed to be covered by the warranty, we will repair, replace, or refund the product as deemed appropriate.

### 6.5 Limitations of Liability

In no event shall we be liable for any incidental, consequential, or indirect damages arising from the use or inability to use the Berry Impact Recorder.

Our liability under this warranty is limited to the repair, replacement, or refund of the product as stated in these terms.

## 6.6 Legal Rights

This warranty does not affect any legal rights that may apply under local laws or regulations.

## 6.7 Disclaimer

Except as expressly stated in this warranty, we make no other warranties, representations, or guarantees, whether expressed or implied, including but not limited to any implied warranties of merchantability or fitness for a particular purpose.

## 7 Contact

**General information:**

Email: [info@alphaagtech.com](mailto:info@alphaagtech.com)

**Technical support:**

Email: [support@alphaagtech.com](mailto:support@alphaagtech.com)

For more information about our products, please visit our website at [alphaagtech.com](http://alphaagtech.com).