BMAxxx Desktop Development 2.0 User Manual

BMAxxx User Manual

Document revision	1.2
Document release date	August 2020
Document number	BST-MAS-SD008-00
Sales Part Number	0 273 141 282
Notes	Data and descriptions in this document are subject to change without notice. Product photos and pictures are for illustration purposes only and may differ from the real product appearance.

1. About user manual

This manual describes the installation and usage of the Development Desktop 2.0 User Interface (DD2.0 UI); a Windows based PC software application and related embedded firmware/software developed by **Bosch Sensortec** for demonstration and evaluation of sensors.

1.1 Who should read this manual

This information intended to users who wish to use DD2.0 UI to demonstrate use of the BMAxxx.

1.2 DD2.0 UI Overview

DD2.0 UI is a PC based software used to read, capture, and display sensor data. To display the sensor data of BMAxxx on DD2.0 UI, mount the sensor on the **Bosch Sensortec** application board. This is a universal demonstration environment for **Bosch Sensortec** sensor products.

Bosch Sensortec sensors are mounted on sensor specific shuttle boards. All sensors shuttle boards have an identical footprint and can be plugged into the application board's shuttle board socket. DD2.0 UI automatically detects the sensor that has been plugged in and starts the corresponding software application.

1.3 Sensor Communication:

DD2.0 UI software supports both SPI and I^2C to communicate with the sensor.

1.4 Graphical display:

DD2.0 UI displays the sensor data and interrupts in different graphical formats.

1.5 Data logging:

DD2.0 UI offers data logging of the sensor data.

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2. About the BMAxxx

- An accelerometer is a device that measures the proper acceleration. The accelerometer measures the components of the earth's gravity. This is not necessarily the same as the coordinate acceleration (change of velocity of the device in space), but is rather the type of acceleration associated with the phenomenon of weight experienced by a test mass that resides in the frame of reference of the accelerometer device. However, an accelerometer in gravitational free fall toward the center of the Earth will measure a value of zero because, even though its speed is increasing, it is in an inertial frame of reference, in which it is weightless.

- The BMAxxx sensor specific details can be referred in Sensor Datasheets.

3. Getting Started

The below sections highlight the procedure to set up connections between BMAxxx, DD2.0 UI and the PC.

3.1 Setting Up the board-PC connection

The procedure to connect sensor to PC via USB is as below:

- Install DD2.0 UI.
- Insert the shuttle board and application board.

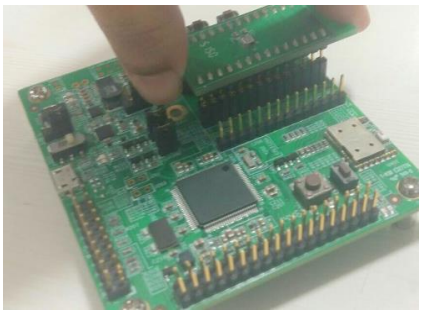

Figure 1 : Insert sensor

- Connect the board and PC using a USB cable/Bluetooth.

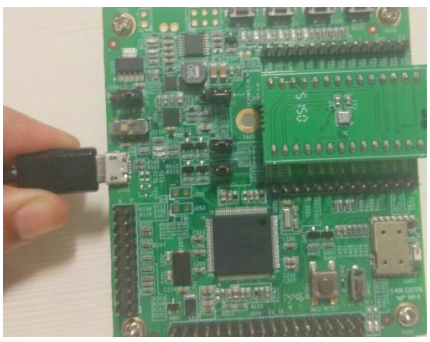

Figure 2 : Connect board and PC

- Turn the on/off switch **ON**. The LED glows.

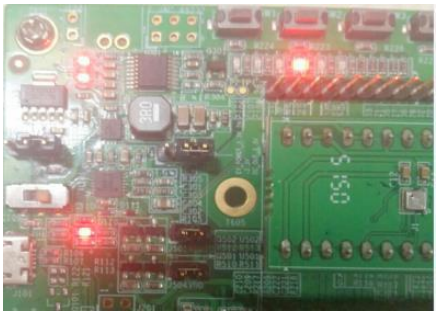

Figure 3 : Connection complete

3.2 Startup View

To start the DD2.0 UI software:

▶Click **Start -> Programs -> Development Desktop 2.0**.

Or

▶Double click the  DD2.0 UI software icon on the desktop.

The Graphical User Interface (GUI) of the software is as seen below:

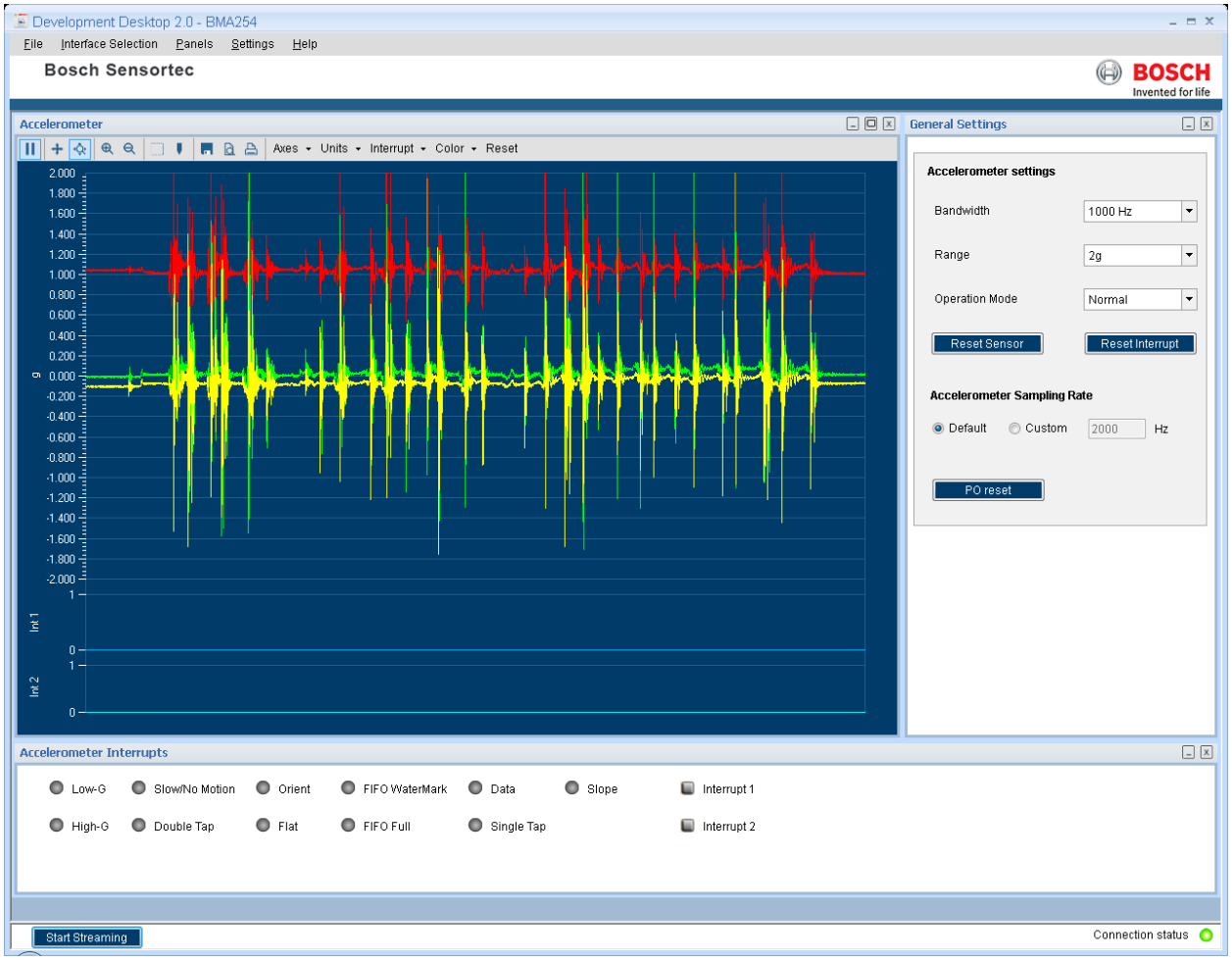

Figure 4 : DD2.0 startup view

- Additional panels/views can be opened by selecting views from panel menu item.
- If the connection status indicator glows green, the Board and the PC are connected. Once you press the **Start** button, the sensor signals are plotted on the graph.
- If you press the **Stop button,** the plotting of sensor signals is stopped.

4. Working with DD2.0 UI

DD2.0 UI offers complete access to BMAxxx sensor.

4.1 Sensor Data and Interrupts Monitoring

BMAxxx sensor compromises of accelerometer in a single package and the sensor signals can be monitored for accelerometer.

4.1.1 Accelerometer

- This panel plots real time sensor signals from the accelerometer on the graph. The sensor data can be analyzed by using graph features like Play/Pause, view history, graph speed, Zoom In/Out, Zoom particular area in the graph, save and print current instance.
- The accelerometer data can be represented in following units
    1. LSB : Raw acceleration signals read from sensors Data x, Data y and Data z registers
    2. m/s2 : Acceleration signals from sensor converted to meter per second square
    3. g : Acceleration signals from sensor
- To view this panel, click on Panels in the main menu and select Accelerometer. Alternately, **Ctrl + A** can be used as a shortcut.

Figure 5 : Accelerometer data plotter

4.1.2 Accelerometer Interrupts

- This view shows the real time interrupt status of the accelerometer of the BMAxxx sensor. The accelerometer has two interrupt lines where any interrupt can be latched. The round LEDs are the sensor interrupt status and the square LEDs are the interrupt pin status. The Interrupt occurrence can be visualized by the LED status to green.
- To view this panel, click on Panels in the main menu and select **Accel Interrupts**. Alternately, **Alt + A** can be used as a shortcut.

Figure 6 : Accelerometer interrupts

4.2 Data Export

- The sensor signals are logged to a file by using the option **Data Export**. Both accelerometer and magnetometer data can be logged to a file. At least, one axis and the corresponding at least one unit must be to enable data log.
- To launch this view, click on Panels in the main menu and select **Data Export**. Alternately, **Alt + D** can be used as a shortcut.
- Follow these steps to carry out the data export:

1. Launch **Data Export** from Panels and click on **Select Destination** button.

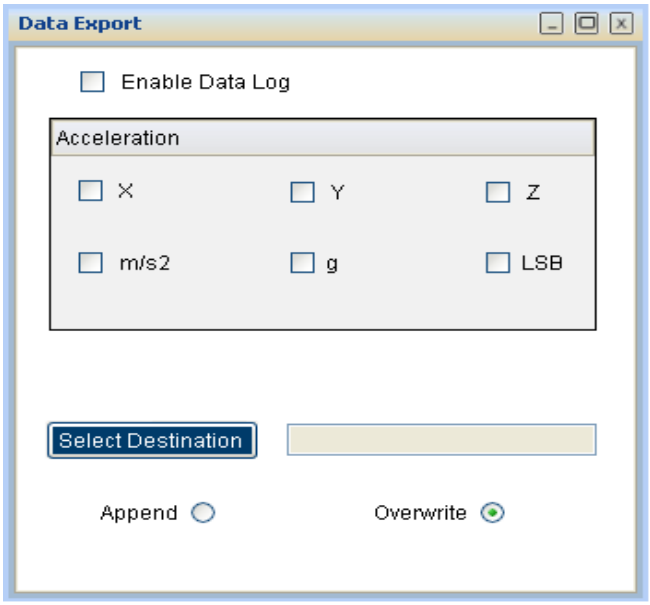

Figure 7 : Data export window

2. Click the 

to select the destination path.

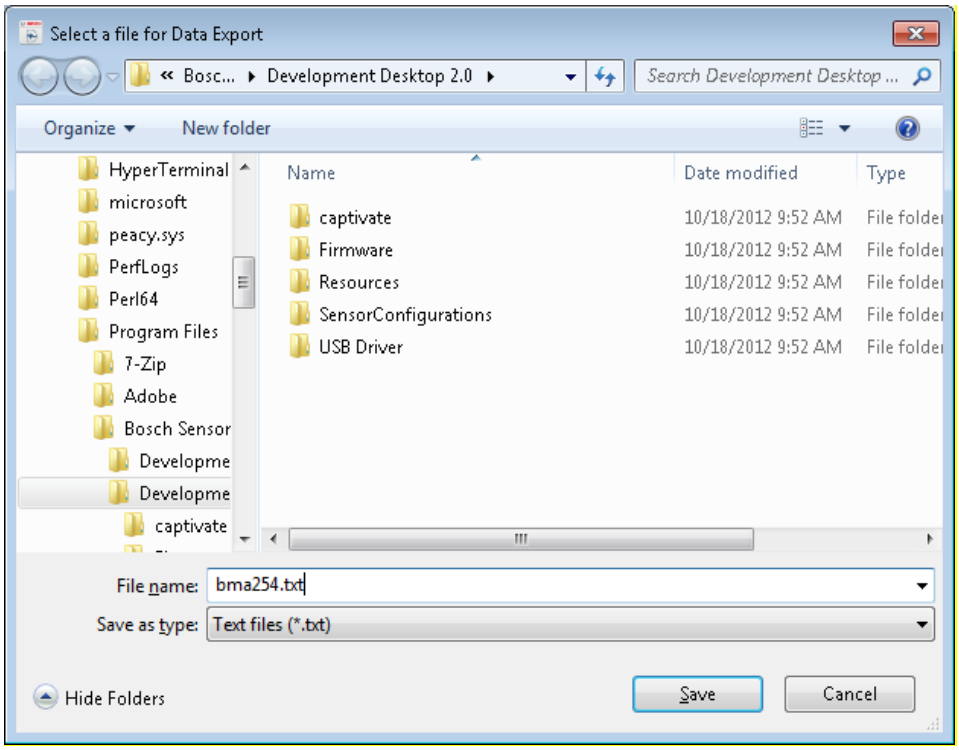

Figure 8 : Select the file location

3. Enable the axis data to be logged. Change the toggle button to append or overwrite. Then click **OK**. In **Append** mode, the new data is appended to the selected file. In **Overwrite** mode, the old data is erased from the selected file and the data from the new measurement is saved to it.
4. Check the **Enable Data Log** check box.

5. Click the **Start** button to plot acceleration signals in the graph. Click **Stop** to end the plotting of the acceleration signals in the graph. The output of the acceleration signals is saved in the desired destination path.

4.3 Sensor Configuration

DD2.0 UI allows user to configure the sensor without any limitations. The configurations can be classified as basic and advanced configuration. The entire basic configurations are available in the **General Settings** panel. The advance configuration can be accessed by various panels available under **Memory Map** and **Register Access**.

4.3.1 Selecting accelerometer Bandwidth

- Two different streams of sensor data are available, unfiltered and filtered. The unfiltered data is sampled at 2 kHz. The sampling rate of the filtered data depends on the selected filter bandwidth and is always twice the selected bandwidth.
- The band width can be selected from **Accelerometer settings** in the **General Settings** panel. Use the **Bandwidth** dropdown menu

Figure 9 Accelerometer bandwidth

4.3.2 Selecting accelerometer Range

The accelerometer range setting configures the measurement range of the accelerometer sensor. The range can be selected to 2G, 4G, 8G or 16G from **Accelerometer settings** in the **General Settings** panel.

Figure 10: Accelerometer range

4.3.3 Selecting accelerometer Operation Mode

BMAxxx accelerometer sensor can be configured to any one of the operation modes by selecting the options available in the drop down menu. The operation mode can be selected from **Accelerometer settings** in the **General Settings** panel

Figure 11 : Accelerometer mode

Note:
For a detailed description of the sensors power saving modes and their applications, refer to the BMAxxx sensor data sheet.

4.3.4 Reset sensor

This feature can be used to bring the sensor back to its default state. All the configuration data are reset to the default values. This is a soft reset and can be triggered for accelerometer and magnetometer separately. Sensor can be reset by the button click under **General Settings** panel.

4.3.5 Power – On reset

This is hard reset functionality. The VDD and VDDIO are turned OFF and then ON. This triggers the power-on-reset circuitry of the sensor. PO Reset button is available under **General Settings** panel.

4.3.6 Binary View

- In the binary view, the sensor registers are identified by their addresses. The values displayed are the actual representation of the sensor memory map. This view is available for both accelerometer and magnetometer. If exact addresses of the sensor registers are known, this view can be helpful in writing direct values to the sensor memory map.

- The value entered is converted to binary format and is displayed in the **Binary** text box.
  1. Click **Write** to transfer values to the actual registers.
  2. Click **Read** to read the current register setting of the sensor in the memory map window.

- To launch this view, click on Panels in the main menu and select Memory Map -> Binary View. Alternately, **Ctrl + B** can be used as a shortcut.

4.3.7 Offset View

- The offset view provides a detail on slow compensation and offset compensation of accelerometer and can be controlled by this view. For information regarding the Offset view configuration of the Accelerometer sensor, refer to the corresponding user manual.
- To launch this view, click on Panels in the main menu and select **Memory Map -> Offset View**. Alternately, **Ctrl + O** can be used as a shortcut

4.3.8 Interrupt configuration

- The BMAxxx is equipped with eight programmable interrupt engines. Each interrupt can be independently enabled and disabled. The BMAxxx provides two interrupt pins INT1 and INT2; interrupts can be freely mapped to any of these pins.

4.3.9 General features

- An interrupt is cleared depending on the selected interrupt modes which is common to all the interrupts. There are three different interrupt modes: non latched, latched and temporary.
    1. In non-latched mode the interrupt status bit and the selected pin is cleared as soon as activation condition is not valid. Exceptions to this behaviour are new data orientation and flat interrupts, which will automatically get reset after a fixed time.
    2. In latched mode the interrupt status bit and the selected pin are latched permanently. This will be cleared only on reset interrupt.
    3. In temporary mode an asserted interrupt status bit and the selected pin are cleared after a defined period of time.
    4. It is strongly recommended to set the interrupt parameters prior to enabling the interrupt. Changing the parameters of an already enabled interrupts may cause unwanted interrupt generation and generation of false interrupt history.

4.3.9.1 New data interrupt

- This interrupt serves for synchronous reading of accel data. It is generated after storing the new value of z-axis acceleration data in the data register. The interrupt is cleared automatically when the data acquisition starts.
- The interrupt can be enabled by going to panels-> memory map->interrupt view and clicking on the data. If it needs to be mapped with the two interrupt pins INT1 and INT2 click on int1 and int2.

4.3.9.2 Slope / any motion detection

- Slope / any motion detection use the slope between two successive acceleration values to detect the changes in motion. An interrupt is generated when the sloe exceeds a preset threshold. It is cleared soon as soon as the slope falls below the threshold. In order to suppress false triggers the interrupt is only generated (cleared) if a certain no N of consecutive slope data points is larger (small) than the threshold.
- The interrupt can be enabled (disabled) for each axis by going to panels-> memory map->interrupt view and clicking on the Slope X, Y, Z. If it needs to be mapped with the two interrupt pins INT1 and INT2 click on int1 and int2.

4.3.9.3 Tap sensing

Tap sensing has a functionality similarity with a common laptop touch pad or clicking keys of a computer mouse. A tap event is detected if a predefined slope of the acceleration of at least one axis is exceeded. Two different tap events are distinguished. A single tap is a single event with a certain time, followed by a certain quiet time. A double tap consist of first such event followed by a second event with in a defined time frame.

4.3.9.4 Orientation recognition

- The orientation recognition feature informs on an orientation change of the sensor with respect to the gravitational field vector'g'.
- Orient can be enabled by clicking on orient in panels-> memory map->interrupt view->Interrupt mapping. If it needs to be mapped with the two interrupt pins INT1 and INT2 click on int1 and int2.

4.3.9.5 Flat detection

- The flat detection feature gives information about the orient of the devices z- axis relative to the g-vector i.e. it recognizes whether the device is in flat position or not.
- The flat interrupt will occur when the device is in flat position, but it will get cleared automatically after one sample period.

4.3.9.6 Low-g interrupt

- This interrupt is based on the comparison of acceleration data against a low-g threshold, which is most useful for free fall detection.
- The low G threshold is set through the selection box threshold in low-g settings.
- The duration can be set.
  Mode can be 'sum' mode or 'single' mode and hysteresis.

4.3.9.7 High-G interrupt

- This interrupt is based on the comparison of acceleration data against a high–g threshold for the detection of shock or other high-acceleration events.
- The high G threshold is set through the selection box threshold in high-g settings. The high-g duration can be also set through duration.

4.3.9.8 No motion/ slow motion detection

- No motion/ slow motion detection interrupt engine can be configured in two modes.
- In slow motion mode an interrupt is triggered when the measured slope of at least one enabled axis exceeds the programmable slope threshold for a programmable no of samples.
- In no-motion mode an interrupt is generated if the slope on all selected axis remains smaller than a programmable threshold for programmable delay time.

- After selecting all these write image need to be clicked.

Note: No motion / slow motion detection feature is available only in selected BMAxxx variants, please refer sensor specific data sheet.

4.4 Register Access

- This view provides direct access to the sensor registers. If the correct register address of the sensor memory map is know, this view can be very useful. The values can be read from or can be written to the sensor register.

- To launch this view, click on Panels in the main menu and select **Register Access**. Alternately, **Ctrl + R** can be used as a shortcut.

4.5 FIFO view

- The BMAxxx features an integrated FIFO memory capable of storing 32 frames.

Conceptually each frame consists of x, y, z axis which are sampled at same point in time.

- FIFO can be operated in three modes.
    1. FIFO mode
    2. STREAM mode
    3. BYPASS mode

Note: FIFO feature is available only in selected BMAxxx variants, please refer sensor specific data sheet.

4.6 Self Test

- The **Self Test** menu permits to check the sensor functionality by applying electrostatic forces to the sensor core instead of external accelerations.
- The Self Test View can be selected by clicking on panels-> memory map-> Self Test view. The self test is activated individually for each axis by selecting each axis from the drop down list.
- The direction of excitation can be chosen by clicking self-test sign from the drop down menu.

5. General Troubleshooting

Follow below guidelines while working with DD2.0 UI:

- Ensure that the shuttle board (with a valid sensor) is seated properly in the application board.
- Ensure that the PC-board connection is properly established.
- When switching on/ off DD2.0 UI, close and restart DD2.0 UI.
- Ensure that at least one channel is selected.

Follow these steps to check the USB connection:

1. Click **My Computer -> Manage** -> **Computer Management.**
2. Go to **System Tools** -> **Device Manager**.
3. Click on BST board and check for the USB connection.

Sometimes, data transfer between PC and application board does not work despite the USB device being properly enumerated in the Device Manager.

This could be because the application board is older or that the USB PID and VID has been used with that computer before. In this case, Windows is unable to install the required drivers automatically.
Follow these steps to check the USB connection:

1. Right-click on the USB-device corresponding to your application board (if you are not sure which device corresponds to your application Board, unplug all other USB devices like keyboard and mouse temporarily).

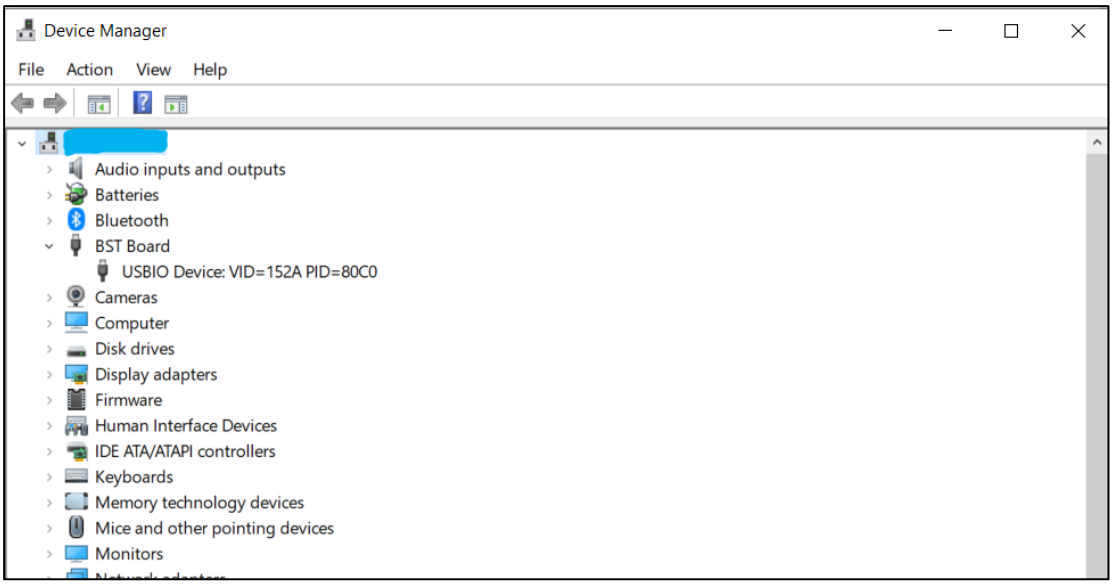

Figure 12 ：Selecting USB device corresponding to application board

2. Click **Action** -> **Scan for hardware changes**. The new USB driver installed automatically. Thereafter, the device communication will function properly.

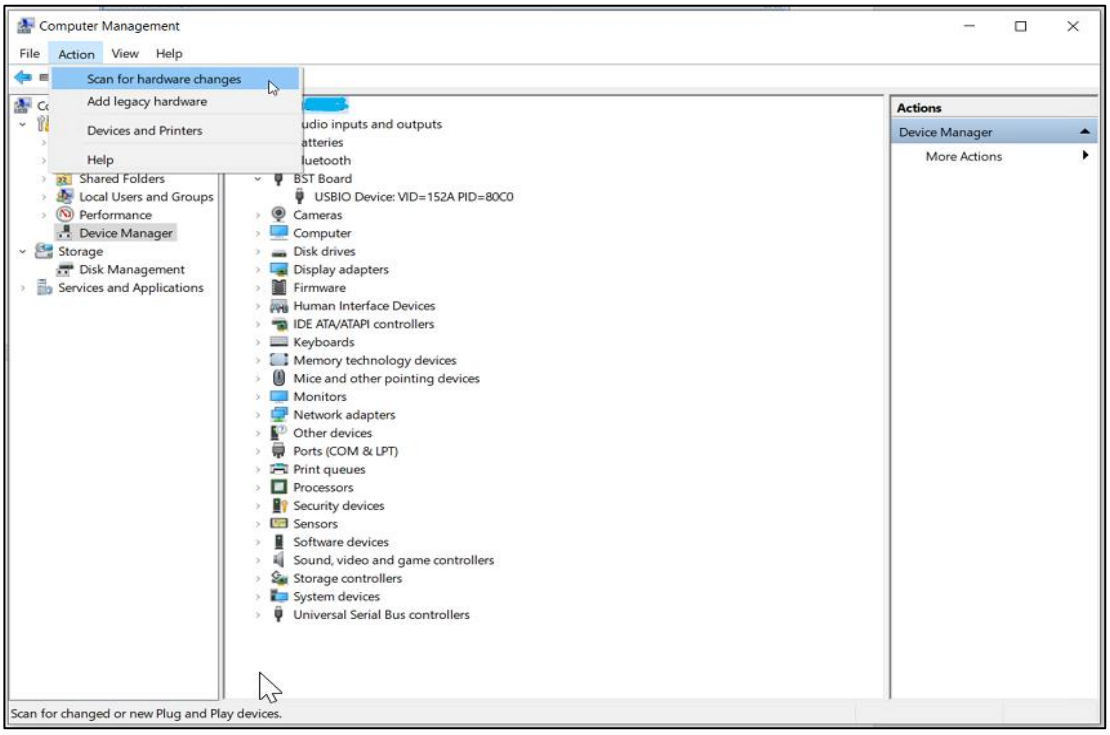

Figure 13：USB driver installation

The following table lists some of the possible faults that you might encounter and the troubleshooting method.

Table 1 : Troubleshooting Fixing

Condition	Possible cause	Solution
If **Communication Status** remains grey red after checking the **Start** Button.	Application Board is turned off.	**Power on** the application Board and restart the DD2.0 application. If the board is powered by rechargeable battery, ensure that the battery is charged.
Unable to locate the data logged file.	Destination path not properly defined.	Locate the file in the setup path of Development Desktop**.**
Error message **Please connect application Board** is displayed.	Application Board is not connected properly.	Ensure that the PC is connected with the application Board properly. If the board is powered by rechargeable battery, ensure that the battery is charged.
Error message **Please connect Shuttle Board** is displayed.	Shuttle Board is not fixed properly.	Ensure that the Shuttle Board is correctly fixed in the Development Board.
Error message **Please select a path or file for logging** is displayed.	Destination path for saving the logged data is not defined.	Select the **Data Export** option in the file menu and specify the destination path.
Error message **Please select File from File Menu → Data Export option to proceed** is displayed.	Destination path not selected.	In the file menu, select the **Data Export** option and select the destination path.
Error message **Please Connect Valid Sensor** is displayed.	Wrong sensor fixed on the application Board.	Ensure that correct sensor is fixed on the application Board.
Graph for x, y, z channel not plotted.	Channel x, y, z not checked.	Ensure that x, y, z channels are checked.

6. Legal disclaimer

i. Engineering samples

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7. Document history and modification

Rev. No	Chapter	Description of modification/changes	Date
1.0		Initial release	January 2012
1.1		Changed the application icon	December 2012
1.2		Adopt to new format	August 2020

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Modifications reserved
Preliminary - specifications subject to change without notice
Document number: BST-MAS-SD008-00