

BMCxxx Desktop Development 2.0 User Manual

BMCxxx User Manual

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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 BMCxxx.

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 BMCxxx 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 I²C 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 BMCxxx

- ▶ BMCxxx is a combination of a three axis MEMS magnetometer and a three axis MEMS accelerometer. The accelerometer measures the components of the earth's gravity and the magnetometer measures the components of the earth's magnetic field (the geomagnetic field). The BMCxxx is a tilt compensated digital compass system where the magnetometer output is used for the heading computation with respect to the earth's magnetic north. The accelerometer is used to compensate the tilt error of the magnetometer against the pitch and the roll axes.
- ▶ The packaging and interfaces of the BMCxxx have been designed to match a multitude of hardware requirements. As the sensor features an ultra-small footprint and a flat package, it is ingeniously suited for mobile applications.
- ▶ The BMCxxx offers ultra-low voltage operation (VDD voltage range from 1.62V to 3.6V, VDDIO voltage range 1.2V to 3.6V) and can be programmed to optimize functionality, performance and power consumption in customer specific applications. The programmable interrupt engine sets new standards in terms of flexibility.
- ▶ The BMCxxx senses orientation, tilt, motion, shock, vibration and heading in cell phones, handhelds, computer peripherals, man-machine interfaces, virtual reality features and game controllers.
- ▶ Key Features
 1. User programmable high/low magnetic field detection interrupt
 2. Low-power consumption
 3. SPI (4-wire/3-wire) and I²C interfaces
 4. Programmable interrupt application
 5. Ultra-low-power short wake-up mode, low current consumption
 6. Self test and advanced self test capability
 7. LGA package (3 mm x 3 mm x 0.9 mm)
 8. RoHS compliant, Pb-free

3. Getting Started

The below sections highlight the procedure to set up connections between BMCxxx, 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.

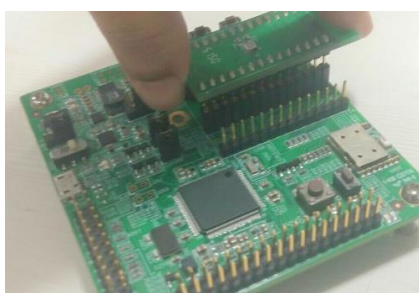


Figure 1 : Insert sensor

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

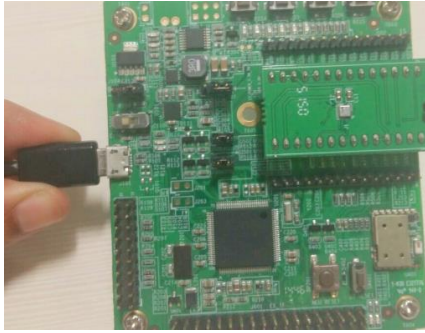


Figure 2 : Connect board and PC

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

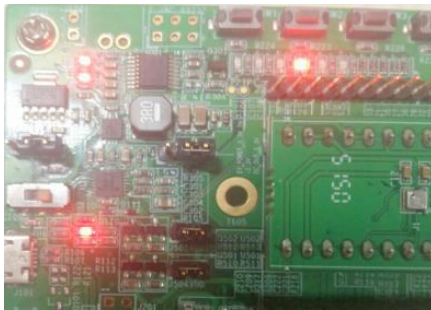



Figure 3 : Connection complete

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 BMCxxx sensor.

4.1 Sensor Data and Interrupts Monitoring

BMCxxx sensor comprises of accelerometer and magnetometer in a single package and the sensor signals can be monitored simultaneously for both accelerometer and magnetometer.

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 Gyro. Alternately, **Ctrl + P** can be used as a shortcut.



Figure 5 : Accelerometer data plotter

4.1.2 Magnetometer

- This panel plots real time sensor signals from the magnetometer 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 magnetometer data can be represented in following units
 1. Raw : Raw magnetometer signals read from sensors Data x, Data y and Data z registers
 2. LSB : Compensated magnetic field strength in integer format as delivered by the API
 3. μT : Magnetic field strength signal represented in μT .
- To view this panel, click on Panels in the main menu and select Magnetometer. Alternately, **Ctrl + M** can be used as a shortcut. Set power mode to “Normal mode”



Figure 6 : Magnetometer data plotter

4.1.3 Accelerometer Interrupts

- ▶ This view shows the real time interrupt status from the accelerometer part of the BMCxxx 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 7 : Accelerometer interrupts

4.1.4 Magnetometer Interrupts

- ▶ This view shows the real time interrupt status from the magnetometer part of the BMCxxx sensor. The magnetometer has one interrupt line. 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 **Mag Interrupts**. Alternately, **Alt + M** can be used as a shortcut.

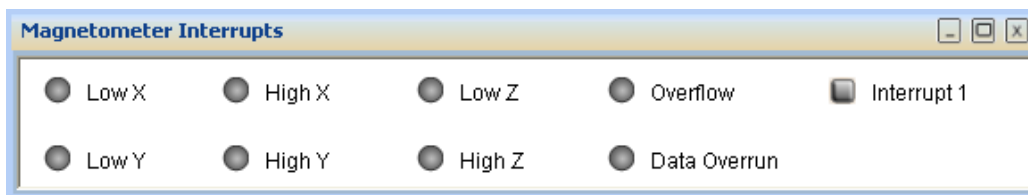


Figure 8 : Magnetometer interrupts

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 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.

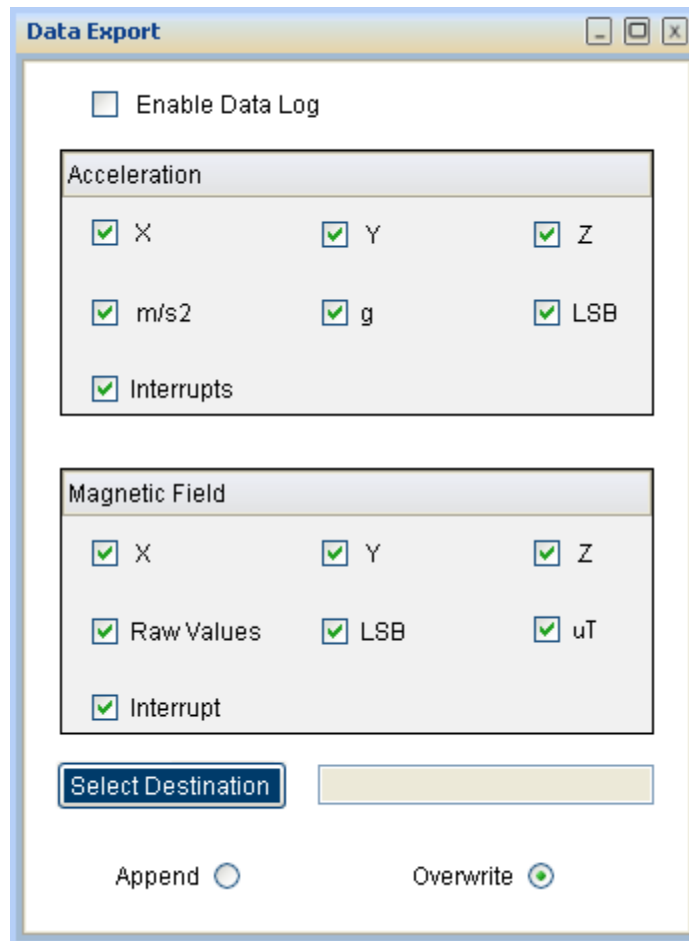


Figure 9 : Data export window

2. Select the file and location to export the sensor signal data.

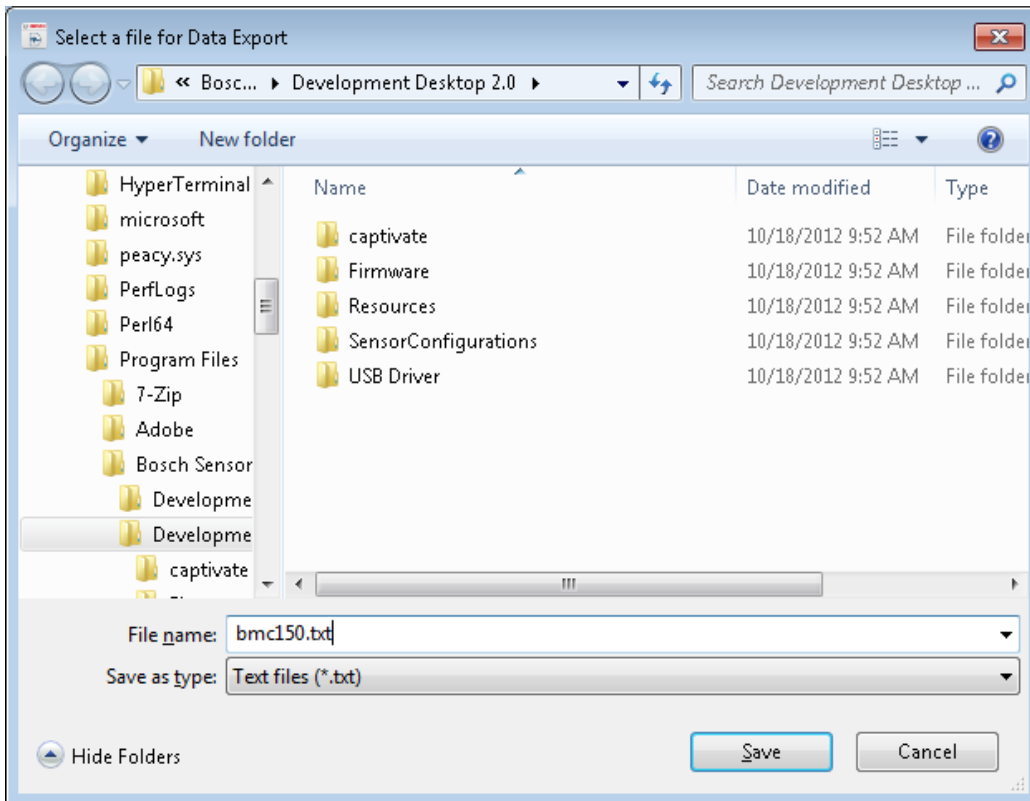


Figure 10 : Select file location

3. Select the axis and units for data logging and change the toggle button to append or overwrite. 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.

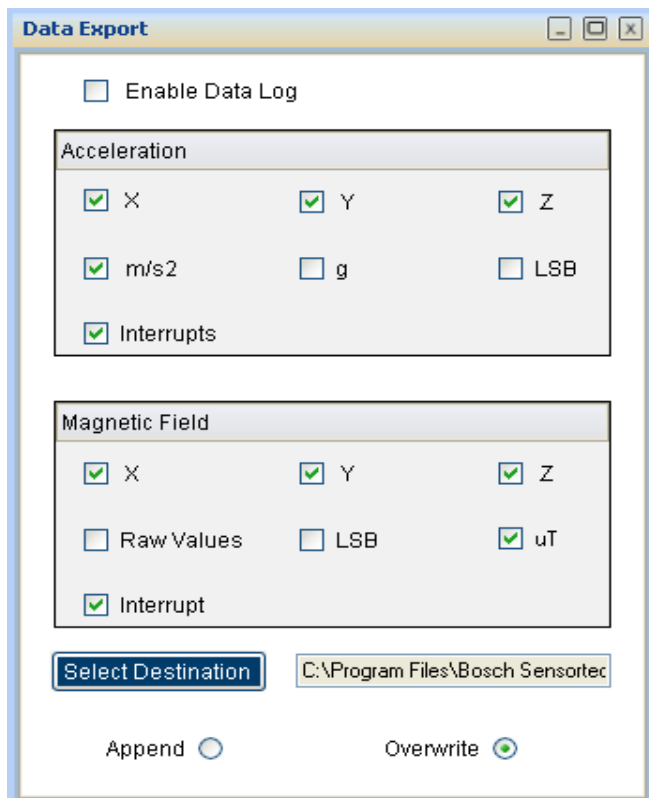


Figure 11 : Select mode and axis

4. Check the **Data Export** check box.

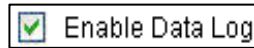


Figure 12 : Enable data log

5. Click the **Start** button to plot acceleration sensor signals in the graph. Click **Stop** to end the plotting of the sensor signals in the graph. The output of the sensor 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 13 : 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 14 : Accelerometer Range

4.3.3 accelerometer Operation Mode

BMCxxx 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 15 : Accelerometer mode

Note:

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

4.3.4 Selecting magnetometer Operation Mode

- ▶ Using the operational mode option, measurement samples of the sensor can be controlled. The mode ranges can be selected from the drop down list. The operation mode can be selected from **Magnetometer settings** in the **General Settings** panel. By default, the **Custom Mode** is selected

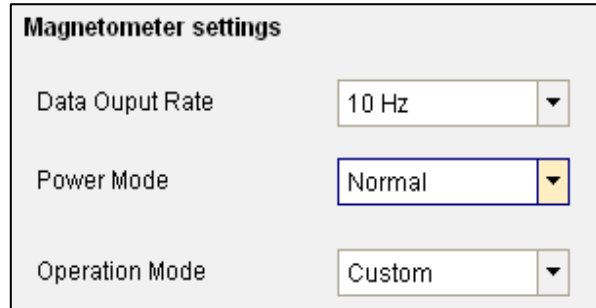


Figure 16 : Magnetometer settings

- ▶ Low power mode:
 1. 10 Hz data rate
 2. Low power consumption
- ▶ Regular Mode:
 1. 10 Hz data rate
 2. Low noise
- ▶ High Accuracy Mode:
 1. 20 Hz data rate
 2. Lowest possible noise

4.3.5 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.

4.3.6 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.

4.3.7 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.

4.3.8 Offset View

- ▶ The offset view provides a detail on magnetometer's trimming values. Slow compensation and offset compensation on accelerometer also can be controlled by this view. For information regarding the Offset view configuration of the Accelerometer sensor, refer to the corresponding user manual. The Mag Trimming values displayed are taken up for calculating the offset for the magnetometer.
- ▶ 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

4.3.9 FIFO view

- ▶ The BMCxxx features an integrated FIFO memory capable of storing 32 frames of accel data. 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 BMCxxx variants, please refer sensor specific data sheet.

4.3.10 Interrupt configuration

- ▶ BMCxxx sensor provides INT1 and INT2 interrupt pins for accelerometer and INT1 for magnetometer. The sensor interrupts can be independently enabled or disabled and can be freely mapped to any of these pins.
- ▶ To launch this view, click on Panels in the main menu and select **Memory Map -> Interrupt View**. Alternately, **Ctrl + I** can be used as a shortcut

4.3.10.1 Enable Interrupt Pin

Enable interrupt works based on the pin out from the sensor. If the interrupt pin is enabled and if, an interrupt occurs, this pin will go high and will remain high until interrupt is cleared. When this interrupt pin is disabled, even if any interrupt occurs it will not go high.

Note:

The interrupt pin is high-Z when disabled as it does not have a defined voltage level.

4.3.10.2 Overflow Interrupt Enabled

If overflow interrupt is enabled, and if, any of the X, Y and Z values exceeds the maximum value, then an interrupt is generated and the interrupt indicator turns green.

4.3.10.3 Enabling Low/High level IRQs

BMCxxx provides two interrupts for the magnetic part: low level and high level IRQs. Low level and high level IRQs can be activated separately for each magnetic axis of BMCxxx by checking the corresponding checkboxes.

4.3.10.4 Setting thresholds

Low level IRQ is issued when one of the activated axes (logic OR) is less than the value set in **Threshold Low** field. High level IRQ is issued when one of the activated axes (logic OR) exceeds the value set in **Threshold High** field.

Note:

Both **Threshold Low** and **Threshold High** are expressed in “ μT ” units. However, the internal interrupt engine only compares the uncompensated ADC values to the selected threshold. This means that the accuracy of the setting is limited.

4.3.10.5 Latch IRQ

Checking the **Latch IRQ** checkbox enables IRQ latching, which means that the interrupt pin stays high after an interrupt event until the interrupt status register is read. After reading, the register is cleared. If latching is disabled, the interrupt status register will always reflect the result of the last measurement and retain its value until the next measurement is finished.

4.3.10.6 Magnetic sensor IRQ status display

The MAG interrupts tab shows the status of the magnetic interrupts of BMCxxx and the status of the IRQ pin. In the **ACCEL interrupts** tab, the accelerometer interrupt status is displayed. However the accelerometer interrupts are configured solely from the accelerometer tab and not in the magnetic tab.

4.4 Register Access

- ▶ This view provides direct access to the sensor registers. If the correct register address of the sensor memory map is known, 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 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.
- ▶ The **Self Test** menu enables access to the self test features of the magnetic sensor. During normal self-test, the following processes are executed
 1. FlipCore signal path is verified by generating signals on-chip. These are processed through the signal path and the measurement result is compared to known thresholds.
 2. FlipCore (X and Y) bondwires to ASIC are checked for connectivity.
 3. FlipCore (X and Y) bondwires and MEMS are checked for shorting.
 4. Hall sensor connectivity is checked for open and shorted connections.
 5. Hall sensor signal path and hall sensor element offset are checked for overflow.
- ▶ The sensor features an internal coil-on-chip advance self test mode. Advanced self test can be performed only for z axis.
- ▶ Click the **Adv Self Test** button to display the result of the advanced self test. The value indicated after the advanced self test should be around 200 μT .

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).

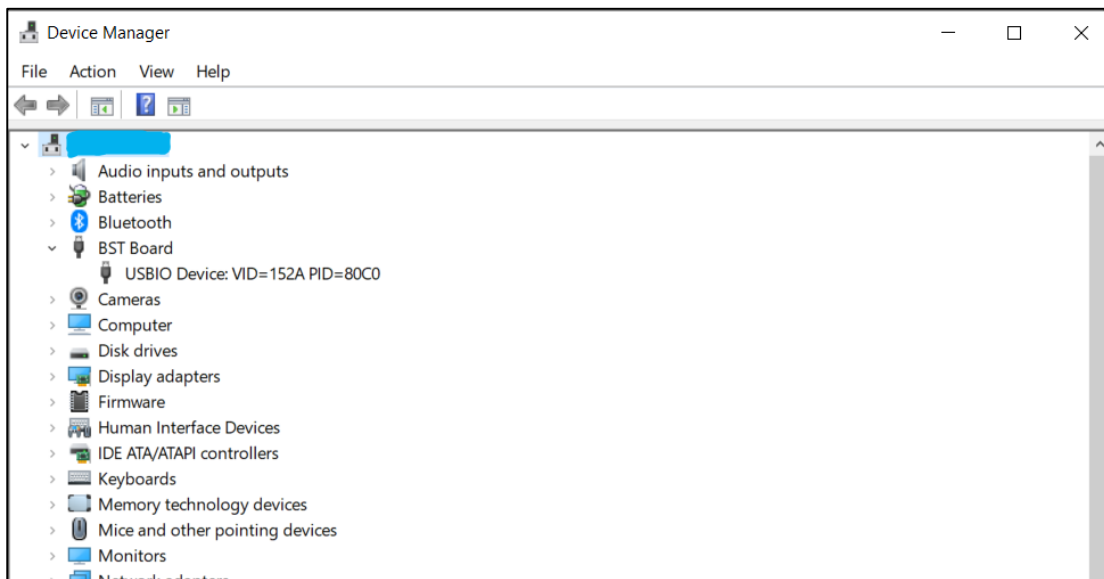


Figure 17 : Selecting USB device corresponding to application board

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

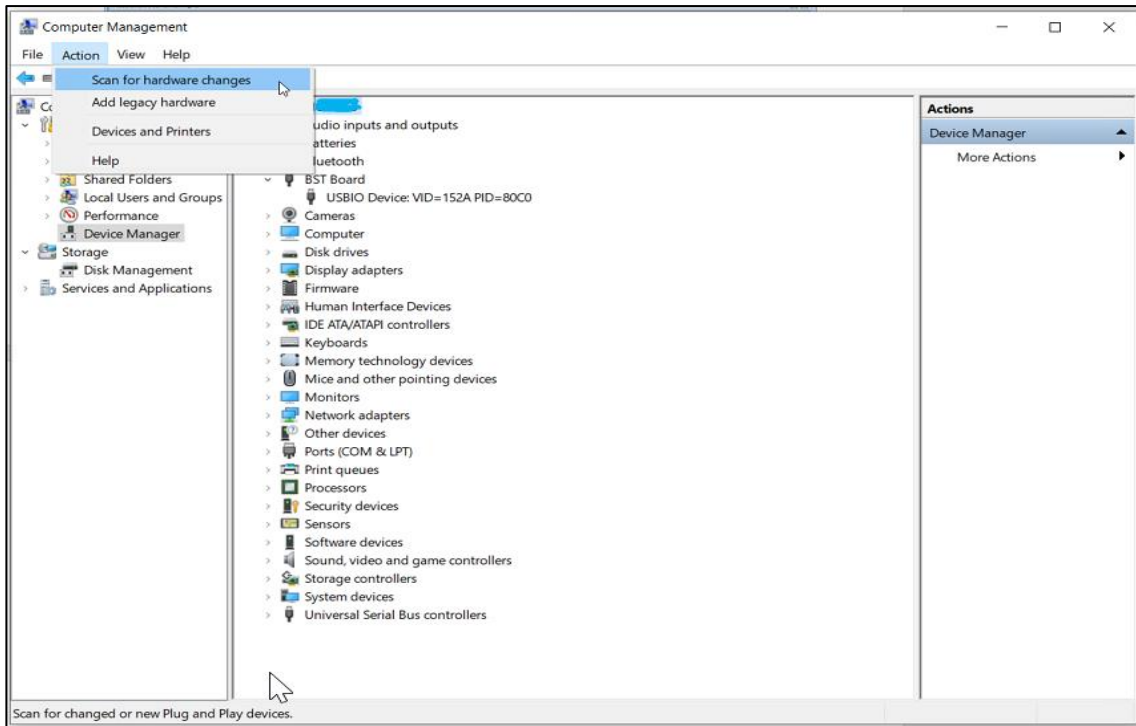


Figure 18 : USB driver installation

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

Engineering Samples are marked with an asterisk (*) or (e). Samples may vary from the valid technical specifications of the product series contained in this data sheet. They are therefore not intended or fit for resale to third parties or for use in end products. Their sole purpose is internal client testing. The testing of an engineering sample may in no way replace the testing of a product series. Bosch Sensortec assumes no liability for the use of engineering samples. The Purchaser shall indemnify Bosch Sensortec from all claims arising from the use of engineering samples.

ii. Product use

Bosch Sensortec products are developed for the consumer goods industry. They may only be used within the parameters of this product data sheet. They are not fit for use in life-sustaining or safety-critical systems. Safety-critical systems are those for which a malfunction is expected to lead to bodily harm, death or severe property damage. In addition, they shall not be used directly or indirectly for military purposes (including but not limited to nuclear, chemical or biological proliferation of weapons or development of missile technology), nuclear power, deep sea or space applications (including but not limited to satellite technology).

The resale and/or use of Bosch Sensortec products are at the purchaser's own risk and his own responsibility. The examination of fitness for the intended use is the sole responsibility of the purchaser.

The purchaser shall indemnify Bosch Sensortec from all third party claims arising from any product use not covered by the parameters of this product data sheet or not approved by Bosch Sensortec and reimburse Bosch Sensortec for all costs in connection with such claims.

The purchaser accepts the responsibility to monitor the market for the purchased products, particularly with regard to product safety, and to inform Bosch Sensortec without delay of all safety-critical incidents.

iii. Application examples and hints

With respect to any examples or hints given herein, any typical values stated herein and/or any information regarding the application of the device, Bosch Sensortec hereby disclaims any and all warranties and liabilities of any kind, including without limitation warranties of non-infringement of intellectual property rights or copyrights of any third party. The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics. They are provided for illustrative purposes only and no evaluation regarding infringement of intellectual property rights or copyrights or regarding functionality, performance or error has been made.

7. Document history and modification

Rev. No	Chapter	Description of modification/changes	Date
1.0		Initial release	January 2019
1.1		Changed the application icon	December 2012
1.2		Adopt to new format	August 2020

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