BMI090L Desktop Development 2.0 User Manual

BMI090L User Manual

Document revision	2.1
Document release date	June 2021
Document number	BST-DHW-SD024-00
Sales Part Number	0 273 017 020
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 BMI090L.

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 BMI090L 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.

Table of Contents

List of figures

List of tables

2. About the BMI090L

High-performance longevity Inertial Measurement Unit
The 6-axis IMU combines a 16-bit triaxial gyroscope and a 16-bit triaxial accelerometer in a miniature 3 x 4.5 x 0.95 mm3 (16-pin) LGA package. BMI090L features a closed-loop gyro and a robust accelerometer with a built-in mechanical filter to suppress high-frequency vibrations, thus enabling precise orientation and motion tracking in harsh and demanding industrial environments. The BMI090L targets applications such as white goods, robots, drones, precision agriculture, logistics and asset tracking as well as IIoT.

The technical specifications of the BMI090L sensor are as seen below:

Table 1 : The technical specifications of the BMI090L sensor

Parameter	Technical Data
Digital resolution	Accelerometer (A): 16-bit Gyroscope (G): 16-bit
Measurement range and sensitivity (calibrated)	(A): ± 3g: 10920 LSB/g ± 6g: 5460 LSB/g ± 12g: 2730 LSB/g ± 24g: 1365 LSB/g (G): ± 125°/s: 262.144 LSB/°/s ± 250°/s: 131.072 LSB/°/s ± 500°/s: 65.536 LSB/°/s ± 1000°/s: 32.768 LSB/°/s ± 2000°/s: 16.384 LSB/°/s
Zero offset (typ. Over life-time)	(A): ± 20 mg (G): ± 1°/s
TCO	(A): ± 0.2 mg/K (G): ± 0.015 °/s/K
Noise density (typ.)	(A): 120 µg/√Hz (G): 0.014 °/s/√Hz
Bandwidths (progr.)	5 Hz ... 684 Hz
Selectable output data rates	12.5 Hz ... 2 kHz
Digital inputs/outputs	SPI, I²C, 4x digital interrupts
Supply voltage (VDD)	2.4 ... 3.6 V
I/0 supply voltage (VDDIO)	1.2 ... 3.6 V
Temperature range	-40 ... +85°C
Temperature sensor Measurement range	-104... +150°C
Current consumption (full operation)	(A)150 µA (G) 5 mA
LGA package	3 x 4.5 x 0.95 mm³

3. Getting Started

The below sections highlight the procedure to set up connections between BMI090L, 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:

1. Install DD2.0 UI.
2. Insert the shuttle board and application board.

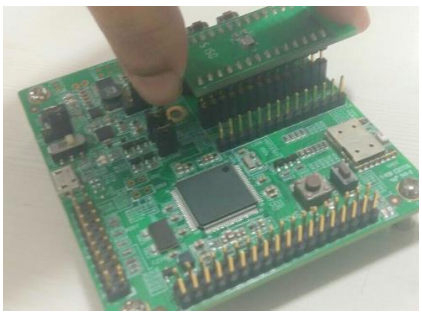


Figure 1 : Insert sensor

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

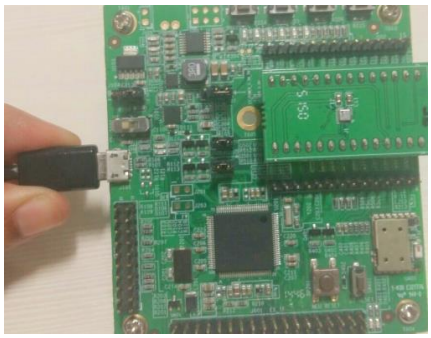


Figure 2 : Connect board and PC

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

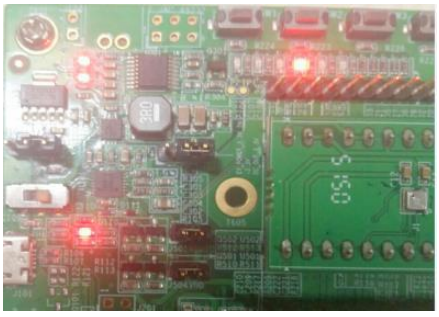


Figure 3 : Connection complete

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:

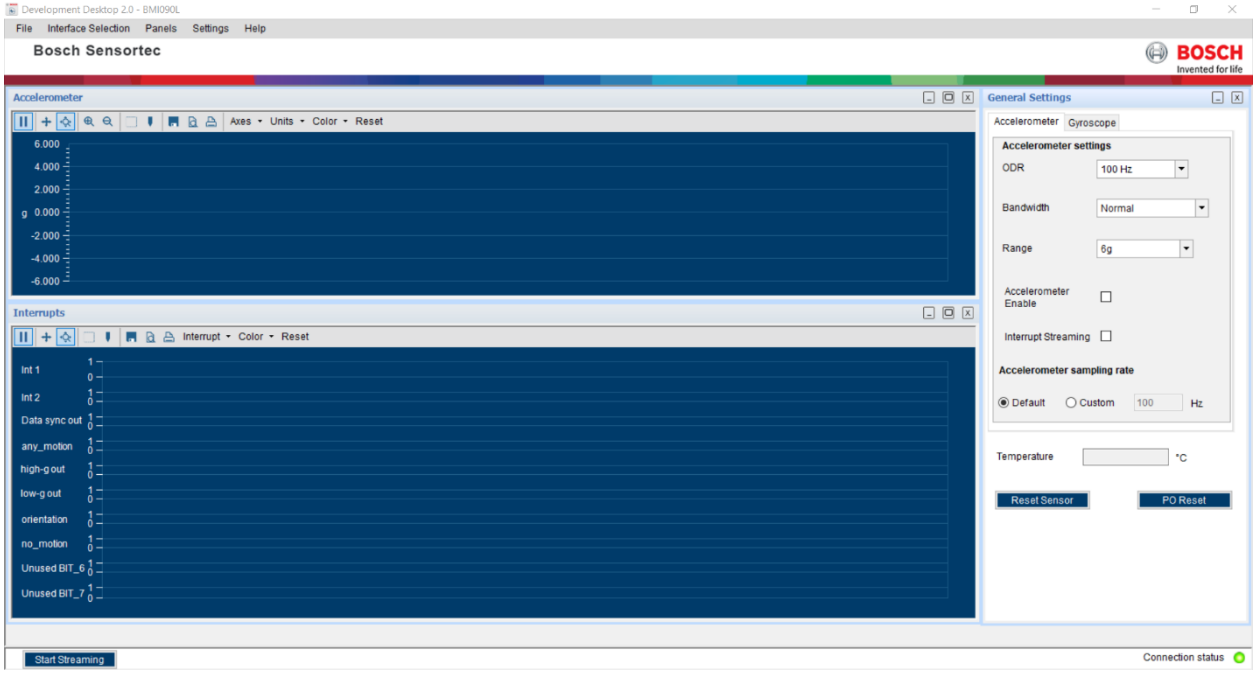


Figure 4 : DD2.0 UI Startup View

When the PC and board are connected, the Communication Status glows green as shown below:

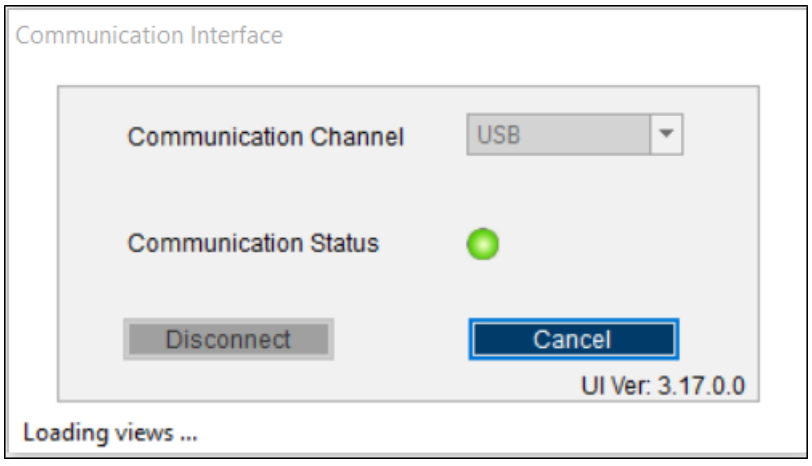
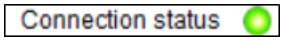


Figure 5 : Communication Status

- The communication status is also indicated at the bottom right of the GUI at all times:



- Other menu options include:
  - File
  - Interface Selection
  - Panels
  - Settings
  - Help

These menu options are explained in detail in the following sections.

3.3 Upgrading Firmware

To upgrade the firmware of DD2.0 UI to match the current version, follow the steps below:

1. Click **Menu -> Settings**-> **Firmware Upgrade.** The following window appears:

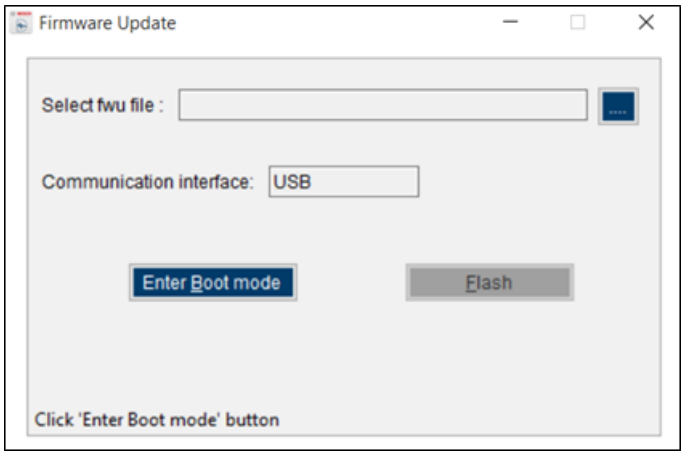


Figure 6 : Firmware upgrade window

2. Click **Enter Boot mode**.

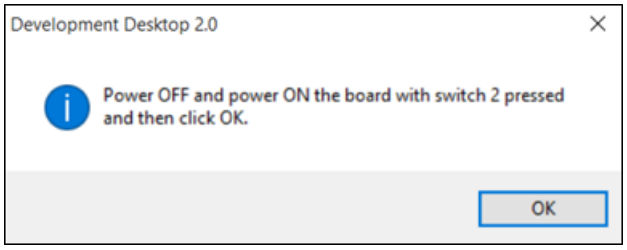


Figure 7 : Application Boot Loader

3. Switch off board, and press **Switch 2**.In Application board, all four LEDs will glow simultaneously.
4. Click **OK**.
5. All four LEDs will glow simultaneously.
6. Press **OK**.

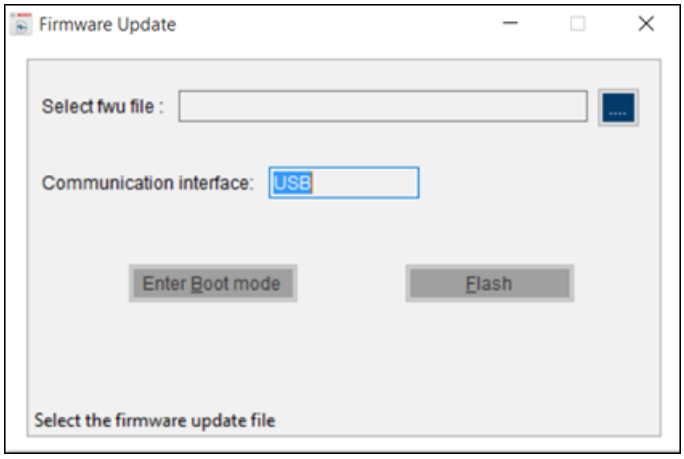


Figure 8 : Boot mode Detected

7. Select the default firmware update file (**.fwu2*) from the DD2.0 UI installation directory in the folder **Firmware**.
8. Click **Flash.**

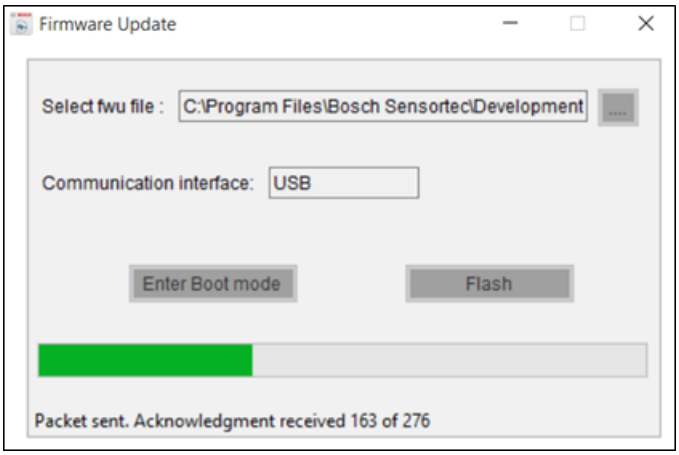


Figure 9 : Firmware upgrade completion

9. Once firmware upgrade is complete, restart the application board, and DD2.0 UI.

4. Working with DD2.0 UI

The functions of BMI090L in DD2.0 UI are discussed in the below sections.

4.1 Sensor Data Monitoring

DD2.0 UI offers sensor data monitoring for both accelerometer and gyroscope in BMI090L.

4.1.1 Accelerometer

- To view accelerometer data, go to **Menu -> Panels -> Accelerometer**, or click **Ctrl+A**.
- When an interrupt occurs, the changes in accelerometer data can be seen in the interrupt plotter.

4.1.2 Gyroscope

- To view the gyroscope data, **Menu -> Panels -> Gyroscope**, or click **Ctrl + Alt + G**.
- These panels plot the real time sensor signals from the sensor. 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.

4.2 General Settings

The General Settings panel is present in the right side of the DD2.0 UI screen. The various general settings available in BMI090L as discussed in the below sections:

4.2.1 Accelerometer Settings

The accelerometer settings panel is as seen below:

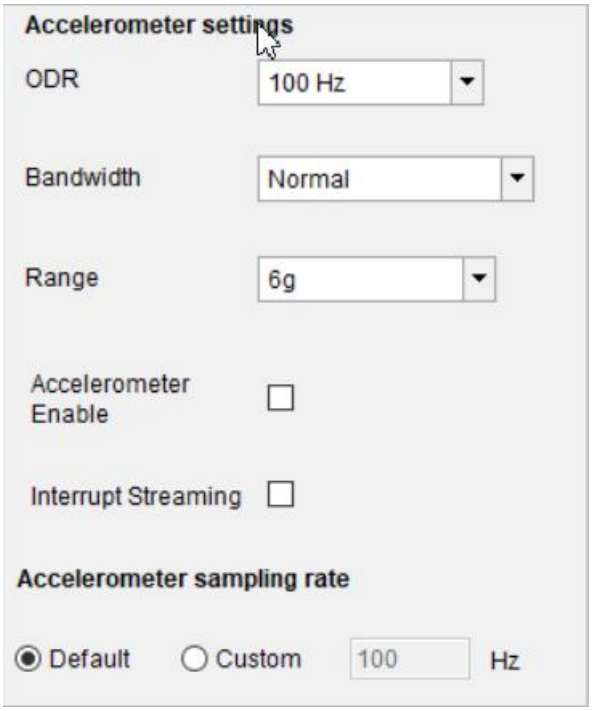


Figure 10 : Accelerometer settings

- Accelerometer Enable: This check box (when checked) enables the accelerometer sensor:
- Interrupt streaming: This check box sets the necessary interrupt conditions, so that the user can plot the data based on the interrupt streaming.
- ODR: To choose the Output Data Rate (ODR), select the relevant values from the drop-down list which are:
    1. 12.5 Hz
    2. 25 Hz
    3. 50 Hz
    4. 100 Hz
    5. 200 Hz
    6. 400 Hz
    7. 800 Hz
    8. 1600 Hz

Note: The BMI090L be customized based on the different ranges of ODR

- Bandwidth: To set a bandwidth, the user must select any one of the following options from the bandwidth drop-down list
    1. OSR 4
    2. OSR 2
    3. Normal
- Range: To set a range, the user must select any one of the following options from the range drop-down list
    1. 3g
    2. 6g
    3. 12g
    4. 24g
- To reset all values to its default state, click

Figure 11 : Reset Button

- The two sampling rates offered by DD2.0 UI for BMI090L are:

    Default: A pre- defined sampling rate value supported by the sensor. A pre-defined sampling rate value.

    Custom: User-defined sampling rate value. Custom sampling rate can only be a value between 12.5 Hz and 2000 Hz.

Select relevant value by clicking the radio button next to the option name.

Note: When the DD2.0 UI UI is launched, sampling rate will be Default. When you wish to input a custom sampling rate, please enter the value next to the corresponding option.

4.2.2 Gyroscope Settings

The gyroscope settings panel is as seen below:

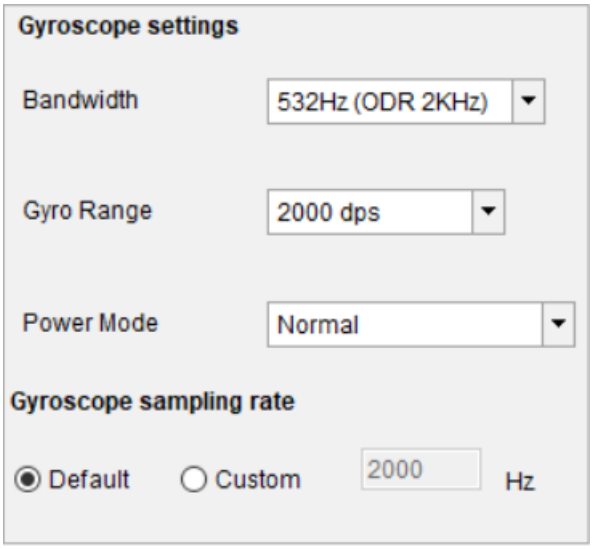


Figure 12 : Gyroscope settings

- Power Mode: To choose the operating mode for streaming, select the power mode from the drop-down list. The different power modes available are:
    1. Normal Mode
    2. Suspend Mode (to disable sensor streaming)
    3. Deep Suspend Mode
- Bandwidth: To select the bandwidth of output streaming for gyroscope, select the relevant option from the drop-down list next to the option name. The different available bandwidths are:
    1. 532Hz (ODR 2 KHz)
    2. 230 Hz (ODR 2 KHz)
    3. 116 Hz (ODR 1 KHz)
    4. 47 Hz (ODR 400 Hz)
    5. 23 Hz (ODR 200 Hz)
    6. 12 Hz (ODR 100 Hz)
    7. 64 Hz (ODR 200 Hz)
    8. 32 Hz (ODR 100 Hz)
- Range: To choose the range, select the relevant value from the drop-down list. The range values available are:
    1. 2000 °/s
    2. 1000°/s
    3. 500°/s
    4. 250°/s
    5. 125°/s
- The two sampling rates offered by DD2.0 UI for BMI090L are:
    1. Default: A pre- defined sampling rate value supported by the sensor. A pre-defined sampling rate value.
    2. Custom: User-defined sampling rate value. Custom sampling rate can only be a value between 100 Hz and 2000 Hz.
- Select relevant value by clicking the radio button next to the option name.

Note: when the DD2.0 UI UI is launched, sampling rate will at Default. When you wish to input a custom sampling rate, please enter the value next to the corresponding option.

- To set default sensor value, click **PO Reset**. 

- To reset all values to its default state, click 

- DD2.0 UI offers two kinds of data streaming for BMI090L. They are:
    1. Polling: In **Polling**, data is polled/ streamed at periodic time intervals. These time intervals are defined by the sampling rate.
    2. Interrupt: In Interrupt, data is streamed as and when data is ready. Select relevant value by clicking the radio button next to the options.

4.3 Panels

To choose the panels for which you wish to view data, go to **Menu -> Panels.**
The different panels available for BMI090L are:

4.3.1 Configuration

To view the **Configuration** settings panel, go to **Menu ->Panels -> Configuration** or click **Ctrl + C**. The following window appears:

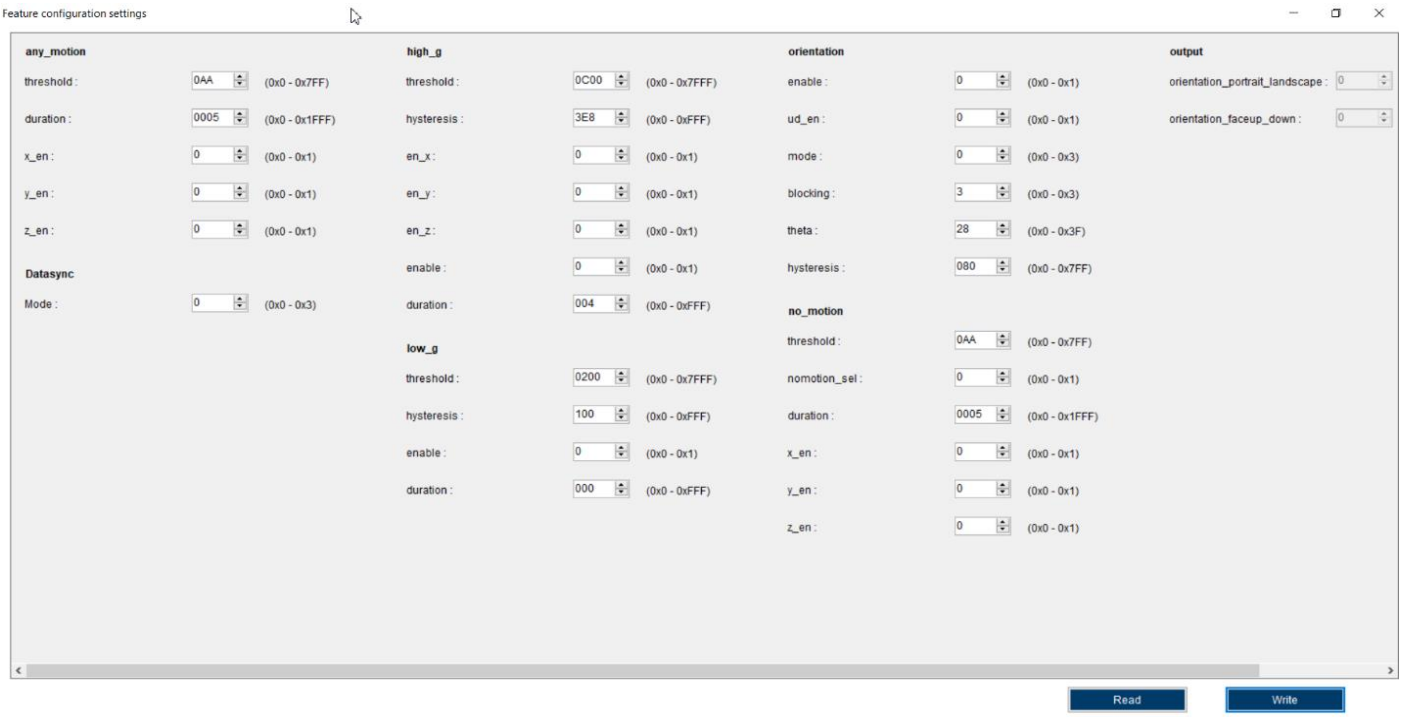


Figure 13 : Configuration settings

Refer to Interrupt View for more information on mapping the interrupts.

- Once the interrupt is mapped, simulate the interrupt that has to be triggered.
- Once the interrupt is generated, the following will happen:
    1. The interrupt will be plotted in the DD2.0 UI plotter.
- Using the above procedure, some of the interrupts in BMI090L which can be enabled and verified using DD2.0 UI are as seen below:
    1. Any motion
    2. No Motion
    3. Orientation
    4. High-g
    5. Low-g
    6. DataSync

4.3.2 Interrupt View

To map the interrupts in **Interrupt View**, go to **Menu -> Panels -> Memory Map -> Interrupt View,** or click **Alt+Shift+I**. The following window appears

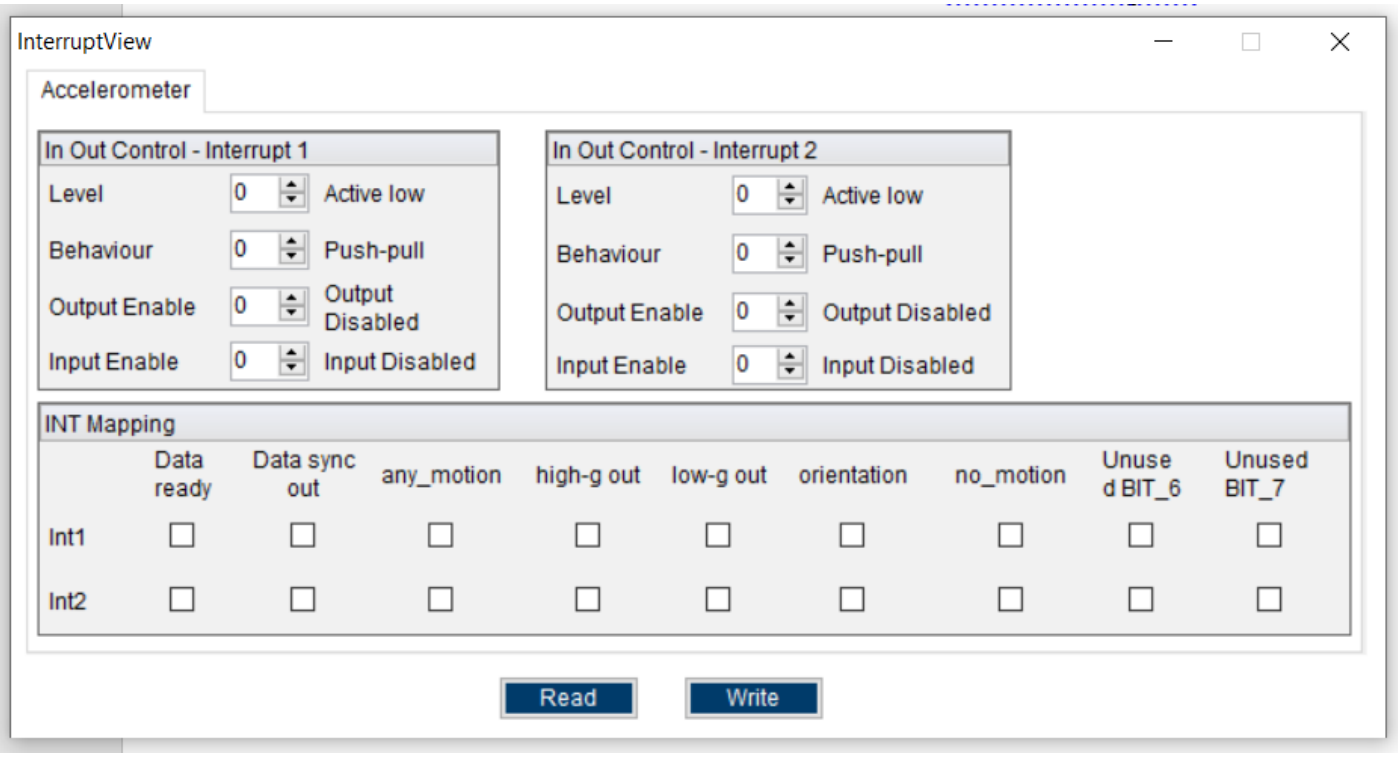


Figure 14 : Interrupt View

- Enable Int1, or Int 2, or both. To accomplish this change the below settings in "**In Out Control – Interrupt1" (or) "In Out Control – Interrupt2**":
    1. Set **Level** to 1. The **Level** settings will change from **Active low** to Active high.
    2. Set **Output Enable** to 1. The **Output Enable** value will change from **Output Disabled** to **Output Enabled**.
    3. Select the parameters for which the interrupt has been configured.

Refer to Configuration for more information on enabling the interrupts.

- Click **Write** to write the new values into the sensor.
- To view the interrupts in the plotter, click **Start Streaming**.

4.3.3 FIFO View

To view the FIFO data, go to **Menu -> Panels -> Memory Map -> FIFO View,** or click Ctrl + O.
The FIFO view contains tab pages for accelerometer and gyroscope. This allows the user to configure the accelerometer and the gyroscope fifo registers.
The following window appears:

Accelerometer FIFO configuration:

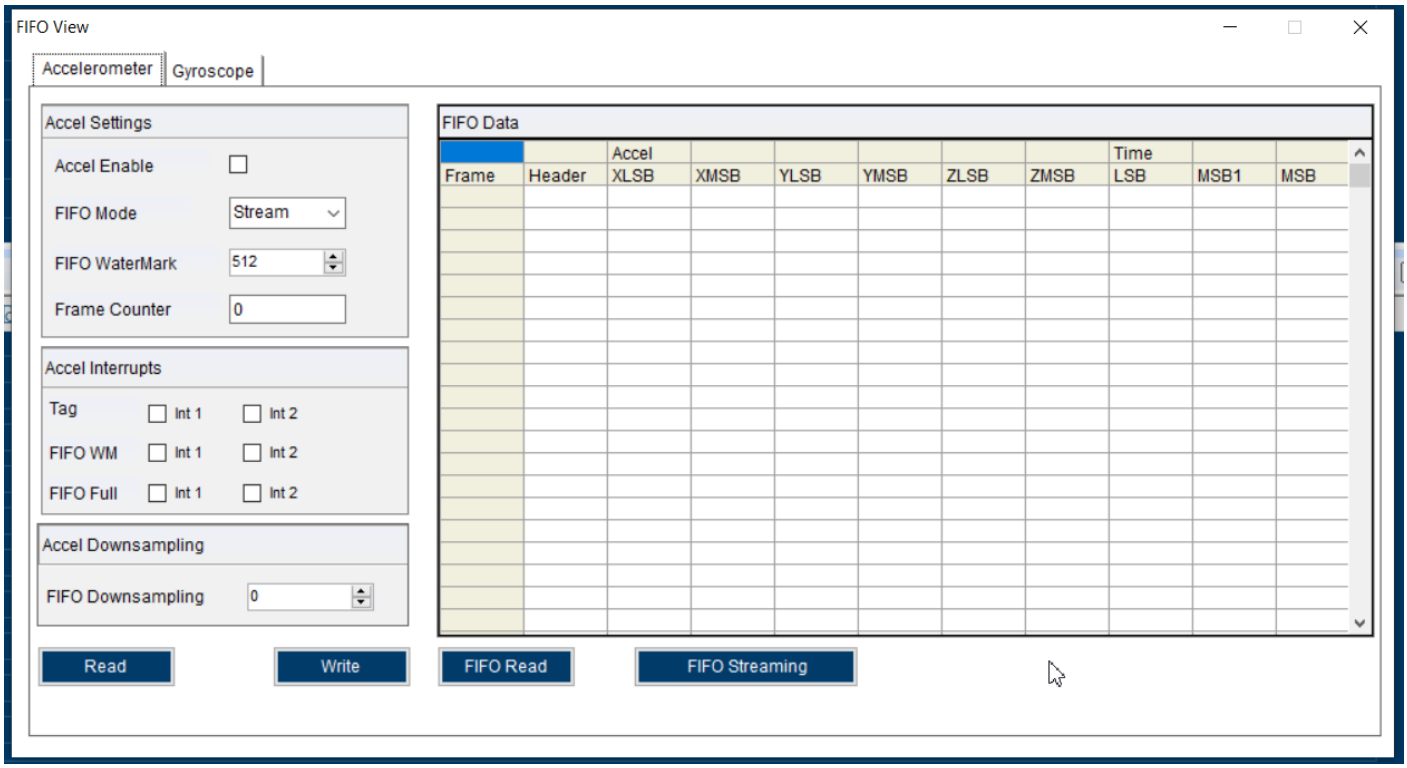


Figure 15 : FIFO View (Accelerometer)

- To enable data streaming with **FIFO view**, follow the steps below:
    1. As per requirement, enable the accelerometer.
    2. Map the enabled interrupt to **Int1**, **Int2**, or both.
    3. In **FIFO Watermark**, set a non-zero watermark value.
    4. Click **Write** to write the values into the sensor.
    5. Click **FIFO Read**.
- The sensor values are displayed in the **FIFO Data** data grid.
- Click **Start FIFO Streaming** to stream FIFO data in the accelerometer panel.

Gyroscope FIFO configuration:

- To enable data streaming with **FIFO view**, follow the steps below:
    1. As per requirement, select the FIFO mode of gyroscope.
    2. Map the enabled interrupt to **Int1**, **Int2**, or both.
    3. In **FIFO Watermark**, set a non-zero watermark value.
    4. Click **Write** to write the values into the sensor.
    5. Click **FIFO Read**.
- The sensor values are displayed in the **FIFO Data** grid.

  Click **Start FIFO Streaming** to stream FIFO data in the gyroscope panel.

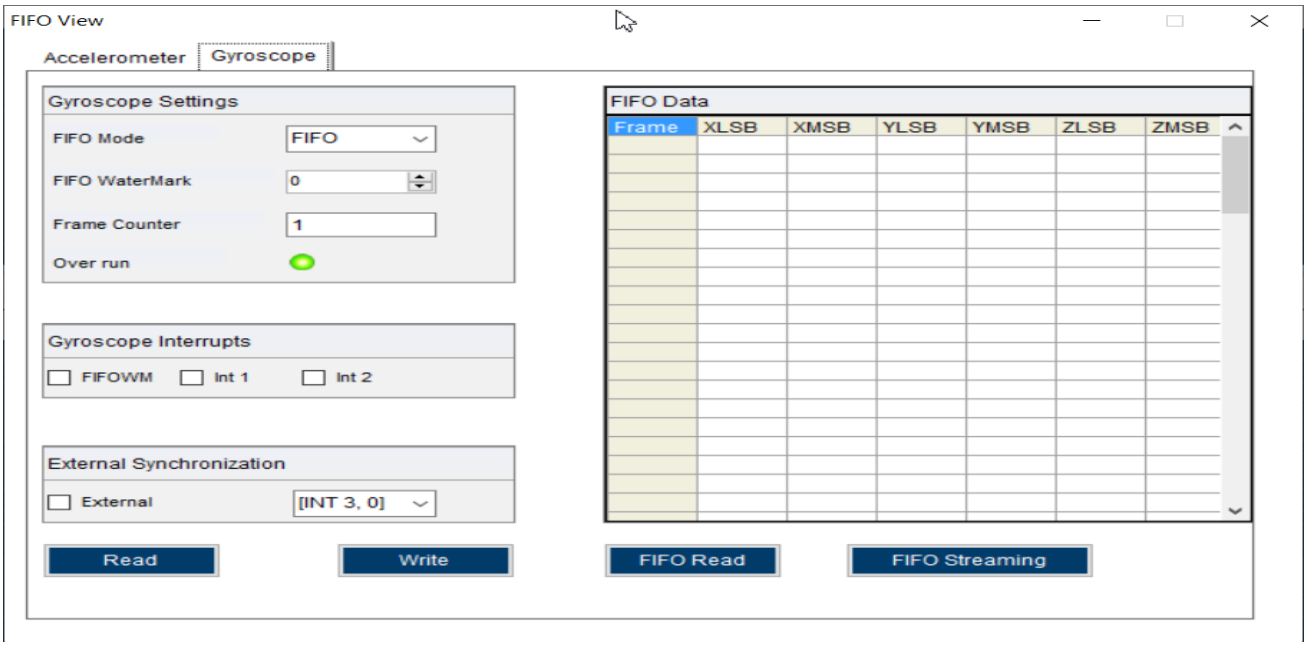


Figure 16 : FIFO View (Gyroscope)

4.3.4 Binary View

To view the data in binary format, go to **Menu -> Panels -> Memory Map -> Binary View**, or click **Ctrl+K**. The following window appears:

The Binary view contains tab pages which allows the user to configure the registers of accelerometer and gyroscope separately **Binary View** is used to read or write values into multiple registers of accelerometer and gyroscope in one view. The binary view contains tab pages for accelerometer and gyroscope. To implement this, follow the below steps:

Enter the value in the box alongside the register name.

- As per requirement, click **Read/Write**.

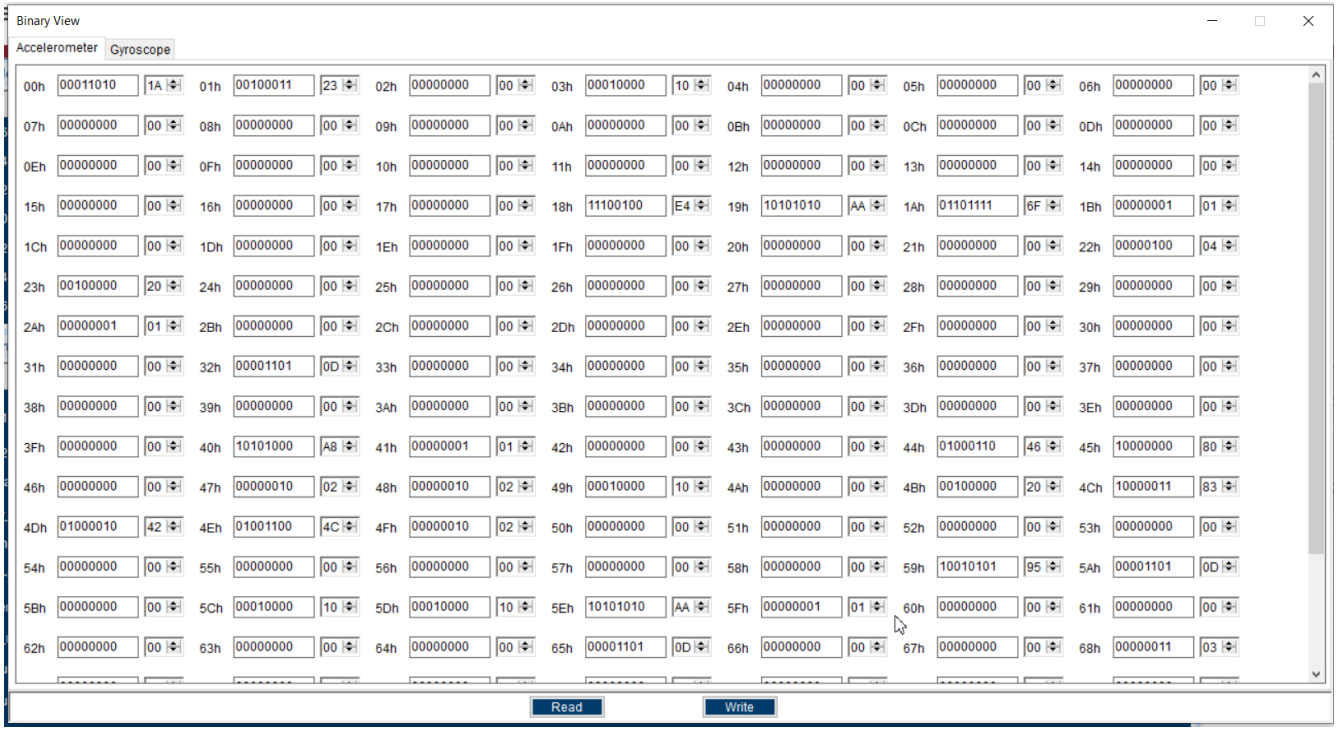


Figure 17 : Binary: Accelerometer view

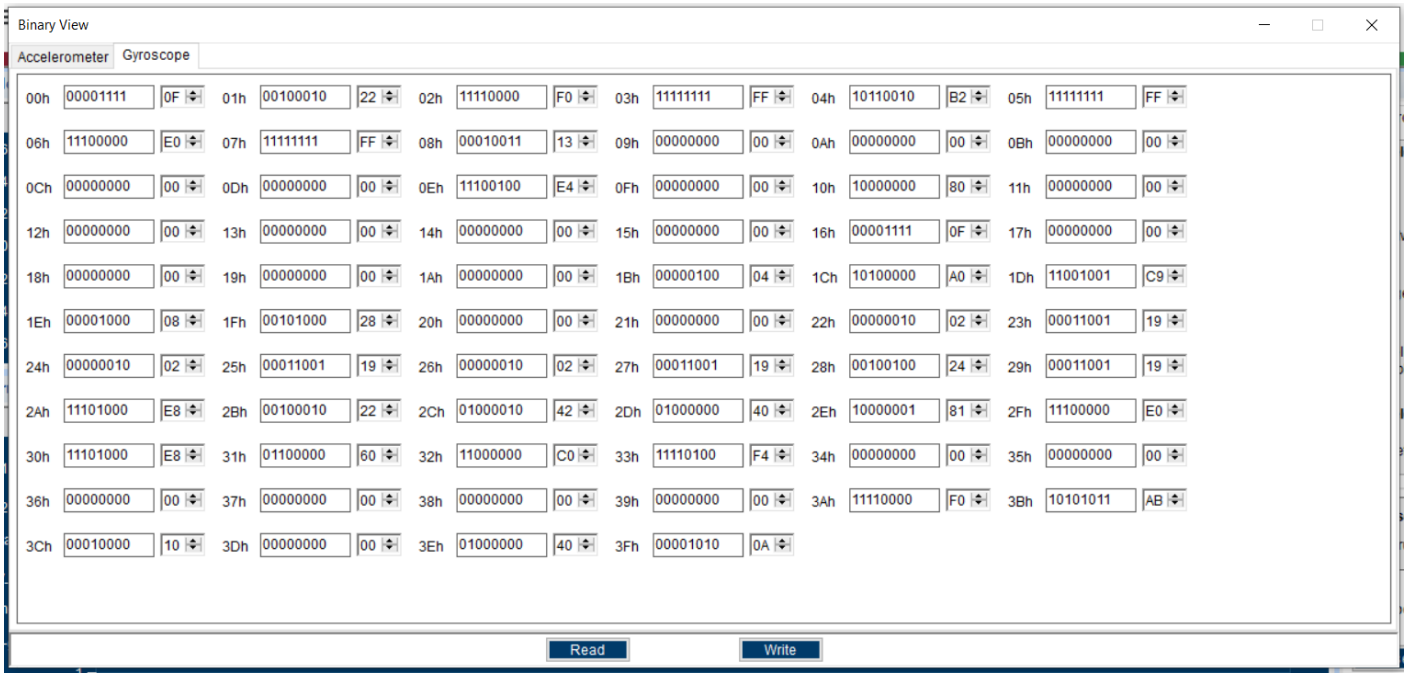


Figure 18 : Binary: Gyroscope view

4.3.5 Register Access

To go to Register Access, go to **Menu -> Panels -> Register Access**, or click **Ctrl+R.**
The register access provides the user an option to choose accelerometer (or) gyroscope
The following window appears:

Register Access used to read or write values into a register. To implement this, follow the below steps:

- Choose either the accelerometer (or) gyroscope
- Enter the hexadecimal register address in **Address [h]**.

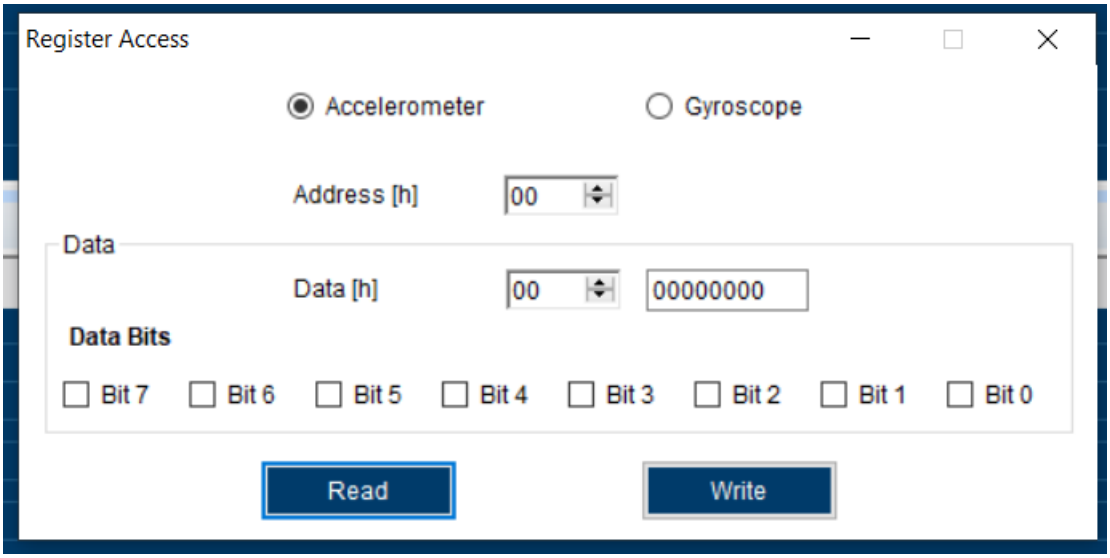


Figure 19 : Register Access

- Enter the hexadecimal data you wish to read/ write in **Data [h]**.
- Select the data bits into which data has to be write or read
- As per requirement, click **Read/Write**.

4.3.6 Data Export/ Data Log

- To save the output values plotted by DD2.0 UI, go to **Menu -> Panels -> Data Export**, or click **Ctrl+D.**
- By default, the data values logged into a text (*.txt*) file in the destination folder of DD2.0 UI.
- The steps to follow data logging are as seen:

1. Go to **Menu -> Panels-> Data Export**, or click **Ctrl + D.**
2. Click **Select Destination**, and select required destination folder.

Note: The data log will be stored in the destination folder selected by you.

3. To log new data into the selected file, click **Append.**
   Or
   To erase old data from the selected file and log new data in its place, click **Overwrite.**

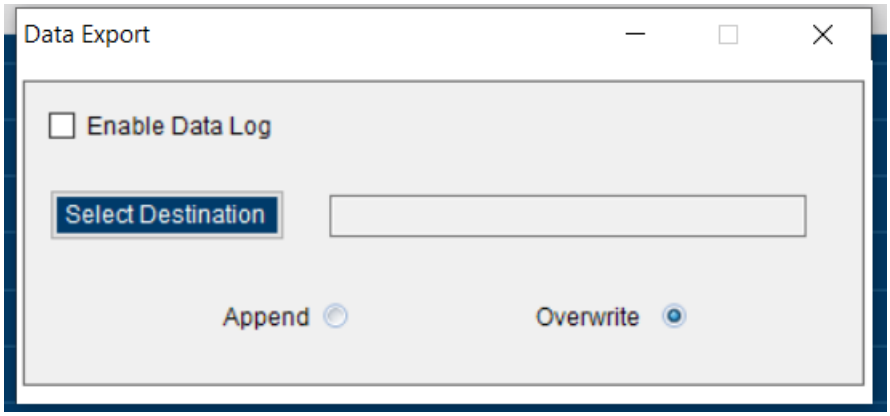


Figure 20 : Data Log

4. Check **Enable Data log**.
5. Click **Start streaming** button to plot the sensor data in the plotter.

Click **Stop streaming** to end the plotting of the sensor data. The output of the sensor data is saved in the desired destination path.

4.3.7 Default View

- To view the Default View, go to Menu -> Panels -> Default View, or click Ctrl+Shift+D.
- The DD2.0 UI will revert to its default GUI view.
- The panels available in this view are:

1. Accelerometer Panel
2. Interrupts Panel
3. General Settings Panel

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).

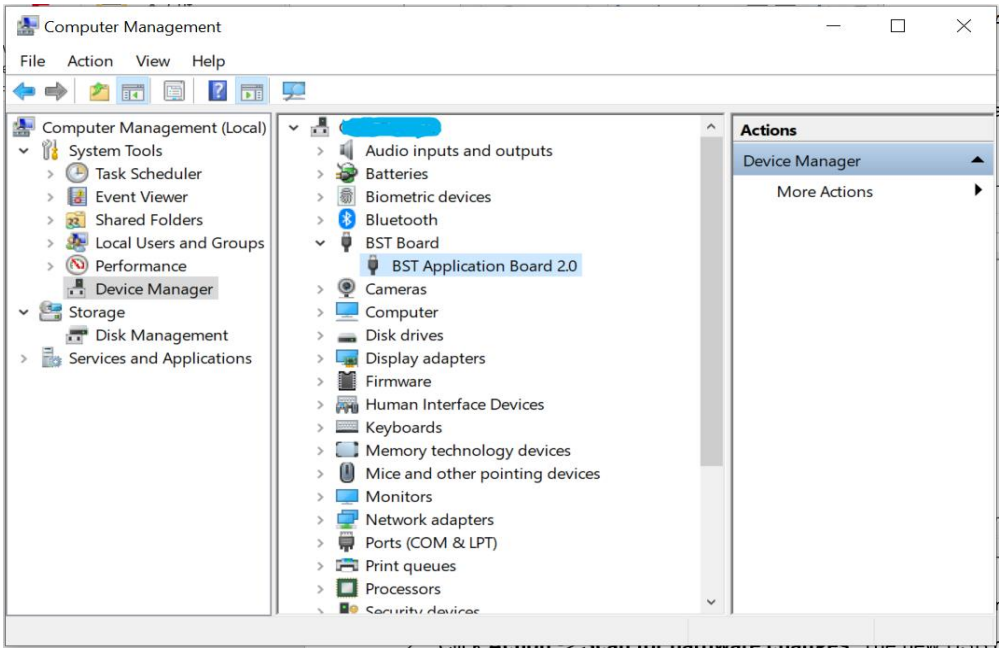


Figure 21 : Selecting USB device corresponding to application board

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

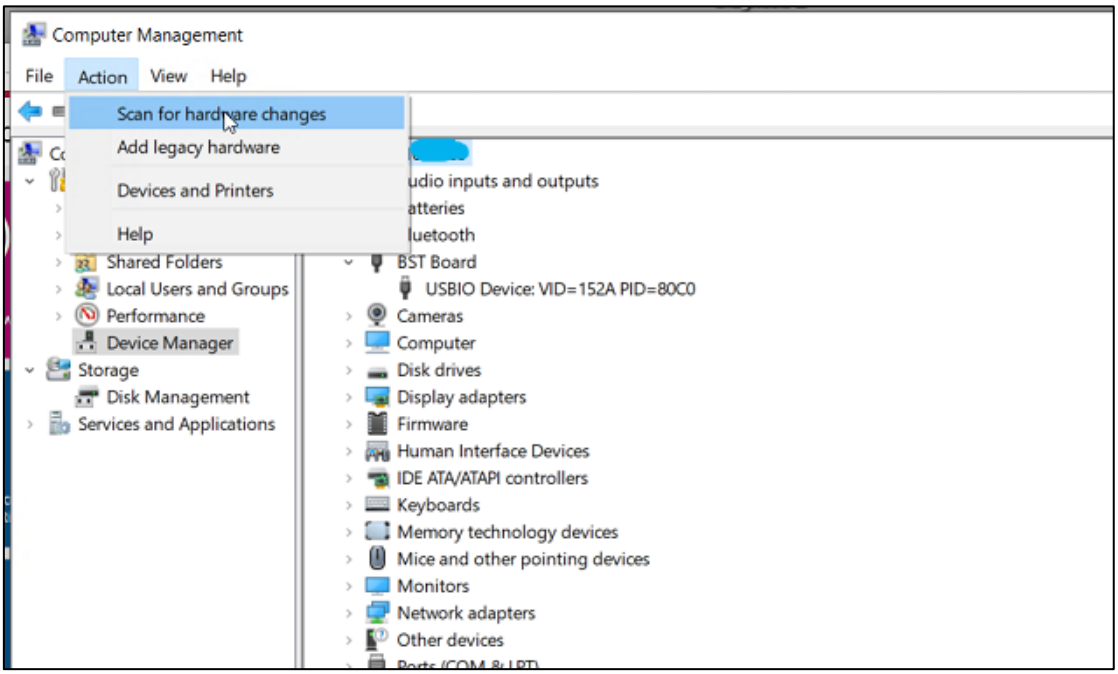


Figure 22 : USB driver installation

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

Table 2 : Troubleshooting

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 UI 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	BMI090L User Manual	Initial release	July 2020
2.0	BMI090L User Manual	Adopt New Format	August 2020
2.1		Correct List of Figure Link	June 2021

Bosch Sensortec GmbH
Gerhard-Kindler-Straße 9
72770 Reutlingen / Germany

contact@bosch-sensortec.com
www.bosch-sensortec.com

Document number: BST-DHW-SD024-00