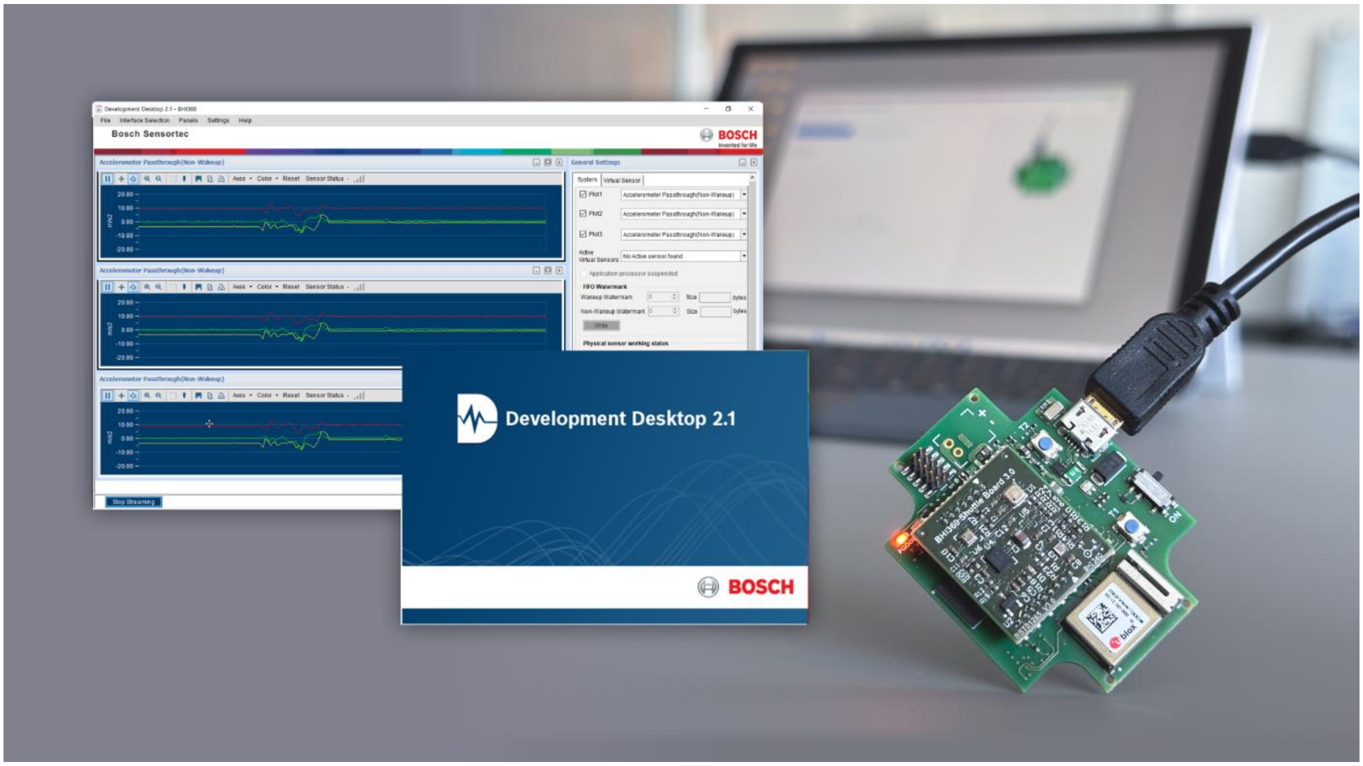
Development Desktop 2.1
User Manual



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Note: 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. The technical details and legal disclaimer of the respective product datasheet apply.

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Acronyms and abbreviations

APP3.X	:	Application Board 3.0 and Application Board 3.1
APP3.0	:	Application Board 3.0
APP3.1	:	Application Board 3.1
CRT	:	Component Re-Trim
DD	:	Development Desktop
EMC	:	Electromagnetic Compatibility
FOC	:	Fast Offset Compensation
FIFO	:	First In First Out
GBIST	:	Gyro Built In Self-Test
HW	:	Hardware
IAQ	:	Indoor Air Quality
IMU	:	Inertial Measurement Unit
I2C	:	Inter-Integrated Circuit
NVM	:	Non-Volatile Memory
ODR	:	Output Data Rate
OSR	:	Over Sampling Rate
POR	:	Power On Reset
SPI	:	Serial Peripheral Interface
VDD	:	Voltage Drain to Drain
VDDIO	:	Voltage Drain to Drain Input Output
VOC	:	Volatile Organic Compounds

1 About this user manual

This user manual describes the installation and use of the Development Desktop 2.1 Software (DD 2.1), which is a Windows-based PC software application developed by Bosch Sensortec. DD 2.1 can only be used in connection with Bosch Sensortec engineering boards (called Application Boards) and sensor shuttle boards.

1.1 Who should read this user manual?

This user manual is intended for users who want to evaluate Bosch Sensortec sensors with the Application Board and shuttle board offered by Bosch Sensortec.

1.2 DD 2.1 Overview

Bosch Sensortec sensors are mounted on sensor-specific shuttle boards. All sensor shuttle boards have an identical footprint and can be plugged into the Application Board's shuttle board socket. DD 2.1 is a PC-based software that reads, captures, and displays sensor samples. DD 2.1 automatically detects the sensor plugged in and starts the corresponding software application.

1.3 Sensor Communication

DD 2.1 software supports both SPI and I2C to communicate with the sensor.

1.4 Graphical display

DD 2.1 displays the sensor samples and interrupts in different graphical formats.

1.5 Data logging

DD 2.1 offers logging of the sensor samples in .txt or.csv file formats.

1.6 Key Features of DD 2.1

The key features of DD 2.1 are below:

- USB 2.0/USB 3.0 full-speed interface to Bosch Sensortec Application Board.
- Visualize real-time sensor signal and monitoring.
- Sensor data/sample acquisition
- Sensor configuration and register access.
- Interrupt configuration and monitoring
- Firmware upgrade via USB/COM
- On-the-fly change of the SPI/I2C Interface of the sensors

2 Installation

The procedure to install DD 2.1 is described in this section.

2.1 System requirements

The PC on which DD 2.1 will be installed needs to have the following requirements:

- **Operating system**: Windows 10 (64-bit)/Windows 11
- **Memory**: 1 GB
- **Processor**: 1 GHz or higher (Recommended)
- **Host controllers**: USB 2.0, USB 3.0

2.2 Installing the software

Follow the steps below to download and install DD 2.1:

1. To download the Development Desktop software from the Bosch Sensortec tools website - Bosch Sensortec Development Desktop, users must provide the required fields and agree to the license agreement.
2. Users will receive a link via email to download a Zip file which contains the executable.
3. Extract the zip file and Double-click the *DevelopmentDesktop21_ VX.X.exe* icon to install.
4. Follow the instructions from the Setup Wizard.
5. Read the text in the introduction dialog and click **Next**.

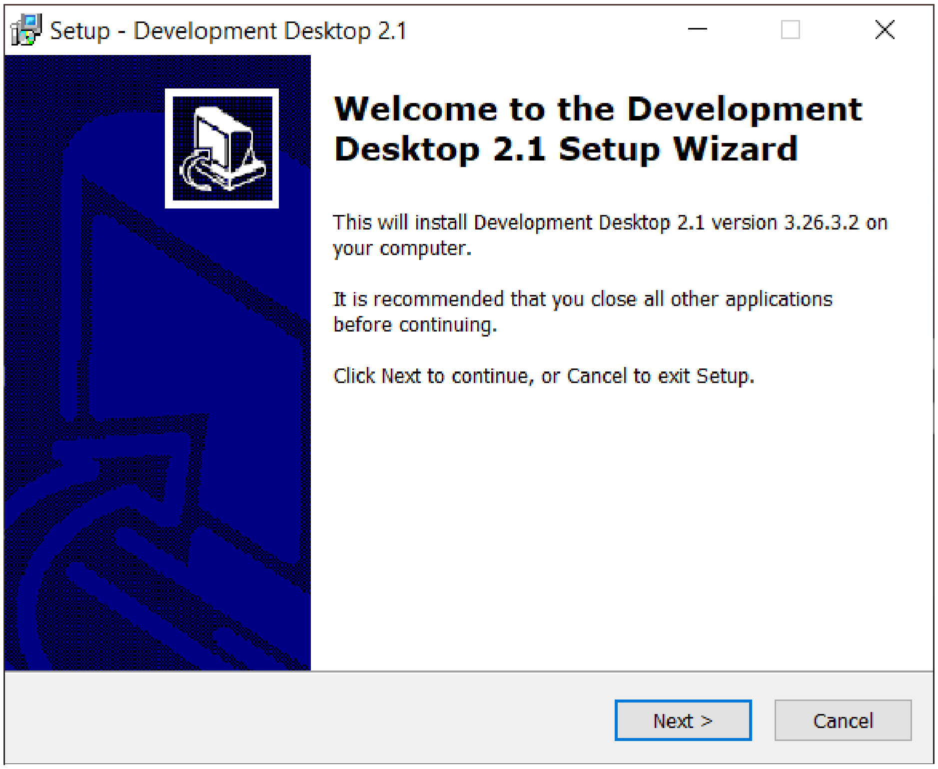


Figure 1: Installation setup window

6. From the **License Agreement** dialog box, read the license agreement and select **I accept the agreement** only if you agree to the license agreement and Click **Next**.

Figure 2: License agreement

7. By default, DD 2.1 installs in C:\Program Files\Bosch Sensortec\Development Desktop 2.1 (Recommended). Click **Browse** to change the destination directory.
8. Click **Next**.
9. From the **Select Destination Location** dialog box, select the destination folder to save the DD 2.1.

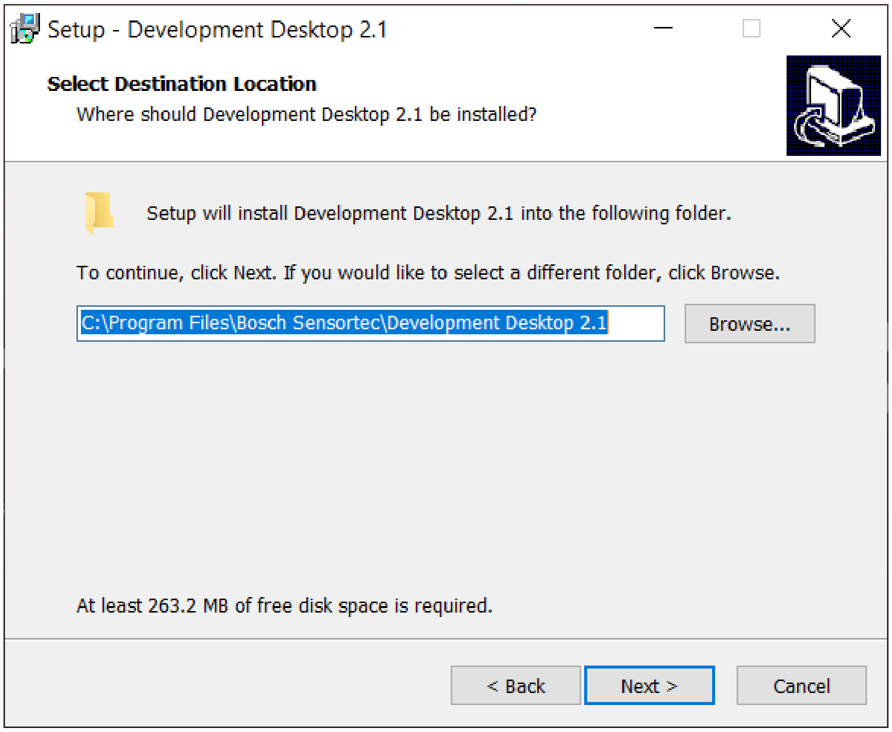


Figure 3: Select destination to save DD 2.1 software

10. Select the folder name for the DD 2.1 shortcuts and click **Next**.

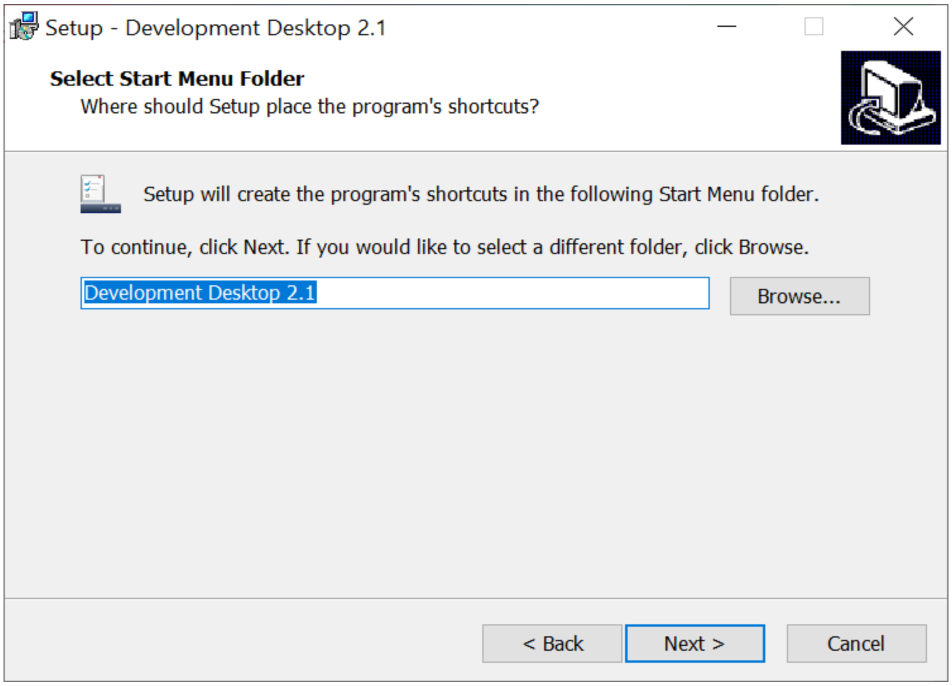


Figure 4: Select the Start Menu folder

11. From the **Ready to Install** dialog box, click **Install**.

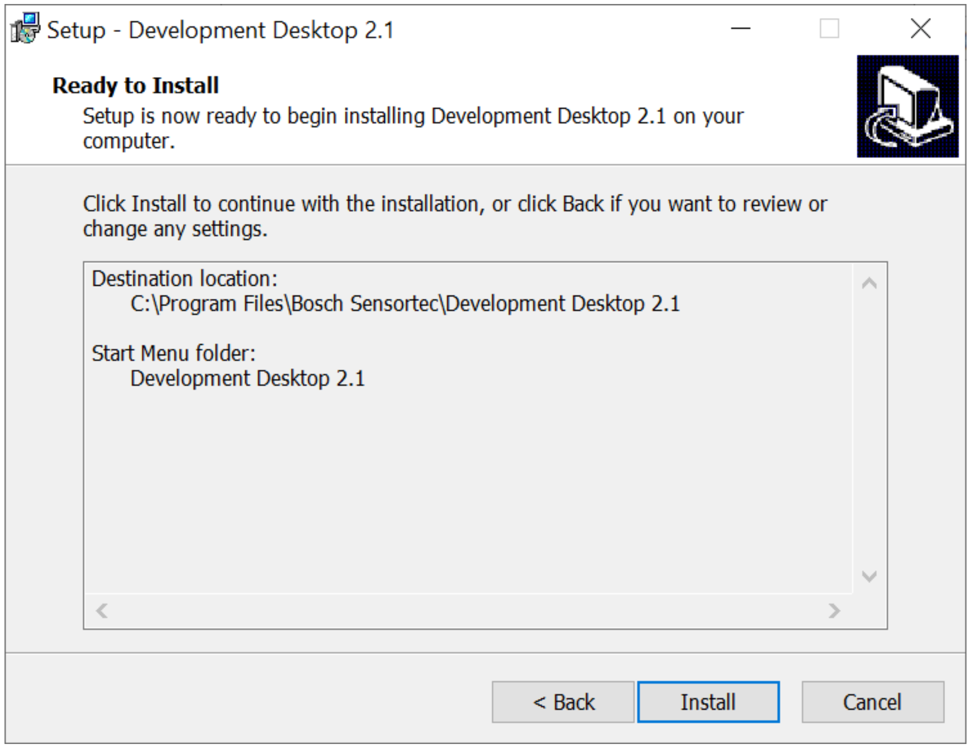


Figure 5: Install DD 2.1

12. The Application Board USB drivers will be automatically enabled by default and are recommended to be installed to connect to the Application Board.

    Install App Board USB driver – To install the default driver and display the Bosch Sensortec name on the COM port for APP3.X boards.

    To exit the installation completion dialog, click **Finish**.

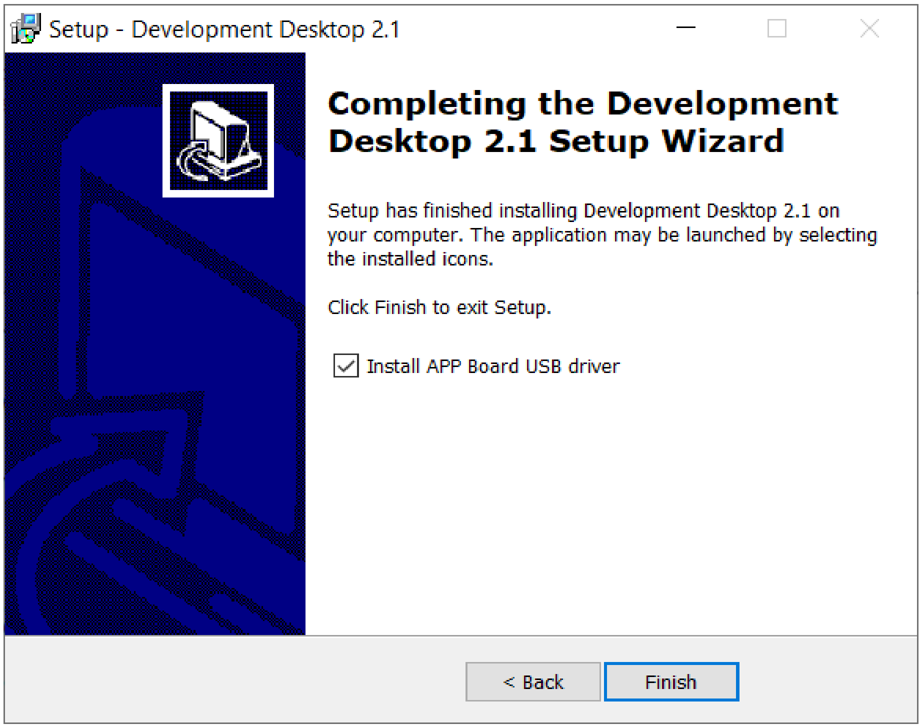


Figure 6: Installation completion dialog

2.3 Installing App Board USB Drivers

1. The Device Driver Installation Wizard appears after the DD 2.1 setup Wizard is completed. Click Next to set the completion panel.

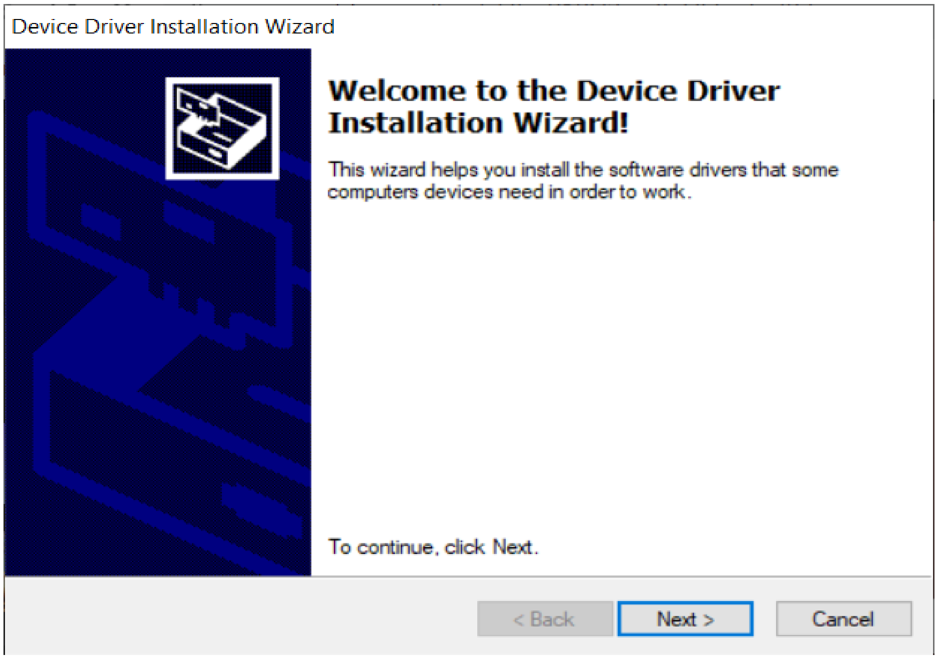


Figure 7: Device driver installation wizard

2. Click on **Finish** to complete the Device Driver installation wizard, which will show the USB/COM port names as Bosch Sensortec GmbH.

Figure 8: Complete installation wizard

2.4 Uninstalling DD 2.1

The uninstall program removes all the system's DD 2.1 components. It removes the DD 2.1 software files, directories, folders, and registry key items.

Perform the following procedure to uninstall the DD 2.1 software:

1. Close DD 2.1.
2. Click **Start** > **Development Desktop 2.1** > **Uninstall Development Desktop 2.1**.
3. The uninstaller dialog box appears. Click **Yes**.

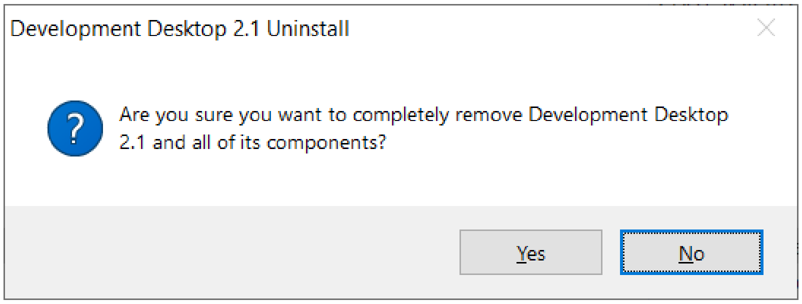


Figure 9: DD 2.1 uninstall window

2.5 Setting up the board-PC connection

The user needs to follow this procedure to connect the sensor shuttle board to the PC.

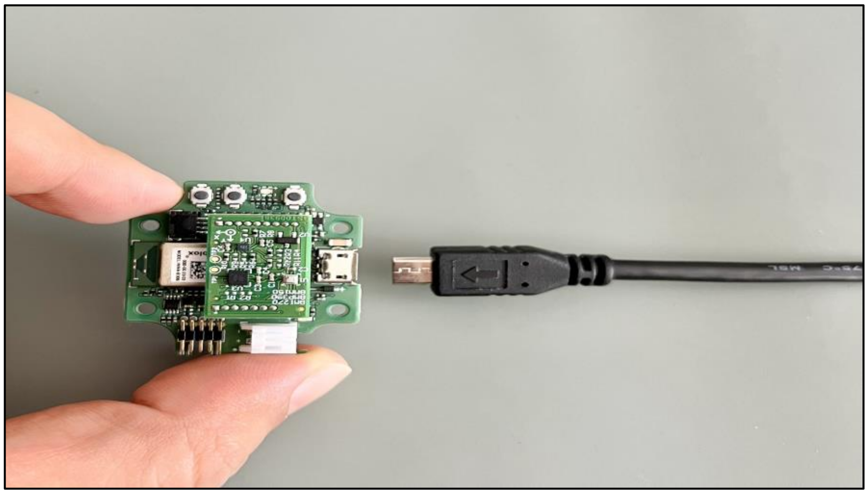


Figure 10: Connecting the shuttle board onto the APP3.1

1. Insert the shuttle board onto any Application Board.
2. Connect the APP3.X and PC using a Micro USB cable.

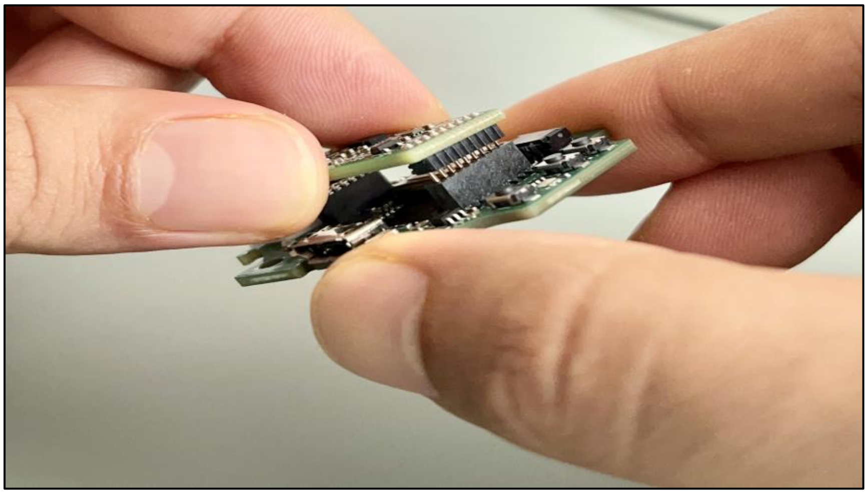


Figure 11: Connect the board and PC

The connection is complete, and the Application Board will be turned ON.

2.6 Startup View

To start the DD 2.1 application:

1. Click **Start** > **Programs** > **Development Desktop 2.1**, or
   Double-click the DD 2.1 software icon on the  desktop.

Depending on its features, the DD application's GUI will differ for different sensors. The landing page will be similar for all sensors, as shown below Figure for the BMI270 sensor.

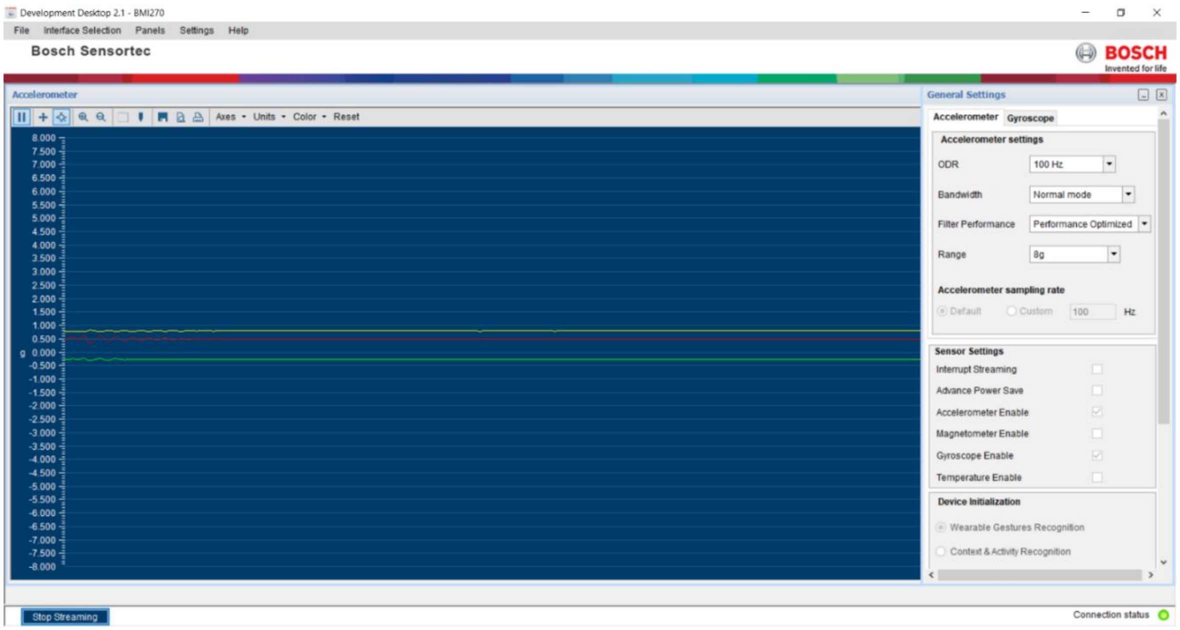


Figure 12: Startup view of BMI270

Below Figure shows the landing page for BHY sensors (smart sensors)

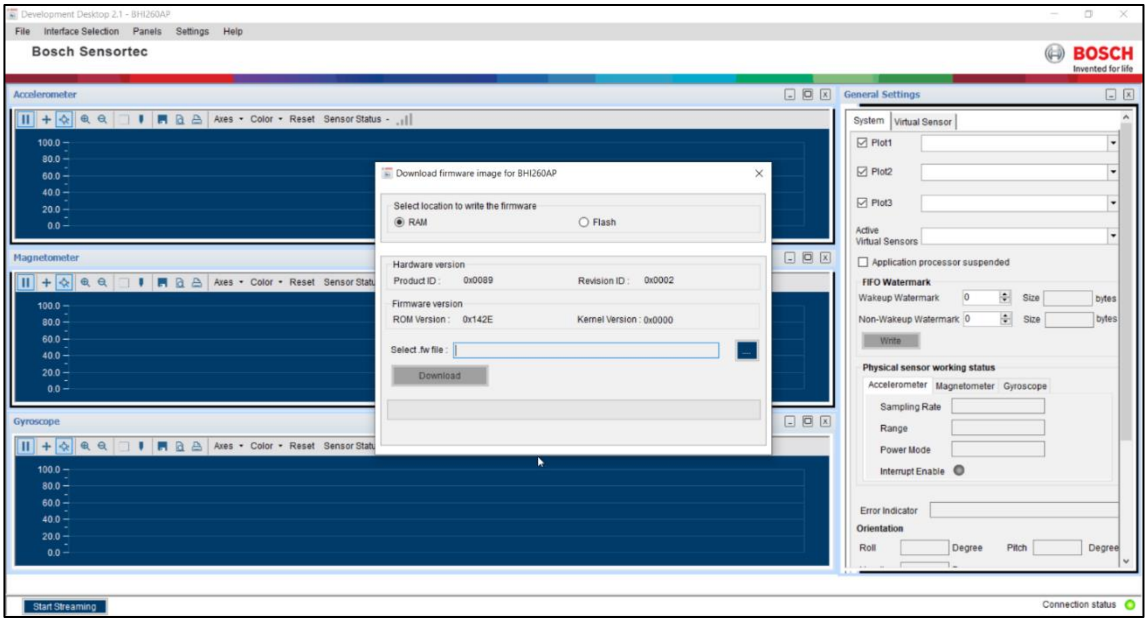
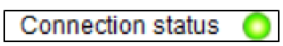


Figure 13: Startup view of BHI260AP Sensor

Note: The communication status is indicated at the bottom right of the GUI:



Other menu options include:

- File
- Interface Selection
- Panels
- Settings
- Help

2.6.1 Upgrading the Firmware

The DD 2.1 application requires Bosch Sensortec APP3.X hardware, which should have relevant firmware (COINES Bridge firmware) flashed in it.

By default, the Application Board might have different firmware flashed in it, and each DD application might recommend that the user upgrade to the appropriate supported firmware.

To upgrade the firmware of DD 2.1 to match the current version, follow the steps below:

If the firmware flashed to the Application Board and DD 2.1 is incompatible, an information message will be displayed as shown in below Figure.

- **Ignore**: To resume with the available firmware in the app board, click **Ignore**. (**Note:** The firmware can also be updated from **Menu** > **Settings** > **Firmware Upgrade**).
- **Upgrade**: To flash the required firmware file (which varies based on the installer variant), click **Upgrade**.
- **Exit**: To close the DD application, click **Exit**.

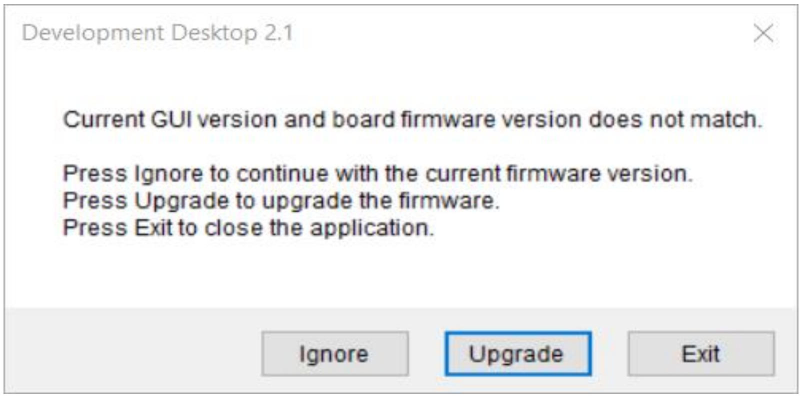


Figure 14: Firmware mismatch window

1. From the **Firmware Update** dialog, select the **RAM** or **FLASH** option to flash the latest recommended firmware file.
    - RAM is for temporary flashing of the firmware in the app board, which resets to the old firmware when the app board is reset.
    - FLASH is for permanent flashing of the firmware in the app board, which will be retained even after the app board is reset.
2. The file path will be automatically chosen/selected in the **select firmware file** path textbox (Recommended). The user can also select the firmware as required.

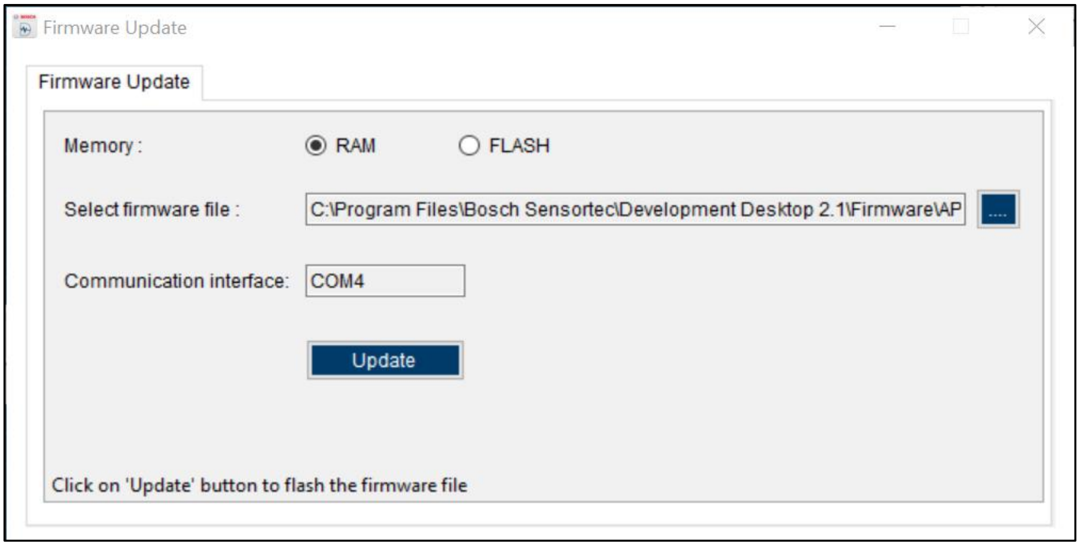


Figure 15: Firmware upgrade window

DD 2.1 recommended firmware is COINES_bridge_flash_firmware/COINES_bridge_ram_firmware for APP3.1. If the user chooses to flash DD firmware, a popup message will be shown that DD firmware (DevelopmentDesktop_2.1_Firmware_v1.9.bin) might not work as expected for all the features, where users still have the option to flash DD firmware.

3. Click **Update**.

Note: Default firmware file (*.bin) will be automatically chosen from the DD 2.1 installation directory in the folder Firmware**\App3.1** for APP3.1 & **Firmware\App3.0** for APP3.0.

4. Once the firmware update is completed, close the popup, and the DD 2.1 application will automatically reload.

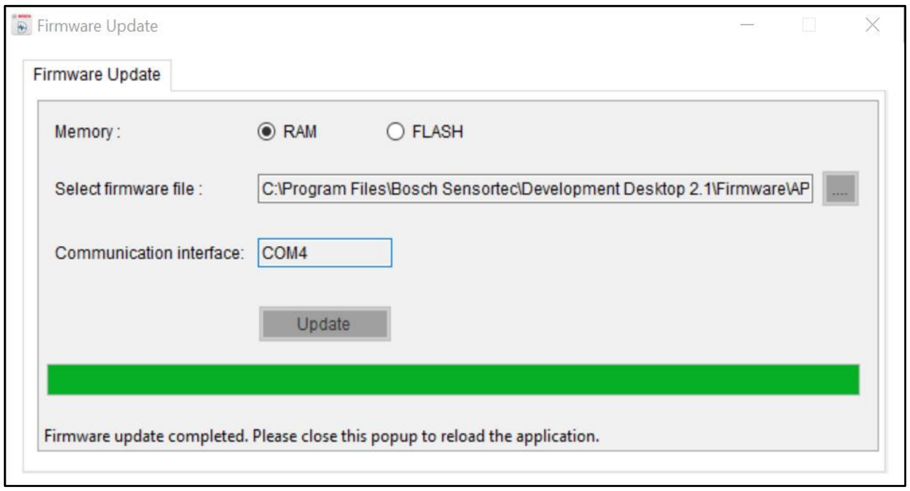


Figure 16: Firmware upgrade completed.

2.6.2 VDD/VDDIO

User can change the Voltage Power supply(VDD/VDDIO) to the shuttle board from **Menu** > **Settings** > **VDD/VDDIO** or click **Ctrl+Shift+V.** VDD/VDDIO can be entered in steps of 100mV power supply. This feature is applicable only for APP3.1 Board.

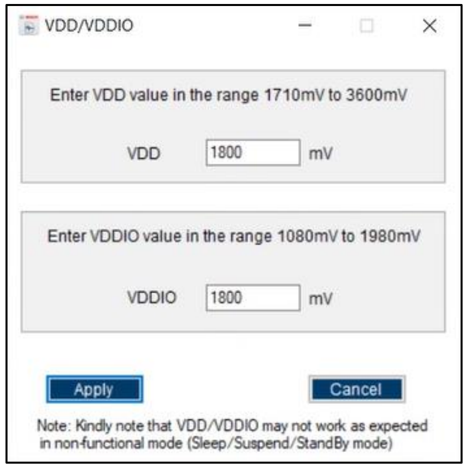


Figure 17: VDD/VDDIO option

2.6.3 Changing the graph settings

This section describes the different graph settings options in the application.

2.6.3.1 Selecting the data channel

To select the signals (X, Y, and Z) shown on the graph, perform **Channel Selection**. By default, all channels are displayed. From the **Axes** menu, select the axes to show them or unselect the axes to hide them.

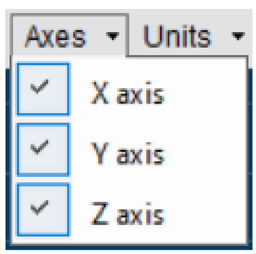


Figure 18: Selecting the data channel

2.6.3.2 Selecting the sensor data/sample representation unit

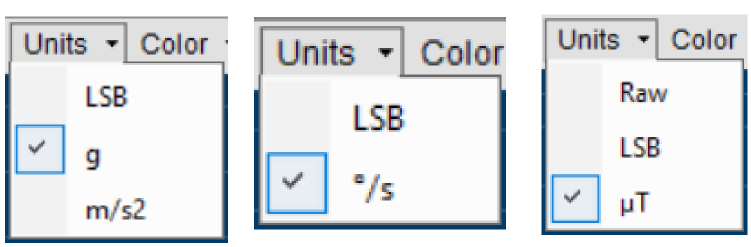


Figure 19: Selecting data representation unit (accel, gyro, and mag)

From the **Units** menu, select any of the units for the connected Sensor. Available units are:

- LSB
- g
- m/s^2

2.6.3.3 From the Interrupt menu, select the interrupt status lines.

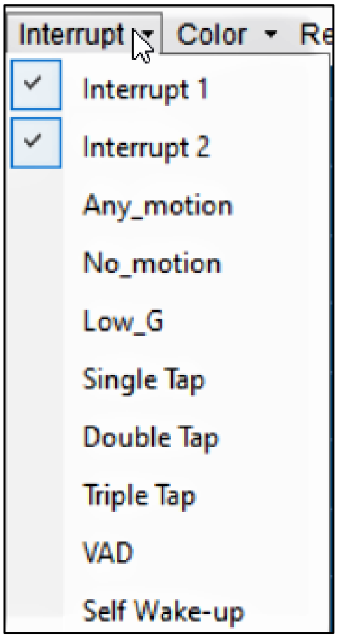


Figure 20: Selecting the interrupt status line

The sensor interrupt status lines can be monitored on the plotter by enabling the interrupts from the **Interrupt** menu on the graph. Similarly, based on the individual sensor features, the interrupt status line can be enabled/disabled from the **Interrupt** menu on the plotter.

2.6.3.4 Selecting color

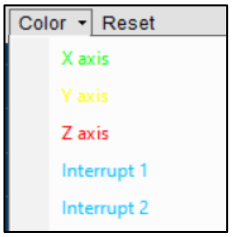


Figure 21: Selecting color

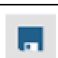
Different colors are used to distinguish between the three axes' signals in the plotted graph. These colors and the graph's background color can be modified using **Channel Selection.**

2.6.3.5 Graph Utilities

The sensor samples can be analyzed using graph features like Play/Pause, view history, graph speed, Zoom In/Out, zoom specific areas in the graph, and an option to save the snapshot and print. The graph utilities shown in below Figure enhance the user experience.

Figure 22: Graph Utilities

Table 1: Graph utility description

	Sensor sample plotting is paused. Click this button to view the sensor samples in the plotter.
	Sensor samples are plotted on the graph. Click this button to pause the sensor samples.
	Scroll the graph to view the history.
	Zoom in/out of the X-axis to control the speed of samples plotted
	Zoom in
	Zoom out
	Zoom in a particular area of the graph
	View the X and Y values on the graph.
	Save the current instance of the graph.
	Print previews the current instance of the graph.
	Print the current instance of the graph.

3 Key Terms

Below are some of the key terms used in this user manual.

- **ODR** stands for "Output Data Rate" in the context of sensors. It refers to the rate at which a sensor provides samples or measurements as output. ODR specifies how often the sensor updates and reports its readings, typically in measurements per second (e.g., Hertz - Hz). Some of the sensors will have the ODR as “**Sample Rate**”.

In an accelerometer or gyroscope, an ODR of 100 Hz means the sensor provides 100 samples per second, and each data point represents the sensor's measurements at that moment in time.
Adjusting the ODR can impact the sensor's power consumption, data accuracy, and the number of samples it generates, making it an important setting when using sensors in various applications.

- **Bandwidth** refers to the range of frequencies of motion or vibration the sensor can effectively detect. It affects the sensor's ability to accurately capture high-frequency or rapid changes in motion.

- **Power Mode** in sensors refers to different operating states or configurations that determine the sensor's power consumption and performance characteristics. These modes are used to optimize the sensor's behaviour based on the specific requirements of an application. Power modes supported in Bosch Sensortec sensors are below:
  - **Low-Power mode** is designed for minimal power consumption. It allows the sensor to operate with reduced power usage while sacrificing some performance features. This mode is often used when extended battery life or energy efficiency is a priority.
  - **Normal mode** has the sensor operate with a balance between power consumption and performance. This mode provides adequate sensitivity and accuracy for many common applications without excessive power drain.
  - **High-Performance mode** maximizes the sensor's data accuracy and output frequency capabilities. It's typically used when precise measurements or rapid data updates are essential, even if it means higher power usage.
  - **Suspend mode** is the lowest power state, often used when the sensor must be on standby but maintain its configuration. Power consumption is minimized in this mode, and the sensor can quickly return to an active state when required.
  - **Sleep mode** puts the sensor in a sleep state such that no measurements are performed, and there is minimal power consumption. A sensor usually starts in sleep mode after the power-up sequence.
  - **Non-stop mode** applies only to the BMP580 sensor, where repetitive measurements can be done without duty cycling.
  - **Forced mode** also allows triggering new measurements at any rate, depending on the sensor feature. In force mode, the sensor will wake up from sleep mode, read the data, and return to sleep mode.

  The BMM350 sensor has two flavors: "Forced Mode" and "Forced Mode Fast." It is possible to switch to Forced Mode from Suspend Mode only.

- **Filter Performance** refers to the effectiveness of the filters or signal processing techniques employed to remove unwanted noise, interference, or artifacts from the sensor's raw data. The term "filter" can refer to hardware (analog or digital filters) and software-based algorithms used to enhance the quality and accuracy of the sensor's output.

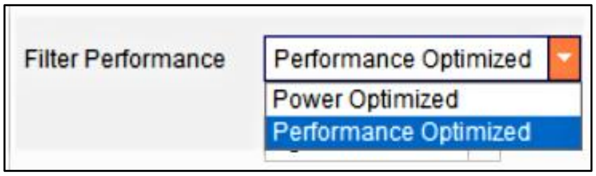


Figure 23: Filter performance values in BMI270

If the user selects any **Filter Performance** option, such as **Power Optimized** or **Performance Optimized,** the sensor's other configurations, bandwidth, range, and ODR will be changed accordingly without user intervention.

Filter performance is crucial in various sensor applications, such as accelerometers, gyroscopes, and environmental sensors, as it helps do the following:

  - **Reduces noise**: Filters can eliminate random or unwanted variations in the sensor data, making detecting meaningful patterns or changes in the measured parameter easier.
  - **Improves accuracy**: By minimizing interference and noise, filter performance can enhance the precision and reliability of sensor measurements.
  - **Enhances data interpretation**: Clear and filtered data allow for better analysis and interpretation, aiding in decision-making and problem-solving.

- **Range** refers to the sensor's measurement range or dynamic range. It specifies the minimum and maximum values that the sensor can accurately measure. The range is typically expressed in physical units (e.g., g/meters per second square/LSB for accelerometer and degrees per second for gyroscope). It determines the span of values within which the sensor can provide reliable and accurate measurements.
  - **Accelerometer Range**: If an accelerometer has a range of ±2 g (g represents the acceleration due to gravity), it can accurately measure accelerations ranging from -2 g to +2 g. Accelerations outside this range may result in distorted or clipped data.
  - **Gyroscope Range**: A gyroscope with a range of ±2000 degrees per second can provide accurate measurements of angular rates within the range of -2000 degrees per second to +2000 degrees per second.

4 Accelerometer

Bosch Sensortec has specifically designed the 3-axis accelerometer family for low-power applications optimized for devices such as smartphones and wearables. Accelerometers measure the change of linear motion by applying the sensing principle of capacitive detection.

- By default, the accelerometer plotter will be enabled and visible in the master view. To toggle the accelerometer plotter, select **Menu** > **Panels** > **Accelerometer** or click **Ctrl+A.**
- From the **general settings** tab, select **Accelerometer** (refer below Figure) to modify the accelerometer settings.

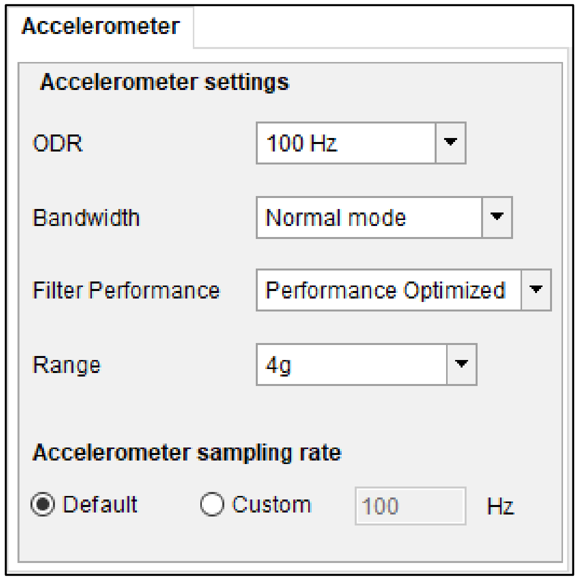


Figure 24: Accelerometer settings

5 Gyroscope

Gyroscopes are motion sensors that detect and measure an object's angular motion and orientation. Sensors with gyroscope features often share common settings such as power modes, Output Data Rate (ODR), bandwidth, filter performance, and range.

- In some cases, the gyroscope plotter is hidden by default. To toggle the Gyroscope plotter, navigate to **Menu -> Panels -> Gyroscope,** or click **Ctrl+Alt+G.**
- From the **general settings** tab, select **Gyroscope** to modify the gyroscope settings (refer below Figure).

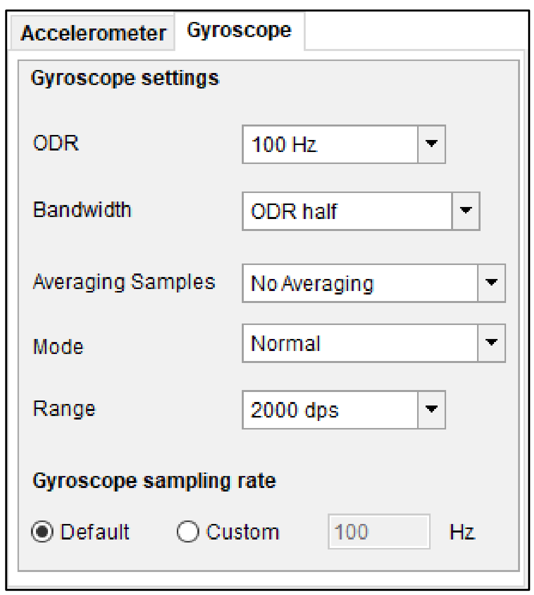


Figure 25: Gyroscope settings in IMU sensor

6 Magnetometer

The magnetometer is a small, robust triaxial sensor measuring the terrestrial magnetic field at low power for heading calculation. It accurately measures orientation in relation to the Earth's magnetic field.

- The magnetometer plotter will be visible by default in some cases. To toggle the magnetometer plotter, select **Menu** > **Panels** > **Magnetometer** or click **Ctrl+M.**
- From the **general settings** tab, select **Magnetometer** to modify the magnetometer settings (refer below Figure)
- Data will be displayed only in the Forced Mode, as shown in below Figure.

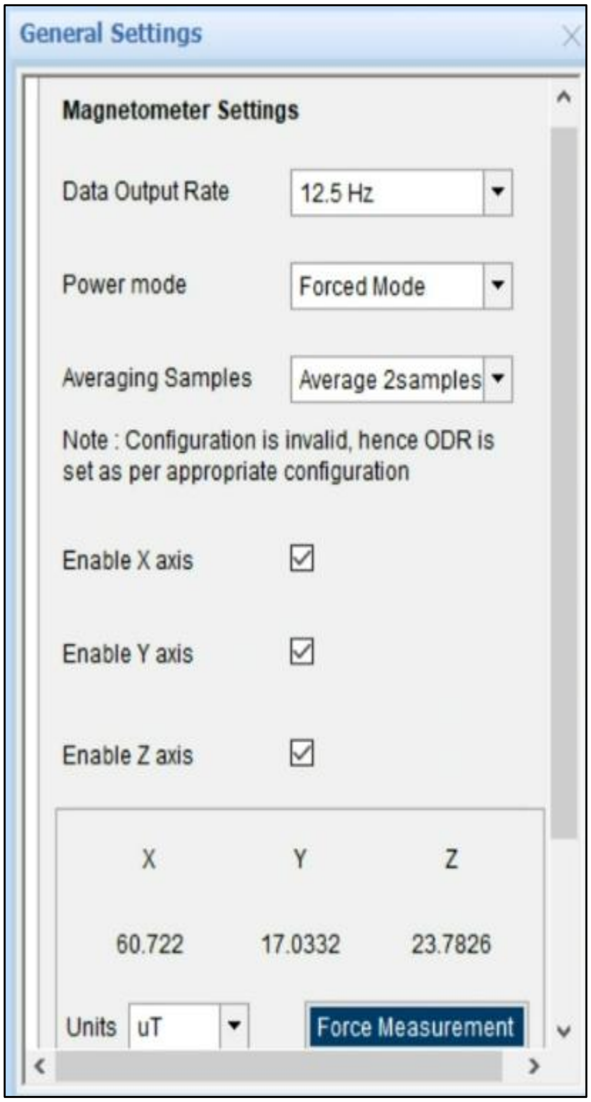


Figure 26: Magnetometer settings in the BMM350 sensor

7 Pressure Sensors

Bosch Sensortec low-power barometric pressure sensors stabilize the altitude and enable accurate indoor navigation and outdoor activities. Set different Oversampling Rates (OSR), and samples will be collected accordingly.

Calibration for sea level pressure is done by entering the reference sea level pressure, which only applies to the BMP58x sensor.

In some cases, the pressure plotter will be visible by default.

- From the **general settings** tab, select **Pressure settings** to modify the pressure settings (refer below Figure).

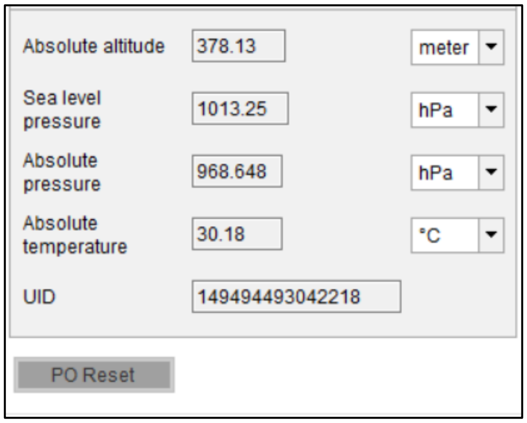


Figure 27: Pressure Settings

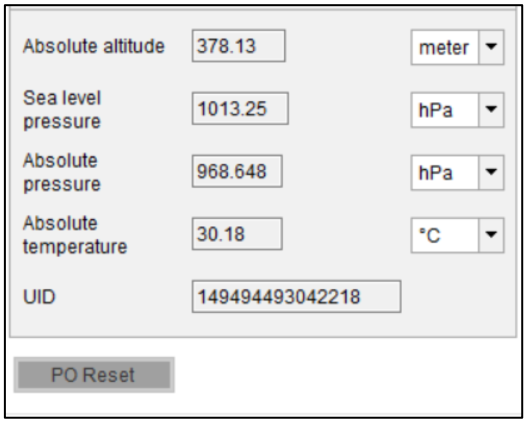


Figure 28: Sea level pressure and altitude calibration

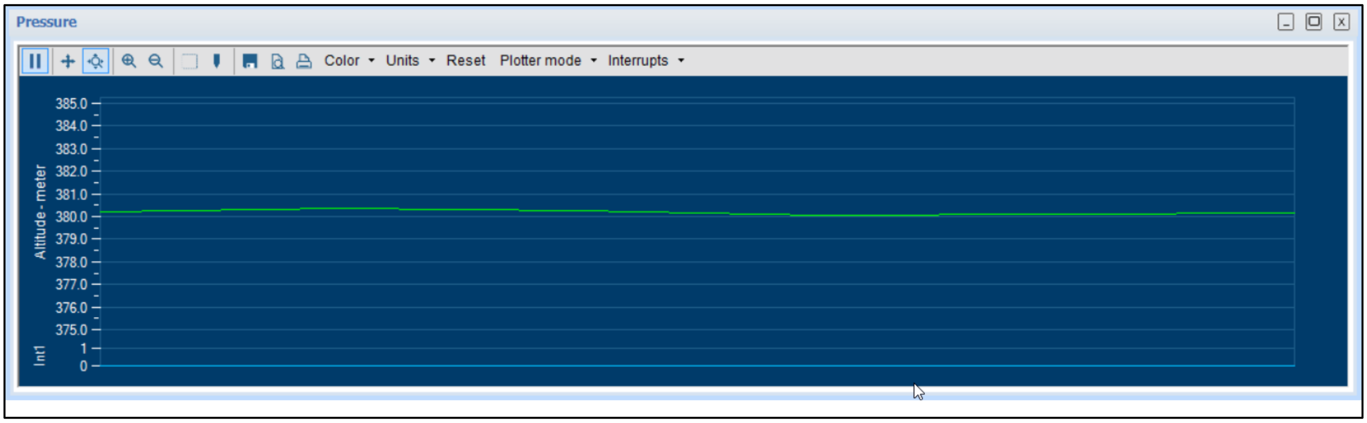


Figure 29: Pressure plotter

8 Humidity Sensors

Bosch Sensortec humidity sensors combine high linearity and high accuracy sensors and are perfectly feasible for low current consumption, long-term stability, and high EMC robustness. The humidity sensors offer an extremely fast response time, supporting performance requirements for emerging applications such as context awareness and high accuracy over a wide temperature range for environmental sensors.

A GUI named **Roger** is created to represent the humidity better, which can be referred to here.

- In some cases, the humidity plotter is visible by default. To toggle the humidity plotter, select **Menu** > **Panels** > **Relative Humidity** or click **Ctrl+H.**

- Humidity samples can be viewed in the plotter (refer below Figure), and the general settings will display the run-time value in a textbox, represented in %.

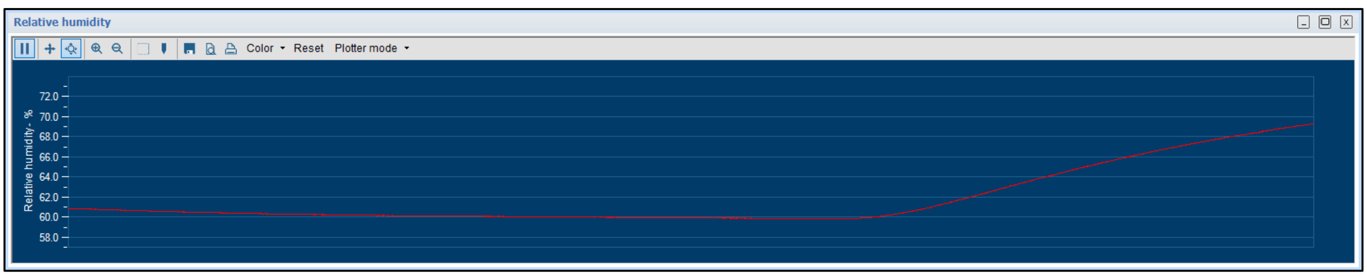


Figure 30: Relative humidity plotter

9 Altitude Sensors

Bosch Sensortec altitude sensors utilize barometric pressure changes to calculate relative altitude. The sensor provides accurate altitude readings by measuring changes in atmospheric pressure. View the readings in the Altimeter panel.

Altitude data can be viewed in the plotter as shown in below Figure, and it can also be viewed in a circular gauge by enabling it from **Panels** > **Altimeter** or clicking **Ctrl +Shift + D.**

Figure 31: Altimeter

In some cases, the altitude plotter will be visible by default (refer below Figure). To toggle the altitude plotter, select **Menu** > **Panels** > **Altitude** or click **Ctrl+P.**

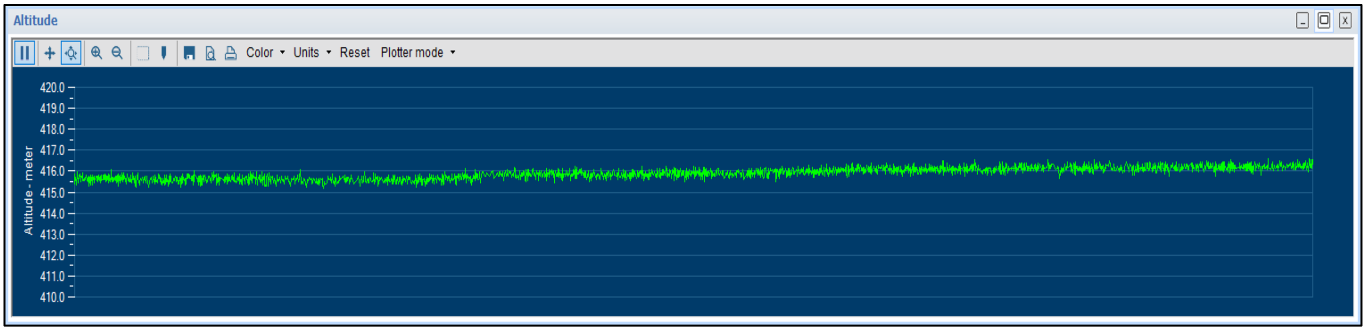


Figure 32: Altitude plotting in sensor mode

10 Gas/Air Quality

10.1 Gas resistance

Bosch Sensortec gas sensors are highly integrated four-in-one environmental sensors combining barometric pressure, ambient temperature, relative humidity, and gas measurement in one small package. Consider the following:

- Gas resistance range values will be different for the BME680 and BME688 sensors.
- Gas resistance can be viewed in the plotter, as shown in below Figure, and the general settings display the run-time value in a textbox.

The gas resistance plotter can be toggled by navigating to **Menu** > **Panels** > **Gas** or click **Ctrl+Alt+G.**

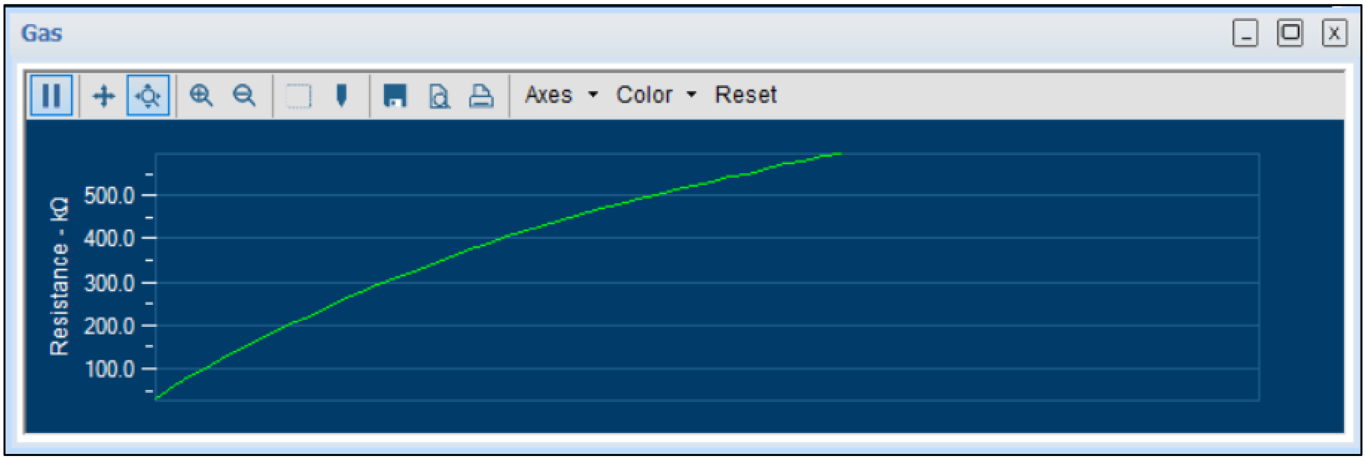


Figure 33: Gas resistance plotter in BME680

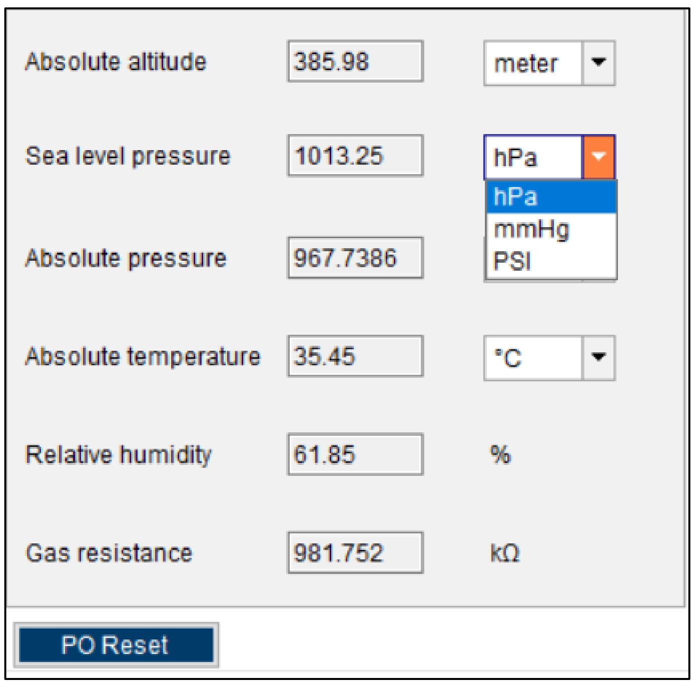


Figure 34: Values captured in BME680 General settings.

Select the **Sea level pressure** drop-down menu to select the unit for reading the sample (**hPa**, **mmHg,** or **PSI).**

10.2 Indoor Air Quality (IAQ)

Indoor Air Quality (IAQ) is an index used to measure the air quality inside closed environments to estimate the well-being of the occupants. The absolute IAQ values indicate the presence of volatile organic compounds.

The DD 2.1 UI displays the IAQ and other environmental parameters like pressure, relative humidity, and temperature. They detect a broad range of gases, including Volatile Organic Compounds (VOC), for air quality monitoring in smart homes.

- In some cases, the IAQ plotter is visible by default. To toggle the gas plotter, select **Menu** > **Panels** > **IAQ** or click **Ctrl+I**.
- View IAQ in the plotter as shown in below Figure, and a circular gauge is displayed in the **General Settings** for the BME680 sensor.

IAQ is calculated based on the BSEC algorithm. It's displayed in the circular gauge plotter in **General Settings** > **Measurement Settings** and shows values based on the air quality range. By default, the BME680 sensor has BSEC mode, which users can modify from **Panels** > **Mode selection settings.**

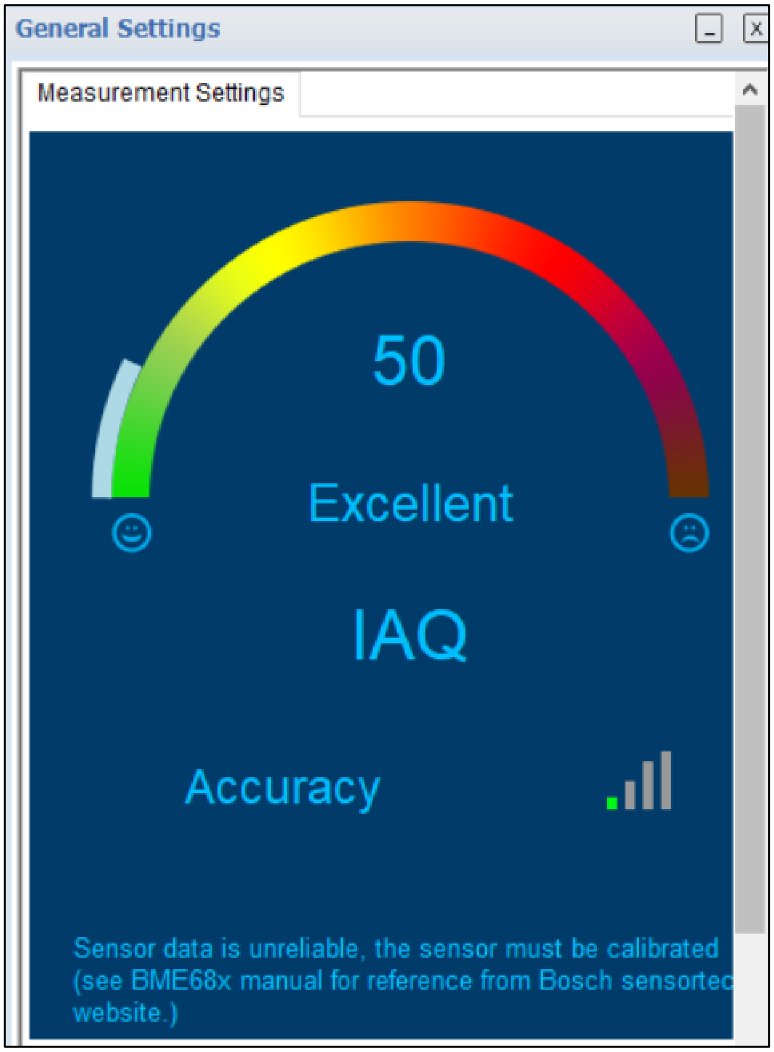


Figure 35: IAQ in BME680

There are two modes available in the **Mode Selection settings** dialog (refer below Figure):

- **Sensor Mode**: Raw samples from the connected virtual sensor are plotted directly. When switched to sensor mode, the **General Settings** dialog for the BME680 sensor has its sensor feature configuration, as shown in below Figures.

BSEC Mode: Raw samples are fed into the BSEC library, which processes input signals from the sensor and produces the required output, such as IAQ, Humidity, and Accuracy status.

The BME680 sensor in BSEC mode receives the samples based on the sampling mode chosen.

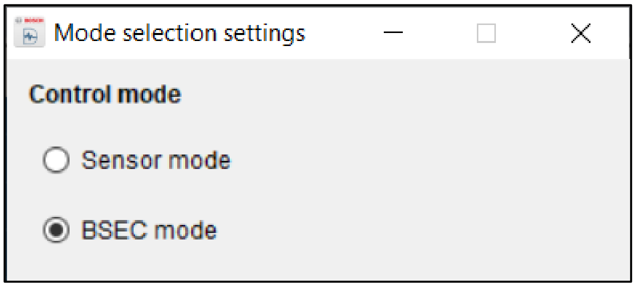


Figure 36: Mode selection in BME680

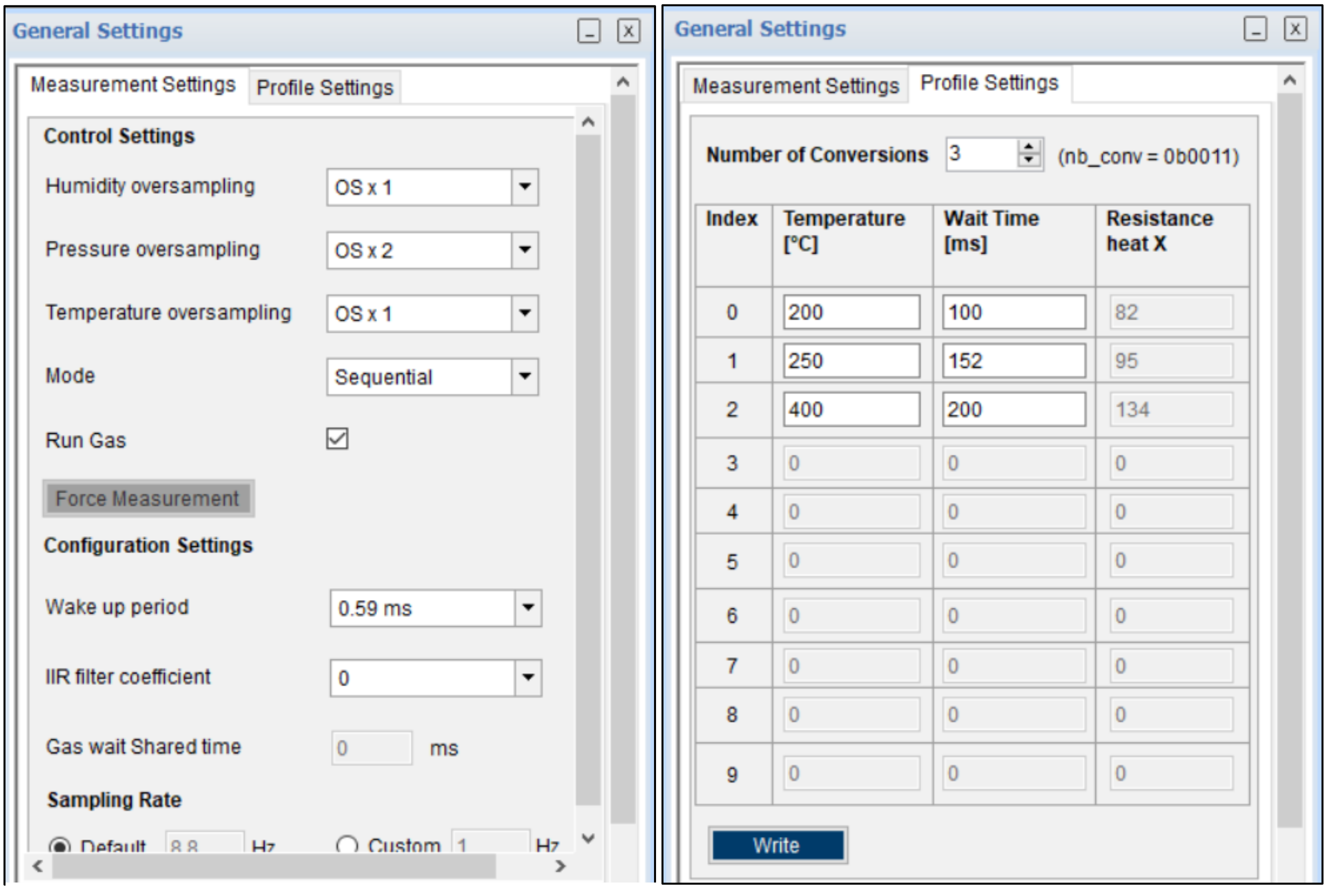


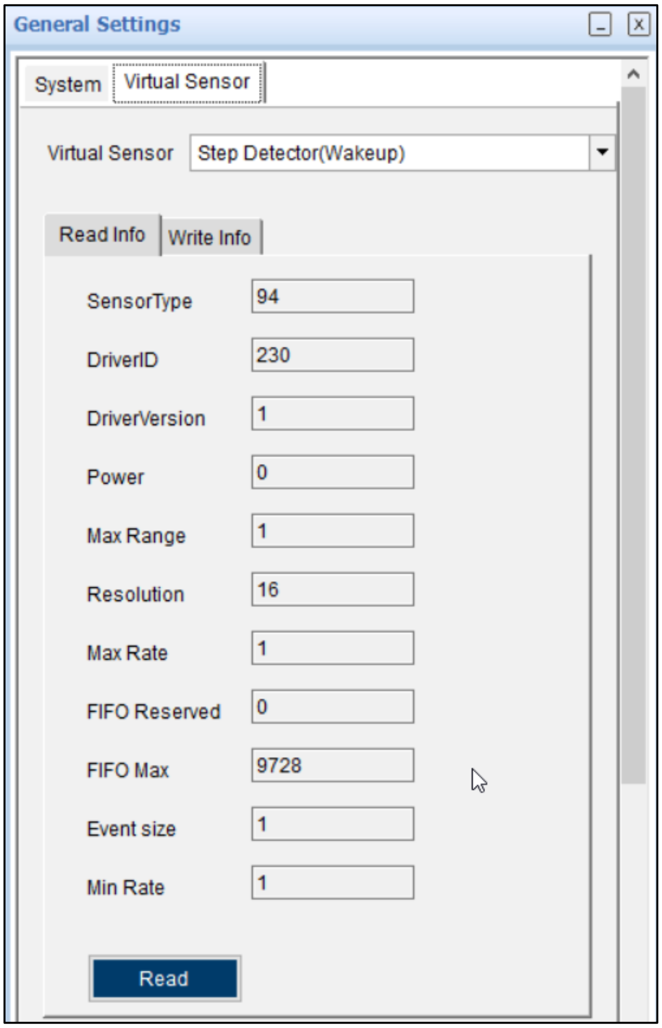
Figure 37: General Settings in the BME68x sensor (sensor mode)

11 BHY (Smart) Sensor

11.1 Virtual Sensor in General Settings

Configure and view the virtual sensor parameter information for BHY (smart) sensors by selecting **General Settings**, where the user can configure and view the virtual sensor parameter information.

- From the **Read Info** tab, users can view the virtual sensor parameter details.
- From the **Write Info** tab, users can choose the virtual sensor and the Sample Rate (By default, 100Hz is selected and user must click on **Write** button to configure the sensor).



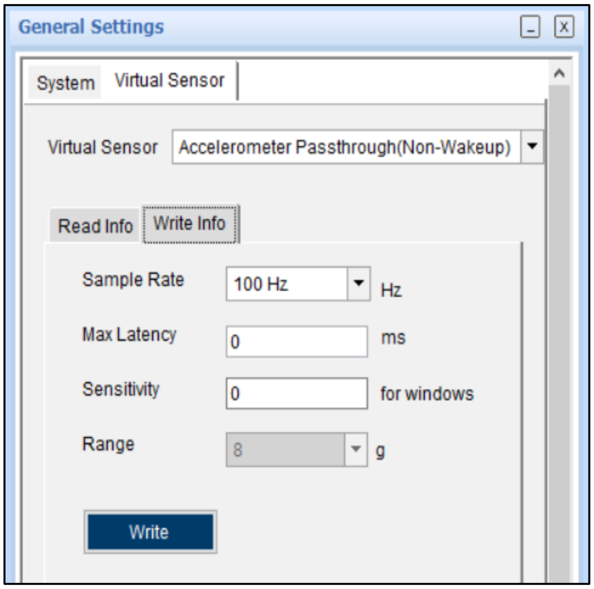


Figure 38: Virtual Sensor in BHY(smart) sensors (Read Info & Write Info) tab

11.2 System in General settings

Users can choose different plotters to view in the plotter and other options like updating the FIFO watermark level, disabling interrupt and general settings page.

All active virtual sensors will be listed from **General Settings** > **Virtual Sensor** > **Active Virtual Sensor** field.

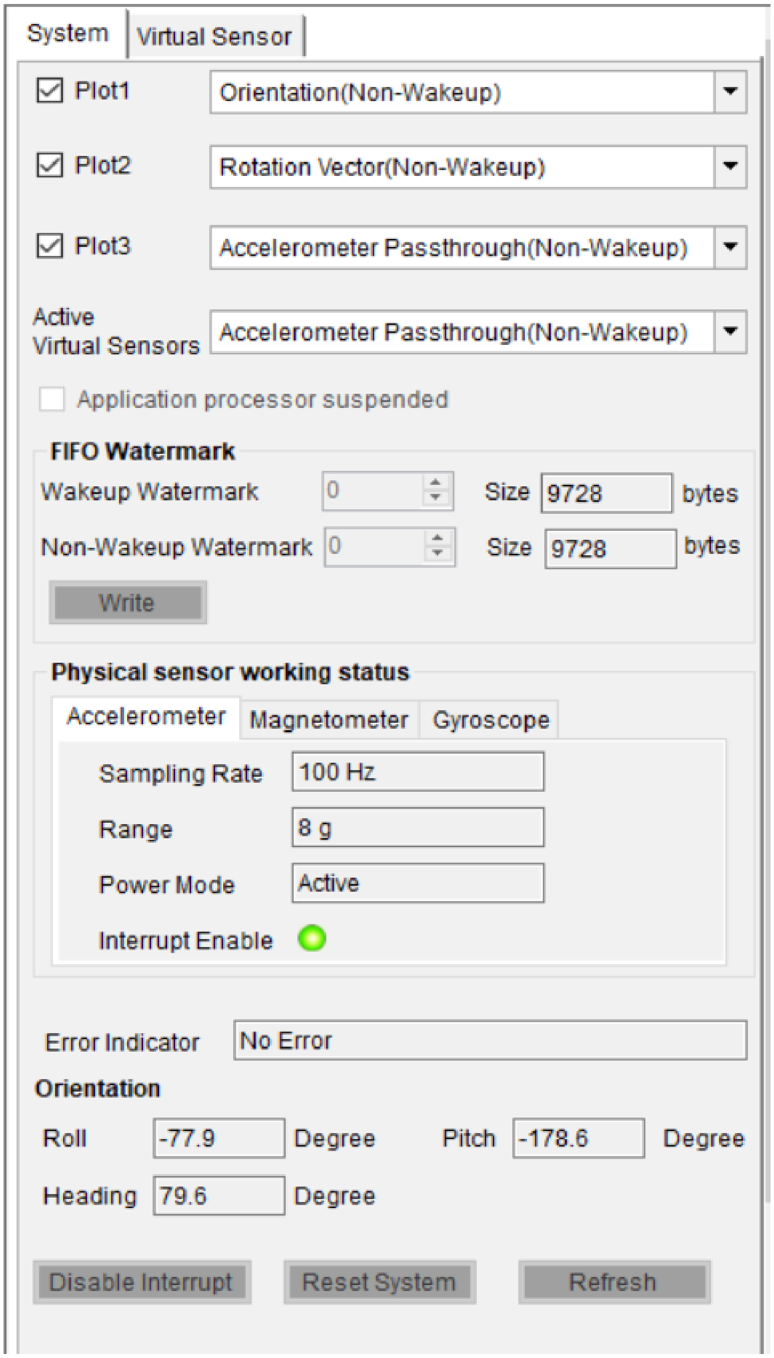


Figure 39: General settings for BHY sensors (smart sensors)

11.3 Download the firmware image for BHY

For smart sensors, users can download and flash the virtual sensors and view the sensor samples in the plotter. This firmware will be flashed in the shuttle board's microcontroller, and the corresponding virtual sensor is listed in the **General Settings**.

1. In **the Download firmware image for "sensor name"** dialog, go to the **Select the firmware (.fw)** field and select the appropriate file. Then, click **Download** to flash the firmware file in it. A confirmation message appears indicating the progress of the firmware download (see
2. Select one of two options: RAM or Flash
   - RAM: Firmware will be flashed in RAM location
   - Flash: Firmware will be flashed in Flash location

Once the firmware is flashed, the application will show a confirmation message, as shown in below Figure.

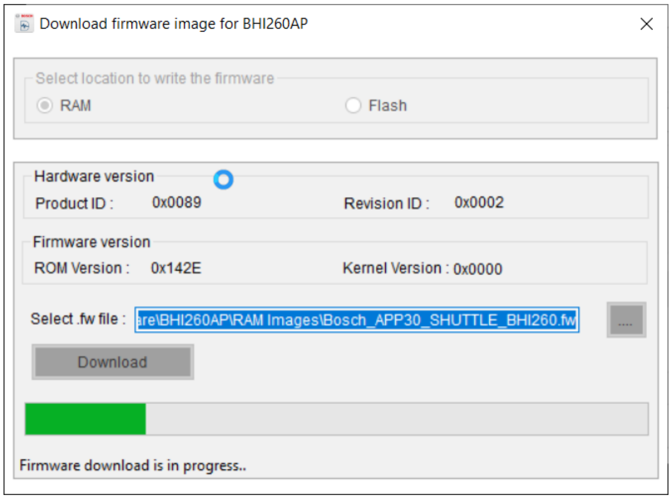


Figure 40: Firmware download in Progress for BHI260AP

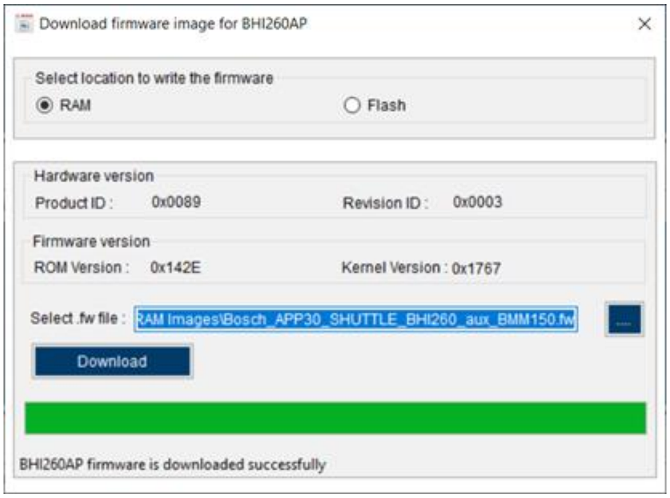


Figure 41: Firmware downloaded completed for BHI260AP

3. From **General Settings**, the user can choose the required virtual sensors and view the samples in the plotter, as shown in below Figure.

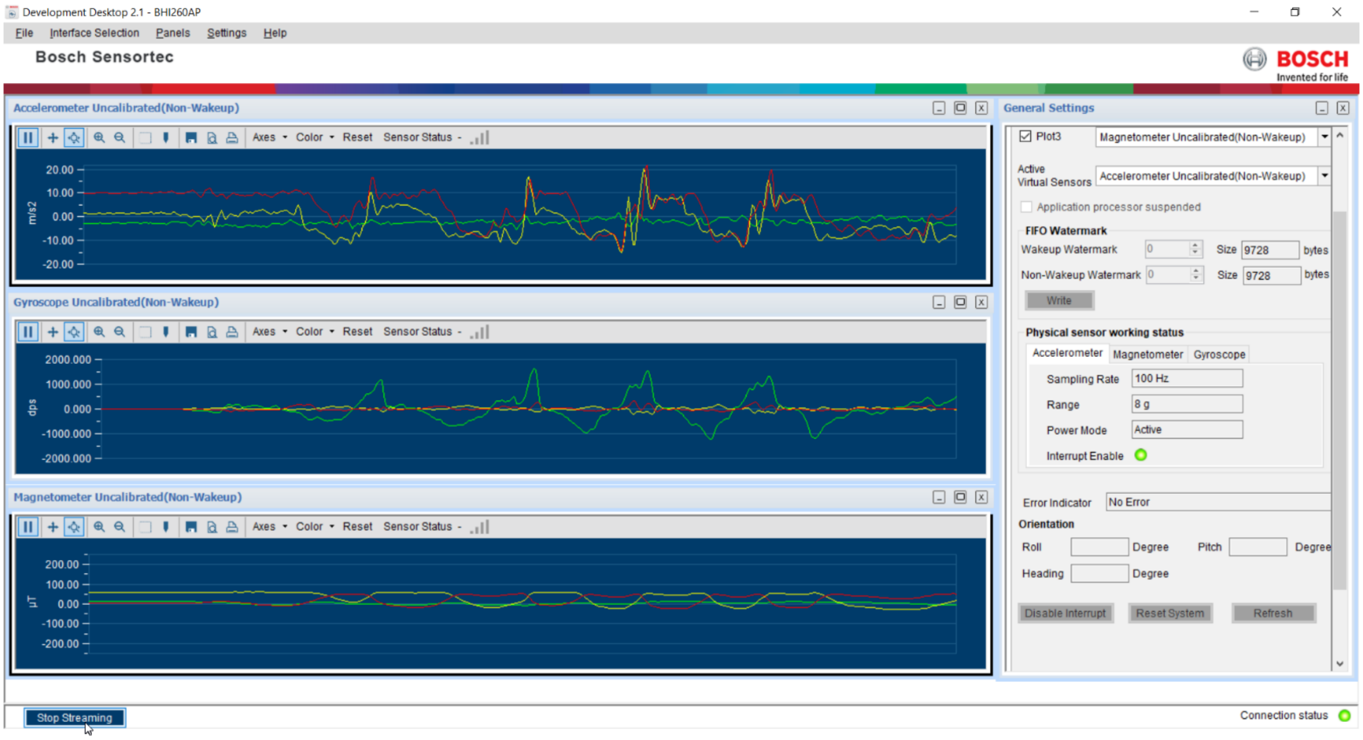


Figure 42: Virtual Sensor Plotter for smart sensors in BHI260AP

Binary View in smart sensors (BHY)

Panels > **Binary View** (refer below Figure) displays the mapping feature/functionalities where the user can view the register info and grouping of parameters.

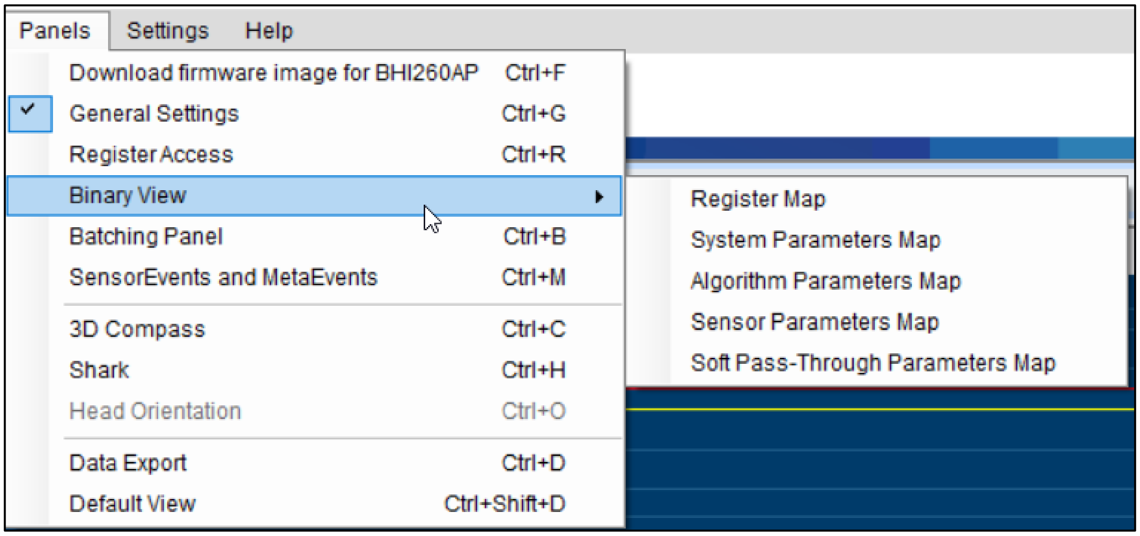
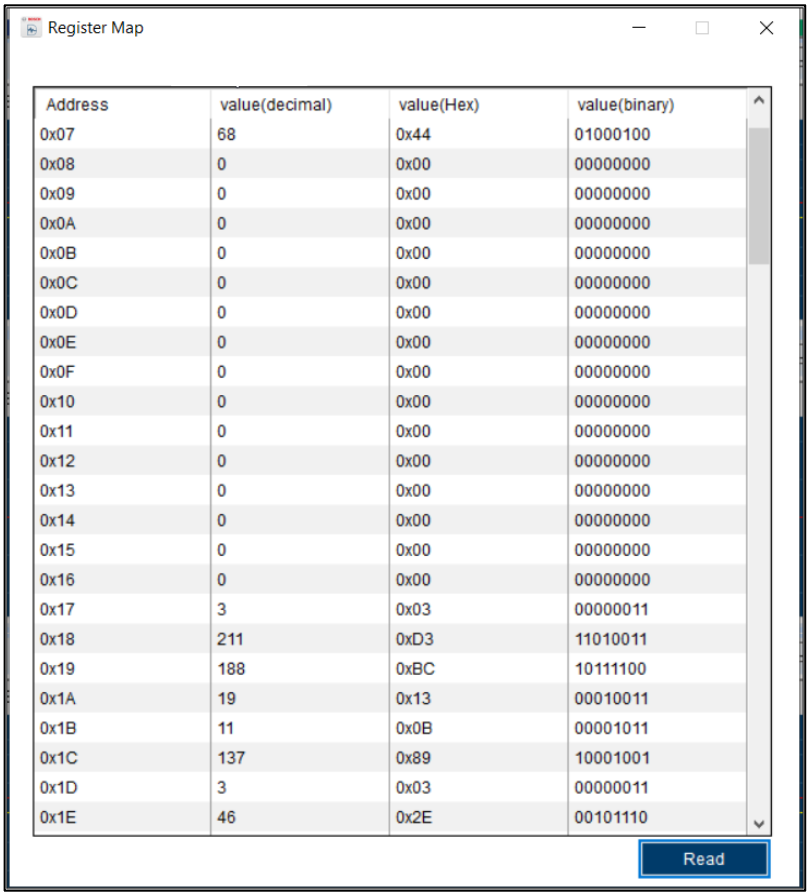


Figure 43: Binary View for BHY/smart sensors (BHI260AP)

Each mapping functionality is described in detail below.

11.4 Register Map

The **Register Map** view dialog displays the list of register addresses and their values in decimal, Hex, and binary. It's only used for read operations. Click **Read** to view the Register Map (refer below Figure).



Address	value(decimal)	value(Hex)	value(binary)
0x07	68	0x44	01000100
0x08	0	0x00	00000000
0x09	0	0x00	00000000
0x0A	0	0x00	00000000
0x0B	0	0x00	00000000
0x0C	0	0x00	00000000
0x0D	0	0x00	00000000
0x0E	0	0x00	00000000
0x0F	0	0x00	00000000
0x10	0	0x00	00000000
0x11	0	0x00	00000000
0x12	0	0x00	00000000
0x13	0	0x00	00000000
0x14	0	0x00	00000000
0x15	0	0x00	00000000
0x16	0	0x00	00000000
0x17	3	0x03	00000011
0x18	211	0xD3	11010011
0x19	188	0xBC	10111100
0x1A	19	0x13	00010011
0x1B	11	0x0B	00001011
0x1C	137	0x89	10001001
0x1D	3	0x03	00000011
0x1E	46	0x2E	00101110

Figure 44: Register map view in BHI260AP

11.5 System Parameters Map

The **System Parameters Map** dialog (refer below Figure) displays the parameter values (per the datasheet).

1. To select the system parameter to view its values, open the **System Parameter Map** dialog.
2. From the **Param Selection** section:
   a. In the **Starting Param Number** field, select the parameter to start the value range.
   b. In the **Ending Param Number** field, select the parameter to end the value range.
   c. To update the parameter settings with your starting and ending selections, click **Update**.

Note: Only three parameters are displayed on the landing page by default.

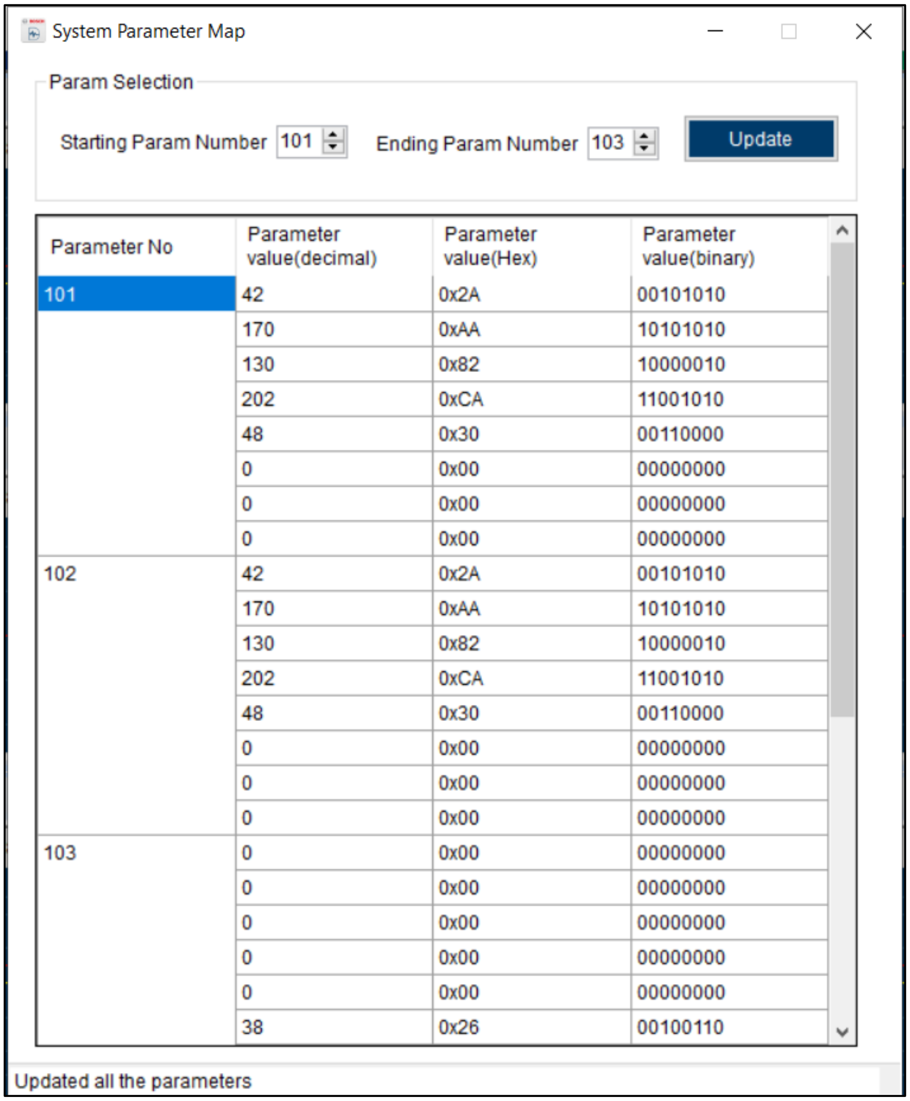


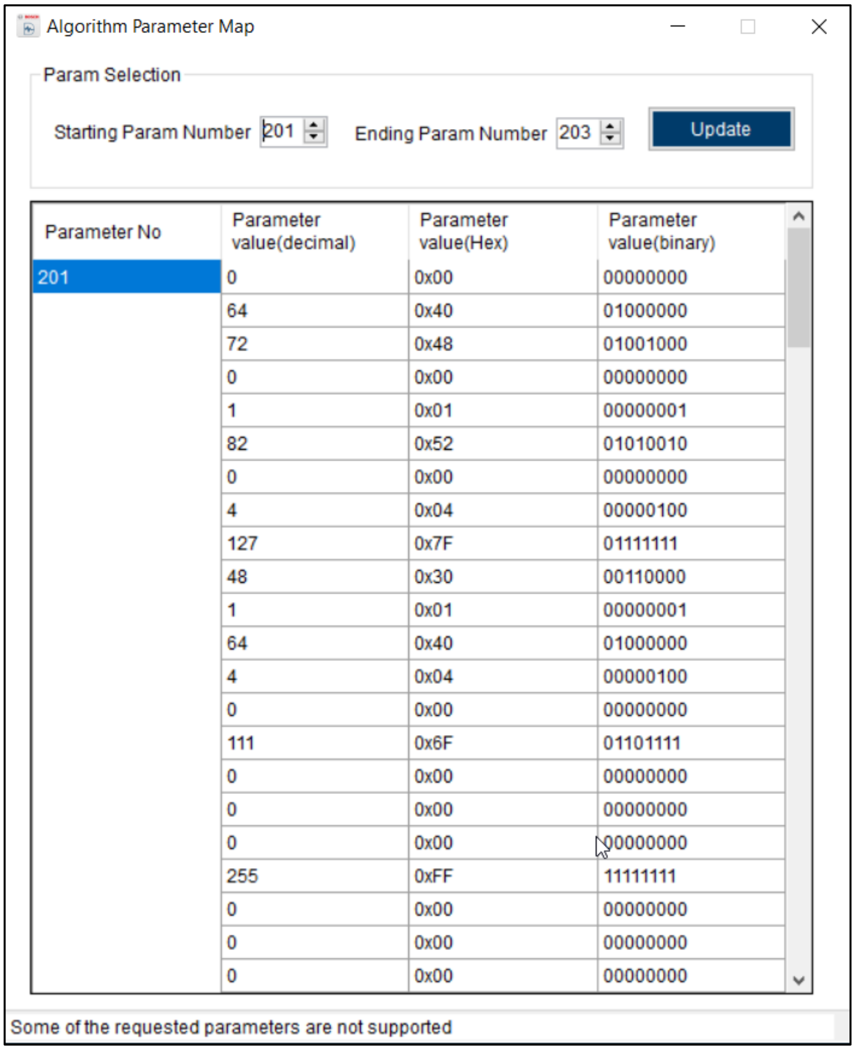
Figure 45: System Parameters Map view in BHI260AP

11.6 Algorithm Parameters Map

The **Algorithm Parameters Map** dialog (refer below Figure) displays the parameter values (per the datasheet).

1. To select the algorithm parameters map view, open the Algorithm Parameters Map dialog.
2. From the **Param Selection** section:
   a. In the **Starting Param Number** field, select the parameter to start the value range.
   b. In the **Ending Param Number** field, select the parameter to end the value range.
   c. To update the parameter settings with your starting and ending selections, click **Update.**

Note: Only one parameter will be displayed on the landing page by default.



Parameter No	Parameter value(decimal)	Parameter value(Hex)	Parameter value(binary)
201	0	0x00	00000000
	64	0x40	01000000
	72	0x48	01001000
	0	0x00	00000000
	1	0x01	00000001
	82	0x52	01010010
	0	0x00	00000000
	4	0x04	00000100
	127	0x7F	01111111
	48	0x30	00110000
	1	0x01	00000001
	64	0x40	01000000
	4	0x04	00000100
	0	0x00	00000000
	111	0x6F	01101111
	0	0x00	00000000
	0	0x00	00000000
	0	0x00	00000000
	255	0xFF	11111111
	0	0x00	00000000
	0	0x00	00000000
	0	0x00	00000000

Figure 46: Algorithm Parameter Map view in BHI260AP

11.7 Sensor Parameter Map

The **Sensor Parameters Map** dialog (refer below Figure) displays the parameter values (per the datasheet).

1. To select the algorithm parameters map view, open the Sensor Parameters Map dialog.
2. From the **Param Selection** section:
   a. In the **Starting Param Number** field, select the parameter to start the value range.
   b. In the **Ending Param Number** field, select the parameter to end the value range.
   c. To update the parameter settings with your starting and ending selections, click **Update.**

Note: Only one parameter will be displayed on the landing page by default.

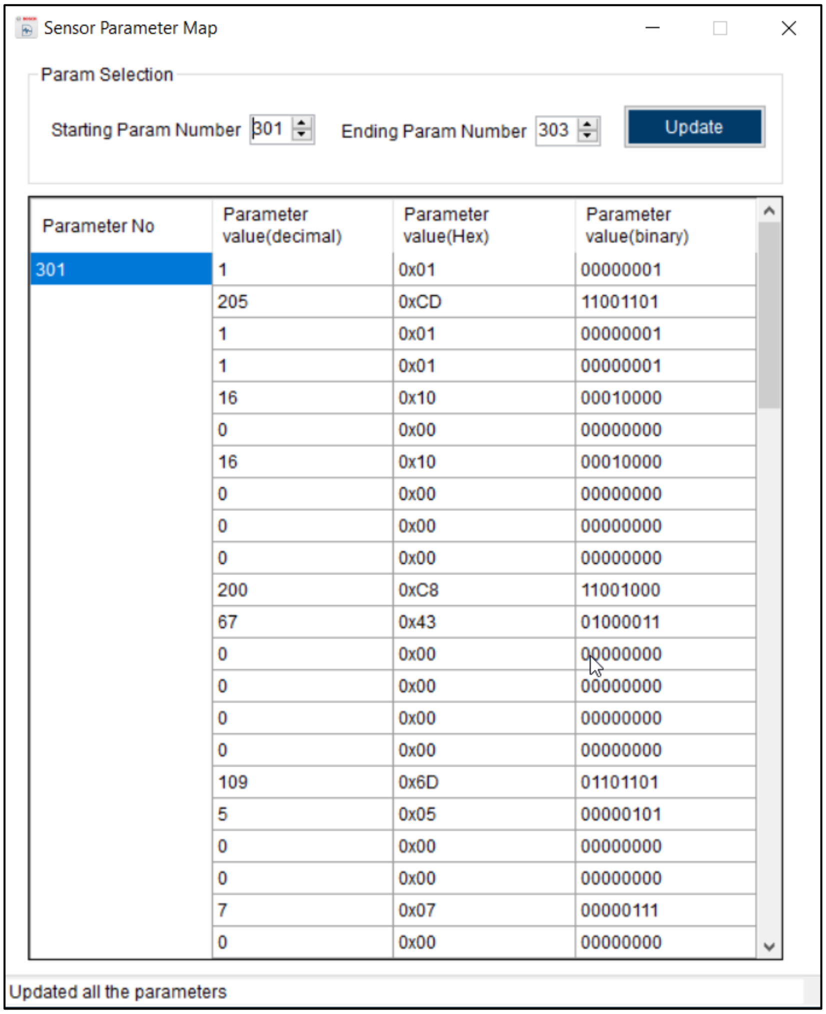


Figure 47: Sensor Parameter Map view in BHI260AP

11.8 Soft Pass-Through Parameters Map

The **Soft Pass-Through Parameter Map** dialog displays the sensor interface and interface settings in which the user can do the following from the Mode Settings section:

- input the Start address.
- input the add delay.
- choose the transfer type as **Burst/Normal**
- Select the direction as **Read/Write**

The user can view the selections in Hex format in the **Register Data (He**x) field. Users can also write the required values in the **Write Data** field by clicking **Write**.

Users can view the success/failure messages at the bottom of the dialog (refer below Figure).

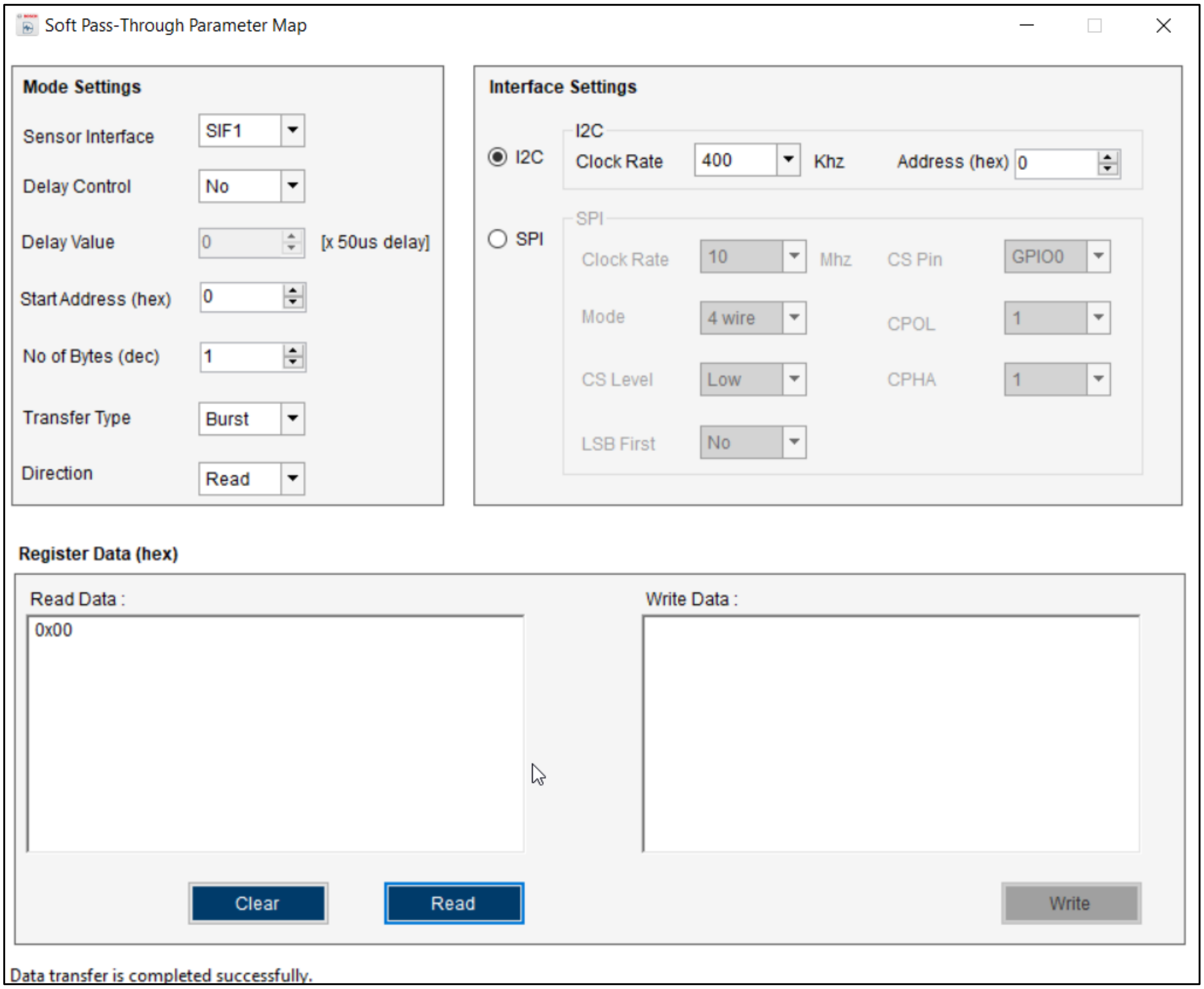


Figure 48: Soft Pass-Through Parameters Map view in BHI260AP

11.9 Batching Panel

The **Batching Panel** dialog allows the virtual sensors to be written simultaneously by modifying the sampling range and Latency. The ODR/Sampling Rate configuration done on the virtual Sensor in general settings will also be updated in the batching panel section.

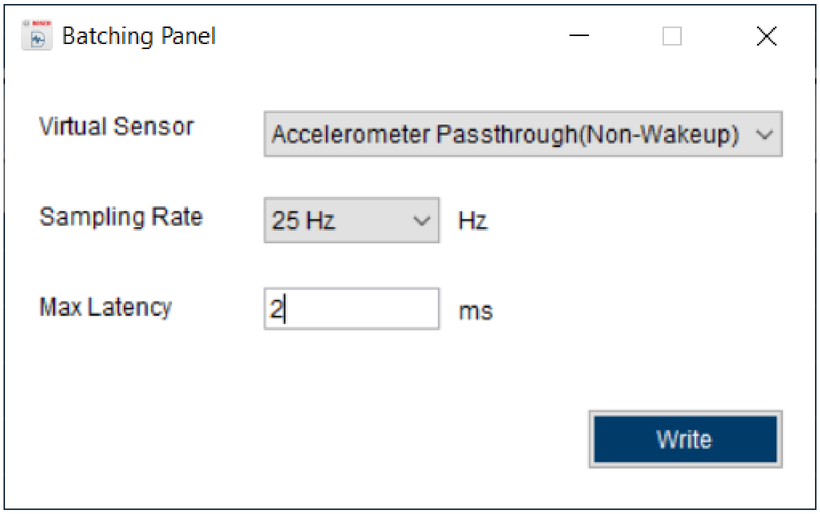


Figure 49: Batching panel from BHI260AP

12 Temperature Sensors

DD 2.1 offers a temperature plotter for a sensor that supports temperature. The temperature plotter is visible by default in some cases. To open the temperature plotter, select **Menu** > **Panels** > **Temperature**, or click **Ctrl+T**.

From the **Temperature** dialog, users can view the temperature in *C/Fahrenheit/Kelvin, which can be modified from the **Units** menu drop-down menu.

Temperature samples can be viewed in the Temperature plotter, as shown in below Figure.

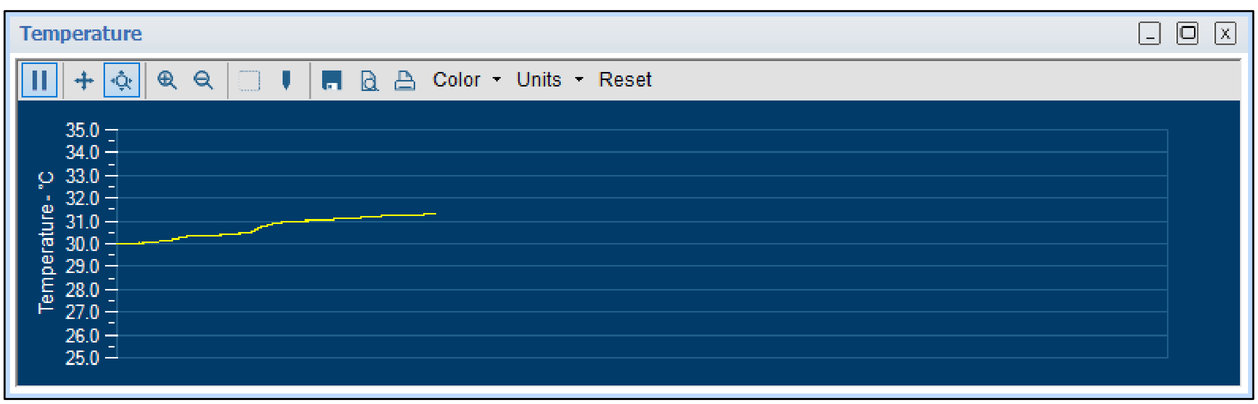


Figure 50: Temperature plotter

In the DD 2.1 **General Setting**s, select **Temperature** to open the Temperature dialog that displays the run-time value in the Temperature field, as in below Figure.

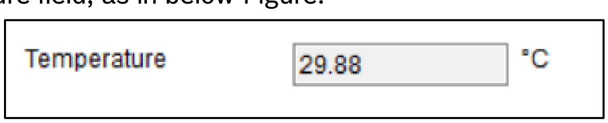


Figure 51: Temperature

13 DD 2.1 GUI common features

DD 2.1 has a distinct user interface for adjusting sensor functionalities. The following sections of the user manual outline the shared features accessible for all the sensors.

13.1 File

The **File** menu includes the **Exit** option to close DD 2.1.

13.2 Interface selection

The **Interface Selection** menu offers two options, each briefly explained below.

13.2.1 Board communication

You can choose the communication mode between the board and PC to establish a USB or COM interface. Follow these steps to change the communication Interface:

1. Click **Interface Selection** -> **Board communication**. The **Communication Interface** dialog opens. The **Communication Channel** displays the current mode of communication. The connection is active if the Communication Status is green (refer below Figure).

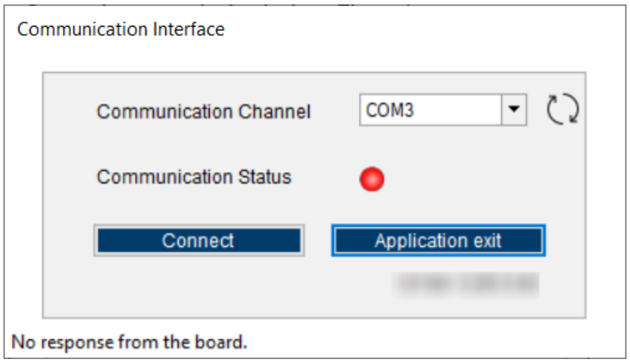


Figure 52: Communication Interface

2. To change the interface, click **Disconnect**. The **Communication Status** turns red (refer below Figure).
3. To select the desired interface, click the **Communication Channel** drop-down field. The **Communication Status** turns green, indicating the connection is established.

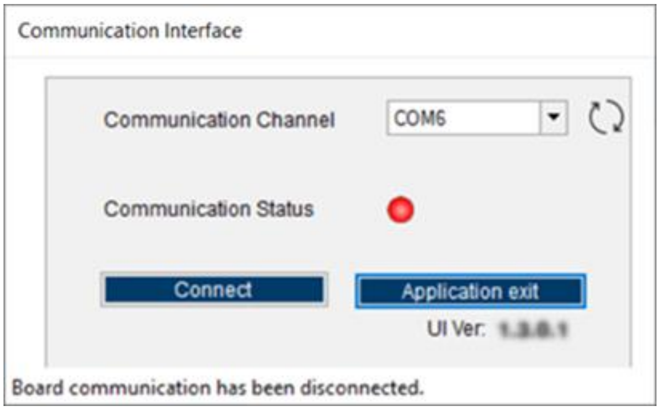


Figure 53: Communication Status

13.3 Sensor Interface

The **Sensor Interface Selection** dialog specifies the communication protocol for the sensor interface. Bosch Sensortec provides SPI and I2C protocols to read or write data/samples from the sensor. The interfaces are completely configurable, where some sensors, like BMA5xy, will be loaded by default in the I2C interface, and others might not be supported by the SPI interface (BMM350).

To configure the I2C interface for the connected sensor (refer below Figure):

1. Open the **Sensor Interface Selection** dialog.
2. From the **Sensor Interface** section, select **I2C**.
3. From the **I2C settings** section, select the I2C address by clicking the **I2C Address** drop-down field.
4. Select the I2C speed by clicking the **I2C Speed** drop-down field.
5. Click **Apply**.

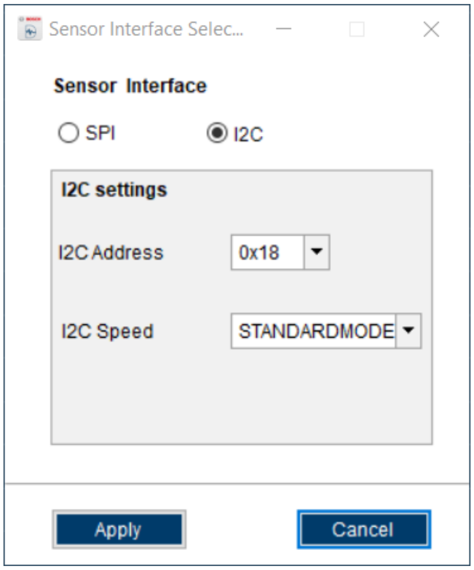


Figure 54: Sensor Interface selection I2C

6. Open the **Sensor Interface Selection** dialog.
7. From the **Sensor Interface** section, select **SPI**.
8. From the **SPI settings** section, select the SPI speed by clicking the **Speed** drop-down field.
9. Select the SPI length by selecting the length from the **Length** drop-down field.
10. Select the SPI mode by selecting the mode from the **Mode** drop-down field.
11. Click **Apply**.

To configure the SPI interface for the connected sensor (refer below Figure):

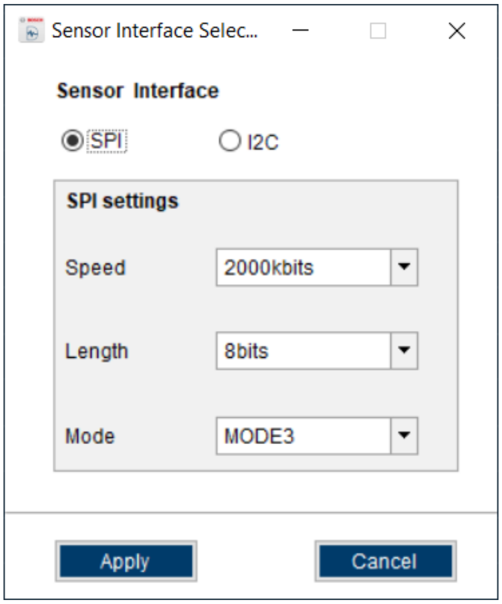


Figure 55: Sensor Interface Selection SPI

13.4 Panels

The **Panels** menu lists different sensor options and provides a way to configure the sensor and view the results. Refer below figures for examples of the **Panels** menu.

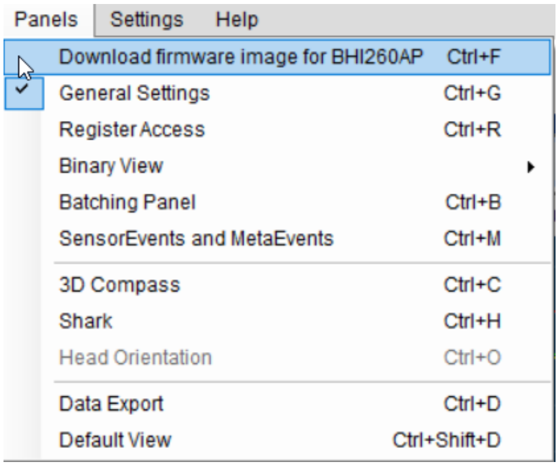


Figure 56 : Panels menu for BHI260AP

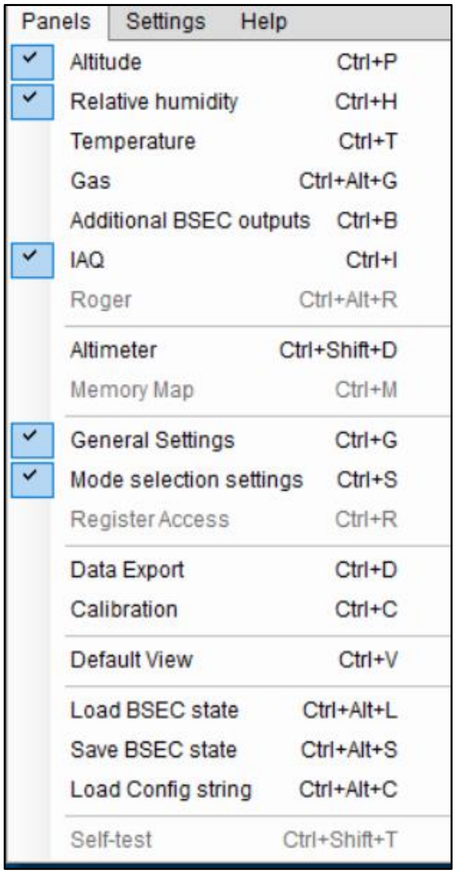


Figure 57: Panels menu for BME680

13.4.1 Sensor Events and Meta Events

The **Sensor Events and Meta Events** dialog is used to view the interrupts triggered, which have been configured in the virtual sensor. Users can also view the activity status (still/walk/run etc.) in the grid. Users can toggle the events and interrupts from this view and do a read/write based on the functionality. It also provides a timestamp in micro-seconds, along with the Meta event type.

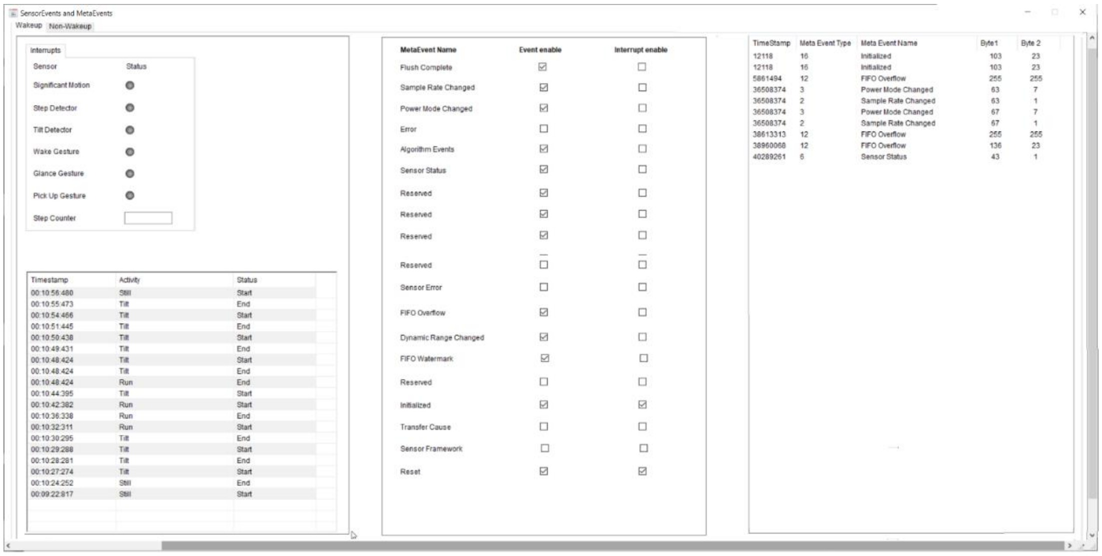


Figure 58: Sensor Events and Meta events

13.4.2 Reset

13.4.2.1 PO Reset (Power On Reset)

During Power On Reset (POR), the voltages VDD/VDDIO are ramped to their respective target values. After reaching the target supply voltages, all registers are accessible after a delay of 450 us.
After every POR or soft reset, the IMU remains in suspend mode. To prepare the device for operation, it must be initialized.

13.4.2.2 Soft Reset

A soft reset can be initiated at any time by writing the command soft reset (0xB6) to register CMD. The soft reset performs a fundamental reset to the device, mainly equivalent to a power cycle. Following a delay, all user configuration settings are overwritten with their default state (setting stored in the NVM) wherever applicable.

13.4.3 Data Export

The DD application allows the export of the sensor samples to .txt or .csv file format using the **Data Export** dialog under **Panels** menu.

By default, the application will suggest saving the file in the Documents folder, but the user can choose any other location.

Users can follow the procedure below to export the data:

1. From the **Panels** menu, click **Data Export** (or) **ALT + D.**
2. Select the required data to be exported.
3. Click **Select Destination** to save the log file (supported formats are .txt and .csv only).
4. Select **Append/Overwrite**.
5. Click **Start Logging**.

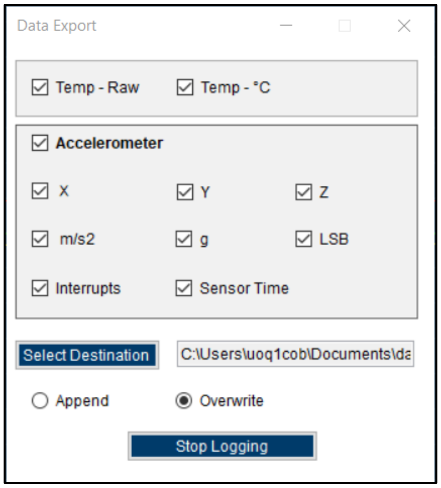


Figure 59: Data Export view

13.4.4 Memory Map

The **Memory Map** option under the **Panels** menu allows the user to choose sensor-supported features like Binary view, Interrupt view, Self-Test view, CRT, User Gain Update, etc.

The different options within **Memory Map** are described in the sections below

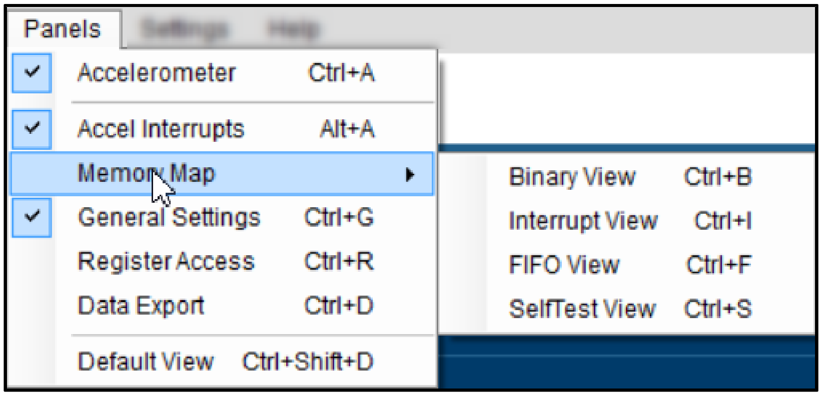


Figure 60: Memory Map

13.4.4.1 Binary View

To view the data in binary format, navigate to **Menu -> Panels -> Memory Map -> Binary View**, or click **Ctrl+B**. The **Binary View** dialog appears.

From the **Binary View** dialog, the user can read or write values into multiple registers in one view.

To read or write values from the **Binary View** dialog, use the following procedure:

1. Enter the value in the box alongside the register name.

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

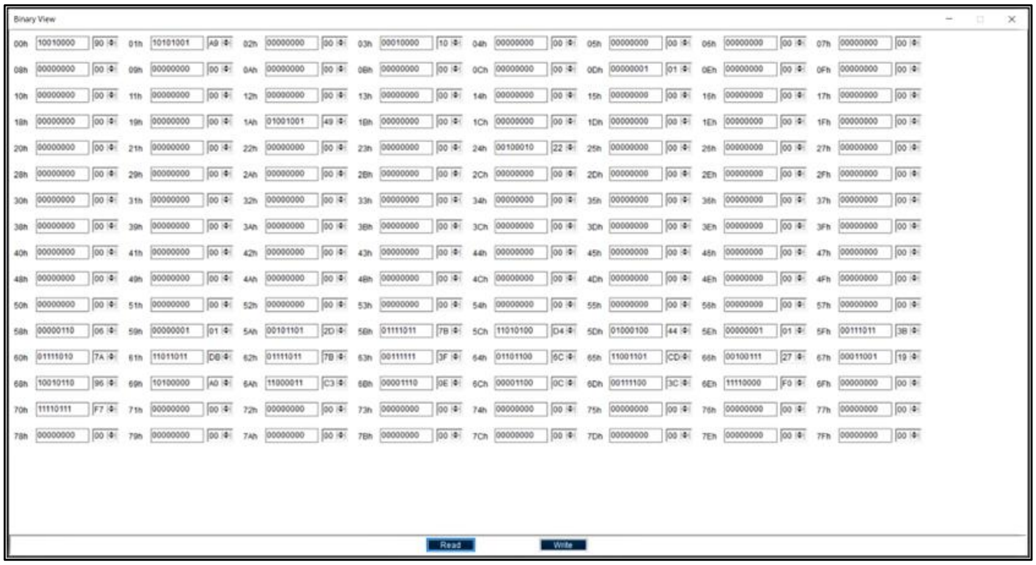


Figure 61: Binary View

13.4.4.2 Self-Test View

To conduct a self-test of the three axes in an Accelerometer, navigate to **Menu > Panels > Memory Map > SelfTest View**, or click **Ctrl+S**. The **Self-test** dialog opens as shown in below Figure.

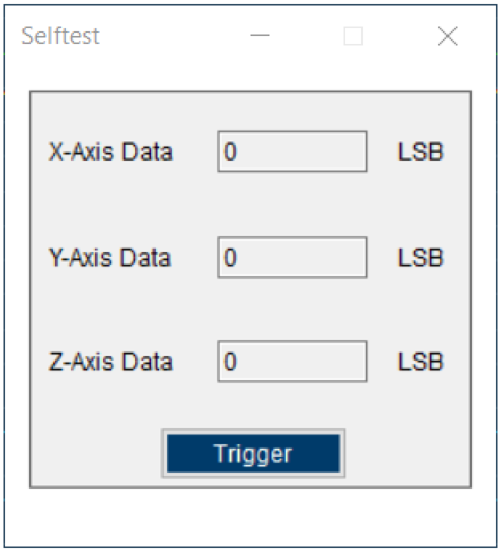


Figure 62: Selftest View

Click **Trigger**. The self-test results are displayed in the same dialog as show in below Figure.

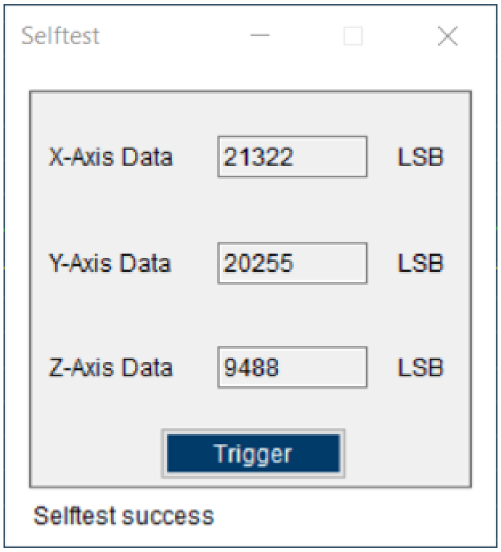


Figure 63: Selftest View results in BMA530

13.4.4.3 Register Access

The **Register Access** dialog reads or writes values into a register.

To view and configure the **Register Access** dialog, use the following procedure:

1. Select **Menu** > **Panels** > **Register Access** or click **Ctrl+R.**
   The **Register Access** dialog opens (refer below Figures).

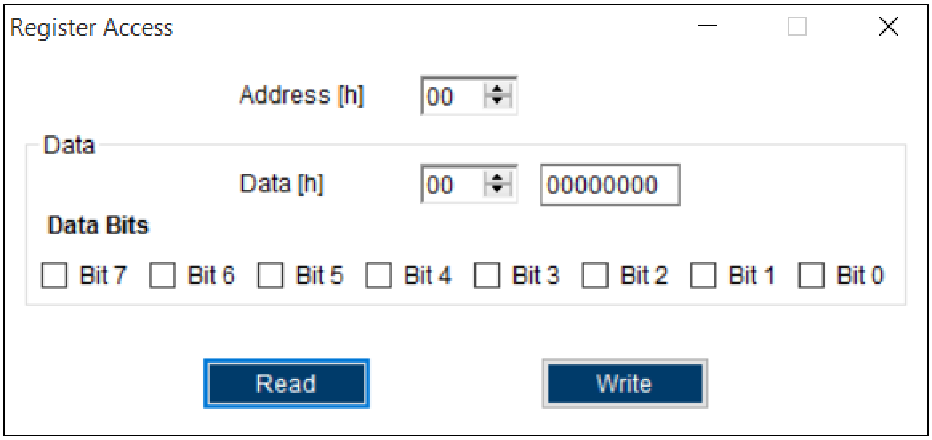


Figure 64: Register Access (8 bit)

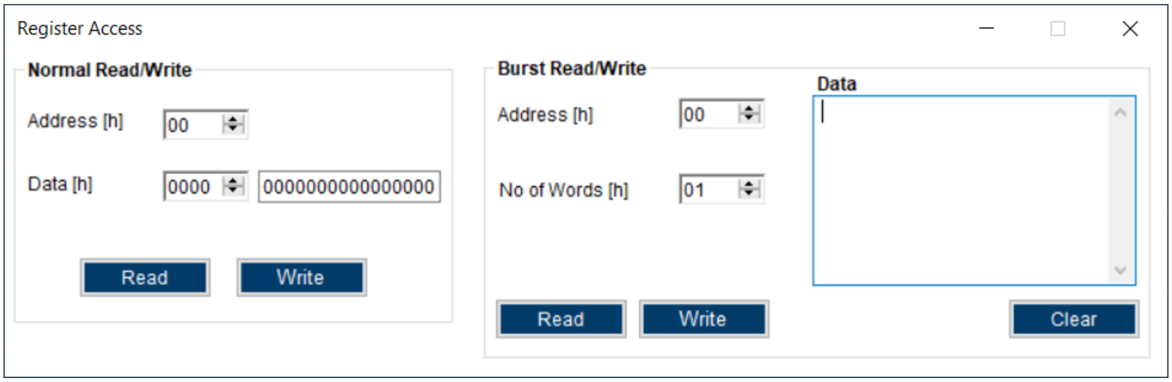


Figure 65: Register Access for BMA5xy/BMI3xy

2. Enter the register address in **Address [h].**
3. Enter the value you wish to read/ write in **Data [h].**
4. Choose the specific data bits for reading or writing the data.
5. Click on **Read/Write** to communicate with the sensor.

13.4.4.4 FIFO view

In FIFO configuration, enable FIFO, X, Y, Z, or a combination of these three axes to do a Read operation.

If the sensor time needs to be included in the logs, choose **Sensor Time** from the drop-down menu. This can be done in either of two ways:

- "**Dedicated Frame**" - The sensor time is added to the data after a certain number of packets.
- "**Each Frame**" - The sensor time is added to each entry in the data grid.

The user has the option to specify the watermark level. The watermark level is set by default, which will vary depending on the sensor feature.

For FIFO data logging, choose the desired file folders under "**Select Destination**" and check the "FIFO data log" box to enable it. The logs can be either appended or overwritten, and the user can make this choice through the radio buttons.

- Click **Start FIFO Streaming** to stream FIFO.
- Click **FIFO Flush** to clear the FIFO memory.

Click **FIFO Read** after enabling all settings, and data will be populated in the grid. The FIFO view is displayed in below Figure.

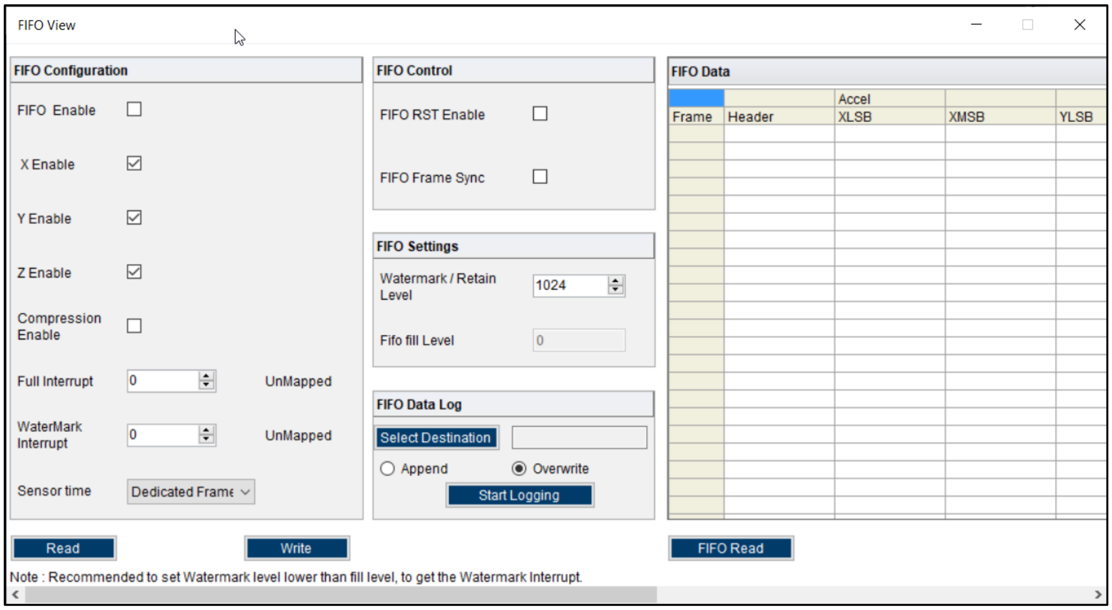


Figure 66: FIFO View in BMA5xy

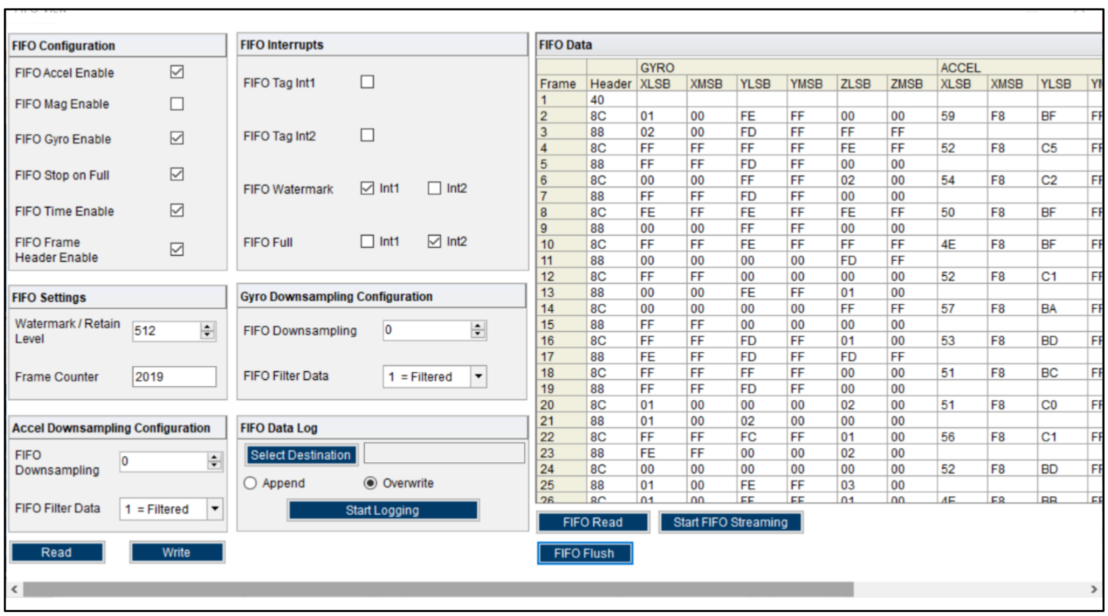


Figure 67: FIFO View in BMI270

13.4.4.5 FIFO Streaming

The FIFO streaming feature enables FIFO streaming based on input parameters such as Output Data Rate (ODR), Range, and Sensor Time until a specified watermark level is determined by the FIFO buffer size.

From the **FIFO Streaming View** dialog, the data in the FIFO queue is plotted until it reaches the designated watermark level.

If **Stop on full** is selected, the streaming will halt once the designated watermark is reached.

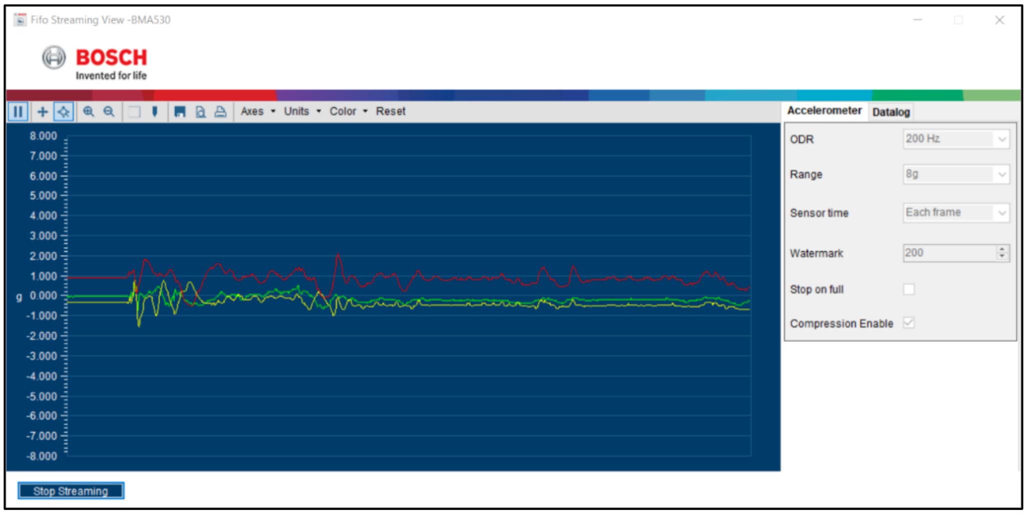


Figure 68: FIFO streaming in BMA5xy

FIFO streaming samples can be logged by selecting the destination (By default, it will prompt to save in the Documents Folder) and clicking **Start Logging** (refer below Figure)

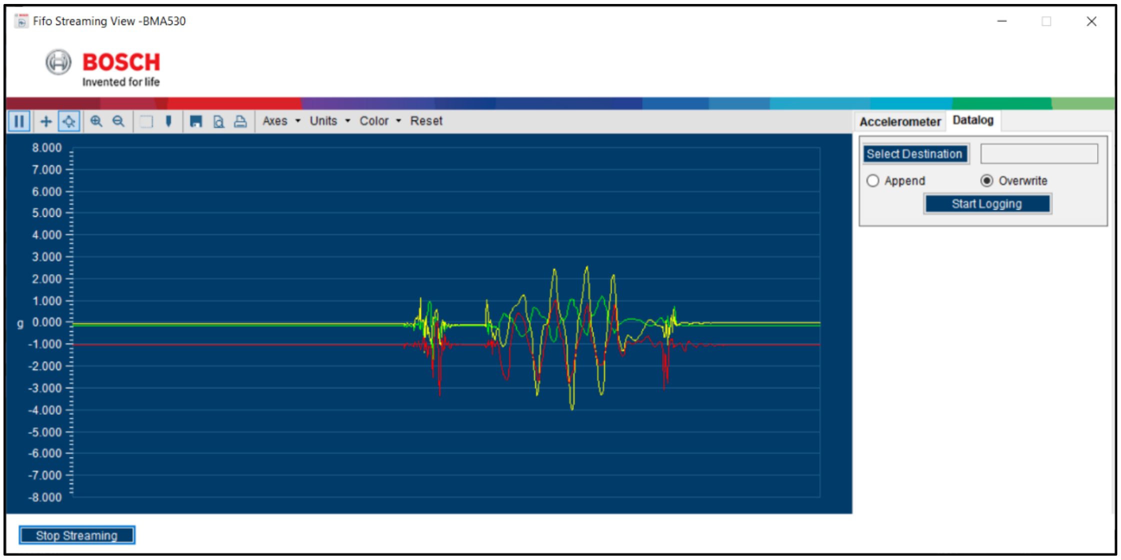


Figure 69: Data Streaming in BMA5xy

Note: FIFO Streaming applies to BHY/BMI3xy/BMA456/BMA400/BMI270 sensors.

13.4.4.6 FOC View

The **FOC View** provides details on the offset compensation of the accelerometer and can be controlled by this view.
To launch this feature, select the **Panels** menu in the main menu and then select **Memory Map** > **FOC View** or **Ctrl + O** as a shortcut.

Fast-offset compensation must be executed only when the device is still and one axis is parallel to the gravitation vector. This axis can be either aligned with the gravitational vector or in the opposite direction.

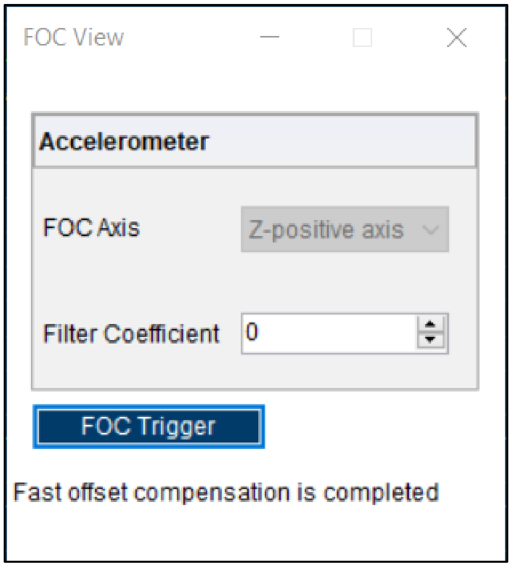


Figure 70: FOC View

13.4.4.7 G Trigger

G Trigger comprises two features. To view the G Trigger feature, select from the menu **Panels** > **Memory Map** > **G Trigger** or click **Ctrl + T.**

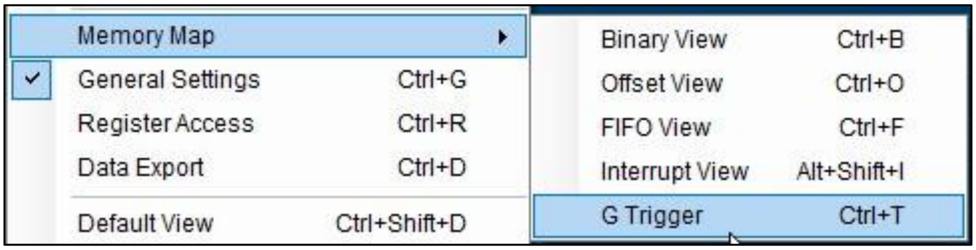


Figure 71: G Trigger

13.4.4.8 CRT (Component Re-Trim)

The **Component Re-trim** feature re-trims the gyroscope's sensitivity. During this process, the gyroscope is not usable for generating the rate of the samples.

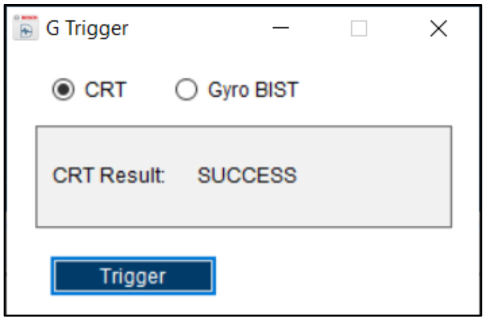


Figure 72: CRT view In BMI270

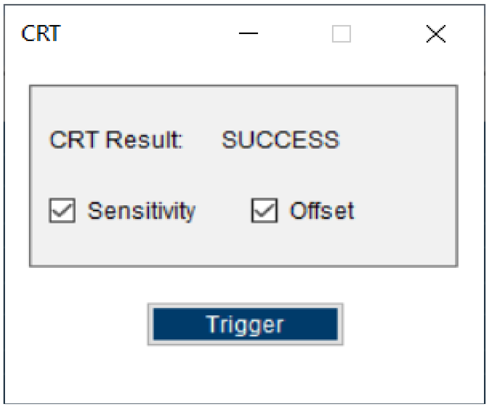


Figure 73: CRT in BMI3xy

13.4.4.9 GBIST (Gyroscope Built-in Self-Test)

The gyroscope's built-in self-test can be used to determine whether the relative deviation in quadrature is measured within a specific range.

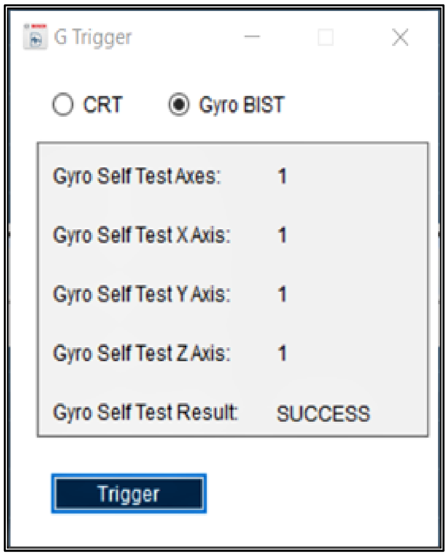


Figure 74: Gyro BIST

13.4.4.10 User Gain update

The **User Gain update** feature is used to amplify the signal. For example, when the accelerometer is operated at a specific ODR, the sensor must use the gain data and offset values from the DMR register space to correct the accel data using these factors.

To view the **User Gain update** feature, from the main menu, select **Panels** -> **Memory Map** -> **User Gain Update** or press **Ctrl + U**.

For filtered data, the ASIC always applies gain and offset correction. The operation result is updated once the gain values are updated, as shown in below Figure.

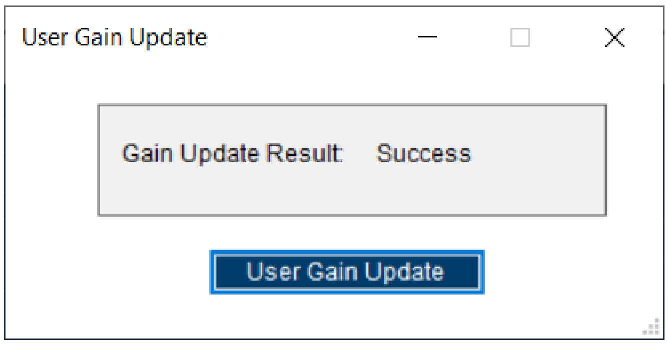


Figure 75: User Gain Update

Note: The host must switch off advanced power save mode for the Gyro User Gain update.

13.4.4.11 Interrupts

The **Interrupts** feature shows the real-time interrupt status of sensors (refer below Figure). The round LEDs show the sensor interrupt status, and the circle LEDs show the interrupt pin status. A green LED shows the interrupt occurrence.

To view the **Interrupt** dialog, from the main menu, select **Panels** > **Accel Interrupts** or **Alt + A**.

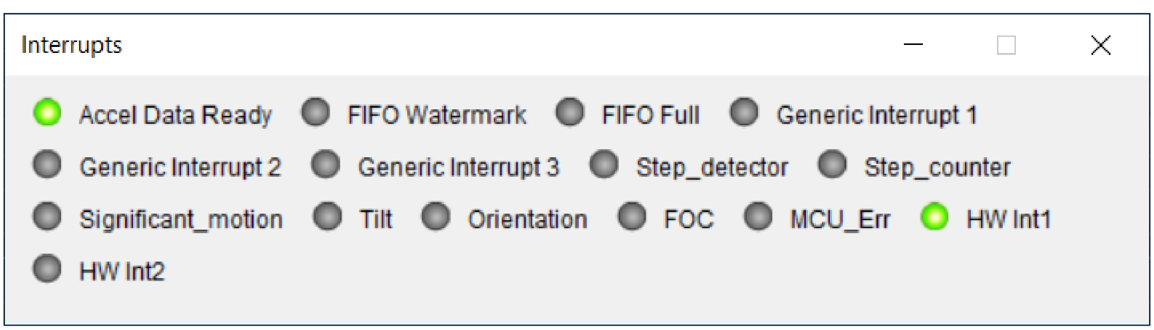


Figure 76: Accelerometer interrupts

13.4.4.12 Interrupt View

The Interrupt View feature enables and assigns interrupts to Interrupt 1 and Interrupt 2 hardware lines. The user can modify the interrupt configuration for each of the interrupt lines. Once changes are made, click **Write** to save the values to the respective registers. To confirm that the values have been successfully written to the registers, click **Read**.

Open the **Interrupt View** dialog from **Panels** > **Memory map** > **Interrupt View.**

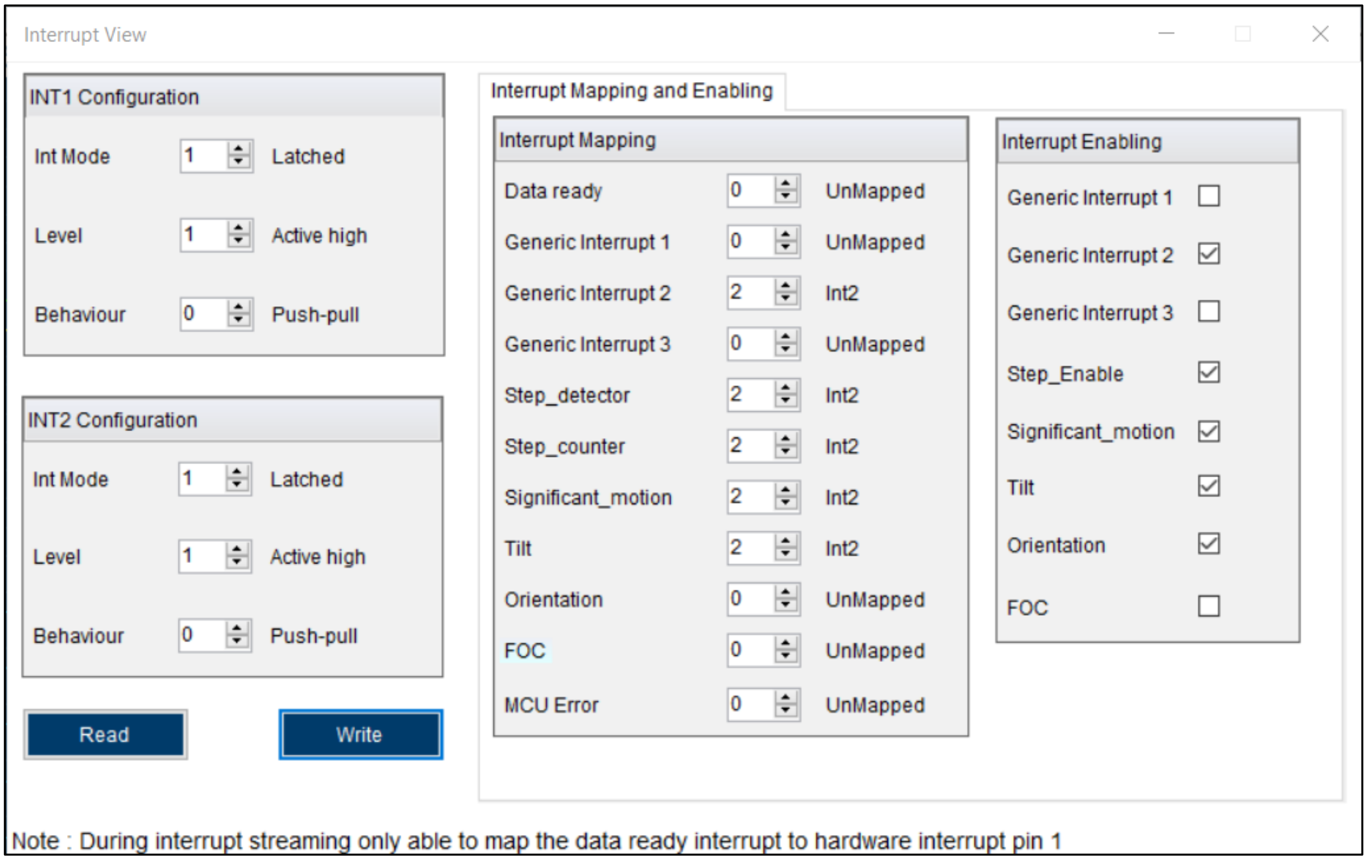


Figure 77: Interrupt View for BMA530

13.4.4.13 Interrupt Streaming

Interrupt streaming is the sensor data based on the hardware interrupt.

13.4.4.14 Context Selector/Device initialization

The Context Selector is a feature that allows users to customize and optimize their interaction with the Sensor based on specific preferences and needs. This feature enables the sensor to adapt its functionality and behavior according to two distinct contexts: Wearable and Smartphone.

Wearable: Select this mode when using the sensor in conjunction with wearable technology such as smartwatches or other portable devices. In this mode, the sensor optimizes its output to seamlessly integrate with and complement your wearable technology, offering convenient, hands-free operation.

Hearable: Select this mode if you are using hearable variants of sensors or for testing the hearable properties of sensors. Once the user is switched to this mode, the configuration settings of the sensor will be changed to hearable configurations.

Smartphone: This mode is ideal for users using mobile phones or smartphones to engage with the sensor. The sensor will adjust its settings to align with smartphone interfaces, enabling seamless connectivity and compatibility with various smartphone functionalities.

Selectors are represented in different ways as per their use case and features for different sensors in DD 2.1. For example, in BMI270, BMI323, and BMA530, context selectors are named as shown in below Figures.

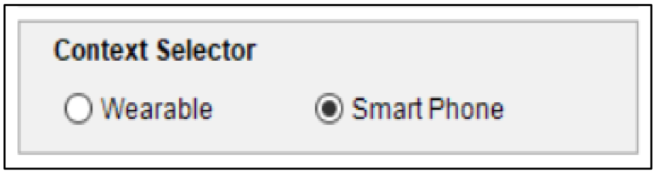


Figure 78: Context Selector in BMA530 in General Settings

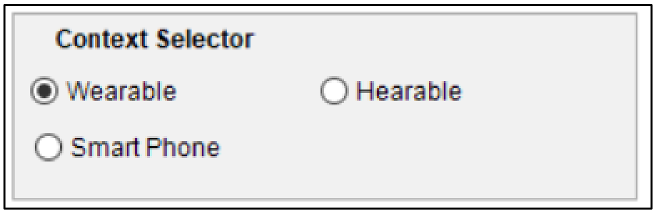


Figure 79: Context Selector in BMI323 in General Settings

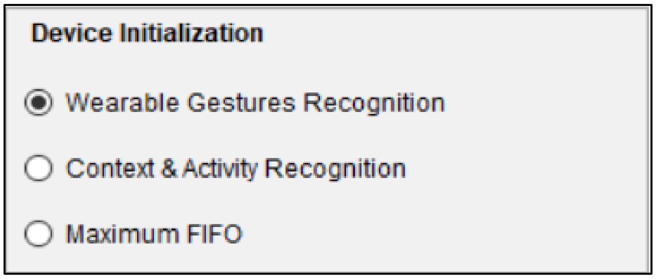


Figure 80: Device Initialization in BMI270

13.4.4.15 Offset View

The offset refers to an inherent bias or error in the sensor readings when no actual motion or acceleration occurs. This offset can occur due to factors such as manufacturing imperfections, environmental conditions, or sensor calibration issues.

The offset represents a deviation from the true zero level for accelerometers when the sensor is supposed to measure zero acceleration. This offset could result from gravitational effects or mechanical variations in the sensor, causing it to output a non-zero value even when it's at rest.

For gyroscopes, the offset signifies a bias in the angular rate measurement when there is no rotation. It means the sensor might detect a non-zero rotation rate even if it's perfectly still. This offset can stem from imperfections in the sensor's construction or the electronics involved in its measurement.

Calibration processes are often used to minimize or eliminate these offsets. During calibration, these biases are identified and compensated for, allowing the sensor readings to be more accurate by adjusting the output data to reflect true zero values when there is no motion or rotation.

1. To enable the offset, select the box before the sensor name.
2. Set the offset for X, Y, Z axes in the input box before the respective columns.

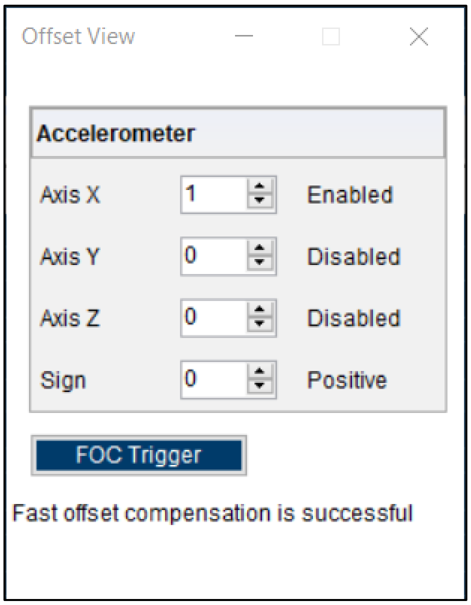


Figure 81: Offset View

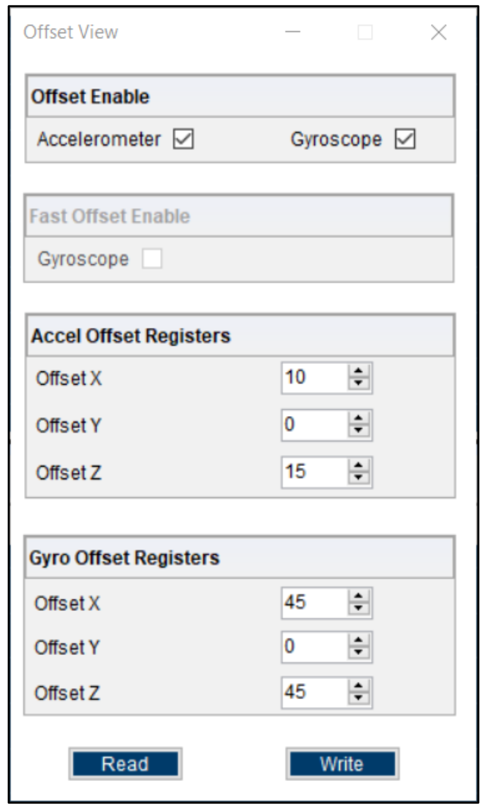


Figure 82: Offset View in BMI3xy

14 Additional GUI Features

DD 2.1 provides additional features so users can view the samples in 3D representation specific to some sensors like BME68x and BHI360.

14.1 Roger

Roger is a panel that demonstrates the changes in different environmental parameters by modifying the features of an image of a boy (Roger). To view this panel, select to **Panels > Roger** or click **Ctrl+Alt+R.**

Note: Roger is available only in BSEC mode and specific to BME68x.

Some common features of Roger include the following:

- When ambient environmental parameters change, the image of Roger or his background will change.
- The panel settings can be customized per geographical region to demonstrate changes more accurately.

The real-time pressure, temperature, humidity, and IAQ values are displayed in the top left corner of the panel, as shown in below Figure.

Figure 83: Roger

The different parameters that are captured and displayed by Roger are the following:

- IAQ
- Relative humidity
- Temperature
- Pressure

To change the parameter settings or view the existing settings from Roger, click the **Settings** Icon at the top right of the Roger panel. The settings dialog opens with existing settings, as shown in below Figure.

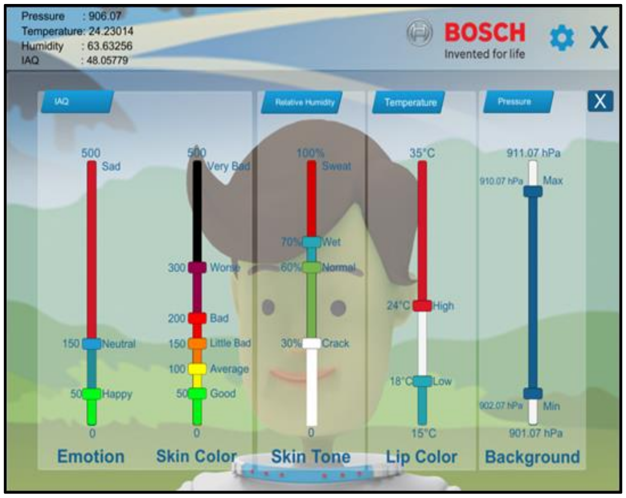


Figure 84: Roger settings

14.1.1 Roger and IAQ

Roger's emotion and skin color changes indicate the changes in IAQ.
Keeping the settings in the changes in IAQ are reflected in the **Emotion** setting as follows

Table 2: IAQ and Roger's Skin Colour

Range	0-50	50-100	100-150	150-200	200-300	300-500
Name	Good	Average	A Little Bad	Bad	Worse	Very Bad
Color						
IAQ	The IAQ is good, and Roger's skin is of natural color.	The IAQ is average, and Roger's skin color changes to yellow.	The IAQ is a little bad, and Roger's skin color changes to orange.	The IAQ is bad, and Roger's skin color changes to red.	The IAQ is worsening, and Roger's skin color changes to dark purple.	The IAQ is very bad, and Roger's skin color changes to black.

Roger's emotion and skin color based on bad IAQ is shown in below Figure.

Figure 85: Bad IAQ in Roger

14.1.1.1 Roger and Relative Humidity

The changes in relative humidity are indicated by the changes in **Roger's** skin tone. Below Figure shows Roger’s skin tone in very high relative humidity.

Figure 86: Very high relative humidity in Roger

The settings of relative humidity are reflected in Table 3.

Table 3: Relative Humidity and Roger's Skin

Range	0%-30%	30%-60%	60%-70%	70%-100%
Name	Crack	Normal	Wet	Sweat
Color				
Relative Humidity	The relative humidity is very low, and Roger's skin is cracked.	The relative humidity is at the optimum level, Roger's skin is normal.	The relative humidity is a little high, and Roger's skin is wet.	The relative humidity is very high, and Roger is sweating.

14.1.1.2 Roger and Temperature

The changes in relative humidity are indicated by the changes in Roger's lip color.

Keeping the Roger settings, the temperature changes are shown in Table 4.

Table 4: Temperature and Roger's Lip Colour

Range	0℃-18℃	18℃-24℃	24℃-35℃
Name	Low	High	Very High
Color			
Temperature	The temperature is very low, and there is no change in lip color.	The temperature is optimum, and there is no change in lip color.	The temperature is very high, and Roger's lip color is red.

Note: DD 2.1 in Roger has only a temperature ranging from 0℃ to 35℃.

Roger's lip color is shown at a very high temperature in below Figure.

Figure 87: Very high temperature in Roger

14.1.1.3 Roger and Pressure

The change in background in the Roger panel indicates the changes in pressure.
Keeping the Roger settings, the changes in pressure are shown in Table 5.

Table 5: Temperature Range details

Range	902.07hPa – 910.07 hPa	901.07 hPa-902.06 hPa and 910.08 hPa– 911.07 hPa
Name	Min-Max	Outside the user-defined range
Color		
Temperature	The pressure is within the user-defined range, and the background remains unchanged.	When the pressure is between 901.07 hPa and 902.05 hPa, the image background image moves downwards. When the pressure is between 910.08 hPa and 911.07 hPa, the image background image moves upwards.

Note: DD 2.1 in Roger only measures pressure ranging from 901.07 hPa to 911.07 hPa.

The Roger panel’s background at in-range pressure (between 902.07 hPa and 910.07 hPa) is shown in below Figure.

Figure 88: In-range pressure in Roger

14.2 Shark

DD 2.1 offers a Shark panel for virtual sensors, which will show the orientation of the Sensor on the 3D model of a shark.

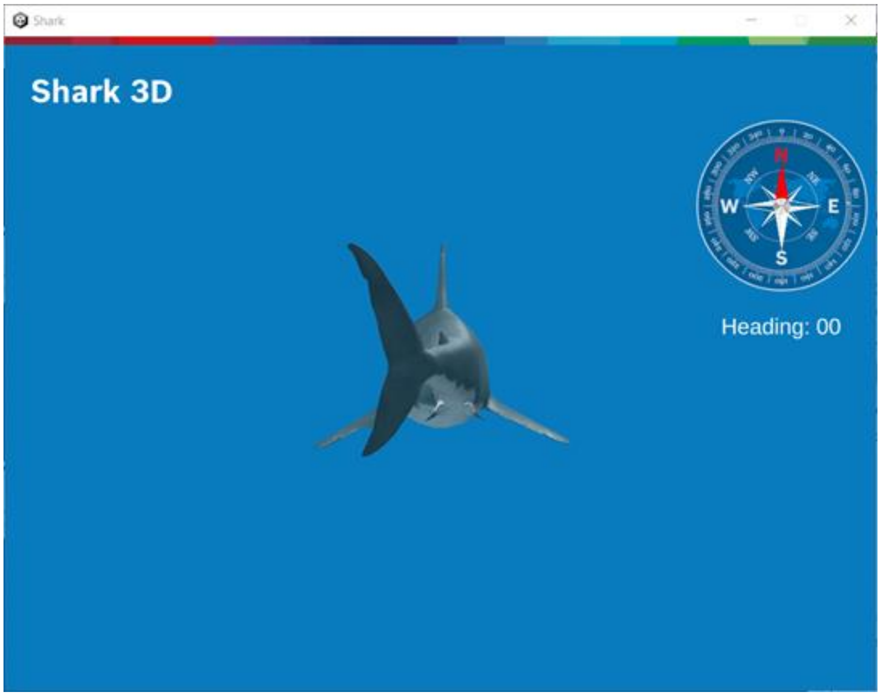


Figure 89: Shark view from BHI360

14.3 3D Compass

The 3D Compass is a panel that shows the orientation of App board for the XY axis when the board is connected. The orientation and rotation data are also displayed in the GUI.

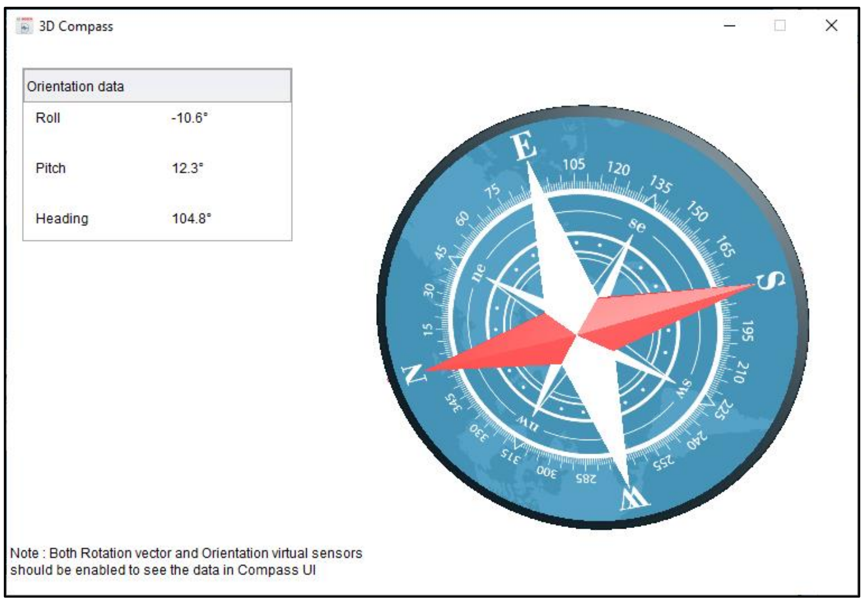


Figure 90: 3D Compass

14.4 Head Orientation

DD 2.1 offers a head orientation panel for virtual sensors implementing fusion (please refer to below Figure 96).

14.4.1 Steps to Calibrate in BMI290

1. User must do the calibration in BMI290 before launching the Head Orientation to achieve high accuracy. DD application will prompt the user to calibrate the sensor, by default.

- If the user connects the shuttle board with APP3.X for the first time, click on Calibrate Now button.
- If the user has done the calibration already (same shuttle board with same APP3.X board), click on Skip and Proceed button.

Note: It is always recommended to calibrate the sensor to achieve high accuracy.

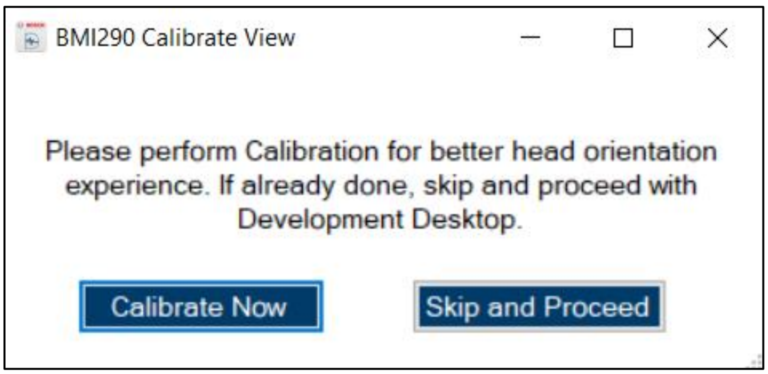


Figure 91: Calibrate popup window

2. Once Calibrate Now is chosen, the Accel FOC will be triggered followed by Gyro FOC, by default as shown in below Figures.

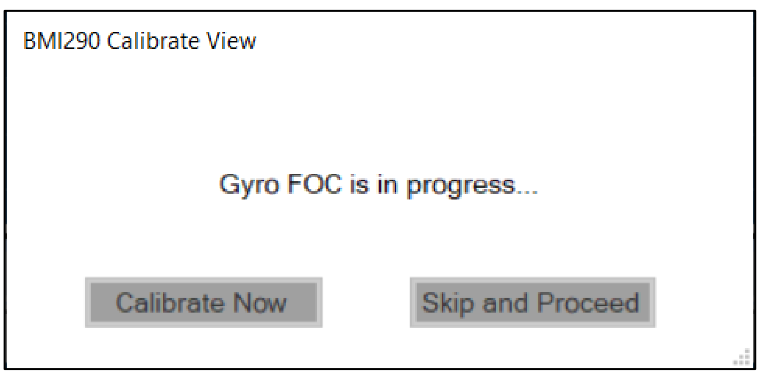


Figure 92: Gyro FOC in progress

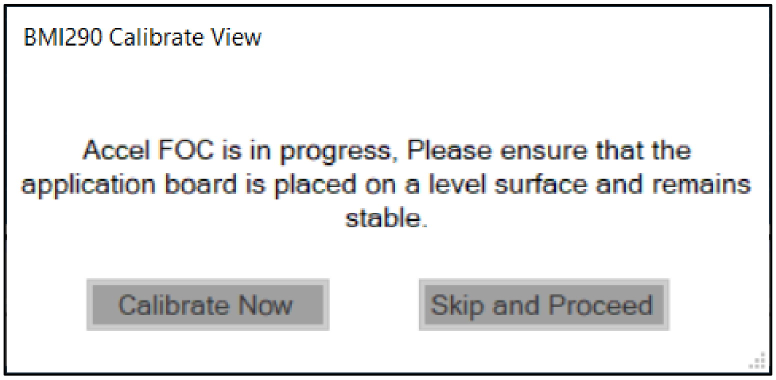


Figure 93: Accel FOC

3. User shouldn't move the APP3.X board and should be kept stable on a flat surface. If the user moves the board during the CRT & FOC, the calibration will be failed, and user must re-do the calibration.

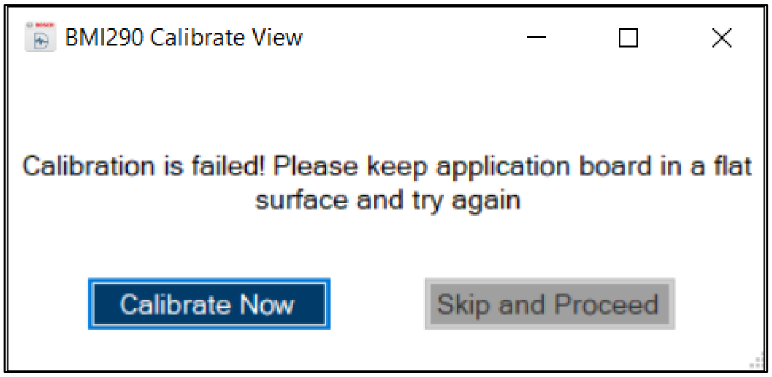


Figure 94: Calibration Failed

4. Once the Calibration is success, user shall close this popup and navigate to Configuration panel.

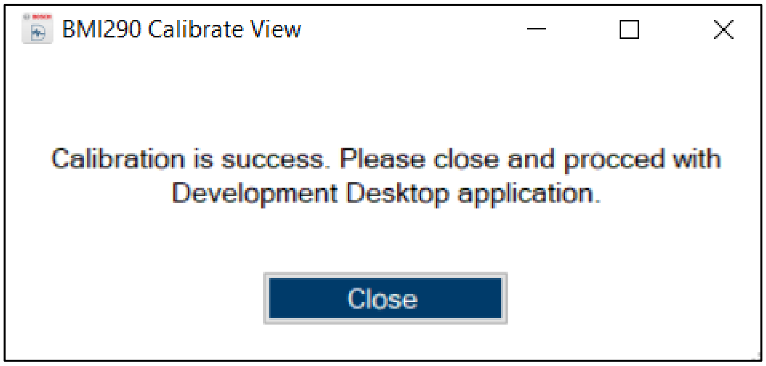


Figure 95: Calibration Success

For BMI290, DD application offers users the choice to calibrate the HMC by updating values in the configuration panel or by clicking on the calibrate button in Head Orientation panel.

- **With configuration Panel:** User must navigate to Panels → Configuration Panel and update the values as mentioned in the below table.

Feature configuration settings	Value	Description
Head_orientation_config: Hmc_mode	2	• 0 denotes that the calibration is failed or yet to start. • 1 denotes calibration has started (Need to keep the head Idle to calculate the position) • 2 denotes calibration is in progress and user must nod the head to get the orientation data (data to calculate based on the algo) • 3 denotes calibration is done successfully.
Head_orientation_config: Calib_trigger	1	To trigger the calibration.
Any_motion: enable	1	To enable the Head Orientation for any motion.
Hmc_correction_quarternion_input	Hex format	User can update any values based on the calibration done previously or based on the orientation.

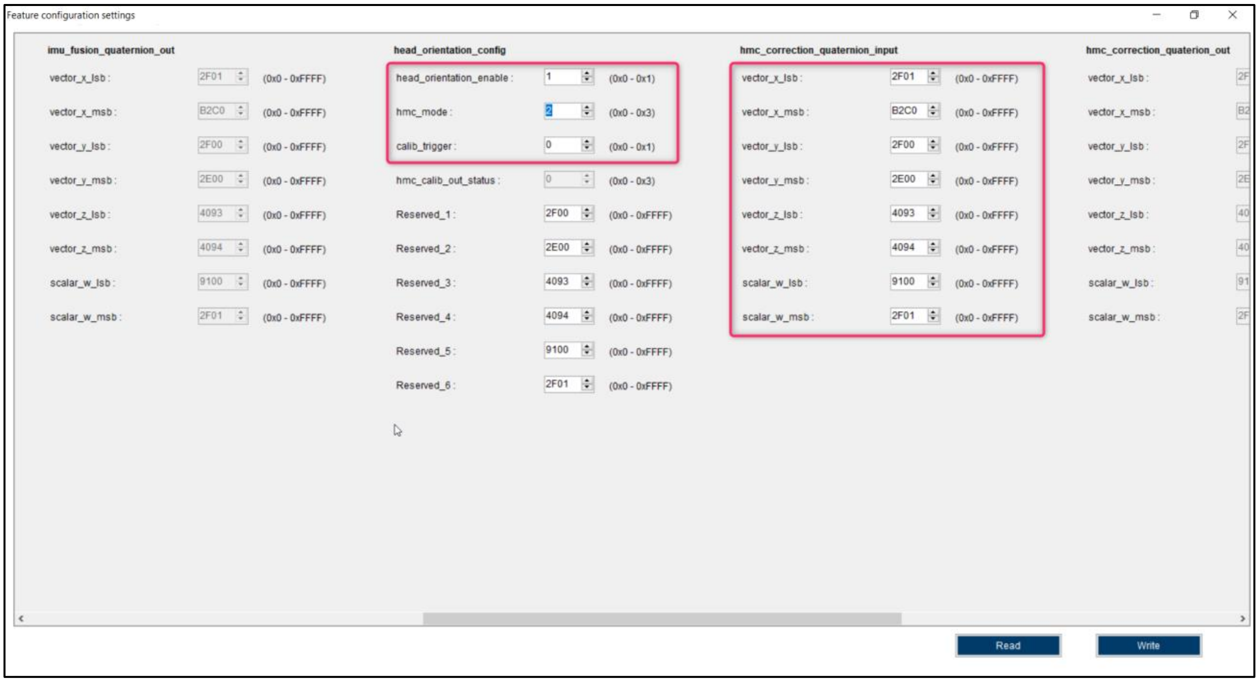


Figure 96: Configuration Panel in BMI290

- **With Head Orientation panel:** The user can calibrate the model by clicking Calibrate from the Head Orientation panel.

  During the calibration, the coordinates are reset and mapped to the position of the Application Board. The head orientation GUI holds Euler and Quaternion values from the sensor data based on the head orientation, which is calculated and displayed in the UI.

After keeping the sensor stable for a few minutes, click **Calibrate,** and once the calibration is complete, the status is displayed on the left side of the **Head Orientation** panel.

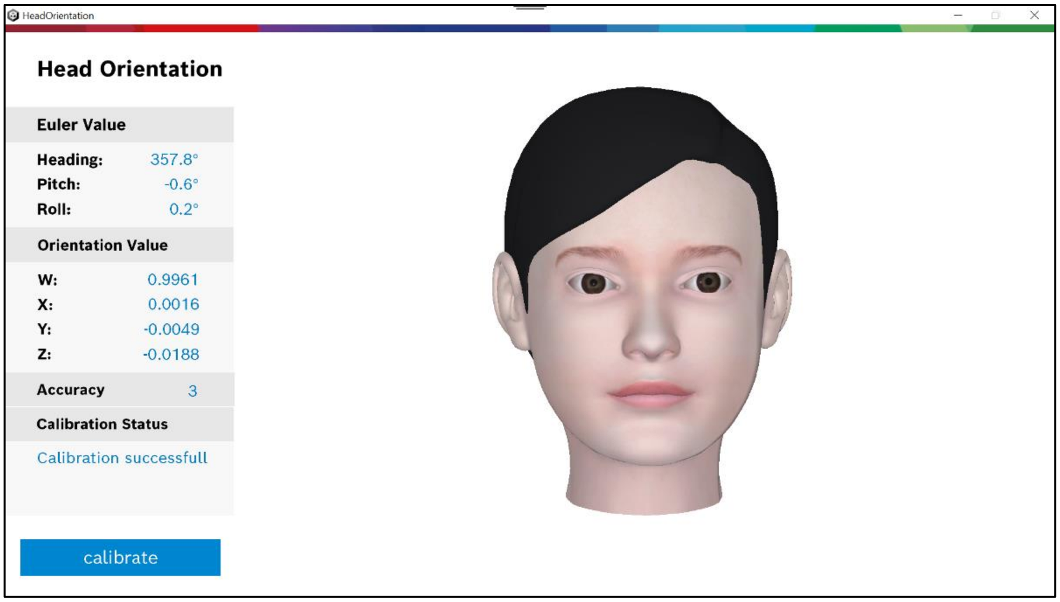


Figure 97: Head orientation calibration

14.4.2 Steps to Calibrate in BHI360

For BHI360, user must do the calibration by clicking on the calibrate button in Head Orientation panel.

14.5 Out of Range Detection

Out of Range Detection (refer below Figure) detects the magnetic field whenever it is more than 2400 micro-Tesla (μT). It will get automatically restored if it is back to the normal range of less than 2000.

Figure 98: OOR with external magnetic field

14.6 TDM interface

TDM is an interface which is specific to BMA550 along with I2C, where user can view the data, log the data in both .wav format and .csv format.
It is specific for hearables.

Figure 99: TDM Feature in BMA550

15 Troubleshooting Procedure

After installing DD 2.1, the user may encounter connection issues, such as an error during the initialization of the App Board. This section highlights the potential causes of these situations and their solutions.

1. Connect the Bosch Sensortec board and DD 2.1 via COM.
   When the PC does not recognize the Bosch Sensortec board, the connection is not established. Below Figure shows the message that is displayed.

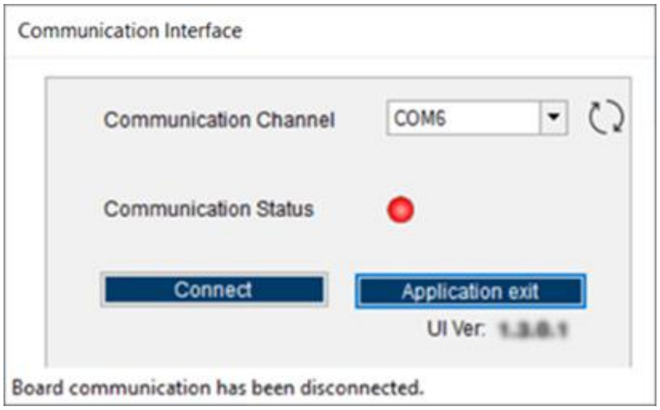


Figure 100: Communication Interface dialog

Note: If the Bosch Sensortec board is not recognized in the USB port, update the Boot loader with the latest version to be functional.
For APP board 3.0, kindly refer this section.
For APP board 3.1, kindly refer this section.

In most troubleshooting cases, the resolution ensures that the device manager recognizes the App Board.

15.1 How do I know if the Bosch Sensortec board is recognized?

1. Open Computer Management by right clicking on **My Computer** > **Manage**.
2. In Computer Management, navigate to **System Tools** > **Device Manager**.
3. From Device Manager, locate the Bosch Sensortec board the list.

OR

1. Search for “Device Manager” in MS Windows search.
2. From Device Manager, locate the Bosch Sensortec board in the list.

15.1.1 How do I list the Bosch Sensortec board under Device Manager?

15.1.1.1 Check the PC-Board Connection

Plug out and plug in the USB cable (from both the computer and board) and restart the board. When the connection is established, all LEDs glow simultaneously.

15.1.1.2 Update USB Driver

Uninstall the old USB drivers:

1. Open the Device Manager.
2. Select **View** > **Show hidden devices**.

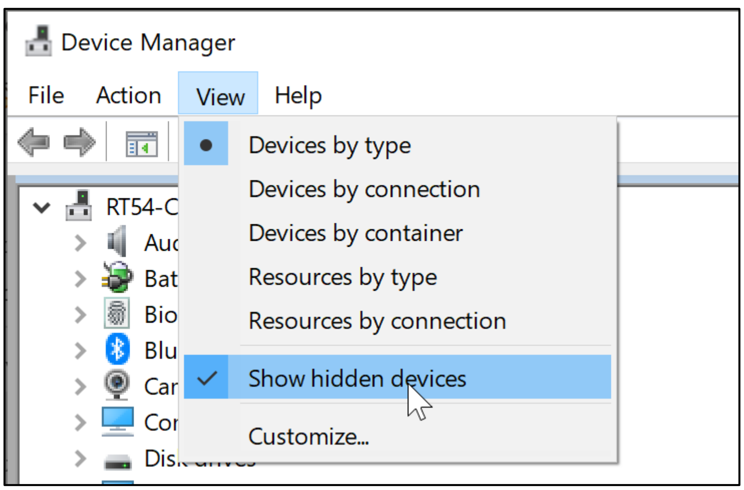


Figure 101: Showing Hidden Devices

3. From the Device Driver, to view devices by container, select **View** > **Devices by container**.

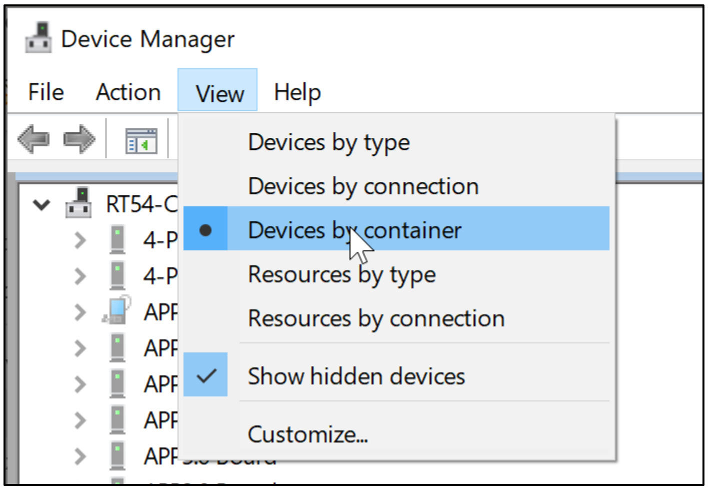


Figure 102: View Devices by container

4. If the board is connected, uninstall all the drivers for the board, whether connected or hidden.
5. Reinstall the driver.
6. Reconnect the board.

The USB driver can be updated either manually or automatically.

Automatic Update

1. Reinstall the application.
2. Check if the Bosch Sensortec board is recognized (in the Device Manager)
3. If the board is still not recognized, switch the board off and on.

Manual Update

The firmware can be updated using two methods.

Method 1:
1. Connect the Application board and turn it on.
2. Download the COINES-SDK from the Bosch Sensortec website here
3. Extract the and install the COINES-SDK.
4. Navigate to the COINES-SDK folder from the installation path, open the firmware folder, and then the APP3.X folder according to the appropriate Application Board connected.
5. Double-click the batch file **update_coines_bridge_ram_fw.bat/update_coines_bridge_flash_fw.bat** to execute it.

Method 2:
1. Open Computer Management by right clicking on **My Computer** > **Manage**.

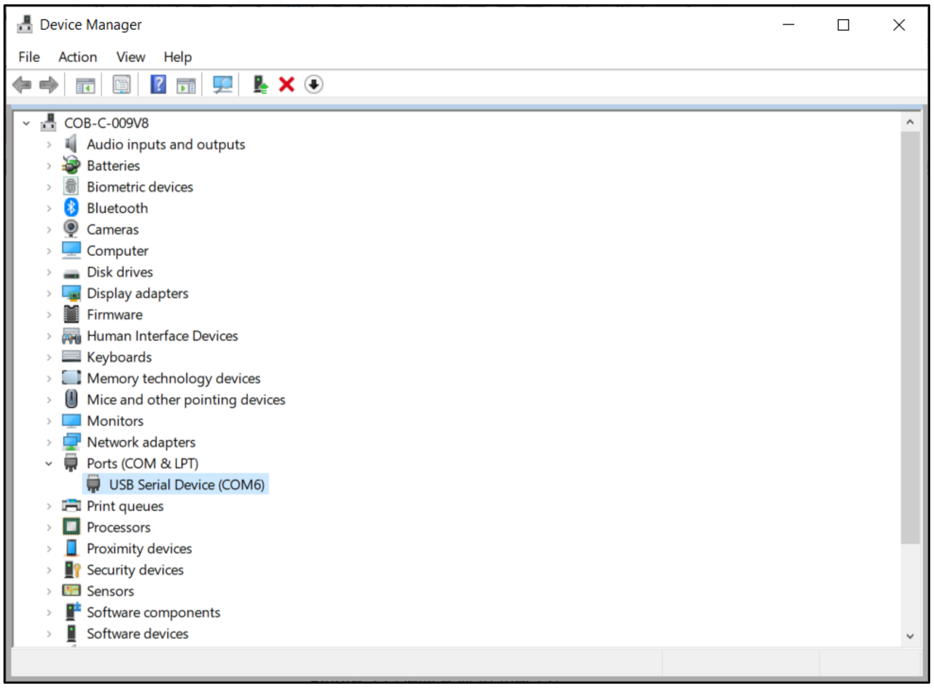


Figure 103: Device Manager (when drivers are not installed)

2. In Computer Management, select **System Tools** > **Device Manager**.
3. Right-click on the Bosch Sensortec Application Board > **Update Driver Software** > Browse My Computer for Driver Software > C:\Program Files\Bosch Sensortec\Development Desktop 2.1\USB Driver > **Next**.
4. After the driver installation, click **Next**.
5. Check if the Bosch Sensortec board is recognized (in the Device Manager).

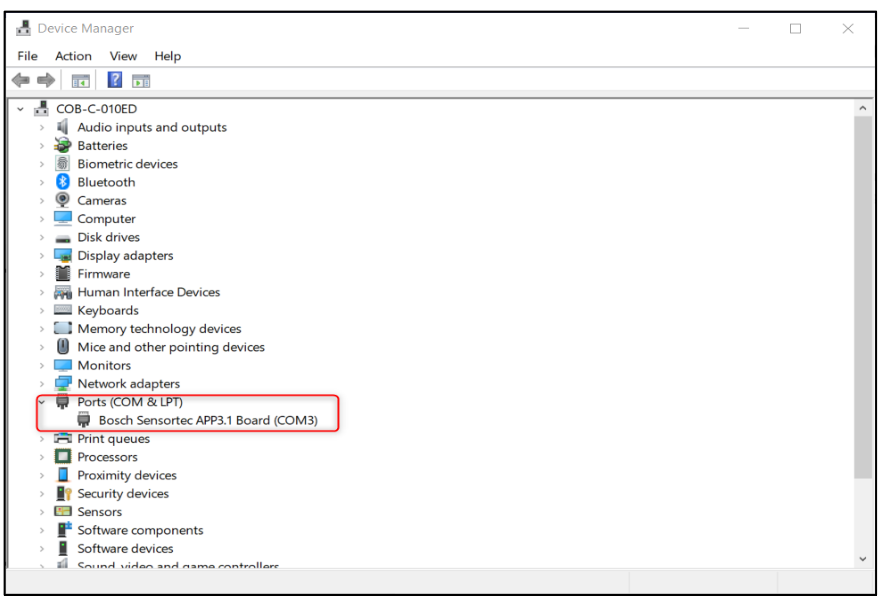


Figure 104: Device Manager (when the correct driver is installed)

15.1.1.3 Upgrade Firmware

For APP3.0, when the firmware file is absent, the LED next to the T1 switch is Blue. To upgrade the firmware on all boards, use the following procedure:

1. Keep T2 pressed, power off, and on the board. A prompt (refer below Figure) indicates that Boot mode is detected.

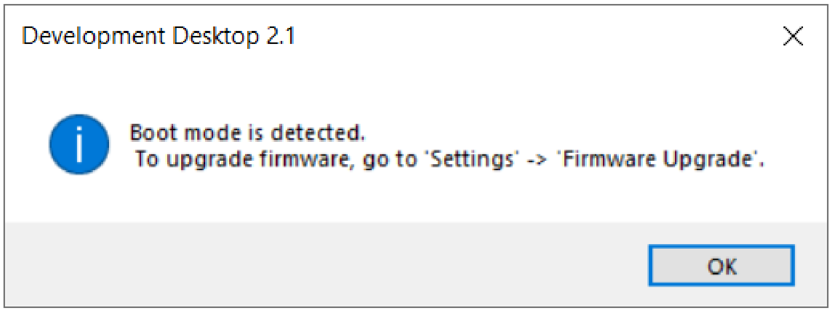


Figure 105: Boot-mode detected

2. Click **OK**.
3. Click **Settings** > **Firmware Upgrade**.
4. Select the firmware to install and install it in RAM or FLASH.
5. Click **Update**.
6. Restart the board and DD 2.1.

15.2 EEPROM flash on new shuttle board

When a user receives a new shuttle board to be connected to a fresh APP3.X board, it is recommended to flash the EEPROM content on the shuttle board.

To flash the EEPROM content, a batch file needs to be executed to align the shuttle board pins with the mapping of the APP3.X board. This batch file also used to retrieve the Shuttle Name and Shuttle ID from the sensor shuttle board.

If the user has not flashed the EEPROM content, DD application will not recognize the shuttle board and will prompt the message as shown in the below Figure.

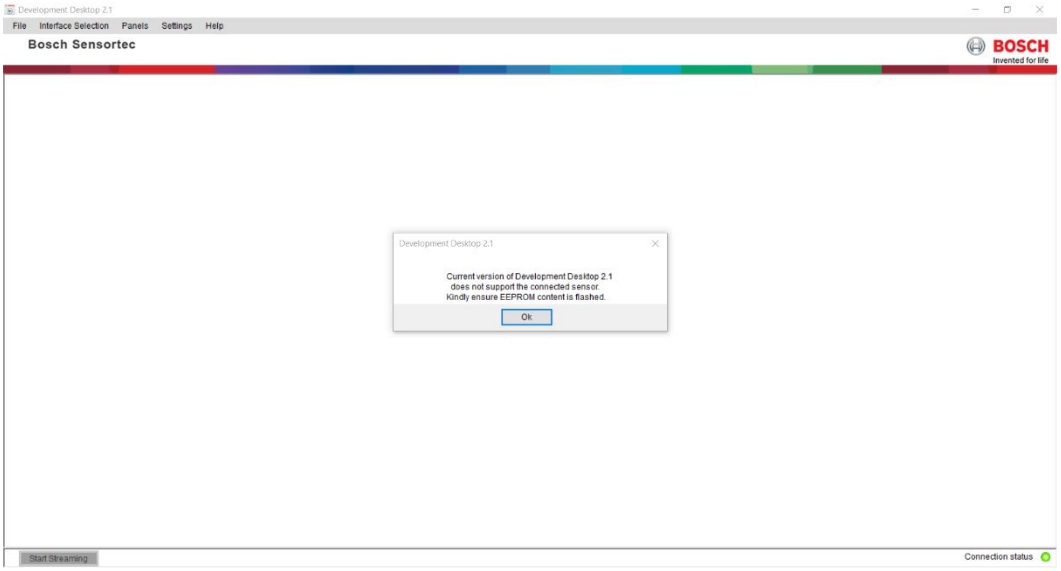


Figure 106: EEPROM to be flashed

If the user encounters the above-mentioned prompt in the DD application, it is recommended to close the application and navigate to the DD installation path (C:\Program Files\Bosch Sensortec\Development Desktop 2.1\Firmware\EEPROM\program_shuttle_board_eeprom). Here, the user can locate the executable file relevant to the shuttle board that needs to be flashed (example: bmi270_shuttle_program.bat).

Once the batch file is executed & the application is launched, an error message will be received as mentioned in below screenshot.

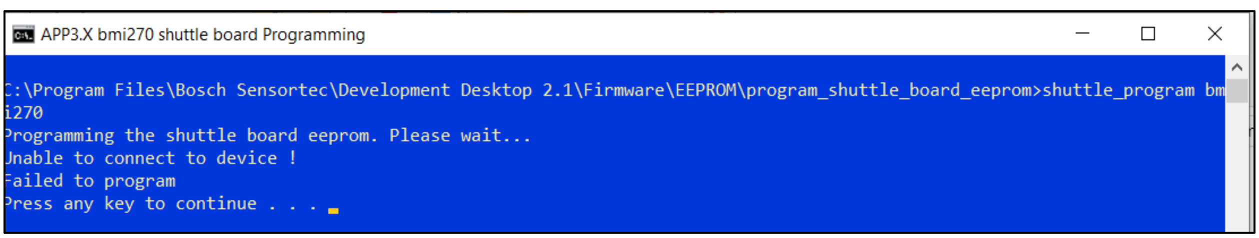


Figure 107: EEPROM Failed

User would get a success message as shown in below Figure, if the batch executed is successful.

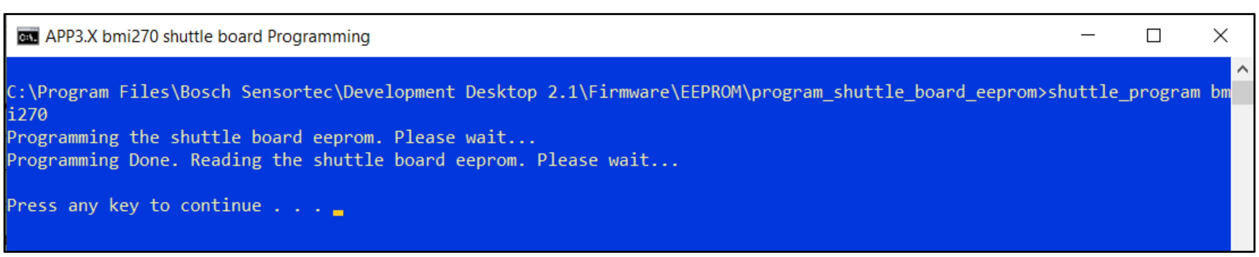


Figure 108: EEPROM Success

16 References

The table below links the datasheets for the main sensors supported in DD 2.1.

Sensor	Sensor Datasheet
BMA400	BMA400
BMA456	BMA456
BMI270	BMI270
BMI323	BMI323
BMP390	BMP390
BMP581	BMP581
BMP585	BMP585
BMM150	BMM150
BMM350	BMM350
BME280	BME280
BME680	BME680
BME688	BME688
BHI360	BHI360
BHI260AP	BHI260AP
BMP388	BMP388
BMP280	BMP280
BMP384	BMP384
BNO055	BNO055

Appendix A. Ram Patch Update

Users can use the **Ram Update** dialog to update the .tbin file for the BMI2xy sensor.

Steps for updating the RAM for the BMI270 sensor:

1. Go to the DD installation folder and open the Development Desktop 2.1.exe.config file in Notepad.
2. Edit line 12 with the content “<add key="**EnableRAMUpload**" value="false"/>” and change the value to “true”. The dialog is enabled in DD and is visible under the **Panels** menu.
3. Launch the DD 2.1 application. Go to RAM Patch in the **Panels** menu. The **Ram Update** dialog appears.
5. From the **RAM image file** field, select the RAM file.
6. From the **Image config file** field, select the encrypted configuration file.
7. Click **Upload**.
8. When the upload is complete, verify it from **Panels** > **Configuration**.
   Under output, there will be a field called “message”. If the value is 1, it indicates the upload is successful. Otherwise, it is unsuccessful.

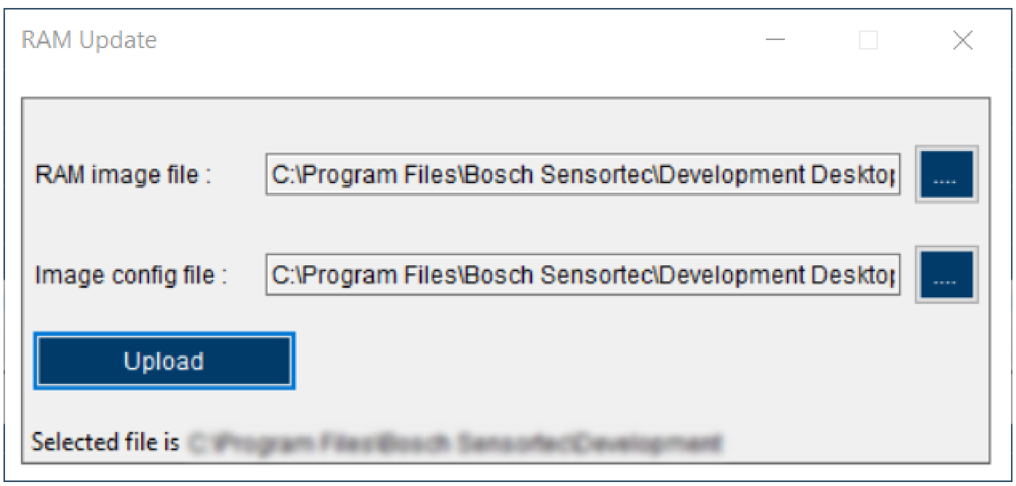


Figure 109: RAM Update

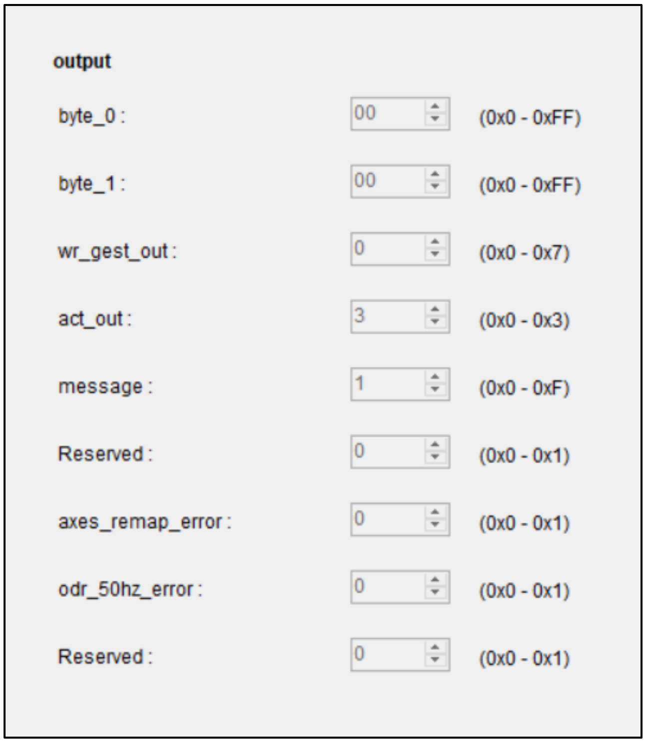


Figure 110: Output in Configuration Panel

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