## BME280 User Manual

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1 About user manual

This manual describes the installation and usage of the Development Desktop 2.1 User Interface (DD2.1 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 is intended to users who wish to use the BME280 sensor alongside DD2.1 UI to graphically display the Indoor Air Quality (IAQ), relative humidity, altitude, and associated components.

1.2 DD2.1 UI Overview

DD2.1 UI is a PC based software used to read, capture, and display sensor data. To display the sensor data of BME280 on DD2.1 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. DD2.1 UI automatically detects the sensor that has been plugged in and starts the corresponding software application.

1.3 Sensor Communication:

DD2.1 UI software supports both SPI and I²C to communicate with the sensor.

1.4 Graphical display:

DD2.1 UI displays the sensor data and interrupts in different graphical formats.

1.5 Data logging:

DD2.1 UI offers data logging of the sensor data.
2 About the BME280

The typical applications that use BME280 are:

• Context awareness, e.g. skin detection, room change detection
• Fitness monitoring / well-being
• Warning regarding dryness or high temperatures
• Measurement of volume and air flow
• Home automation control
• control heating, venting, air conditioning (HVAC)
• Internet of things
• GPS enhancement (e.g. time-to-first-fix improvement, dead reckoning, slope detection)
• Indoor navigation (change of floor detection, elevator detection)
• Outdoor navigation, leisure and sports applications
• Weather forecast
• Vertical velocity indication (rise/sink speed)

The targeted devices that use BME280 are:

• Handsets such as mobile phones, tablet PCs, GPS devices
• Navigation systems
• Gaming, e.g flying toys
• Camera (DSC, video)
• Home weather stations
• Flying toys
• Watches

Table 1: The technical specifications of the BME280 sensor

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Technical Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Package Dimensions</td>
<td>8-Pin LGA with metal</td>
</tr>
<tr>
<td></td>
<td>2.5 x 2.5 x 0.93 mm³</td>
</tr>
<tr>
<td>Operation Range (full accuracy)</td>
<td>Pressure: 300...1100 hPa</td>
</tr>
<tr>
<td></td>
<td>Temperature: -40...85°C</td>
</tr>
<tr>
<td>Supply Voltage $V_{DDIO}$</td>
<td>1.2 ... 3.6 V</td>
</tr>
<tr>
<td>Supply Voltage $V_{DD}$</td>
<td>1.71 ... 3.6 V</td>
</tr>
<tr>
<td>Interface</td>
<td>I²C and SPI</td>
</tr>
<tr>
<td>Average current consumption</td>
<td>1.8 μA @ 1 Hz (H, T)</td>
</tr>
<tr>
<td>(1Hz data refresh rate)</td>
<td>2.8 μA @ 1 Hz (P, T)</td>
</tr>
<tr>
<td></td>
<td>3.6 μA @ 1 Hz (H, P, T)</td>
</tr>
<tr>
<td></td>
<td>$T = \text{temperature}$</td>
</tr>
<tr>
<td>Average current consumption in sleep mode</td>
<td>0.1 μA</td>
</tr>
<tr>
<td>Pressure sensor</td>
<td>0.2Pa (equiv. to 1.7cm)</td>
</tr>
<tr>
<td>RMS Noise</td>
<td>±0.25% (equiv. to 1m at 400m height change)</td>
</tr>
<tr>
<td>Sensitivity Error</td>
<td>±1.5Pa/K (equiv. to ±12.6cm at 1 °C temperature change)</td>
</tr>
<tr>
<td>Temperature coefficient offset</td>
<td></td>
</tr>
<tr>
<td>Humidity sensor:</td>
<td>1 s</td>
</tr>
<tr>
<td>Response time (t63%)</td>
<td>±3% relative humidity</td>
</tr>
<tr>
<td>Accuracy tolerance</td>
<td>≤2% relative humidity</td>
</tr>
<tr>
<td>Hysteresis</td>
<td></td>
</tr>
</tbody>
</table>
3 Getting Started

The below sections highlight the procedure to set up connections between BME280, DD2.1 UI, and the PC.

3.1 Setting Up the board-PC connection

The procedure to connect sensor to PC via USB is as below:
- Install DD2.1 UI
- Insert the shuttle board and application board.

Figure 1: Insert sensor for APP2.0

Figure 2: Insert sensor for APP3.0

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

Figure 3: Connect board and PC for APP2.0


> Turn the on/off switch ON. The LED glows.

![Figure 5: Connection complete for APP2.0](image)

To start the DD2.1 UI software:

- Click Start -> Programs -> Development Desktop 2.1.
- Or
- Double click the DD2.1 UI software icon on the desktop.

The Graphical User Interface (GUI) of the software is as seen below:
When the PC and board are connected, the Communication Status glows green as shown below:

- 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.
3.2 Upgrading Firmware

3.2.1 For App 2.0 Board:

To upgrade the firmware of DD2.1 UI to match the current version, follow the steps below:

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

![Firmware upgrade window](image)

Figure 9: Firmware upgrade window

► Click **Enter Boot mode.**

![Application Boot Loader](image)

Figure 10: Application Boot Loader

- Switch off board, and press **Switch 2.** In Application board, all four LEDs will glow simultaneously.
- Click **OK.**
- All four LEDs will glow simultaneously.
- Press **OK.**
Select the default firmware update file (*.fwu2) from the DD2.1 UI installation directory in the folder Firmware.

Click Flash.

Once firmware upgrade is complete, restart the application board, and DD2.1 UI.

3.2.2 For App 3.0 Board:

To upgrade the firmware of DD2.1 UI to match the current version, follow the steps below:

1. Click Menu -> Settings -> Firmware Upgrade. The following window appears:
Default firmware file (*.bin) will be automatically chosen from the DD2.1 UI installation directory in the folder Firmware\App3.0.

2. Choose RAM or Memory option to flash the latest recommended firmware file.

3. The file path will get automatically chosen/selected in the select firmware file path textbox. User can also select the firmware as required.

4. Click on Flash.

5. DD2.1 recommended firmware is COINES_bridge firmware for App3.0 shuttle board. If the user chose to flash DD firmware, a popup message will be shown. User can still choose the DD firmware and proceed.
6. Once firmware update is completed, Please close the popup and DD 2.1 application will get automatically reloaded.

4 Working with DD2.1 UI

The functions of the BME280 sensor are discussed in details in the below sections.

4.1 Sensor Data

4.1.1 Altitude

- To view altitude on the plotter, go to Panels -> Altitude, or click Ctrl+P.
- The altitude can be seen in either the altitude panel, or altimeter dial display.
- To see variations in the altitude data, move the sensor up and down vertically.
- Units of measurement include:
  - Meter
  - Feet
- The different plotter modes in altitude include:
  - Altimeter: Displays altitude in the plotter and dial
  - Barometer: Displays Sea level pressure in the plotter
  - Manometer: Displays absolute pressure in the plotter

4.1.2 Relative Humidity

- To view relative humidity data on the plotter, go to Panels -> Relative Humidity, or click Ctrl+H.
- To see variations in humidity data, introduce elements of different humidity/moisture levels over the sensor.
- The different plotter modes in relative humidity include:
  - Relative Humidity
  - Absolute Humidity
  - Dew Point

4.1.3 Temperature

- To view temperature data on the plotter, go to Panels -> Temperature, or click Ctrl+T.
- To see variations in temperature data, introduce elements of different temperature levels over the sensor.
- DD2.1 UI is equipped to display temperature data in the following units of measurement:
4.2 Default View

To reset the DD2.1 UI homepage to its default view, go to Panels->Default View, or click Ctrl+V.

4.3 Memory Map

- Memory map is used to launch the binary view of the sensor.
- This view contains information on all sensors and their respective addresses.
- To launch Memory Map, go to Panels -> Memory Map, or click Ctrl+M. The following window appears:
  - To configure sensor values, click Write.
  - To read the current register settings on the sensors, click Read.

Note: This option is disabled when the sensor is streaming data.
4.4 Sensor Mode

- BME280 offers three different power modes:
  - Sleep mode
    - No operation, all registers accessible, lowest power and Selected after startup
  - Forced mode
    - Perform one measurement, store results and return to sleep mode
  - Normal mode
    - Perpetual cycling of measurement and inactive periods

4.5 General Settings:

- To view the General Settings window, go to **Menu -> Panels -> General Settings**, or click **Ctrl+G**
Altitude and Humidity plotter depends on the value selected in Pressure and Humidity plotter mode.
Pressure, temperature and humidity measurement depends on its corresponding oversampling selection.
To skip measurement, set all three oversampling values to **Skipped**.
To initiate measurement, set appropriate oversampling values from the drop down menu.
**IIR filter coefficient** feature is used to suppress unwanted disturbances without causing additional interface traffic and process load. It effectively reduces the bandwidth of the output signals. To select **IIR filter coefficient**, choose appropriate option from the drop-down menu.
The sampling rate is the rate at which the data will be read from the sensor.
While streaming, data is sampled keeping the default sampling rate values as base (based on the sensor configuration settings).
The following values are measured during streaming:
- Uncompensated Humidity (UH)
- Uncompensated pressure (UP)
- Uncompensated temperature(UT)
- Relative Humidity – in percentage (%)
- Absolute Altitude – in meters (m)
- Sea Level Pressure – in hectopascal (hPa)
- Absolute Pressure – in hectopascal (hPa)
- Absolute Temperature – in degree Celsius (°C)
4.6 Reset Sensor

- Resetting the sensor is possible by cycling VDD level or by writing soft reset command

4.6.1 PO Reset

- Power-On Reset option resets the logic part and register values after both VDD and VDDIO reach their minimum levels
- Once PO Reset button clicked, sensor reset to default values and UI reflect the default values

4.6.2 Soft Reset

- Soft Reset option is used to erase the possible old settings
- Once Soft Reset button clicked, the default values would be updated in UI

4.7 Data Export/ Log

- To save the output values plotted by DD2.1 UI, go to Panels -> Data Export, or click Alt+D.
- By default, the data values are logged into a text (.txt) file in the destination folder of DD2.1 UI.
- The steps to follow data logging are as seen:
4.8 Register Access

- To go to Register Access, go to Menu -> Panels -> Register Access, or click Ctrl+R.

The following window appears:

- Register Access is used to read or write values into a register. To implement this, follow the below steps:
  - Enter the register address in Address [h].
  - Enter the data you wish to read/ write in Data [h].
  - Select the data bits into which data has to be written or read from.
  - As per requirement, click Read/Write.

4.9 Calibration

- Calibration sea level pressure done by entering the reference sea level pressure.
- The reference altitude displayed
DD2.1 offers the functionality to display the altitude data in the following units:
- m: meter
- ft.: feet

DD2.1 offers the functionality to display the pressure data in the following units:
- hPa: hecto Pascal
- mmHg: mm of mercury
- PSI: Pounds per square inch.

5 General Troubleshooting

Follow below guidelines while working with DD2.1 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 DD2.1 UI, close and restart DD2.1 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 have 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).
2. Click **Action -> Scan for hardware changes.** The new USB driver is installed automatically. Thereafter, the device communication will function properly.

![Figure 21: Selecting USB device corresponding to application board](image)

![Figure 22: USB driver installation](image)
The following table lists some of the possible faults that you might encounter and the troubleshooting method.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Possible cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>If <strong>Communication Status</strong> remains grey red after checking the Start Button.</td>
<td>Application Board is turned off.</td>
<td><strong>Power on</strong> the application Board and restart the DD2.1 UI application. If the board is powered by rechargeable battery, ensure that the battery is charged.</td>
</tr>
<tr>
<td>Unable to locate the data logged file.</td>
<td>Destination path not properly defined.</td>
<td>Locate the file in the setup path of Development Desktop.</td>
</tr>
<tr>
<td>Error message <strong>Please connect application Board</strong> is displayed.</td>
<td>Application Board is not connected properly.</td>
<td>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.</td>
</tr>
<tr>
<td>Error message <strong>Please connect Shuttle Board</strong> is displayed.</td>
<td>Shuttle Board is not fixed properly.</td>
<td>Ensure that the Shuttle Board is correctly fixed in the Development Board.</td>
</tr>
<tr>
<td>Error message <strong>Please select a path or file for logging</strong> is displayed.</td>
<td>Destination path for saving the logged data is not defined.</td>
<td>Select the <strong>Data Export</strong> option in the file menu and specify the destination path.</td>
</tr>
<tr>
<td>Error message <strong>Please select File from File Menu → Data Export option to proceed</strong> is displayed.</td>
<td>Destination path not selected.</td>
<td>In the file menu, select the <strong>Data Export</strong> option and select the destination path.</td>
</tr>
<tr>
<td>Error message <strong>Please Connect Valid Sensor</strong> is displayed.</td>
<td>Wrong sensor fixed on the application Board.</td>
<td>Ensure that correct sensor is fixed on the application Board.</td>
</tr>
<tr>
<td>Graph for x, y, z channel not plotted.</td>
<td>Channel x, y, z not checked.</td>
<td>Ensure that x, y, z channels are checked.</td>
</tr>
</tbody>
</table>
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.

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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

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7 Document history and modification

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<td>March 2023</td>
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