Contents

1 Preface ........................................................................................................................................ 3
2 Step by Step Setup...................................................................................................................... 4
   2.1 Software and Extensions .................................................................................................... 4
   2.2 Hardware ........................................................................................................................... 4
   2.3 Run the Project .................................................................................................................. 5
3 Application Overview ................................................................................................................. 6
4 References .................................................................................................................................. 9
5 Legal disclaimer .......................................................................................................................... 10
   5.1 Engineering samples ......................................................................................................... 10
   5.2 Product Use ....................................................................................................................... 10
   5.3 Application Examples and Hints ...................................................................................... 10
6 Document History and Modifications ......................................................................................... 11
1 Preface

The Atmel Xplained Pro evaluation kits can be extended with so-called wing boards. The given documents shall guide the user through the first steps that are required to set up a first demo application with the BNO055 wing board from Atmel. The demo application implemented by BNO055 Xplained Pro – Data Stream project reads data from a BNO055 smart sensor and transmits them out to a terminal software in a host computer.

The main intention of the demo application is to be a reference example that shows how to use basic functions of BNO055. It can be extended and altered to implement desired custom use cases.

This document gives instructions how to set up the hardware and software system. It gives the user the necessary hints to see the project running.
2 Step by Step Setup

2.1 Software and Extensions

1. Install the latest version of Atmel Studio from Atmel website
2. Open Atmel Studio
3. Go to “Tools -> Extension Manager” and install the latest version of Atmel Software Framework (Version used in this extension is 3.20.1)
4. Go to “Tools -> Extension Manager” and search for “BNO055 Xplained – Data Stream” extension from Bosch Sensortec GmbH (BST) and install it
5. Go to “Tools -> Extension Manager” and search for “Terminal for Atmel Studio” extension from Atmel and install it (It is not necessary to install this extension if you are going to use another terminal software)
6. Restart Atmel Studio
7. Go to “File -> New -> Example Projects”
8. “Below BST – Bosch Sensortec GmbH” find the project named “BNO055_XPLAINED_PRO_DATA_STREAM – atsamd21j18a”
9. Select it and press “OK” button
10. Read and accept the license agreement and press “Finish” button to create a new example project

2.2 Hardware

11. Connect the BNO055 Xplained Pro wing board to EXT1 extension port of the SAMD21 Xplained Pro
12. Connect the micro USB cable to the EDBG USB port of the board and connect it to the host computer
13. Wait for the drivers to be installed completely
14. Go to “Start Menu -> Control Panel -> Device Manager”
15. Below “Ports (COM and LPT)” find “EDBG Virtual COM Port” and note the COM Port Number
16. In Atmel Studio go to “Project -> Properties” and select the tab named “Tool”
17. Below “Selected debugger/programmer” select the “EDBG” tool. And select “SWD” as the interface and save the changes.
2.3 Run the Project

18. In Atmel Studio to “Build -> Build Solution”

   The build process should succeed with no errors or warnings.

19. Go to “Debug -> Start Without Debugging”

20. Wait for the process to be done.

   (Notice the “Ready” message below, on the status bar)

21. Go to “View -> Terminal Window”

22. Select the EDBG virtual COM port number that you have previously noted, set
    Baud to 115200 an select ASCII as terminal's input format.

23. Press “Connect”

24. Move the board around and check the data on the terminal window
3 Application Overview

For detailed description of application implementation see check the BNO055 Xplained Pro – Data Stream application note.

The application implemented by this project is to read data from a BNO055 smart sensor and transmits them out to a terminal software in a host computer.

This project is implemented on an Atmel evaluation board which is expanded by an Atmel BNO055 extension board (also known as BNO055 wing board). Figure 1 shows the hardware set. The wing board is connected to EXT1 port of the main board.

![Figure 1 - Main and Extension board connections](image)

BNO055 is a 9-axis smart sensor, which integrates a microcontroller and three orientation sensors (accelerometer, magnetometer, and gyroscope) in a package.

The MCU on the main board reads sensor data via an I2C bus. The I2C bus has a baud rate of 400 KHz and sensor data is requested on a period of 100 ms (can be changed). Raw sensor data is then transmitted using UART with baud rate of 115200 bps to the embedded debugger unit (EDBG). EDBG supports a USB Communication Device Class (CDC), which features a virtual COM interface on the device. Output can be read on a terminal software connected to this virtual COM port as shown in Figure 2. Atmel Studio terminal extension can be used here.
Sensor data in this project are the Euler angles, namely Heading (Yaw), Roll and Pitch. Output stream is printed on the terminal in ASCII format in an order depicted on Figure 2.

```
Heading  Roll  Pitch
-----    ----  ----
-----    ----  ----
Sleeping Message
Waking Up Message
-----    ----  ----
```

**Figure 2 - Terminal output for Sensor Data Stream**

The sensor also reacts to motion/ no-motion by generating interrupts. If the sensor is left still, the data stream stops. In order to restart the stream the *any-motion* interrupt of the sensor should be triggered. Therefore the board has to be moved or rotated. Data Stream will continue until a *no-motion* interrupt is triggered, i.e. the sensor in not moved for some time. The movement threshold and waiting time to trigger interrupts can be configured by altering the code.

Figure 3 illustrates the sleep state transition of the system and Table 1 - RGB LED Colors shows RGB LED state in different states. In AWAKE mode BNO055 is operational, Euler data is read and printed on the terminal window and the LED color changes due to the orientation state of the sensor. In SLEEP mode BNO055 sleeps, data stream stops and the LED turns green. After reset the system is in AWAKE mode.

```
SLEEP (LED Green)   AWAKE
No-Motion          Any-Motion
```

**Figure 3 - Sleep State**
### Table 1 - RGB LED Colors

<table>
<thead>
<tr>
<th>Color</th>
<th>SLEEP Mode</th>
<th>AWAKE Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>OFF</td>
<td>Proportional to Pitch</td>
</tr>
<tr>
<td>Blue</td>
<td>OFF</td>
<td>Proportional to Heading</td>
</tr>
<tr>
<td>Green</td>
<td>ON</td>
<td>OFF</td>
</tr>
</tbody>
</table>
4 References

Atmel Studio Documents

Atmel Gallery
https://gallery.atmel.com/

Atmel-42220: SAM D21 Xplained Pro Evaluation Kit User Guide

Atmel-42096: Microcontroller Embedded Debugger (EDBG) User Guide
5 Legal disclaimer

5.1 Engineering samples

Engineering Samples are marked with an asterisk (*) or (e) 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.

5.2 Product Use

Bosch Sensortec products are developed for the consumer goods industry. They may only be used within the parameters of this product data sheet. They are not fit for use in life-sustaining or security sensitive systems. Security sensitive systems are those for which a malfunction is expected to lead to bodily harm or significant property damage. In addition, they are not fit for use in products which interact with motor vehicle systems.

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

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

The purchaser must monitor the market for the purchased products, particularly with regard to product safety, and inform Bosch Sensortec without delay of all security relevant incidents.

5.3 Application Examples and Hints

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

<table>
<thead>
<tr>
<th>Rev. No.</th>
<th>Chapter</th>
<th>Description of Modification/ Changes</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td></td>
<td>Document Created</td>
<td>2015-02-02</td>
</tr>
</tbody>
</table>