Application Note

BMF055
Evaluation Kit – User guide

Bosch Sensortec

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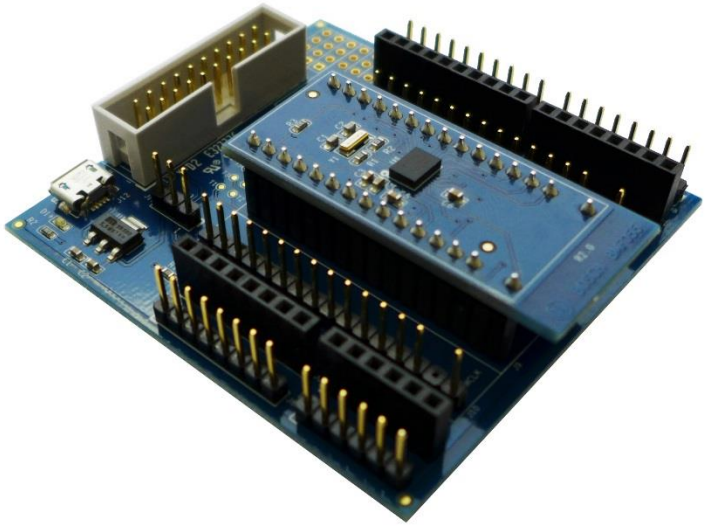

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Contents

1 Preface

This document is a user guide to setup the BMF055 evaluation kit. The kit consists of a BMF055 shuttle board connected to a BMF055 breakout board.

The document describes the modules on the boards and shows the necessary connections to power up the kit, program the chip and run the reference examples provided by Bosch Sensortec. The examples can be downloaded on Atmel Gallery (https://gallery.atmel.com/).

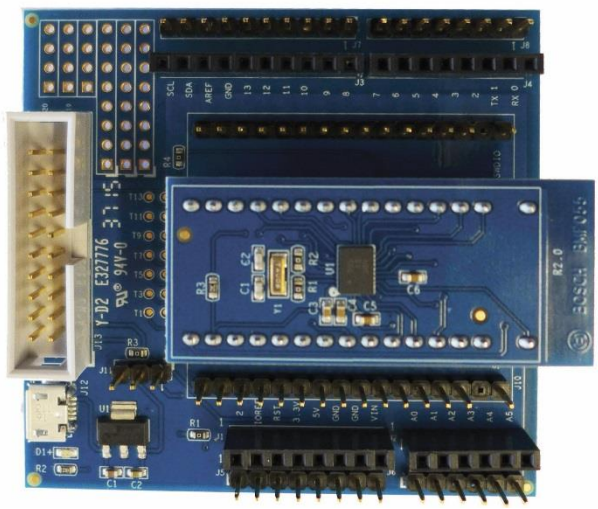

Figure 1 - BMF055 Evaluation Kit

2 BMF055 Breakout Board

2.1 Components

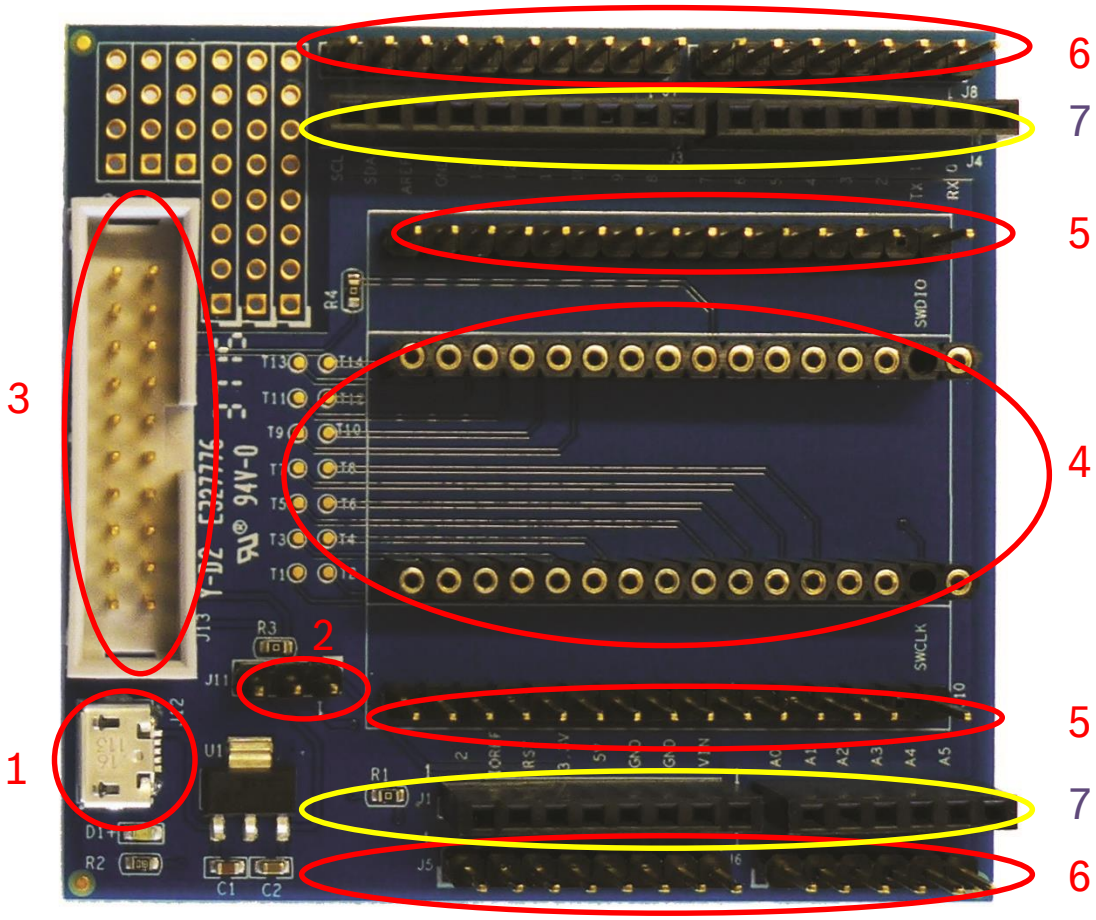

Figure 2 - BMF055 breakout board's components

1 – USB Power Connecter

2 – Power source selection pins (USB/ Arduino)

3 – Programmer/ Debugger JTAG Connector

4 – BMF055 shuttle board connector

5 – Customization pins connected to shuttle board connector

6 – Customization pins connected to Arduino pins

7 – Arduino Connector

2.2 Power

The board can be powered either via a USB cable or an Arduino board. In the former case a jumper should connect pins number 2 and 3 of the power source selection pins. In the latter case a connection between pins 1 and 2 are required.

2.3 BMF055 Shuttle Board

The shuttle board is a small circuit board with a BMF055 chip mounted on it. In addition to the sensor it includes the decoupling/filtering capacitors, reset pull-up resistor (RESETN) and a 32 KHz crystal and load capacitors.

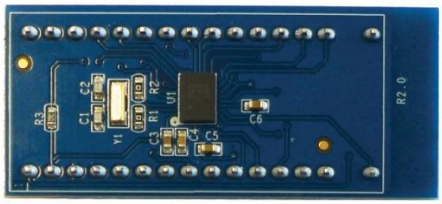

Figure 3 - BMF055 Shuttle Board

2.4 Arduino

BMF055 breakout board can be connected to an Arduino board as a shield. The male connectors at the bottom side provide this possibility. As shown in Figure 4 further shields can also be connected to the female connectors.

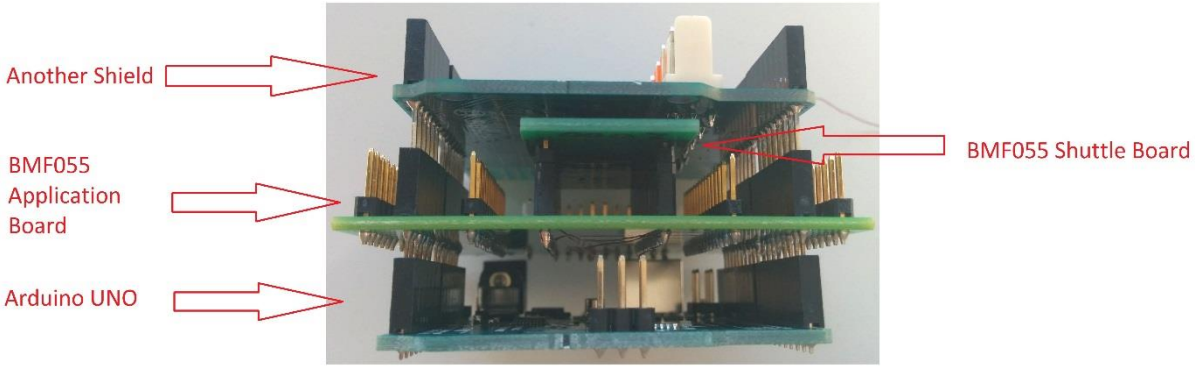

Figure 4 - Connection to Arduino UNO and an Arduino shield

2.5 Customization

The only connections to the Arduino and Shuttle board connectors on the breakout board are VDD and GND. The other pins are left unconnected so that users can customize how they desire. There are the two sets of male connectors available on the board: The inner set (Number 5 in Figure 2) is connected to the shuttle board pins in a one-to-one manner and the outer one (Number 6 in Figure 2) is connected to the Arduino pins in the same manner. These connectors can be used for the customization.

3 Necessary Connections

3.1 Shuttle board

The BMF055 shuttle board should be plugged in to the socket on the breakout board in a way that pin number 1 of the shuttle is connected to the pin number 1 of the socket.

3.2 Power

Either a USB connection or a connection to an Arduino board is required to provide power for the board.

3.3 Power jumper

If the breakout board's power is provided by an Arduino board the jumper J11 must connect pins number 1 and 2.

Otherwise, if a USB cable provides the power, the jumper J11 must connect pins number 3 and 2.

3.4 Programmer/ debugger connection

To program the microcontroller in BMF055 a programmer/ debugger is required. The board has a standard JTAG connector to for this purpose.

4 Connections for Reference Examples

In the reference examples provided by BST, the chip uses a USART interface to communicate to a host computer or another MCU. It receives commands and sends messages via USART. The pin assignment is given in Table 1.

Table 1 - USART Pin Assignment

Shuttle Board Pin #	Description
25	Tx
24	Rx

Figure **5** shows the necessary connections to power-on and program the sensor to run all reference examples. For more information refer to the examples' application notes.

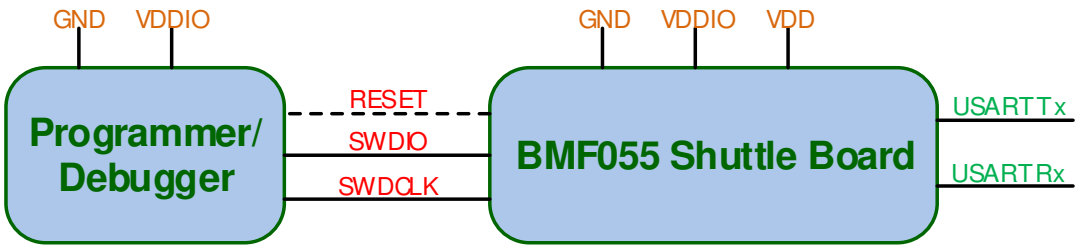

Figure 5 - Minimum Necessary Connections

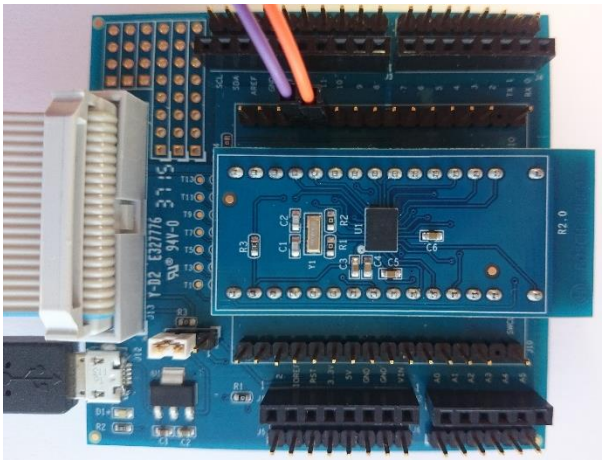

Figure 6 - Necessary connections to run reference examples

5 Quick Setup for Reference Examples

This chapter gives step by step instructions on how to start running this example on a BMF055 Shuttle Board.

5.1 Software and Extensions

1. Install the latest version of Atmel Studio from Atmel website
   - Open Atmel Studio
2. Go to “Tools -> Extension Manager” and install the latest version of Atmel Software Framework (Version used in this extension is 3.26.0)
3. Go to “Tools -> Extension Manager” and search for “BMF055 Shuttle Board – *[Example]*” extension from Bosch Sensortec GmbH (BST) and install it
4. 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 or another microcontroller as the host)
5. Restart Atmel Studio
6. Go to “File -> New -> Example Projects”
7. “Below BST – Bosch Sensortec GmbH” find the project named “BMF055_SHUTTLE_BOARD_*[EXAMPLE]* – atsamd20j18a”
8. Select it and press “OK” button
9. Read and accept the license agreement and press “Finish” button to create a new example project

5.2 Hardware

10. Establish the minimum necessary connections; including power, reset and programmer/debugger.
11. Establish a USART connection between the breakout board and the host computer*. Use bridges if necessary.
12. Install required drivers for your virtual COM port.
13. Go to “Start Menu -> Control Panel -> Device Manager”
14. Below “Ports (COM and LPT)” find the virtual COM port that you are going to use and note the *COM port number*

* It is assumed that the shuttle board would be interfaced to a terminal software running on a host computer.

15. In Atmel Studio go to “Project -> Properties” and select the tab named “Tool”

16. Below “Selected debugger/programmer” select the “SAM-ICE” tool (or another programmer that you are using). And select “SWD” as the interface and save the changes.

5.3 Run the Project

17. Open Atmel Studio

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

    The build process should succeed with no errors or warnings. (Figure 7)

19. In Atmel Studio go to “Tools -> Device Programming” (Figure 8)

    - Under *Tool* Select “SAM-ICE”; under *Device* select “ATSAMD20J18”; under *Interface* select “SWD” and Click Apply.

    - Go to *Memories* and click on *Erase now*. You should see the message “Erasing device... OK”. (Figure 9)

    - Go to *Fuses*, under *fuse name* find “NVMCTRL_BOOTPROT”, set its value to “0x07” and click *Program*. It should be done with no errors messages. (Figure 10)

    - Close the Device Programming window

20. Go to “Debug -> Start Without Debugging” (Figure 11)

21. Wait for the process to be done.

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

22. Run and connect the required software (e.g. Terminal) on the host computer if required

5.4 Check the Use-case

23. Check the application as explained in the example’s application note.

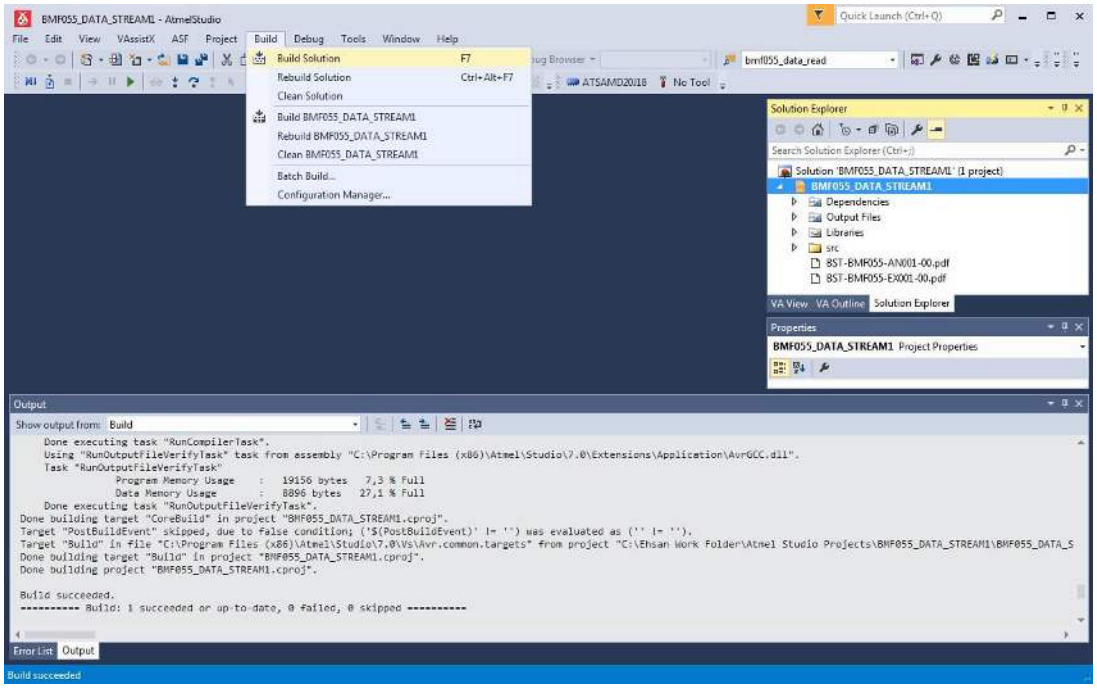

Figure 7 - Atmel Studio, Build Project

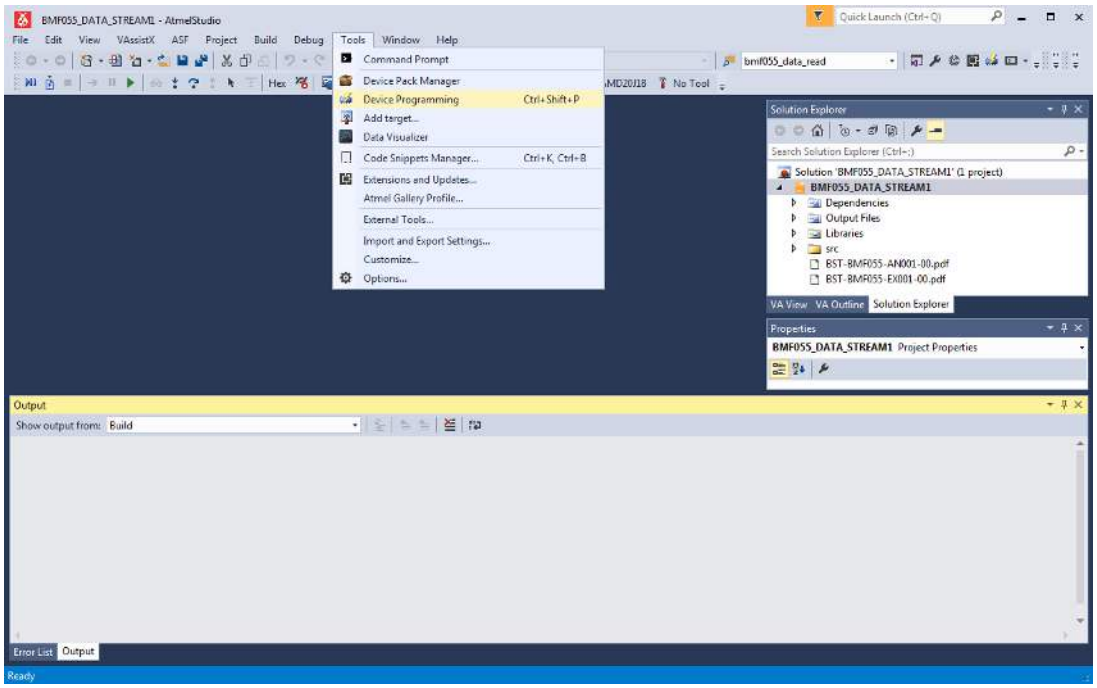

Figure 8 - Atmel Studio, Device Programming

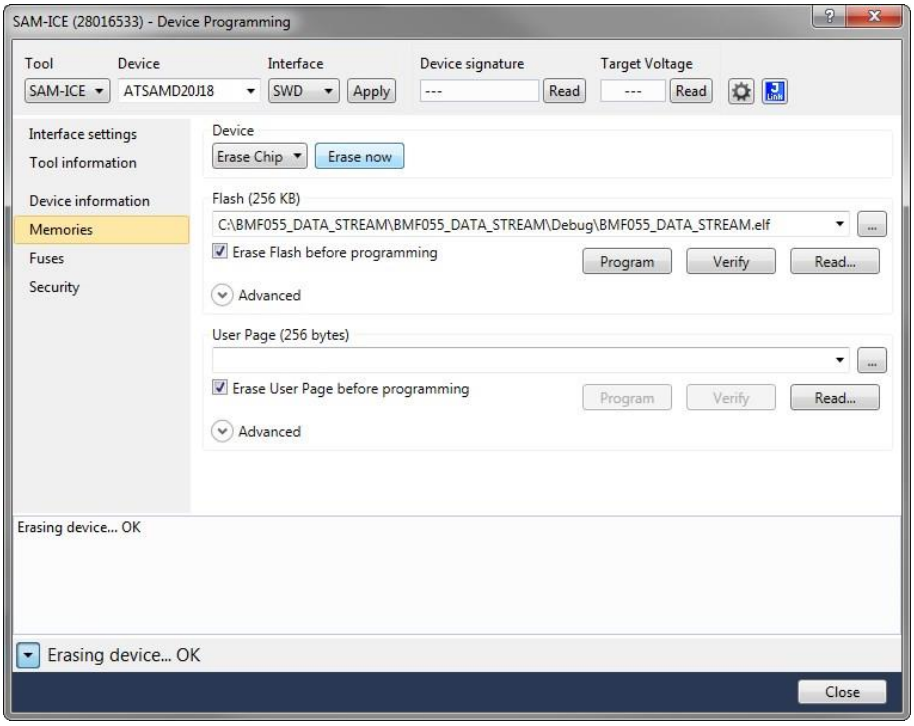

Figure 9 - Atmel Studio, Device Programming, Memories

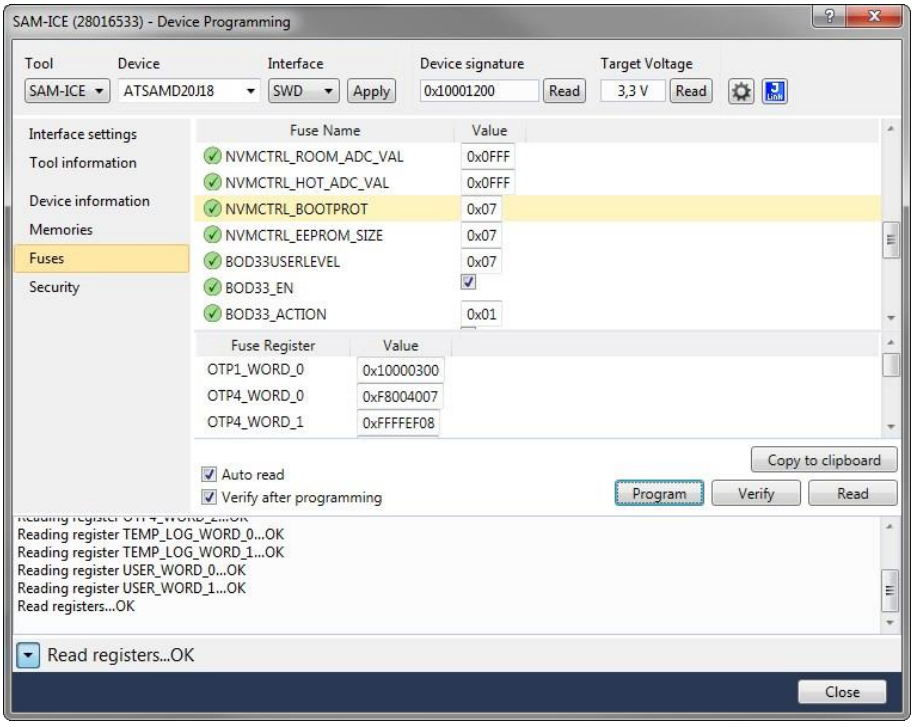

Figure 10 - Atmel Studio, Device Programming, Fuses

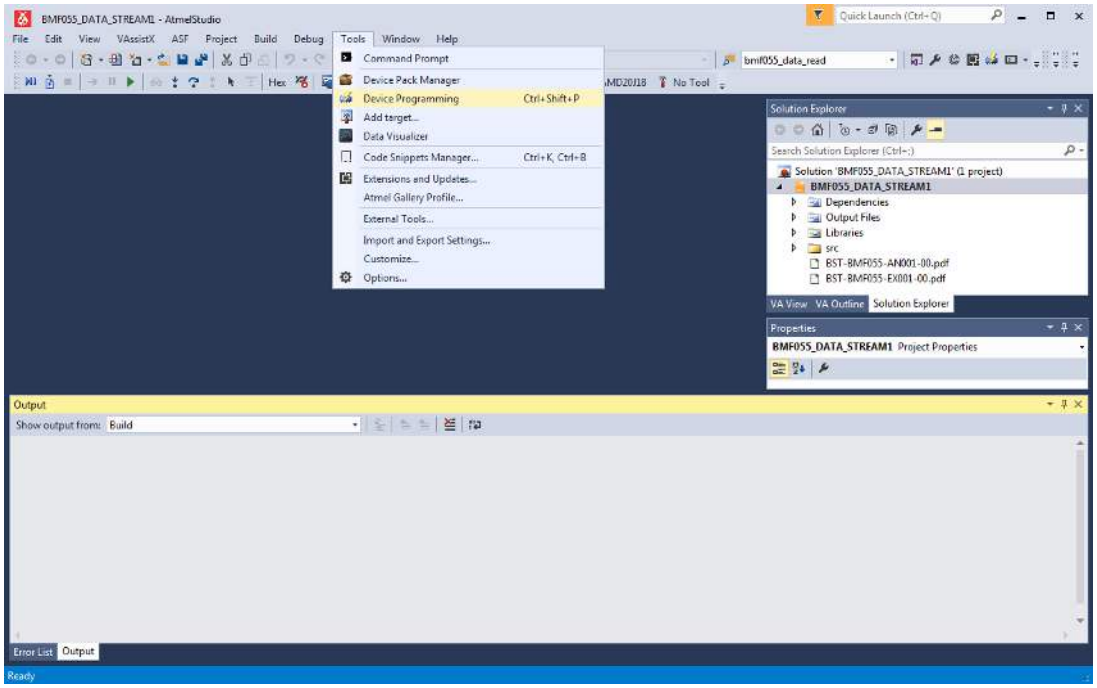

Figure 11 - Atmel Studio, Start without Debugging

6 BMF055 Shuttle Board

Bosch Sensortec BMF055 shuttle board is a PCB with a BMF055 Orientation Sensor mounted on it. It has the required decoupling capacitors, an external 32 KHz crystal and its load capacitors and allows easy access to the sensors pins via a simple socket.

The shuttle board can be plugged into Bosch Sensortec development tools, BMF055 Breakout Board, custom designed boards or breadboards.

6.1 Power

BMF055 has two distinct power supply pins:

- VDD is the main power supply for the internal sensors
- VDDIO is a separate power supply pin used for the supply of the MCU and the digital interfaces

The voltage supply range for VDD is 2.4V to 3.6V and for VDDIO is 1.7V to 3.6V.

For the switching sequence of power supply VDD and VDDIO it is mandatory that V_{DD} is powered on and driven to the specified level before or at the same time as V_{DDIO} is powered ON. Otherwise there are no limitations on the voltage levels of both pins relative to each other, as long as they are used within the specified operating range.

6.2 Programming/ Debugging

Programming and debugging of the chip is done Serial Wire Debug Interface available. Any debugger that supports the interface can be used. (e.g Atmel SAM-ICE)

6.3 Pin-out

Table 2 shows the shuttle board's pin names and their function.

For more information about possible pin functions please refer to the microcontroler's (ATSAMD20J18A) datasheet

Table 2 - BMF055 Shuttle Board Pin-out

Pin No.	Pin Name	BMF055 Pin Connected	SAMD20 Pin Connected	Description
1	VDD	3	-	VDD
2	VDDIO	28	-	VDDIO
3	GND	2, 25	-	GND
4	PA19/MISO	21	PA19	Internal SPI MISO
5	PA16/MOSI	24	PA16	Internal SPI MOSI
6	PA17/SCLK	23	PA17	Internal SPI SCLK
7	PB00	6	PB00	GPIO
8	PA18/CS1	22	PA18	Internal SPI CS1
9	PA27/CS2	12	PA27	Internal SPI CS2
10	PB02	4	PB02	GPIO
11	PB01	5	PB01	GPIO
12	PA28	10	PA28	GPIO
13	NC	-	-	Not connected
14	NC	-	-	Not connected
15	PB23/INT1	13	PB23	Internal interrupt 1/ GPIO
16	PA24	14	PA24	GPIO
17	PA22	16	PA22	GPIO
18	PA23	15	PA23	GPIO
19	RESETN	11	RESETN	Active Low Reset
20	PA21	17	PA21	GPIO
21	PA20	18	PA20	GPIO
22	PB03/INT2	1	PB03	Internal interrupt 2/ GPIO
23	NC	-	-	Not connected
24	PB17	19	PB17	GPIO
25	PB16	20	PB16	GPIO
26	NC	-	-	Not connected
27	NC	-	-	Not connected
28	NC	-	-	Not connected
29	PA30/SWCLK	8	PA30	Programming CLK
30	PA31/SWDIO	7	PA31	Programming IO

6.3.1 Internal Signals

The internal signals are the ones that connect the MCU to the three sensors: accelerometer (BMA280), magnetometer (BMM150) and gyroscope (BMG160). The internal signals are as follows:

- **SPI MISO**: the MISO signal of the SPI bus that connects the MCU and the three sensors
- **SPI MOSI**: the MOSI signal of the SPI but that connects the MSU to the three sensors
- **SPI SCLK**: the clock signal of the SPI but that connects the MSU to the three sensors
- **SPI CS1**: the chip select signal connected to accelerometer and magnetometer
- **SPI CS2**: the chip select signal connected to gyroscope
- **INT1**: interrupt signal connected to INT1 pin of accelerometer and gyroscope
- **INT2**: interrupt signal connected to INT2 pin of accelerometer and gyroscope

Please note that, MCU pins connected to the interrupt signals may be used as GPIOs only if the corresponding sensor interrupt is not configured.

For more information regarding the internal signals please refer to BMF055 datasheet.

7 References

Atmel-42129-SAM-D20_Datasheet

http://www.atmel.com/Images/atmel-42129-sam-d20_datasheet.pdf

BMF055 Datasheet

https://ae-bst.resource.bosch.com/media/products/dokumente/bmf055/BST_BMF055_DS000_01.pdf

8 Legal disclaimer

8.1 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.

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8.3 Application Examples and Hints

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9 Document History and Modifications

Rev. No.	Chapter	Description of Modification/ Changes	Date
1.0		Document Created	07.10.2015
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