Technical Document

How to play with BHI260AB shuttle board

Bosch Sensortec





Table of contents

1		NTRODUCTION	3
2	ŀ	HARDWARE	4
3	S	SOFTWARE	5
3	3.1	DD2.0 SW	5
3	3.2	2 COINES SW	8
3	3.3	ARC GNU IDE 2019.03-RC2 ECLIPSE	. 11
4	L	LEGAL DISCLAIMER	. 16
2	1.1	ENGINEERING SAMPLES	. 16
2	1.2	PRODUCT USE	. 16
2	1.3	APPLICATION EXAMPLES AND HINTS	. 16
5	C	DOCUMENT HISTORY AND MODIFICATION	. 17

[©] Bosch Sensortec GmbH reserves all rights even in the event of industrial property rights. We reserve all rights of disposal such as copying and passing on to third parties. BOSCH and the symbol are registered trademarks of Robert Bosch GmbH, Germany. Note: Specifications within this document are subject to change without notice.



1 Introduction

The BHI260AB is a family of ultra-low power smart sensor hubs consisting of Bosch Sensortec's new, programmable 32-bit microcontroller (Fuser2), a state-of-the-art 6-axis IMU and a powerful software framework containing pre-installed sensor fusion library BSX4 and other sensor processing software within a small 44 pad LGA package.

The Fuser2 Core is configurable to operate at 20 MHz (Long Run mode) and 50 MHz (Turbo mode). It can boot from a wide variety of hosts, ranging from a small Cortex- $M0^{TM}$ MCU up to multicore application processors, while it has also the ability to run standalone, when booting from an attached flash memory.

In combination with its wide connectivity and extendibility, the BHI260AB becomes a versatile and ideal solution when it comes to always-on sensor processing at ultra-low power consumption.

The BHI260AB is the second generation of smart sensor hub compared to the first generation BHI160 and BHI160B smart sensor hubs. The comparison table is as shown in Table 1.

Parameter	BHI160B	BHI260AB
Dimensions	3 mm x 3 mm x 1 mm	3.6 mm x 4.1 mm x 0.83 mm
Processor Clock Speed	10 MHz	20 MHz (long run) or 50 MHz (turbo)
Primary host interface type	(l2C, 3.4MHz)	(I2C, 3.4MHz)/(SPI, 50MHz)
Secondary sensor interface	One (I2C, 400Hz)	Up to four (I2C, 1MHz)/(SPI, 50MHz)
Memory	48KB RAM, 96KB ROM no flash support	256KB RAM, 144KB ROM up to 8MB external flash
Max. Output sample rate (Hz)	200Hz	800Hz
Integrated Algorithms	State of the art BSX3 Sensor Fusion	Enhanced BSX4 Sensor Fusion with : • Higher data rates • Configurability (e.g. Low Power options) • Additional Virtual Sensors
Programmability	Programmable by customer Sensor software framework support Metaware compiler support	Programmable by customer Sensor software framework and OpenRTOS support Metaware compiler and GCC support

Table 1 comparison between BHI160B and BHI260AB

Every time when BHI260AB is powered on, the RAM patch with the filename "*.fw" needs to be downloaded into BHI260AB. Then the host needs to enable one or multiple virtual sensors with selected output data rate (ODR). Then BHI260AB will automatically output results continuously.

This document shows instructions on how to play with the BHI260AB shuttle board to quickly evaluate BHI260AB.

[©] Bosch Sensortec GmbH reserves all rights even in the event of industrial property rights. We reserve all rights of disposal such as copying and passing on to third parties. BOSCH and the symbol are registered trademarks of Robert Bosch GmbH, Germany. Note: Specifications within this document are subject to change without notice.



2 Hardware

The hardware includes one APP2.0 base board, one BHI260AB shuttle board and one micro USB cable as shown in Figure 1.

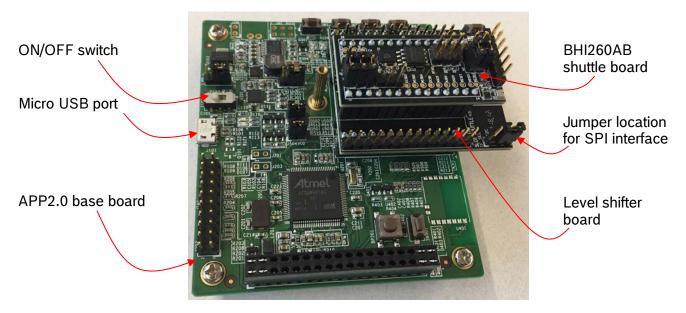


Figure 1 APP2.0 base board and BHI260AB shuttle board

Since BHI260AB operates at 1.8V only and APP2.0 base board uses 3.3V, a level shifter is required to convert 3.3V to 1.8V for BHI260AB power supply and digital interface.

On the level shifter board, please place the jumper at the location for SPI interface because the following software uses SPI interface by default.

APP2.0 base board can be purchased at <u>https://www.mouser.com/ProductDetail/Bosch-Sensortec/Application-Board?qs=sGAEpiMZZMuqBwn8WqcFUoBr6H0DPHbmmKD1%2FZpnPHTNXN07wcSwfQ%3</u>D%3D.

APP2.0 base board schematics is available online at <u>https://ae-bst.resource.bosch.com/media/ tech/media/application board 2 0/BST-DHW-AN001-01 APP2 0 Hardware Description .pdf</u>.

BHI260AB shuttle board can be requested through local sales representative and its schematics is available online at https://ae-

bst.resource.bosch.com/media/ tech/media/shuttleboard flyer/BST-DHW-FL026.pdf. On BHI260AB shuttle board, Bosch BMM150 and AKM AK09915 magnetometers are installed. Bosch 3-in-1 environmental sensor BME280 (temperature, air pressure and humidity) is also installed.

July 2019

Bosch Sensortec

[©] Bosch Sensortec GmbH reserves all rights even in the event of industrial property rights. We reserve all rights of disposal such as copying and passing on to third parties. BOSCH and the symbol are registered trademarks of Robert Bosch GmbH, Germany.



3 Software

In order to evaluate BHI260AB shuttle board, there are three software available,

- Development Desktop 2.0 (DD2.0)
- COINES v2.0
- ARC GNU IDE 2019.03-rc2 Eclipse

Their differences are as shown in Table 2.

Table 2 functionalities of these three SW

Functionalities	DD2.0	COINES	ARC GNU
Real-time waveforms	Yes	No	No
Log data into a CSV file	Yes	Yes	Yes
Low level programming	No	Yes	Yes
Develop and test own algorithm	No	Yes	Yes
Generate customized RAM patch	No	No	Yes

3.1 DD2.0 SW

DD2.0 SW can be downloaded online at <u>https://ae-</u>

<u>bst.resource.bosch.com/media/ tech/media/development_desktop_software/DevelopmentDeskt</u> <u>op20_V3.19.exe</u>. After installation users are able to download the RAM patch into BHI260AB, enable virtual sensors, view real-time results and log results into a CSV file. The instructions are as shown below.

- Connect micro USB cable from APP2.0 base board to PC USB port. Switch on APP2.0 base board.
- Launch DD2.0 SW and DD2.0 will automatically recognize the BHI260AB shuttle board. A dialog window will be popped up asking to download the RAM patch as shown in Figure 2.

Select location to write the firmwa	are	
● RAM) Flash	
Hardware version		
Product ID : 0x0089	Revision ID : 0x0002	
Firmware version		
ROM Version : 0x142E	Kernel Version : 0x0000	
Select .fw file :		
Download		

Figure 2 RAM patch download dialog

• Click the "..." button and select the "Bosch_LGA_SHUTTLE_BMI160_BMM150.fw" that is located in the "C:\Program Files\Bosch Sensortec\Development Desktop

[©] Bosch Sensortec GmbH reserves all rights even in the event of industrial property rights. We reserve all rights of disposal such as copying and passing on to third parties. BOSCH and the symbol are registered trademarks of Robert Bosch GmbH, Germany.



2.0\Firmware\BHI260\RAM Images" folder. Then click the "Download" button. After a short while users should see the text "BHI260 firmware is downloaded successfully". Then close this dialog.

- Next step is to enable one or multiple virtual sensors by clicking the "Virtual Sensor" tab on the top right corner of DD2.0 SW. For example, from the "Virtual Sensor" dropdown list select "Gravity (Non-Wakeup)" and then click "Write Info" tab. Select 100Hz from the "Sample Rate" dropdown list and then click "Write" button.
- Similarly enable virtual sensor "Linear Acceleration (Non-Wakeup)" and "Orientation (Non-wakeup)" with the same 100Hz sample rate and click the "Write" button.
- Click "System" tab on the top right and select the above three virtual sensors from Plot1, Plot2 and Plot3 respectively. Then click "Refresh" button to check if each physical sensor is active or not from their "Power Mode" status respectively.
- Now click "Start Streaming" button on the bottom left to see the waveforms in real-time by rotating the APP2.0 base board with BHI260AB shuttle board plugged in. When moving on a flat surface back and forth, linear acceleration is changing in Plot2, while gravity vector in Plot1 remains the same as shown in Figure 3.

Development Desktop 2.0 - BH260	- 0 ×
Elle Interface Selection Panels Settings Help	
Bosch Sensortec	BOSCH
	Invented for life
Gravity(Non-Wakeup)	General Settings
+ ☆ @ @] A Aves - Color - Reset Sensor Status - ,	System Virtual Sensor
20.000 -	Plot1 Gravity(Non-Wakeup)
15.000	Plot2 Linear Acceleration (Non-Wakeup)
10.000	Elifear Acceleration (volt-valeedp)
\$ 000	Plot3 Orientation(Non-Wakeup) •
	Active Virtual Sensors Gravity(Non-Wakeup)
-10.000 -	
15 000	Application processor suspended FIFO Watermark
-20.000	Wakeup Watermark 0 - Size 17920 bytes
Linear Acceleration(Non-Wakeup)	Non-Wakeup Watermark 0 \$ Size 18432 bytes
+ 🐼 @, @, □ I 🖪 A Aves - Color - Reset Sensor Status - ,	Write
20.00 -	B\$X Library
15:00	ODR
	Physical sensor working status Accelerometer Magnetometer Gyroscope
$= \frac{1}{2} (1 + 1) (1$	Sampling Rate 100 Hz
-10.00	Range 8 g
11500 -	Power Mode Active
-2000	Interrupt Enable
Orientation(Non-Waksup)	
II + 🐼 @ Q □ F 🖪 D A Ass - Color - Reset Sensor Status - ,1]	Error Indicator Algorithm Error: Unsupported Phys Rate
350 000 -	Orientation
300.000 - 250.000 -	Roll -0.5 Degree Pitch 0.2 Degree
	Heading 89 Degree
ğ 100.000	Disable Interrupt Reset System Refresh
8 5000	
-50.000 -	
-100 000 ±	
Stat Streaming	Connection status 📀

Figure 3 BHI260AB virtual sensors' waveforms

• Click "Panels -> Data Export" a dialog window will pop up as shown in Figure 4. The enabled virtual sensors' results can be saved into a CSV file.

[©] Bosch Sensortec GmbH reserves all rights even in the event of industrial property rights. We reserve all rights of disposal such as copying and passing on to third parties. BOSCH and the symbol are registered trademarks of Robert Bosch GmbH, Germany.



Technical Document How to play with BHI260AB shuttle board

Х

_

Non Wakeup

Wakeup

NA

NA

Enable Logging

Overwrite ()

BSX Virtual Sensor	Wakeup	Non Wakeup	Non-BSX Virtual Sen
ccelerometer Passthrough	NA		Temperature
Accelerometer Uncalibrated			Pressure
Accelerometer Corrected			Humidity
Accelerometer Offset	NA		Gas
Gyroscope Passthrough	NA		Step Counter
Gyroscope Uncalibrated			Step Detector
Gyroscope Corrected			Significant Motion
Gyroscope Offset	NA		Any Motion
Magnetometer Passthrough	NA		Ex Camera
Magnetometer Uncalibrated			GPS
Magnetometer Corrected			Custom Sensor
Magnetometer Offset	NA		
Gravity			Select Destination
Linear Acceleration			
Rotation Vector			Append
Game Rotation Vector			
Geomagnetic Rotation Vector			
Orientation			
Tilt Detector		NA	
Step Detector		NA	
Step Counter			
Significant Motion		NA	
Wake Gesture		NA	
Glance Gesture		NA	
Pick Up Gesture		NA	
Activity		NA	
Wrist Tilt		NA	
Device Orientation			
Stationary Detect		NA	
Motion Detect		NA	
SensorTime	\checkmark		
Metaevents			

Figure 4 Log data into a CSV file

July 2019

Bosch Sensortec

© Bosch Sensortec GmbH reserves all rights even in the event of industrial property rights. We reserve all rights of disposal such as copying and passing on to third parties. BOSCH and the symbol are registered trademarks of Robert Bosch GmbH, Germany.



3.2 COINES SW

COINES v2.0 SW can be downloaded online at <u>https://ae-bst.resource.bosch.com/media/ tech/media/coines/COINES v2.0 Windows.exe</u>. After installation users are able to find the folder C:/Windows/COINES/v2.0 as shown in Figure 5.

COINES ("COmmunication with INertial and Environmental Sensors") provides a low-level interface to APP2.0 base board and each sensor shuttle board. Users can access MEMS sensors through a C interface. COINES can be used with the SensorAPI of the sensor. The SensorAPI is available at https://github.com/BoschSensortec. Source code of sample applications and SensorAPI are provided with the COINES library as a package. Users can modify, compile and run the sample applications. However, users cannot create their own virtual sensors with their own algorithms and then generate customized BHI260AB RAM patches.

Name	Date modified	Туре	Size
coinesAPI	7/5/2019 9:09 AM	File folder	
doc 🔤	7/5/2019 9:09 AM	File folder	
driver	7/5/2019 9:09 AM	File folder	
examples	7/5/2019 9:09 AM	File folder	
firmware	7/5/2019 9:09 AM	File folder	
📙 gui	7/5/2019 9:09 AM	File folder	
sensorAPI	7/5/2019 9:09 AM	File folder	
util	7/5/2019 9:09 AM	File folder	
examples.zip	5/27/2019 9:54 AM	zip Archive	210 KB
LICENSES.txt	5/26/2019 11:27 AM	Text Document	35 KB
ReleaseNotes.txt	5/27/2019 9:51 AM	Text Document	4 KB
📄 unins000.dat	7/5/2019 9:09 AM	DAT File	59 KB
🛃 unins000.exe	7/5/2019 9:09 AM	Application	714 KB

Figure 5 COINES folder

One example of using COINES together with the APP2.0 base board and BHI260AB shuttle board is as shown below.

 Go to folder C:\COINES\v2.0\examples\c\bhy2\rotation_vector in Windows File Explorer. Then press and hold "Shift" key on the keyboard and then right click the mouse. Select "Open PowerShell window here" as shown in Figure 6.

[©] Bosch Sensortec GmbH reserves all rights even in the event of industrial property rights. We reserve all rights of disposal such as copying and passing on to third parties. BOSCH and the symbol are registered trademarks of Robert Bosch GmbH, Germany. Note: Specifications within this document are subject to change without notice.



- ♥ - votation_vector								
File Home Share View								
$\leftarrow \rightarrow \checkmark \uparrow$ \blacksquare > This PC > (C:) Windows > COINES	> v2.	0 → examples → c → bhy2	> rotation_vector					
🏥 (C:) Windows	^	Name	Date modified	Туре	Size			
🔒 arc_gnu		bhy2_rotation_vector.c	4/18/2019 9:10 AM	C File		12 KB		
ArduinoIDE		Makefile	5/24/2019 11:22 PM	File		1 KB		
Bosch Parts								
COINES								
ApplicationNote								
📙 bme680								
bsec_iot_example								
v1.2								
v1.8	н.							
v2.0								
coinesAPI								
doc							View	>
driver							Sort by	2
examples							Group by	~
c							Refresh	
bhy							Customize this <u>f</u> older	
bhy2							<u>P</u> aste	
bhy2cli							Paste <u>s</u> hortcut	
bme_altitude							<u>U</u> ndo Copy	Ctrl+Z
bme env							Open PowerShell window here	
gesture_recognition							Enhanced Internet Path (UNC only)	
lean_orientation							<u>P</u> ath Copy	
rotation_vector							Give access to	>
bma400							Ne <u>w</u>	>
bma423							Properties	
bma456						_		

Figure 6 COINES example folder

• Type mingw32-make and press Enter key. The exe file is generated as shown in Figure 7.

	Date modified	Туре	Size			
build	7/10/2019 1:12 PM	File folder				
bhy2_rotation_vector.c	4/18/2019 9:10 AM	C File	12 KB			
bhy2_rotation_vector.exe	7/10/2019 1:12 PM	Application	476 KB			
Makefile	5/24/2019 11:22 PM	File	1 KB			
Windows PowerShell S C:\COINES\v2.0					-	×
cc 1 / / / .	./sensorAPI			w2_api.c		

Figure 7 COINES compiling to EXE file

• Type .\bhy2_rotation_vector.exe and press Enter key. The RAM patch will be downloaded to BHI260AB shuttle board and COINES lists all the virtual sensors. Then COINES displays rotation vector quaternions x, y, z, w continuously as shown in Figure 8.

[©] Bosch Sensortec GmbH reserves all rights even in the event of industrial property rights. We reserve all rights of disposal such as copying and passing on to third parties. BOSCH and the symbol are registered trademarks of Robert Bosch GmbH, Germany.



Technical Document How to play with BHI260AB shuttle board

Confidential

27 Select Windows PowerShell	-	>
5 C:\COINES\v2.0\examples\c\bhy2\rotation_vector> .\bhy2_rotation_vector.exe bund BHI260 Shuttleboard Successfully		
V_REG_HOST_INTERUPT_CTRL: 0x04!		
info]Boot status: 0x18.		
Info]Host interface is ready.		
nfo]No ext_flash is detected, need to upload ram patch.		
Info]Install generic callbacks completely.		
[nfo]Install required sensor callbacks completely. [nfo]Virtual sensor present:		
Info]Sensor ID: 1, acc_passthrough.		
Info]Sensor ID: 3, acc_raw.		
Info]Sensor ID: 4, acc_corrected.		
Info]Sensor ID: 5, acc_offset.		
Info]Sensor ID: 6, wkup_acc_corrected. Info]Sensor ID: 7, wkup_acc_raw.		
Info]Sensor ID: /, wdp_acc_raw. Info]Sensor ID: 10, gyro_passthrough.		
Info]Sensor ID: 12, gyro_raw.		
Info]Sensor ID: 13, gyro_corrected.		
Info]Sensor ID: 14, gyro_offset.		
Info]Sensor ID: 15, wkup_gyro_corrected. Info]Sensor ID: 16, wkup_gyro_raw.		
InfolSensor ID: 19. mag passthrough.		
InfolSensor ID: 21. mag_raw.		
Info]Sensor ID: 22, mag_corrected.		
Info]Sensor ID: 23, mag_offset.		
Info]Sensor ID: 24, wkup_mag_corrected. Info]Sensor ID: 25, wkup_mag_raw.		
Info]Sensor ID: 25, wkup_mag_raw. Info]Sensor ID: 28, gravity.		
Info]Sensor ID: 29, wkup_gravity.		
Info]Sensor ID: 31, linear_acc.		
Info]Sensor ID: 32, wkup_linear_acc.		
Info]Sensor ID: 34, rotation. Info]Sensor ID: 35, wkup_rotation.		
Info]Sensor ID: 37, game_rotation.		
Info]Sensor ID: 38, wkup_game_rotation.		
Info]Sensor ID: 40, geo_rotation.		
Info]Sensor ID: 41, wkup_geo_rotation.		
Info]Sensor ID: 43, orient. Info]Sensor ID: 44, wkup_orient.		
Info]Sensor ID: 44, wkup_orient. Info]Sensor ID: 48, wkup_tilt_detect.		
Info]Sensor ID: 50, step detect.		
Info]Sensor ID: 52, step count.		
Info]Sensor ID: 53, wkup_step_count.		
Info]Sensor ID: 55, wkup_sig_motion. Info]Sensor ID: 57, wkup_wake_gesture.		
Info]Sensor ID: 59, wkup_wake_gesture. Info]Sensor ID: 59, wkup_glance_gesture.		
Info]Sensor ID: 61, wkup_pickup_gesture.		
Info]Sensor ID: 63, wkup_activity.		
Info]Sensor ID: 67, reserved67.		
InfojSensor ID: 69, reserved69.		
Info]Sensor ID: 70, reserved70. Info]Sensor ID: 75, reserved75.		
Info]Sensor ID: 75, reserved75. Info]Sensor ID: 77, reserved77.		
Info]Sensor ID: 94, wkup_step_detect.		
Info]enable RV sensor as 10.000000 HZ		
Info]BHY_WKUP_META_EVENT_INITIALIZED: ram ver: 5685.		
Info]BHY_META_EVENT_INITIALIZED: ram ver: 5685. Info]BHY_META_EVENT_POWER_MODE_CHANGED: sensor type: 34.		
INFOJENYJMETA_EVENI_POMEKJMODE_LHANGED: SENSOF LYDE: 34.		
Info]sensor: rotation timestamp: 0.316875s x: -0.000 y: 0.009 z: 0.000 w: 1.000 accuracy	: -0.858.	
Info]sensor: rotation timestamp: 0.396703s x: 0.000 y: 0.011 z: -0.000 w: 1.000 accuracy	r: -0.858.	
Info]sensor: rotation timestamp: 0.476547s x: 0.000 y: 0.014 z: -0.000 w: 1.000 accuracy	: -0.858.	Γ,

Figure 8 COINES example results

- Users can modify "bhy2_rotation_vector.c" file and compile it again for further evaluation. COINES has its own editor IDE on the desktop of the PC after installation.
- If user's PC is Windows 10 OS x64, then please download TDM64-GCC-5.1.0-2 online at https://sourceforge.net/projects/tdm-gcc/files/TDM-GCC%20Installer/tdm64-gcc-5.1.0-2.exe/download. And then install it because it will be used to compile the code in COINES.

July 2019

[©] Bosch Sensortec GmbH reserves all rights even in the event of industrial property rights. We reserve all rights of disposal such as copying and passing on to third parties. BOSCH and the symbol are registered trademarks of Robert Bosch GmbH, Germany.



3.3 ARC GNU IDE 2019.03-rc2 Eclipse

The ARC GNU IDE 2019.03-rc2 for Windows can be downloaded online at <u>https://github.com/foss-for-synopsys-dwc-arc-processors/toolchain/releases/download/arc-2019.03-rc2/arc gnu 2019.03-rc2 ide win install.exe</u>. It is all-in-one IDE for BHI260AB that allows users to develop their own algorithms, generate their own RAM patch together with the BHI260AB SDK and test the code together with COINES SW as a terminal.

The BHI260AB SDK "BHI260_SDK_Installer_V1.0.0.exe" is available under NDA. Please contact local sales representative for the NDA before BST FAE (field application engineer) sends the BHI260AB SDK to the user.

The following instructions show how to use ARC GNU IDE to develop customized BHI260AB RAM patch.

The example here is to create a new virtual sensor so called "Lean Device Orientation (LDO)" which uses BHI260AB accelerometer data to display which axis is pointing to sky. For example, Z+ means Z axis is pointing to sky and Z- means Z axis is pointing to ground.

- Assume the ARC GNU IDE, BHI260 SDK and COINES v2.0 have been installed on a Windows x64 PC.
- Launch ARC GNU IDE and click menu "File -> Import...". Then select "Existing Code as Makefile Project" and click "Next" button. Then click "Browse" button to locate the BHI260 SDK folder on your PC and click "Finish" button.
- Repeat the above step to import C:\COINES\v2.0\examples\c\bhy2\bhy2cli folder. Bhy2cli is a command line interface tool between PC and BHI260AB shuttle board. Users can open a Terminal in ARC GNU IDE and type commands there to see the results.
- In ARC GNU IDE click "BHI260_SDK" on top left and then click menu "Project -> Properties". Click "C/C++ Build" on the left of the popup window and type "build.bat" on the Build command Edit box as shown in Figure 9.

be filter text	C/C++ Build (> ▼ □) ▼
Resource Builders C/C++ Build C/C++ General	Configuration: Default [Active]
Linux Tools Path Project Natures Project References Run/Debug Settings	Builder
Task Repository	Builder type: External builder v
Task Tags Validation	Use default build command
WikiText	Build command: build.bat Variables
	Makefile generation
	Build location
	Build directory: \${workspace_loc:/BHI260_SDK}/
	Workspace File system Variables
	Restore Defaults Apply

Figure 9 Project Properties Builder Settings

July 2019

Bosch Sensortec

© Bosch Sensortec GmbH reserves all rights even in the event of industrial property rights. We reserve all rights of disposal such as copying and passing on to third parties. BOSCH and the symbol are registered trademarks of Robert Bosch GmbH, Germany.



• Then click "Behavior" tab and make the configurations as shown in Figure 10.

pe filter text	C/C++ Build		⇔ - ⇔ -
Resource Builders C/C++ Build C/C++ Build C/C++ General Linux Tools Path Project References Run/Debug Settings Task Repository Task Regs	Configuration: Default [Active]		e Configurations
Validation WikiText	Workbench Build Behavior	Use unlimited jobs	
	Workbench build type:	Make build target:	
	Build on resource save (Auto build)	all	Variables
	Note: See Workbench automatic build	preference	
	Build (Incremental build)		Variables
	Clean	clean	Variables
		Restore Defau	Its Apply

Figure 10 Project Properties Behavior

• Click menu "Windows -> Show View -> Terminal". A new "Terminal" tab will show up. Then click the "Open a Terminal" icon on the right side and click "OK" button as shown in Figure 11.

Launch Terminal			×
Choose terminal: Loca	l Terminal		\sim
Settings			
Encoding: UTF-8			\sim
	ОК	Cano	

Figure 11 Terminal configuration

• Now ARC GNU IDE is ready to use.

The following three steps show how to create own virtual sensor and generate own RAM patch *.fw file.

• Open the "boards" folder under BHI260_SDK project in ARC GNU IDE. Copy and paste "Bosch_SHUTTLE_BHI260_BMM150.cfg" file and then rename it as "Bosch_SHUTTLE_BHI260_BMM150_LDO.cfg". At the end of this file, add below two lines as shown in Figure 12.

131, -1.000000 # custom LDO data source 132, -1.000000 # custom LDO algo

July 2019

[©] Bosch Sensortec GmbH reserves all rights even in the event of industrial property rights. We reserve all rights of disposal such as copying and passing on to third parties. BOSCH and the symbol are registered trademarks of Robert Bosch GmbH, Germany.



Image: Solution of the second seco	File Edit Source Refactor Navigate Search Project Run Window Help	
 G4 192, 400.00000 # wakeup accel corr depends on a virtual BSX source. G5 200, 400.00000 # wakeup dev orient depends on a virtual BSX source. G5 200, 400.00000 # wakeup dev orient depends on a virtual BSX source. G5 201, 400.00000 # wakeup gev orient depends on a virtual BSX source. G5 202, 400.00000 # wakeup gev orient depends on a virtual BSX source. G5 202, 400.00000 # wakeup gev orient depends on a virtual BSX source. G5 205, SHUTTLE, BHI260_MK0915.fg Bosch_SHUTTLE, BHI260_BMM150.LDD.cfg Bosch_SHUTTLE, BHI260_MM150.fg Bosch_SHUTTLE, BHI260_LBMM150.fg Bosch_SHUTTLE, BHI260_LBMM150.fg Bosch_SHUTTLE, BHI260_AK0915.fg Bosch_SHUTTLE, BHI260_MM150.fg Bosch_SHUTTLE, BHI260_MM150.fg Bosch_SHUTTLE, BHI260_MM150.cfg Bosch_WND_BHI260_AK0915.fg Bosch_WND_BHI260_AK0915.fg Bosch_WND_BHI260_MK01510.cfg Bosch_MND_BHI260_MK01510.cfg Bosch_WND_BHI260_MK01510.cfg Bosch_WND_BHI260_MK01510.cfg Bosch_WND_BHI260_MK01510.cfg Bosch_WND_BHI260_MK01510.cfg Bosch_WND_BHI260_MK01510.cfg Bosch_WND_BHI260_MK01510.cfg Bosch_WND_BHI260_MK01510.cfg Bosch_WND_BHI260_MK01510.cfg Bosch_WND_BHI260_MK01510.cfg<!--</th--><th>No Launch Configurations</th><th>🗸 on: 🗸 🌞 🗄 🗂 🕶 🔚 🔞 🖌 🖷 🖗 🗸 🖬 🖗 🕶 🗒</th>	No Launch Configurations	🗸 on: 🗸 🌞 🗄 🗂 🕶 🔚 🔞 🖌 🖷 🖗 🗸 🖬 🖗 🕶 🗒
 See apps See apps Sech_SHUTTLE_BHI260_AK09915_BME280.cfg Bosch_SHUTTLE_BHI260_AK09915.cfg Bosch_SHUTTLE_BHI260_DMC9915.cfg Bosch_SHUTTLE_BHI260_BMM150_LDO.cfg Bosch_SHUTTLE_BHI260_BMM150.cfg Bosch_SHUTTLE_BHI260_turbo.cfg Bosch_SHUTTLE_BHI260_turbo.cfg Bosch_WND_BHI260_AK0915.cfg Bosch_SHUTTLE_BHI260_turbo.cfg Bosch_WND_BHI260_AK0915.cfg Bosch_SHUTTLE_BHI260_turbo.cfg Bosch_SHUTTLE_BHI260_BMM150.cfg Bosch_SHUTTLE_BHI260_turbo.cfg Bosch_WND_BHI260_AK0915.cfg Bosch_WND_BHI260_AK0915.cfg Bosch_WND_BHI260_AK0915.cfg Bosch_WND_BHI260_AK0915.cfg Bosch_WND_BHI260_AK0915.cfg Bosch_WND_BHI260_AK0915.cfg Bosch_WND_BHI260_CMG1510.cfg Bosch_WND_BHI260_CMG1510		
	 > boards > boards > Bosch_SHUTTLE_BHI260_AK09915_BME280.cfg > Bosch_SHUTTLE_BHI260_BME280.cfg > Bosch_SHUTTLE_BHI260_BMM150_LDO.cfg > Bosch_SHUTTLE_BHI260_BMM150_cfg > Bosch_SHUTTLE_BHI260_AK09915.cfg > Bosch_WRD_BHI260_AK09915.cfg > Bosch_WRD_BHI260_AK09915.cfg > Bosch_WRD_BHI260_BMM150.cfg > Bosch_WRD_BHI260_BMM150.cfg > Bosch_WRD_BHI260_AK0915.cfg > Dosch_WRD_BHI260_AK0915.cfg > Dosch_WRD_BHI260_AK0915.cfg > Dosch_WRD_BHI260_AK0915.cfg > Dosch_WRD_BHI260_AK0915.cfg > Dosch_WRD_BHI260_AK0915.cfg > Dotalnject_nobsx.cfg > Dotalnject_cfg > Dotalnject.cfg > Dotalnject.cfg 	 65 204, 400.000000 # wakeup accel raw depends on a virtual BSX source. 66 164, -1.000000 # wakeup game rotvec depends on a virtual BSX source. 67 200, 400.000000 # wakeup game rotvec depends on a virtual BSX source. 68 201, -1.000000 # wakeup mag rotvec depends on a virtual BSX source. 69 232, -1.000000 # wakeup game rotvec depends on a virtual BSX source. 70 204, 400.000000 # wakeup game rotvec depends on a virtual BSX source. 71 194, 400.000000 # wakeup grav depends on a virtual BSX source. 71 194, 400.000000 # wakeup grav depends on a virtual BSX source. 71 194, 400.000000 # wakeup grav depends on a virtual BSX source. 72 195, 400.000000 # wakeup grav corr depends on a virtual BSX source. 73 197, 400.000000 # wakeup gro corr depends on a virtual BSX source. 74 193, -1.000000 # wakeup gro corr depends on a virtual BSX source. 75 196, -1.000000 # wakeup gro corr depends on a virtual BSX source. 76 106, -1.000000 # wakeup mag raw depends on a virtual BSX source. 77 202, 400.000000 # wakeup orient depends on a virtual BSX source. 78 199, 400.000000 # wakeup orient depends on a virtual BSX source. 79 161, -1.000000 # wakeup rotec depends on a virtual BSX source. 79 162, -1.000000 # wake step count depends on a virtual BSX source. 80 231, -1.000000 # wake step det depends on a virtual BSX source. 81 262, -1.000000 # wake tor det depends on a virtual BSX source. 82 162, -1.000000 # wake tor det depends on a virtual BSX source. 83 244, -1.000000 # wake tor det depends on a virtual BSX source. 83 224, -1.000000 # wake tor depends on a virtual BSX source. 83 224, -1.000000 # wake tor depends on a virtual BSX source. 83 224, -1.000000 # uset tor depends on a virtual BSX source. 83 224, -1.000000 # uset tor depends on a virtual BSX source. 83 224, -1.000000 # uset tord depends on a

Figure 12 Create a new *.cfg file

• Double click the file "config.7189_di03_rtos.cmake" under the "common" folder. Add the line Bosch_SHUTTLE_BHI260_BMM150_LDO as shown in Figure 13.

File Edit Source Refactor Navigate Search Project Run Window Help Image: Search Image: Search V No Launch Configurations	✓ on: ✓ ♣ : 3 ▼ ::: 10 *:: 10 *:: 10 *:: 10 *:: 10 *:: 10 *:: 10 *:: 10 *:::
Ta C/C++ Projects ⊠ ↔ ↔ @ E 🍕 😜 ▽ 🗆 E	Bosch SHUTTLE,BHI260,BMM150_LDO.cfg ☐ config.7189_di03_rtos_bhi260.cmake ☆ 177 AES ARC
Bosch, WRD_BHI260, ORG1510.cfg ^ Bosch, WRD_BHI260.cfg	1/7 FRS_MRC 1/7 StA256_ARC 1/9 ECC_ARC 180) 181
 Batalnject.nobsx.cfg Datalnject.cfg >	<pre>182 #add_custom_target(em7186 DEPENDS \${LIBRARIES} \${ROM_NAME}) 183 IF(NOT BOARDS) 184 set(BOARDS</pre>
> 👝 cmake 💙 👝 common > 🍋 7189	185 Bosch_SHUTTLE_BH1260 186 Bosch_SHUTTLE_BH1260_turbo 187 Bosch SHUTTLE_BH1260_AK89915 188 Bosch SHUTTLE_BH1260_HX89915
> 😂 includes > 🔁 toolchain	100 Dots/f1_sHUTTLE_BHI260_AK409915_BME280 189 Bosch_SHUTTLE_BHI260_AK409915_BME280 190 Bosch_SHUTTLE_BHI260_BME280 191 Bosch_SHUTTLE_BHI260_BME280
☐ config.7189_di03_rtos_bhi260.cmake ☐ config.rmake ☐ config.host.cmake	191 Bosch_WRD_BHI260 192 193 193 Bosch_WRD_BHI260 194 Bosch_WRD_BHI260
 cpack.cmake macros.cmake 	195 Bosch MRD_BHI260 BMM150 195 Bosch MRD_BHI260 BMM150 196 Bosch MRD_RGISI30 197 Bosch MRD_BHI260 BRG1510
> 🧽 docs > 🗁 drivers	198 199 #Example driver injection firmware

Figure 13 Add the new cfg board name

• In the "drivers" folder two driver source codes have been implemented as an example: VirtBSXCustomAccelDataSource and VirtBSXLeanDeviceOrientation. They need to be added under the ENABLED_DRIVERS in the file "config.7189_di03_rtos.cmake" as shown in Figure 14.

The VirtBSXCustomAccelDataSource driver defines the accelerometer data is from the Fuser Core2 BSX4 sensor fusion library.

The VirtBSXLeanDeviceOrientation driver is how the new own customized algorithm is implemented.

July 2019

Bosch Sensortec

[©] Bosch Sensortec GmbH reserves all rights even in the event of industrial property rights. We reserve all rights of disposal such as copying and passing on to third parties. BOSCH and the symbol are registered trademarks of Robert Bosch GmbH, Germany.



ARC_GNU_IDE_Workspace - BHI260_SDK/common/config.7189_di03_rtos_bhi260.cmak	+ - Eclipse IDE	- 0 ×
Elle Edit Source Refactor Navigate Search Project Run Window Help	v m v ∰ [™ +]] [] % + ¶, +]] \$ v + ¶ + [] *] % + @ + @ + @ + [] * 0 + [] * • 0 + [] * • 0 + [] * • [] # [] # [] # [] # [] # [] # [] # []	▼ {\] ▼ \$\> 4 \$\] \$\] \$\] \$\] \$\] \$\] \$\] \$\] \$\] \$\]
© CrC+- Projects 20 CrC V CrC	934 VVrtBXDArentation 935 VVrtBXDArentation 936 VVrtBXDArentation 937 VVrtBXDArentation 938 VVrtBXDArentation 939 VVrtBXDArentation 939 VVrtBXDArentation 939 VVrtBXDArentation 939 VVrtBXDArentation 939 VVrtBXDArentation 939 VVrtBXDArentation 940 VrtBXDArentation 941 VrtBXDArentation 941 VrtBXDArentation 941 VrtBXDArentation 942 VrtBXDArentation 944 Figure BX code	Contract (a) Table (b) Build Targets (c)
> 📴 libs	415 v	
▼ in release > >> confi > >> >> this > > >> this > > > this > > > this > > this > > this	Problems Tests Console Properties Properties Propert	
Subidat Subidat Buidat ChakeListat ChakeListat Subidat Wateria Subidat Wateria By Madrid By Madrid By Madrid Wateria Wateria Wateria Wateria Wateria By Madrid Wateria Wateria Wateria Wateria Wateria Wateria Wateria By Madrid Wateria	Panda Birlan Burla. Panda :: 7280 MAV version : 5465 MAV version : 5166 Nover state : sleeping [Info]Senson ID: 1, scc_passtrough. [Info]Senson ID: 3, scc_rem. [Info]Senson ID: 5, scc_offett. [Info]Senson ID: 5, scc_offett. [Info]Senson ID: 5, scc_offett. [Info]Senson ID: 5, scc_offett. [Info]Senson ID: 1, groupset.rem. [Info]Senson ID: 1, groupset.rem	
> >>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>	[Info]Sensor DD: 11, Mag.ZensorDgD. [Info]Sensor DD: 22, mag.Corrected. [Info]Sensor DD: 23, mag.Corrected. [Info]Sensor DD: 24, whop.Mag.Corrected. [Info]Sensor DD: 25, whop.Mag.Corrected.	

Figure 14 Add the two new custom drivers' names

• Click menu "Project -> Build All". It should show 0 errors. Then click the "release -> gccfw" folder and the "Bosch SHUTTLE BHI260 BMM150 LDO.fw" has been generated there.

The following steps show how to test the new virtual sensor performance.

In Terminal type the following,

bhy2cli -b <path_to_release_gccfw_folder>/Bosch_SHUTTLE_BHI260_BMM150_LDO.fw The new RAM patch will be downloaded into BHI260AB shuttle board as shown in Figure 15.



Figure 15 bhy2cli -b command to download RAM patch to BHI260AB shuttle board

[©] Bosch Sensortec GmbH reserves all rights even in the event of industrial property rights. We reserve all rights of disposal such as copying and passing on to third parties. BOSCH and the symbol are registered trademarks of Robert Bosch GmbH, Germany.



• In Terminal type bhy2cli –i command and press Enter key. It will list all the Sensor IDs as shown in Figure 16. Sensor ID 160 is the new virtual sensor that is just implemented.

📳 Problems 🧔 Tasks 📮 Console 🔲 Properties 🖉 Terminal 🛛
SYV1841C7 🕱
[Info]Sensor ID: 69, reserved69.
[Info]Sensor ID: 70, reserved70.
[Info]Sensor ID: 75, reserved75. [Info]Sensor ID: 77, reserved77.
[Info]Sensor ID: 94, wkup step detect.
[Info]Sensor ID: 160, reserved160.
0x25: Boot Status: 0x00
<pre>Bit[0]: 0 = Flash Not Detected</pre>
Bit[1]: 0 = Flash Verify Not Done
<pre>Bit[2]: 0 = Flash Verify OK</pre>
<pre>Bit[3]: 0 = Flash Installed Bit[4]: 0 = Host Interface Not Ready</pre>
Bit[5]: 0 = Firmware Verify Not Done
Bit[6]: 0 = Firmware Verify OK
Bit[7]: 0 = Firmware Running
Error value: 0x00 = No Error Error Category: -
C:\Users\xug1pal>

Figure 16 bhy2cli -i command to list all sensor IDs

• In Terminal type bhy2cli -a 160:LDO:nw:2:c:c -c 160:10 command and press Enter key. It will display the results at 10Hz when the BHI260AB shuttle board is facing different orientations as shown in Figure 17.

📃 SYV1841C7 🖇	3				
Info]sensor:			1563.851440	s Data:	Z -
Info]sensor:			1563.932251		
Info]sensor:			1564.012817		
Info]sensor:			1564.093506		
Info]sensor:			1564.174194		
Info]sensor:			1564.255005		-
Info]sensor:			1564.335571		
Info]sensor:			1564.416260		
Info]sensor:			1564.496948	s Data:	Z +
Info]sensor:			1564.577759		
Info]sensor:			1564.658325		
Info]sensor:			1564.739014		
Info]sensor:			1564.819702		
Info]sensor:			1564.900391		
Info]sensor:			1564.981079		
Info]sensor:			1565.061768		
Info]sensor:			1565.142456		
Info]sensor:			1565.223145		
Info]sensor:			1565.303833		
Info]sensor:			1565.384521		
Info]sensor:			1565.465210		
Info]sensor:			1565.546021		
Info]sensor:			1565.626587		
Info]sensor:			1565.707275		
Info]sensor:			1565.787964		
Info]sensor:			1565.868774		
Info]sensor:			1565.949341		
Info]sensor:			1566.030029		
Info]sensor:	LDO	timestamp:	1566.110718	s Data:	Z +
xiting					
Info]sensor:			1566.191528		
Info]sensor:					
Info]BHY_META					
Info]BHY_META	EVE	NT_SAMPLE_RA	TE_CHANGED:	sensor t	ype: 160.

Figure 17 bhy2cli –a command to show results

[©] Bosch Sensortec GmbH reserves all rights even in the event of industrial property rights. We reserve all rights of disposal such as copying and passing on to third parties. BOSCH and the symbol are registered trademarks of Robert Bosch GmbH, Germany.



Legal disclaimer 4

4.1 **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.

4.2 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.

Application examples and hints 4.3

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 noninfringement 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.

[©] Bosch Sensortec GmbH reserves all rights even in the event of industrial property rights. We reserve all rights of disposal such as copying and passing on to third parties. BOSCH and the symbol are registered trademarks of Robert Bosch GmbH, Germany. Note: Specifications within this document are subject to change without notice.



5 Document history and modification

Rev. No	Chapter	Description of modification/changes	Date
1.0		Document creation	July 18 th , 2019

Bosch Sensortec GmbH Gerhard-Kindler-Strasse 8 72770 Reutlingen / Germany

Contact@bosch-sensortec.com www.bosch-sensortec.com

Modifications reserved | Printed in Germany Specifications subject to change without notice

July 2019

Bosch Sensortec

[©] Bosch Sensortec GmbH reserves all rights even in the event of industrial property rights. We reserve all rights of disposal such as copying and passing on to third parties. BOSCH and the symbol are registered trademarks of Robert Bosch GmbH, Germany.