BHI360

Ultra-low power, high performance, programmable Smart Sensor with integrated IMU



BHI360 User Version Configuration Application Note

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1 Introduction

This document describes the process of configuring the SDK and FW user versions for the BHI360/380 and guides customers on how to verify the version number after the firmware update is complete.

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2 Overview of BHI3

The BHI360 and BHI380 belong to the BHI family of ultra-low power programmable smart sensors. They integrate the Fuser2 processor, which is based on the 32-Bit ARC™ EM4™ floating point RISC processor, an integrated Inertial Measurement Unit (6DoF IMU) and a powerful Event-Driven Software Framework specifically designed for signal data processing and come with pre-installed sensor fusion and other sensor data processing algorithms within a small LGA package. The BHI3 also provides a variety of interfaces to connect sensors and other peripheral devices like a GNSS receiver, Wi-Fi, and Bluetooth radios. This feature makes the BHI3 a full sensor subsystem and computing platform for always-on sensor data processing algorithms at the lowest power consumption. It is, therefore, an ideal choice for wearable and hearable devices.

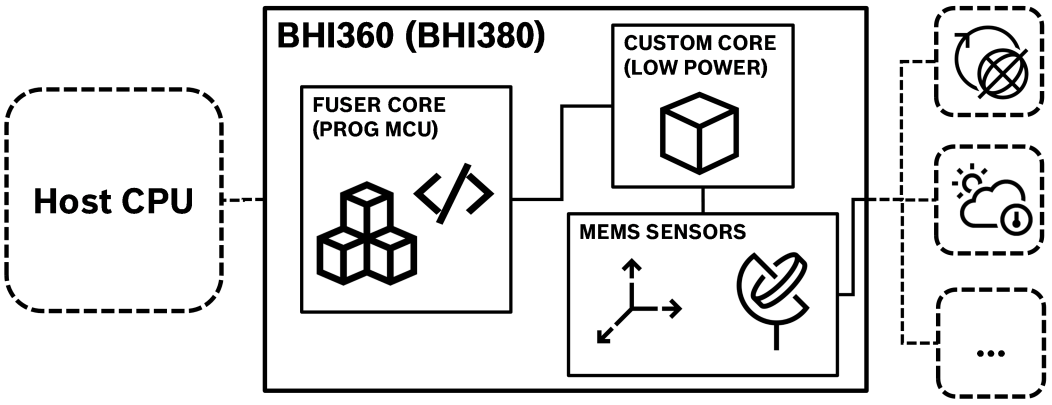


Figure 1: Block diagram of BHI3

The BHI3 is mainly intended to be used as a sensor hub that offloads any sensor data processing related tasks such as sensor fusion, data batching, position tracking, activity recognition, and gesture detection from the host CPU. It provides high precision and low latency processing while significantly reducing the overall system power consumption. When used as a co-processor, the BHI3 can support different applications:

- As a high-end smart sensor with integrated features: The BHI3 can be used as a ready-to-use solution without the need for further programming. The BHI3 comes with a rich set of integrated virtual sensors, which are independently configurable sensor data processing algorithms. They offer device orientation, gesture recognition, smart dynamic offset calibration, activity recognition, and step counting. In addition, the BHI3 can make use of a new set of libraries featuring sophisticated algorithms, including self-learning AI, head orientation tracking, and swimming analytic.
- As an open, programmable smart sensor: In addition to the integrated virtual sensors, the BHI3 functionality can be customized and extended by the customer. Bosch Sensortec offers a Software Development Kit (SDK) that enables the development of additional algorithms for the BHI3. To make it easier to develop efficient data processing algorithms, a sophisticated Event-driven Software Framework provides powerful sensor management services, including power management, FIFO management, and event and time synchronization.

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3 SDK User Version

An SDK user version refers to the specific release of BHI360/BHI380 SDK, which helps developers know which specific drivers, libraries, tools and documents they are working with. It can be read from the User Version Register (0x22-0x23) which is a 16-bit register that contains the build number corresponding to the user portion of the firmware image. If none is present, it will be read back as 0.

3.1 SDK user version description

The SDK user version can be accessed from the User Version register, and the detailed description of the version format is shown in Table 1. Take the SDK user version 1.1.19.3 as an example,

Bit 15-13: Major version, 0b001, range: 0-7

Bit 12-10: Minor version, 0b001, range: 0-7

Bit 9-5: Build version, 0b10011, range: 0-31

Bit 4-0: Fix version, 0b00011, range: 0-31

Thus, the value in the User Version Register is 0x2663.

Table 1: The format of SDK user version

Register Address	0x23								0x22							
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Description	Major(0-7)			Minor(0-7)			Build(0-31)					Fix(0-31)				
Number(e.g.)	1			1			19					3				

3.2 Changing the SDK user version

In the root folder of BHI360/BHI380 SDK (refer to *BHI360/380 SDK Quick Start Guide*), there is a file named “user_version”, and the default value is the current SDK user version number in decimal. Customers can edit and change the value to their own, e.g., 1.1.19.3.

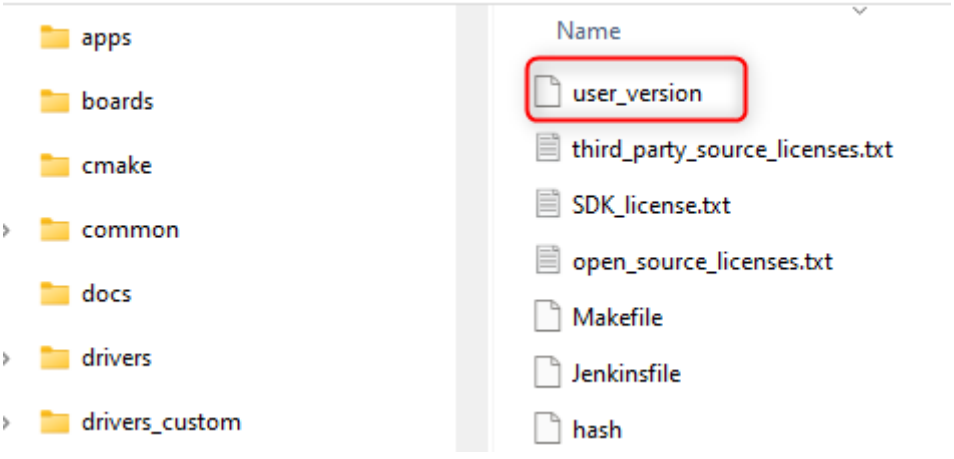


Figure 2: SDK location of user_version file

3.3 Checking the SDK user version

By re-building the SDK and uploading the generated fw, the SDK user version in User Version Register (0x22-0x23) will change to the new version number.

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The SDK user version can be found in the generated fw file by following these steps.

Step 1: Open the xxx.fw and display it in hex format.

Step 2: Get the payload length of the kernel image from address 0x58 to 0x5B. In Figure 3, it shows the kernel image payload length is 0x00014FF0

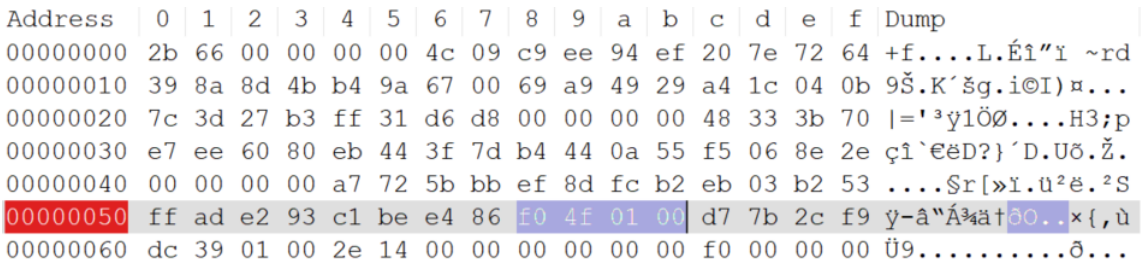


Figure 3: The offset of the payload length of kernel image in fw

Step 3: Calculate the starting address of the user image by adding the kernel image payload length to the header length (0x7C). Thus, the starting address of the user image is 0x00014FF0 + 0x7C = 0x0001506C.

Step 4: In the header of the user image, the user version can be found at the address 0x06-0x07 (represented in User Version Register (0x22-0x23)), shown in Figure 4.

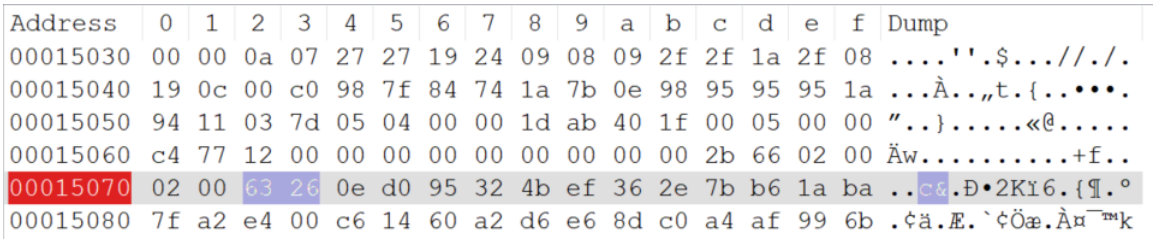


Figure 4: The offset of SDK user version in fw

The SDK user version can also be accessed with either one of the following commands via the bhy2cli tool after uploading the generated firmware. For example, the SDK user version is set to 1.1.19.3.

1. Locate the information after the BHI360 has successfully booted up and the SDK user version is in decimal, refer to Figure 5.

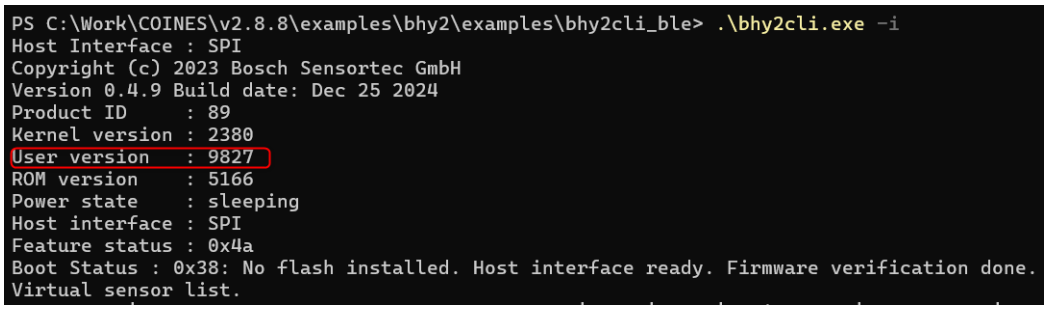


Figure 5: Read the BHI360 information

2. Read the User Version Register (0x22-0x23) to get the SDK user version, refer to Figure 6.

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```
PS C:\Work\COINES\v2.8.8\examples\bhy2\examples\bhy2cli_ble> .\bhy2cli.exe -r 0x22:2
Host Interface : SPI
Copyright (c) 2023 Bosch Sensortec GmbH
Version 0.4.9 Build date: Dec 25 2024
Register address: Data
----------------------
0x22            : 63
0x23            : 26
Read complete
```

Figure 6: Read the User Version Register

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4 FW User Version

A FW user version refers to the specific BHI360/380 FW that helps developers identify their own firmware with specific drivers, libraries, or other features. It can be read out via reading the system parameter interface 0x104. If none is set, it will be read back as 0.

4.1 Changing the FW user version

In the boards folder of the SDK root directory, there are several board configuration files corresponding to different device combinations. Customers can select the target board configuration file (e.g., Bosch_Shuttle3_BHI360.cfg) and modify the version line with their custom firmware version number, as shown in Figure 7. Note that the version value is in decimal and hex values are not supported.



Figure 7: Modify user_version in the board cfg file

4.2 Checking the FW user version

By re-building the FW and uploading the generated fw, the FW version will change to the new version number when reading the content in Firmware Version Parameter (0x104).

The detailed description of getting the parameter is shown in Table 2 and Table 3:

Table 2: The firmware version parameter

Parameter ID	Name	Parameter Read
0x104	Firmware Version	Firmware Version

Table 3: The command format of the firmware version parameter

Field Name	Byte Offset	Description	Access
Parameter ID	0x00 - 0x01	Firmware Version: 0x104	-
Length	0x02 - 0x03	Number of bytes to follow = 20	-
Custom Version Number	0x04-0x05	FW user version number	Read Only
Kernel Hash1	0x06-0x0B	Kernel Hash1 values	Read Only
Kernel Hash2	0x0C-0x11	Kernel Hash2 values	Read Only
User Hash	0x12 - 0x17	User Hash values	Read Only

The Kernel Hash 1, Kernel Hash 2, and User Hash fields provide 6 bytes each for specifying a unique number to identify a build. This could be, for example, the most significant 6 bytes of a Git commit hash. While the

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Kernel hashes are defined by Bosch Sensortec and are fixed with every SDK release, the User Hash can be defined by the customer in the ‘hash’ file under the SDK root directory.

Note that if the SDK is located in a Git tree, the Git hash will be used. If the SDK is not located in git, the values of the file <SDK_root>/version and <SDK_root>/hash will be used.

The FW user version can be accessed using the following command via the bhy2cli tool after uploading the generated fw. For example, the FW version is set to 1001 in decimal.

Read the Firmware Version Parameter (0x0104). The payload bytes at offset 0x04-0x05 (or the first two data bytes returned after the header) represent the FW user version number in little-endian format: e9 03, which corresponds to 0x03E9 (1001 in decimal).

```
PS C:\Work\COINES\v2.8.8\examples\bhy2\examples\bhy2cli_ble> .\bhy2cli.exe -s 0x104
Host Interface : SPI
Copyright (c) 2023 Bosch Sensortec GmbH
Version 0.4.9 Build date: Dec 25 2024
Byte hex      dec | Data
-----------------------------------------
0x000000        0 |e9 03 a9 1a a1 ab 55 17
0x000008        8 |1d ab 40 1f 00 05 1d ab
0x000010       16 |40 1f 00 05
Reading parameter 0x0104 successful
```

Figure 8: Read the FW user version via parameter

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5 Legal disclaimer

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6 Document History and Modifications

Table 4: Change log

Rev No	Chapter	Description of modification/changes	Date
1.0	all	Initial release	January 2025
1.1	Cover Page	change 2025 to January 2025	September 2026
	2	Use consistent product naming/terminology for the BHI360/BHI380 series throughout the Overview section.	
	3	Replace “building number” with the standard term “build number.”	
	3.3	Improve the English description and formula for calculating the hexadecimal start address of the kernel and user firmware.	
	4.1	Replace “boards files for different devices combination” with “board configuration files for different device combinations.”	
	4.2 (Table 3)	Correct the byte offset typo in Table 3 from “0x0C-0x011” to “0x0C - 0x11”, and use “User Hash” consistently as the field name.	
	4.2	Add an explanation of the little-endian interpretation of the return value E9 03 for parameter 0x104.	

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