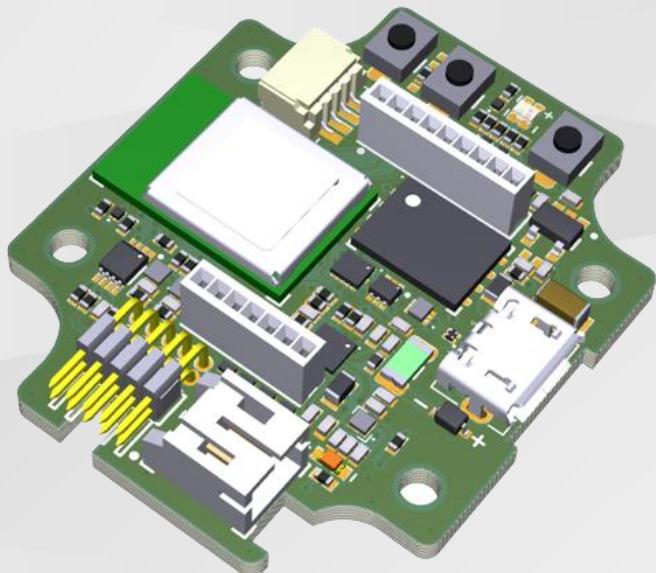# Application Board 3.1 User Guide
Bosch Sensortec's Sensor Prototyping Platform

Application Board 3.1 User Guide

Document revision   Draft

Document release date

Document number

Sales Part Number

Notes

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Abbreviations

ESD : Electrostatic Discharge

FCC : United States of America Federal

Communications Commission

USB 2.0 : Universal Serial Bus 2.0

LED : Light Emitting Diode Li-

ion : Lithium-Ion

KB : Kilobyte MB

: Megabyte Gb :

Gigabit

BLE : Bluetooth Low Energy MTP :

Media Transfer Protocol

RGB LED : Red Green Blue Light Emitting Diode

1 About this document

This document describes the operating procedures of the Application Board 3.1 and additional details about the board itself.

To ensure that the Application Board 3.1 is working correctly, follow these instructions carefully before using it.

1.1 Definition of special notices

Warning: Indicates a hazard that could lead to minor or moderate injuries. Always follow these instructions.

Note: Points of emphasis and reminders of operational peculiarities for the device that could affect performance.
Always follow these instructions.

1.2 Definition of general notices

INFO: General information and instructions that must be followed

TIP: Practical advice

2   Safety and environment

Electrostatic Discharge Caution: ESD (electrostatic discharge) sensitive device. Improper handling may damage the Application Board 3.1 resulting in total or intermittent failures. Use the Application Board 3.1 only in an ESD protected environment and follow ESD-prevention procedures. To prevent ESD damage use an ESD wrist or ankle strap connected to an unpainted metal surface.

2.1   Radio frequency radiation exposure and further information

The radiated output power of the device is far below the FCC radio frequency exposure limits. Nevertheless, the device should be used in such a manner that the potential for human contact during normal operation is minimized.

2.2   Disposal

Disposing of this product correctly will help save valuable resources and prevent any potential negative effects on human health and the environment, which could otherwise arise from inappropriate waste handling.
Please contact your local authority for further details of your nearest designated collection point.
Penalties may be applicable for incorrect disposal of this waste, in accordance with your national legislation.

3 Introduction and intended use

The Application Board 3.1 is a versatile and sensor independent development platform, enabling a fast and easy experience with Bosch Sensortec's sensors. A wide variety of Bosch Sensortec's sensors can be connected to the platform as Shuttle Board 3.0s. The combination of the Application Board 3.1 and Shuttle Board 3.0 can be used to evaluate the sensors and make prototypes to test use-cases.

3.1 Intended use

The Application Board 3.1 operates according to the information provided in this document. Validation and testing of any use or operation, which requires specific requirements and standards, which are not already explicitly mentioned in this document, is under the responsibility of the user.

⚠️ **Warning**: For professional use only. The Application Board 3.1 shall be used by trained personnel only. Improper operation or handling may cause damage to the user or the device itself.

3.2 Scope of delivery

▶ Application Board 3.1
▶ Supporting documentation material (User Guide)

ℹ️ **Note**: Shuttle Board 3.0s are sold separately

4   Application Board 3.1

4.1   Overview

1	Micro USB connector
2	Button 1
3	Button 2
4	Button 3
5	Stemma connector
6	3.0 shuttle connectors
7	External flash
8	Microcontroller
9	SWD connector
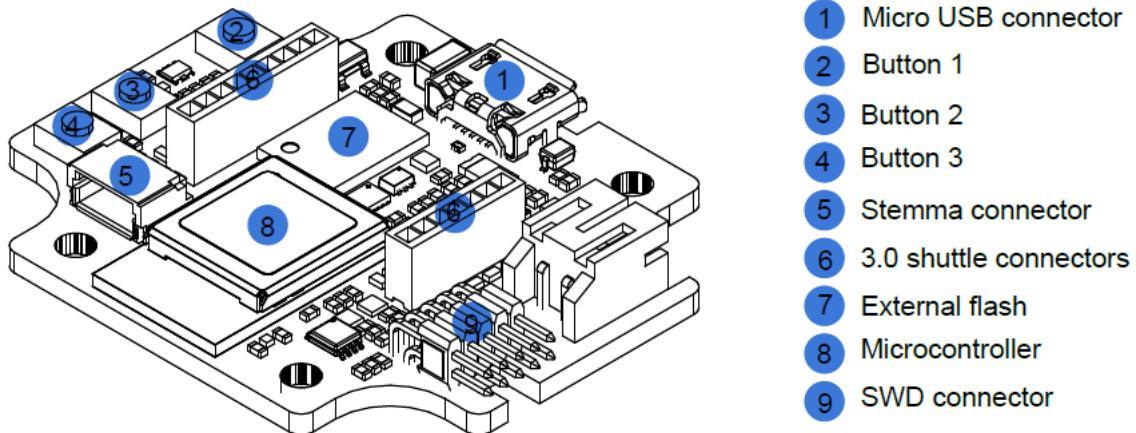
Figure 1: Application Board 3.1 Overview

4.2   Dimensions
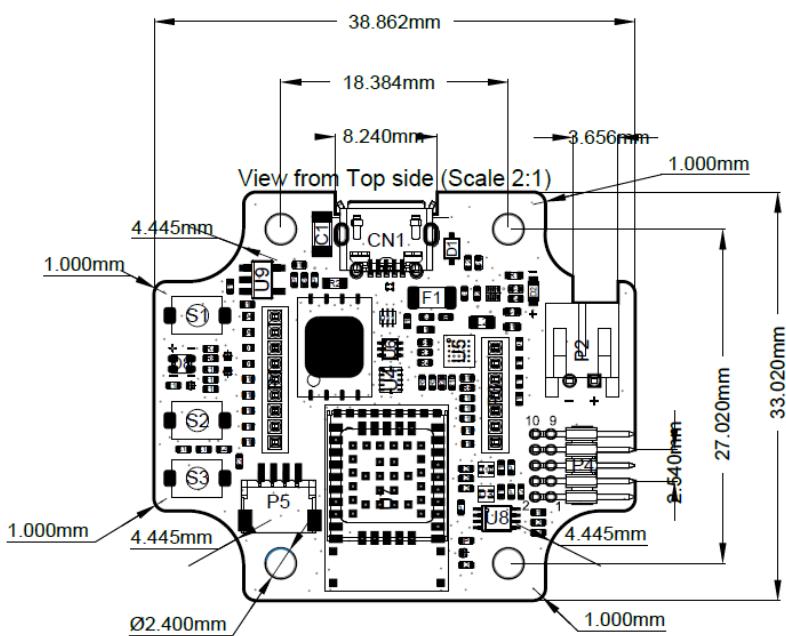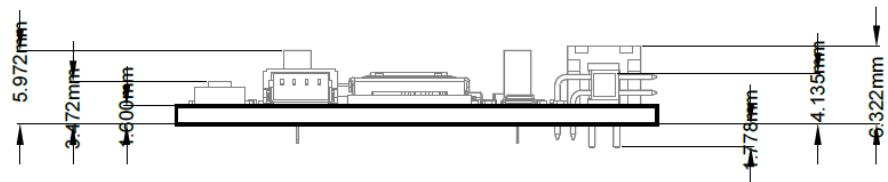
Figure 2: Application Board 3.1 dimensions

4.3 Device specification

Attribute	Nominal Values
Dimensions	38mm x 33mm x 6mm
Supply voltage	5V DC USB
Memory capacity (user data memory)	256 KB RAM, 1MB internal flash, 2Gb external flash
Communication	BLE 5.0 / USB 2.0
Bluetooth Low energy frequency band	2.4GHz, 40 channels
Typical conducted output power	+0 dBm
Radiated output power (EIRP)	+2 dBm

4.4 Operating conditions

Attribute	Value
Operating temperature range	0~65 degree Celsius
Storage temperature range	25+/-3 degree Celsius

4.5 Block Diagram

The following shows a simplified block diagram of the Application Board 3.1.
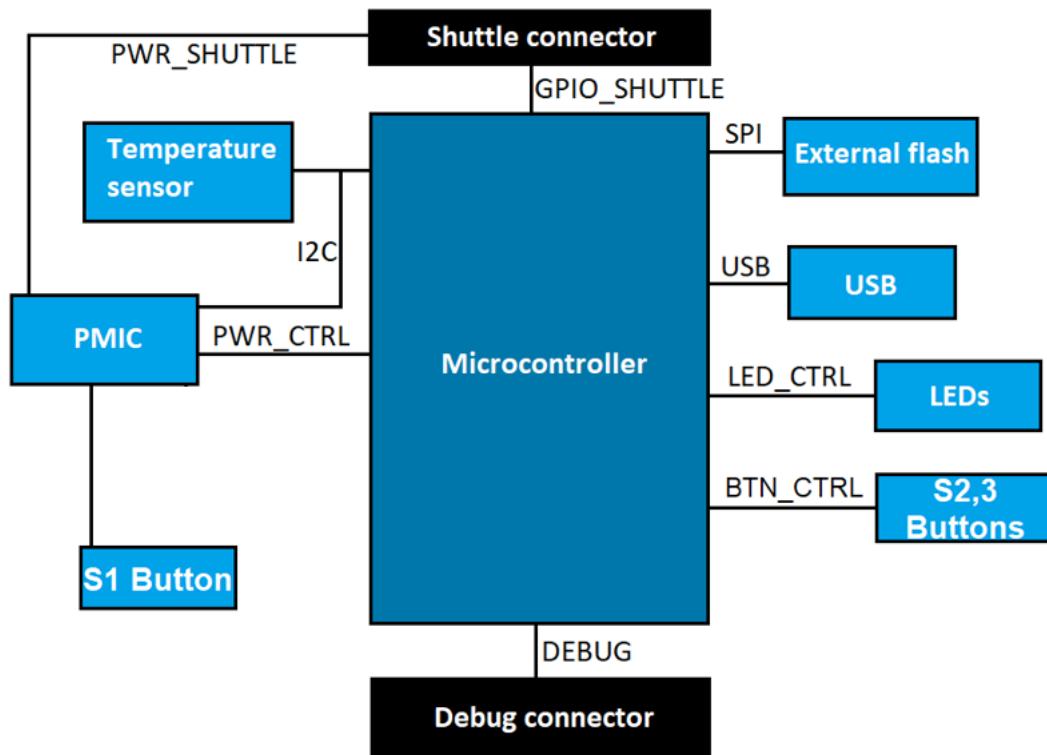
Figure 3: Block Diagram

4.6   Module descriptions

4.6.1   Programmable push buttons

Two programmable push buttons are connected to Ground individually through a 360ohm resistor. It is expected that the internal pull-ups of the microcontroller pins connected to the buttons are enabled to use the button with a falling- edge active-low configuration. The buttons are named BTN-S2 and BTN-S3. There is no predefined scenarios for S2 and S3 buttons, the final user is free to program a personal use scenarios.

One push button connected to the PMIC, can be programmed to set interrupts to the microcontroller depending on the press behavior, also to perform MCU reset. This button is the S1 button, functioning as follow:

-    Short press [80ms < t < 1500ms]: Nothing happens. (User can edit and set scenario suitable for his application)

-    Medium press [1500ms < t < 9000ms]: Ship mode ON => The microcontroller is powered off.

-    Long press [9000ms < t]: Perform microcontroller reset.

/ ! \ Please note that the "Ship mode" is activable only if the board is powered using **only battery**. If the USB power is connected, the board will **never** go into the ship mode.

4.6.2   Debugger connector

This connector helps with recovery of a board with a corrupted nRF52840 while loading custom applications or similar. Debugging is possible with the connection of a Serial-Wire-Debug interface connector.

4.6.3.1   Overview

An ARM Cortex-M4 compatible debugger can be connected using the standard ARM Cortex 10-pin, 2 row, 1.27mm pitch connector.
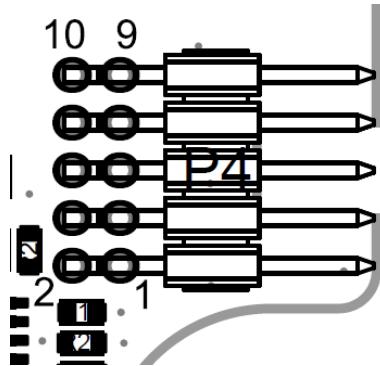
Figure 4: Debugger connector

4.6.3.2   Pin description

Table 1 Shuttle pin description

Pin index	Name	Description	Pin index	Name	Description
1	Vcc/Vref	Set to 1.8V when the board is powered on.	2	SWDIO	Data I/O pin

3	Gnd	Ground	4	SWDCLK	Clock pin
5	Gnd	Ground	6	SWO	Trace output pin
7	Key	Not connected	8	NC	Not connected
9	Gnd Detect	Ground	10	nRESET	Active low hardware Reset

4.6.3   Shuttle Board 3.0 connector

The Shuttle Board 3.0 connector allows for the connection of a Shuttle Board 3.0 to be able to prototype one or more sensors (depending on the Shuttle Board 3.0). Details of the Shuttle Board 3.0 connector can be found under 5.

4.6.4   Temperature sensor

A digital temperature sensor, the Texas Instruments TMP112 is used to be able to measure the temperature of the board. The sensor can be accessed with the I2C-TEMP bus. Details on how to operate the sensor can be found in the datasheet.

4.6.5   Microcontroller

The Application Board 3.1 uses the uBlox NINA-B306 Bluetooth low energy module based on the nRF52840 chipset from Nordic Semiconductor. The nRF52840 among other features supports USB2.0 and Bluetooth Low Energy 5.0 Details about the module and the chipset can be found in the NINA-B306 datasheet and nRF52840 product specification respectively.

4.6.6   External flash

A Winbond **W25N02KWZEIR** 2Gbit NAND Flash is connected to the Microcontroller using SPI. The external flash is used primarily for storing files, particularly sensor data log files. The files can be accessed from a host by switching the device to the pre-loaded MTP firmware mode and connecting via USB.

4.6.7   LEDs

The microcontroller controls the RGB LED. Details on the LED is controlled is found in Table 2 Application Board 3.1 pin description under the LED-CTRL bus.

4.6.8   PMIC

The **BQ25120** is responsible for powering the different board components also provides support for a single cell 3.7V LiPo/Li-ion battery pack connected to the Application board 3.1, allowing the use of the board as a wireless sensor network. The battery charging current is set to 150mA with a termination current of 16mA (around 10%) also can be changed and configured by the final user.

4.7   Pin descriptions

Table 2 Application Board 3.1 pin description

Bus name	Pin name	NINA-B306 pin	nRF52840 pin	Description
SHUTTLE-GPIO	GPIO0	GPIO_2	P0.14	Shuttle pin 4
	GPIO1	GPIO_1	P0.13	Shuttle pin 5
	GPIO2/INT1	GPIO_35	P1.01	Shuttle pin 6
	GPIO3/INT2	GPIO_34	P1.08	Shuttle pin 7
	CS	GPIO_5	P0.24	Shuttle pin 8
	SCK/SCL	GPIO_4	P0.16	Shuttle pin 9
	SDO	GPIO_3	P0.15	Shuttle pin 10

	SDI/SDA	GPIO_43	P0.06	Shuttle pin 11
	GPIO4	GPIO_37	P1.03	Shuttle pin 12
	GPIO5	GPIO_36	P1.02	Shuttle pin 13
	GPIO6	GPIO_39	P1.11	Shuttle pin 14
	GPIO7	GPIO_38	P1.10	Shuttle pin 15
	PROM-RW	GPIO_27	P0.05	Shuttle pin 16, 470ohm pull-up resistor
SPI	SPI-FLASH-MISO	GPIO_48	P0.21	
	SPI-FLASH-MOSI	GPIO_50	P0.20	
	SPI-FLASH-SCK	GPIO_52	P0.19	
	SPI-FLASH-CS	GPIO_51	P0.17	
I2C	I2C-TEMP-SDA	GPIO_23	P0.29	4.7kohm pull-up
	I2C-TEMP-SCL	GPIO_42	P0.26	4.7kohm pull-up
BTN-CTRL	BTN-S2	GPIO_7	P0.25	Active low. When activated, connected to ground through a 360ohm resistor
	BTN-S3	GPIO_33	P1.09	Active low. When activated, connected to ground through a 360ohm resistor
LED-CTRL	LED-RED	GPIO_45	P0.07	Active high. Connected to PMID through a 2200ohm resistor
	LED-BLUE	GPIO_46	P0.12	Active high. Connected to PMID through a 2200ohm resistor
	LED-GREEN	GPIO_32	P0.11	Active high. Connected to PMID through a 2200ohm resistor
PWR-CTRL	VDD-EN	GPIO_21	P1.12	Routes selected Vdd voltage to the Shuttle's Vdd pin when high and routes Ground when low
	VDDIO-EN	GPIO_18	P0.02	Routes selected Vddio voltage to the Shuttle's VddIO pin when high and routes Ground when low

5   Shuttle Board 3.0

5.1   Dimensions

The following figure describes the typical dimensions of the Shuttle Board 3.0 for standard shuttles.
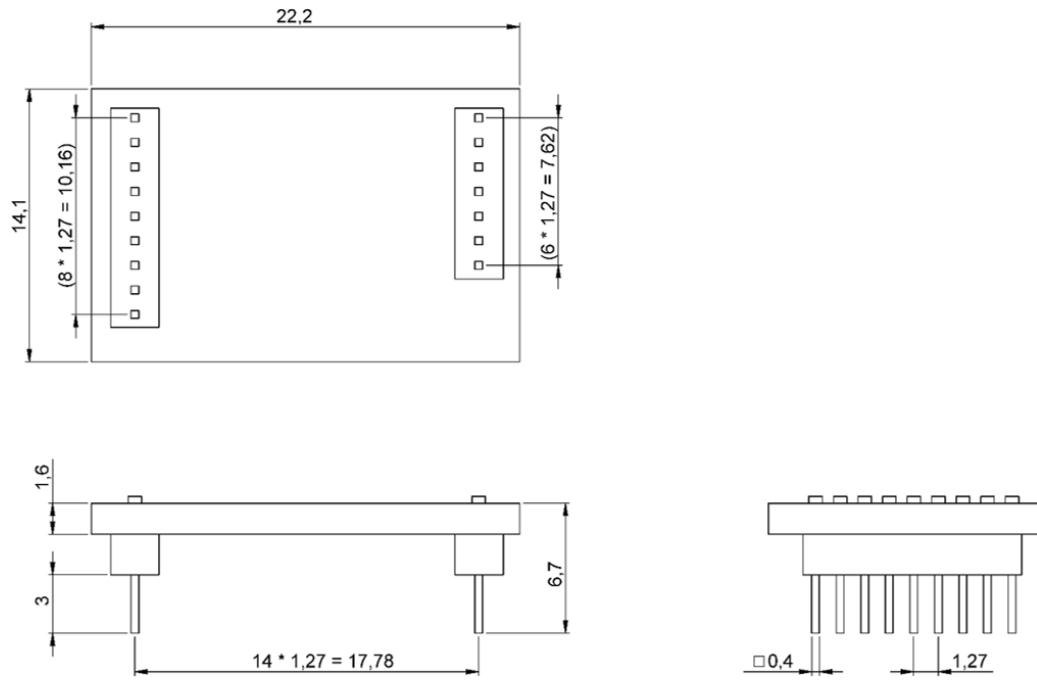

Figure 5: Standard Shuttle Board 3.0 dimensions

The following figure describes the typical dimensions of the Shuttle Board 3.0 for multi-sensor shuttles.
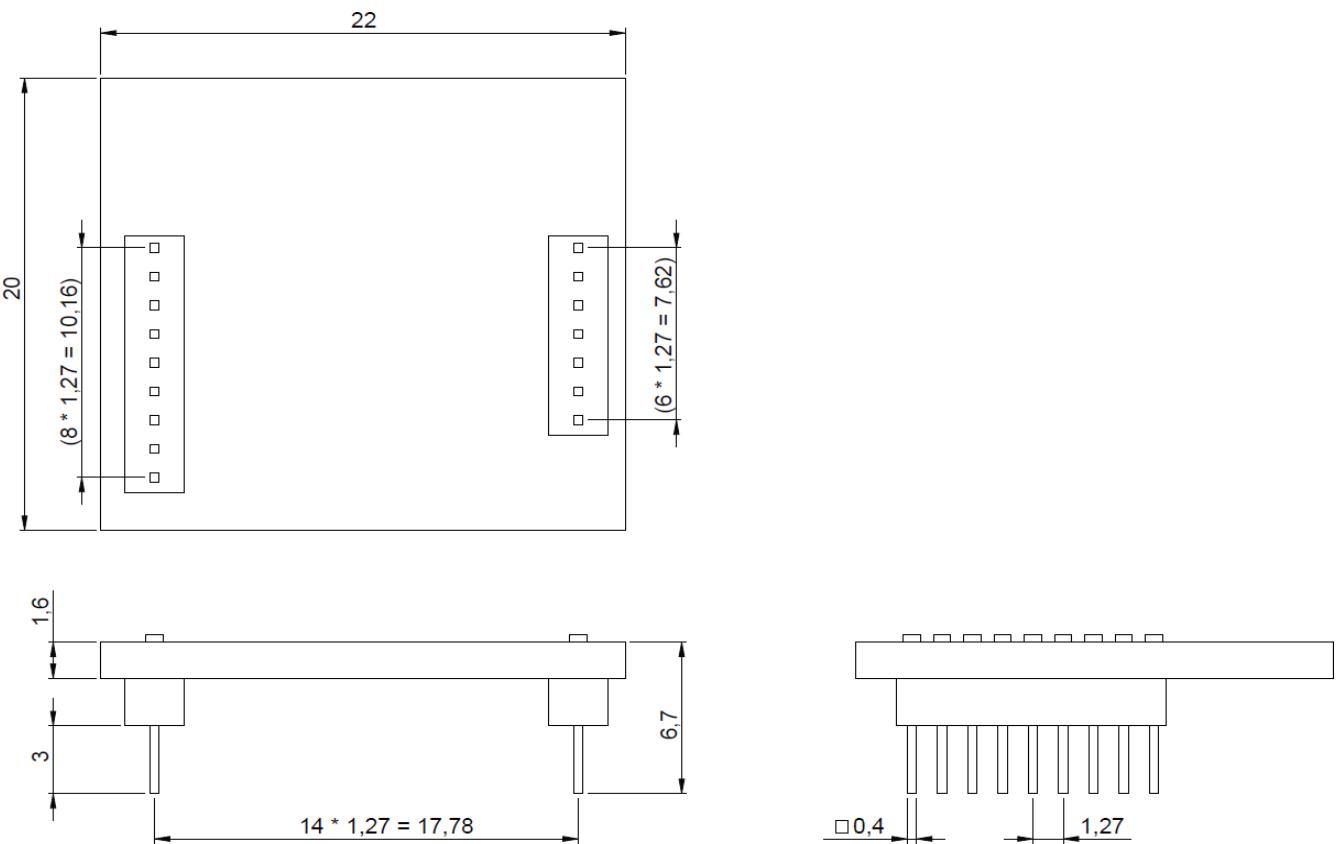
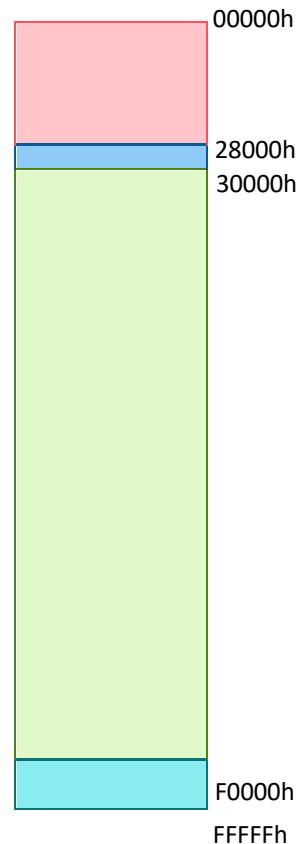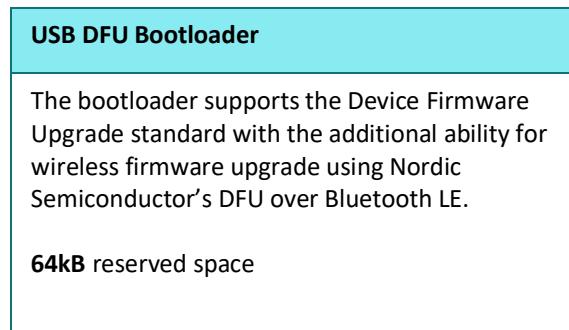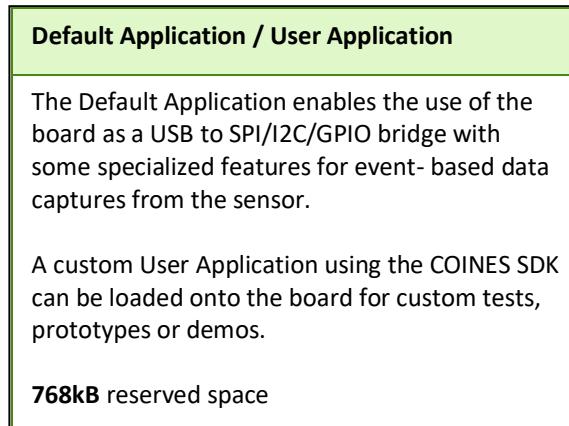Figure 6: Multi-sensor Shuttle Board 3.0 dimensions
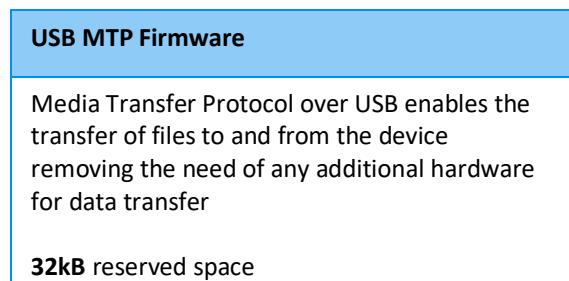
5.2   Pin descriptions

Table 3 Shuttle Board 3.0 pin description

Shuttle Row 1 pin index	Function	Shuttle Row 2 pin index	Function
(1) Vdd	Powers the sensor. Enabled by VDD-EN and provide a programmable range of 0,8V to 3,3V from PMIC.	(1) CS	Typically used as the Chip Select for the SPI bus.
(2) VddIO	Provide reference IO voltage to some sensors and a power domain to other. When VDDIO-EN is enabled, the pin is connected to VDDIO (Microcontroller power supply) and programmable with 1,8V to 3,3V range from the PMIC.	(2) SCK/SCL	Typically used as the Clock for the SPI or I2C buses.
(3) Gnd	Ground	(3) SDO	Typically used as the Data-out line of the sensor.
(4) GPIO0	Assigned depending on Shuttle design.	(4) SDI/SDA	Typically used as the Data-in line of the sensor.
(5) GPIO1	Assigned depending on Shuttle design.	(5) GPIO4/OCSB	Assigned depending on Shuttle design. Typically reserved as the Chip Select for the Optical Image Stabilization (OIS) interface.
(6) GPIO2/INT1	Assigned depending on Shuttle design. Typically reserved for Interrupt 1.	(6) GPIO5/ASCx	Assigned depending on Shuttle design. Typically reserved as the Clock for the Optical Image Stabilization (OIS) interface or Auxiliary I2C interface.
(7) GPIO3/INT2	Assigned depending on Shuttle design. Typically reserved for Interrupt 2.	(7) GPIO6/OSDO	Assigned depending on Shuttle design. Typically reserved as the sensor Data-out for the Optical Image Stabilization (OIS) interface.
		(8) GPIO7/ASDx	Assigned depending on Shuttle design. Typically reserved as the Data-in for the Optical Image Stabilization (OIS) interface or Data for the Auxiliary I2C interface.
		(9) PROM-RW	This pin is used to connect to the 1-Wire EEPROM to identify the Shuttle Board 3.0 connected.

6   Software description

6.1   Overview

Brief description of the memory layout for the Application Board 3.1

Nordic Semiconductor's SoftDevice S140

Feature-rich Bluetooth Low Energy protocol stack

160kB reserved space

Key features
Bluetooth 5.0.

USB MTP Firmware

Media Transfer Protocol over USB enables the transfer of files to and from the device removing the need of any additional hardware for data transfer

32kB reserved space

Default Application / User Application

The Default Application enables the use of the board as a USB to SPI/I2C/GPIO bridge with some specialized features for event- based data captures from the sensor.

A custom User Application using the COINES SDK can be loaded onto the board for custom tests, prototypes or demos.

768kB reserved space

USB DFU Bootloader

The bootloader supports the Device Firmware Upgrade standard with the additional ability for wireless firmware upgrade using Nordic Semiconductor's DFU over Bluetooth LE.

64kB reserved space

00000h

28000h
30000h

F0000h
FFFFFh

NRF52840's 1MB memory space

7   Getting started

7.1   Setup overview

It is recommended to use an ESD safe environment to operate the Application Board 3.1 as depicted in the image.
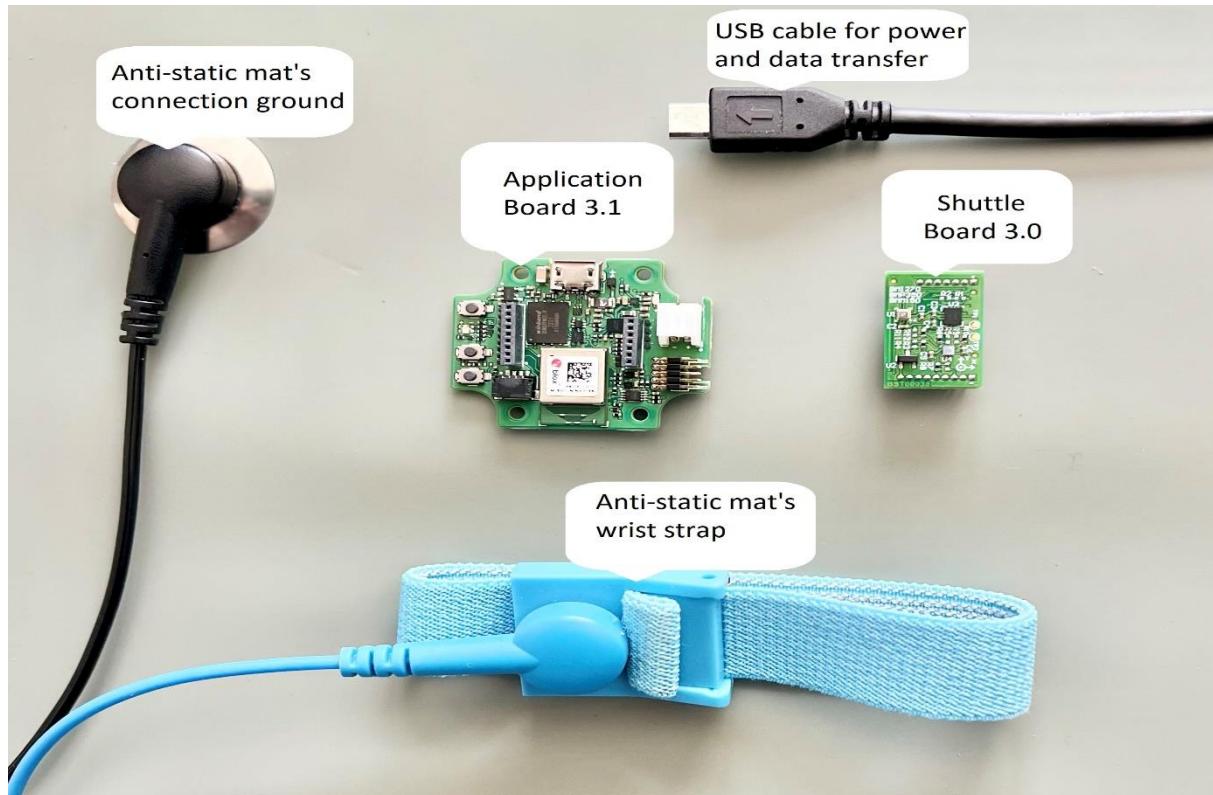

Figure 7: Application Board 3.1 setup

7.2   Connecting a Shuttle Board 3.0 board

Make sure that the pins are aligned correctly to avoid damaging the connector or bending the pins.
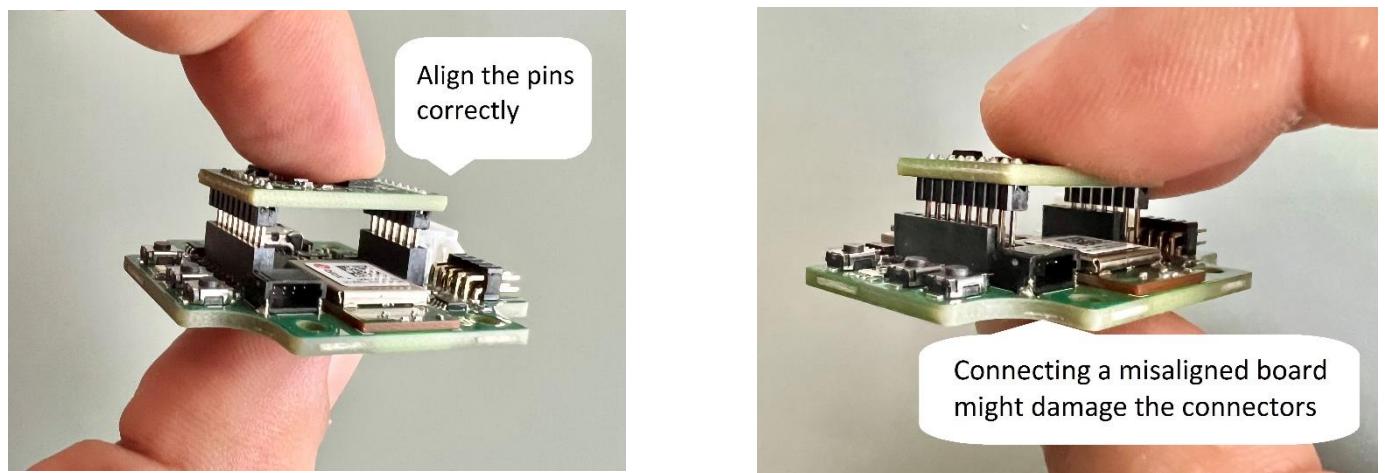

Figure 8: Aligning the pins of the Shuttle Board 3.0 board

Once aligned, press down on the board with both thumbs to fit the Shuttle Board 3.0 onto the Application Board 3.1.
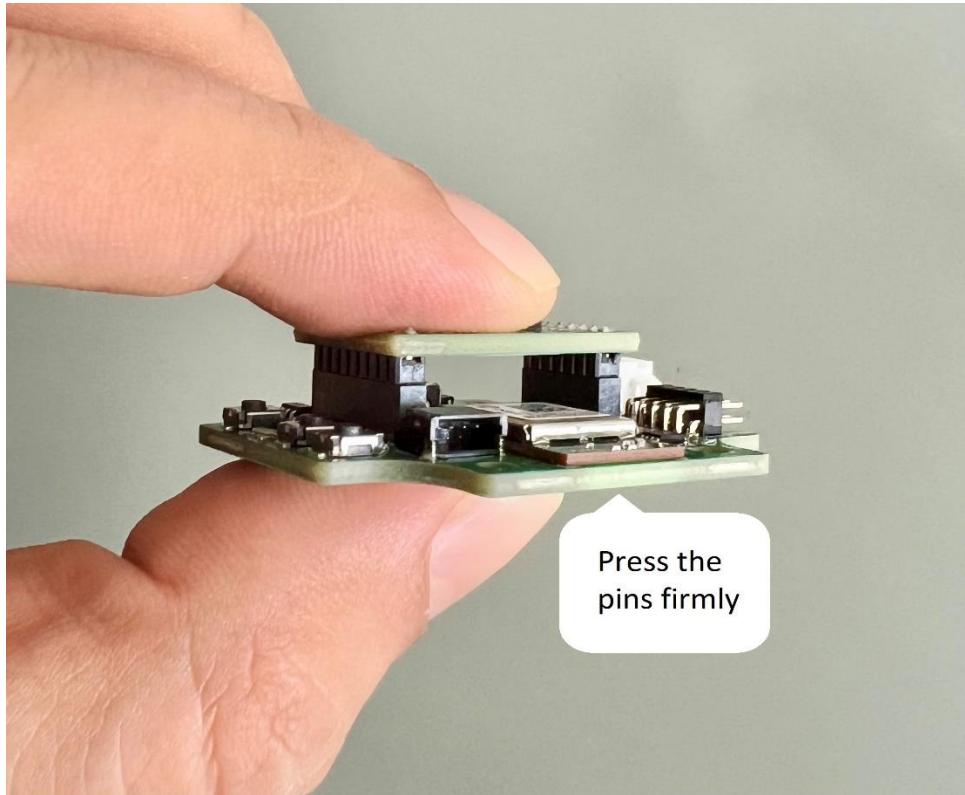
Figure 9: Connecting the Shuttle Board 3.0

7.3 Connecting to the Application Board 3.1 using USB

When connecting the USB cable, the board will be powered on directly.
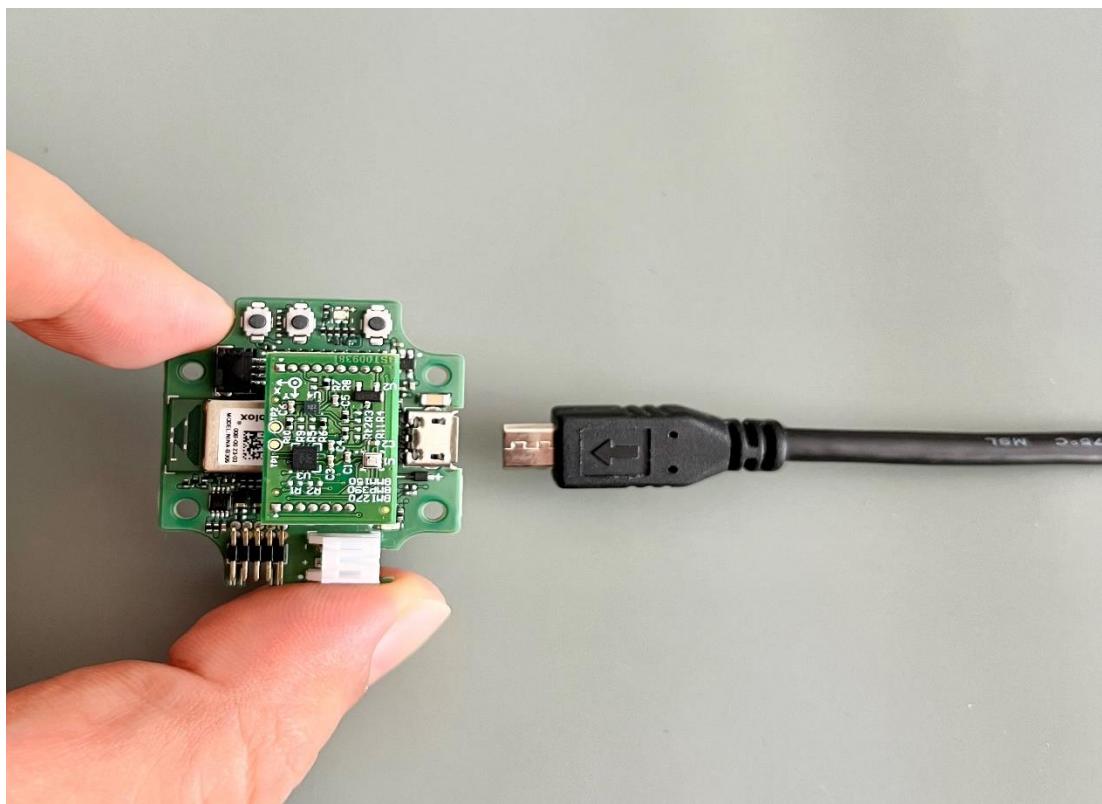
Figure 10: Connecting the USB cable

7.4 Removing the Shuttle Board 3.0

Tug the Shuttle Board 3.0 back and forth to remove the Application Board 3.1. Avoid twisting and turning as this may dislodge the connector from the Application Board 3.1.

Figure 11: Removing the Shuttle Board 3.0

8   Maintenance

Warning: Damage to materials can cause risk of fire!
Liquid entering the device can cause short circuits and damage the device. This could cause fire, data loss and incorrect measurements.

9   Further Product Related Information

Please find all product related documents and user guides on our website: https://www.bosch-sensortec.com/

10   Regulatory and legal information about the Application Board 3.1

10.1 European Union notices

European Union notices Radio Equipment Directive
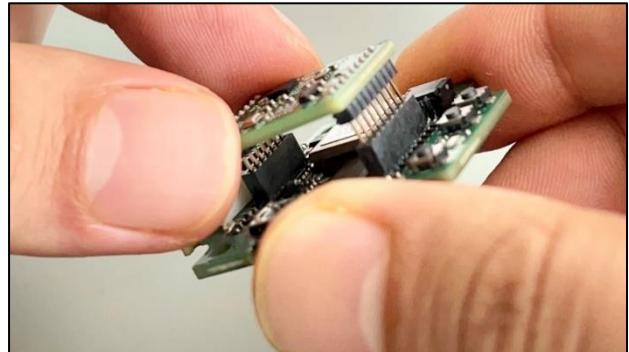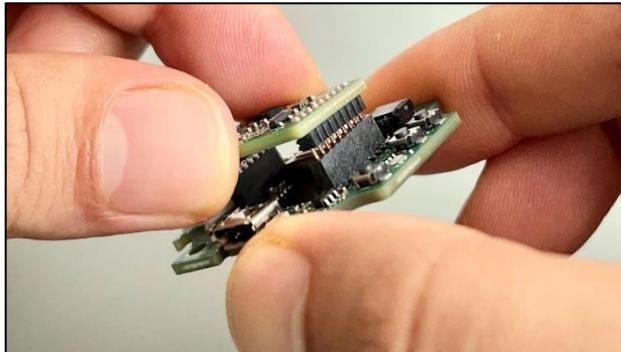Hereby, Bosch Sensortec GmbH declares that the radio equipment type "Application Board 3.1" is in compliance with Directive 2014/53/EU (Radio Equipment Directive). The full text of the EU declaration of conformity is available at the Bosch Sensortec internet address.
Conformity).

RoHS
The Application Board 3.1 meets the requirements of the Directive 2011/65/EU on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS Directive).

Name and content of hazardous substances in products

Component name	Hazardous substance					
	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent chromium (Cr (VI))	Polybrominated biphenyls (PBB)	Polybrominated diphenyl ethers (PBDE)
Diode	X	O	O	O	O	O

This table was developed according to the provisions of SJ/T 11364.

O: The content of such hazardous substance in all homogeneous materials of such component is below the limit required by GB/T 26572.

X: The content of such hazardous substance in a certain homogeneous material of such component is beyond the limit required by GB/T 26572. No mature alternative solution in the industry, complying with EU RoHS.

 * The use conditions of products environment-friendly use period are specified in the product manual.

The certification for the European Union only applies to Application Board 3.0 devices with CE printed on the housing. The user shall verify before using the Application Board 3.1 in the European Union.

10.2 USA: FCC notices

FCC has issued an EQUIPMENT AUTHORIZATION to Bosch Sensortec GmbH for Application Board 3.1 according to FCC rule parts 15 C with the FCC ID: 2AO4I-APP31.

Note: Changes or modifications not expressly approved by Bosch Sensortec GmbH could void the FCC certificate and therefore user's authority to operate the equipment."

The radiated output power of the device is far below the FCC radio frequency exposure limits. Nevertheless, the device shall be used in such a manner that the potential for human contact during normal operation is minimized.

The device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

1)   The device may not cause harmful interferences, and
2)   This device must accept any interferences received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC

Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

▶   Reorient or relocate the receiving antenna.
▶   Increase the separation between the equipment and receiver.
▶   Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
▶   Consult the dealer or an experienced radio/TV technician for help.

Use of the Application Board 3.1 is subject to validation and observation of local legal regulation by the customer. For information on other certifications – which gradually may be issued over time - please, contact our Application Board 3.1 support at contact@bosch-sensortec.com.

FCC RF exposure statement
This equipment complies with radio frequency exposure limits set forth by the FCC for an uncontrolled environment.
This equipment should be installed and operated with a minimum distance of 1.5 cm between the device and the user or bystanders.
This device must not be co-located or operating in conjunction with any other antenna or transmitter.

10.3 Canada: ISED license exemption

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:
(1) This device may not cause interference; and
(2) This device must accept any interference, including interference that may cause undesired operation of the device.
Additional information:
CAN ICES-003(B)/NMB-003(B)
IC:26413-APP31

L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :
(1) L'appareil ne doit pas produire de brouillage;
(2) L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Canada ISED RF exposure statement
This equipment complies with radio frequency exposure limits set forth by the Innovation, Science and Economic Development Canada for an uncontrolled environment.
This equipment should be installed and operated with a minimum distance of 1.5 cm between the device and the user or bystanders.
This device must not be co-located or operating in conjunction with any other antenna or transmitter.

Cet équipement est conforme aux limites d'exposition aux radiofréquences définies par la Innovation, Sciences et Développement économique Canada pour un environnement non contrôlé.
Cet équipement doit être installé et utilisé avec un minimum de 1.5 cm de distance entre le dispositif et l'utilisateur ou des tiers.
Ce dispositif ne doit pas être utilisé à proximité d'une autre antenne ou d'un autre émetteur.

10.4 Bluetooth

The Application Board 3.1 supports Bluetooth 5.0.

10.5 Disposal

The unit, accessories and packaging should be sorted for environmental-friendly recycling. Do not dispose of the device into household and industrial waste!
According to the European Guideline 2012/19/EU, electric and electronic devices that are no longer usable must be collected separately and disposed of in an environmentally correct manner.

10.6 Restrictions of use

The Application Board 3.1 application board is developed for professional use only.
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 safety-critical systems. Safety-critical systems are those for which a malfunction is expected to lead to bodily harm, death or severe property damage. In addition, they shall not be used directly or indirectly for military purposes (including but not limited to nuclear, chemical or biological proliferation of weapons or development of missile technology), nuclear power, deep sea or space applications (including but not limited to satellite technology).
Bosch Sensortec products are released on the basis of the legal and normative requirements relevant to the Bosch Sensortec product for use in the following geographical target market: BE, BG, DK, DE, EE, FI, FR, GR, IE, IT, HR, LV, LT, LU, MT, NL, AT, PL, PT, RO, SE, SK, SI, ES, CZ, HU, CY, US, CN, JP, KR, TW. If you need further information

or have further requirements, please contact your local sales contact.
The use of Bosch Sensortec products at the user's own risk and responsibility.

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.

11 Document history and modification

Rev. No	Chapter	Description of modification/changes	Date

Bosch Sensortec GmbH
Gerhard-Kindler-Strasse 9
72770 Reutlingen / Germany

contact@bosch-sensortec.com
www.bosch-sensortec.com

Modifications reserved
Preliminary - specifications subject to change without notice
Document number: BST-DHW-AN008-00