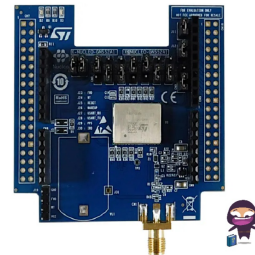




STMicroelectronics
Bluetooth Low
Energy Expansion
Board Based on the
STM32WB05KN



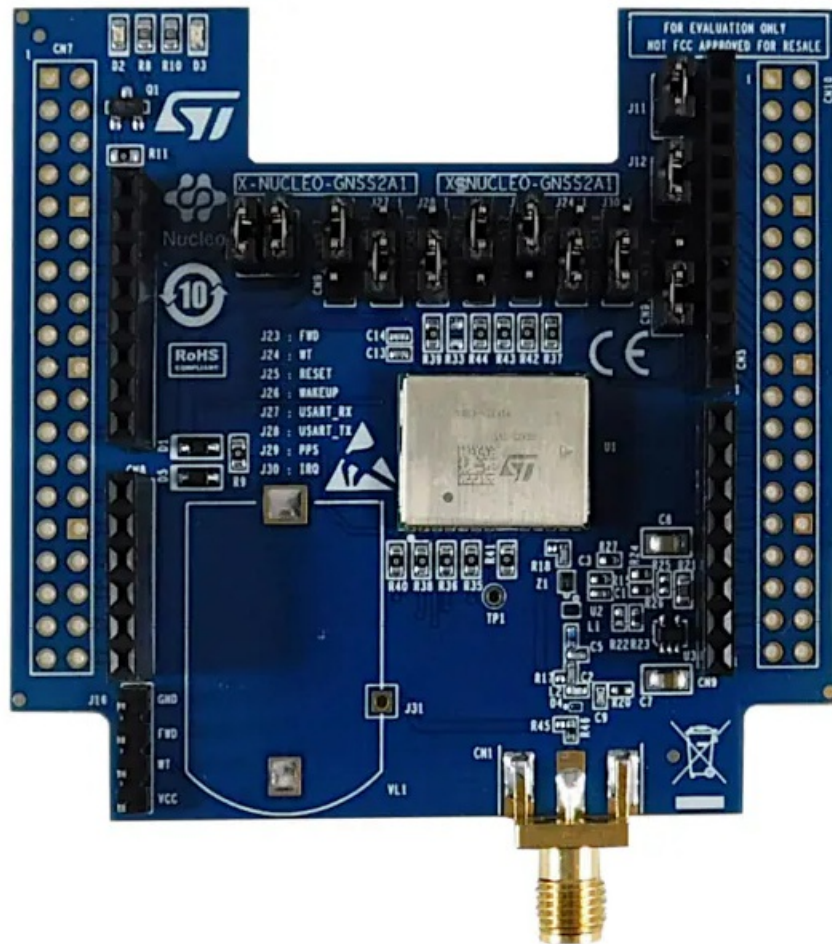
STMicroelectronics Bluetooth Low Energy Expansion Board Based on the STM32WB05KN User Manual

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Specifications

- Based on STM32WB05KN with preloaded network coprocessor firmware
- Embedded MLPF-NRG-01D3 integrated impedance matching network
- On-board PCB antenna
- Compatible with STM32 Nucleo boards
- Scalable solution for cascading multiple boards
- Free comprehensive development firmware library and examples

Product Usage Instructions

1. Typical Applications

The X-NUCLEO-WB05KN1 expansion board is suitable for various applications including:

- Point-to-point communication
- Sensor applications
- Home automation and lighting
- Direct test mode (DTM)

2. Features Overview

The key features of the X-NUCLEO-WB05KN1 expansion board include:

- Preloaded network coprocessor firmware with UART interface
- Impedance matching network with harmonics filter
- SPI interface optional through dedicated firmware
- Compatibility with STM32 Nucleo boards

- Support for cascading multiple boards for larger systems

3. Development Environment

The recommended development environment for the X-NUCLEO-WB05KN1 expansion board includes:

- System Requirements: STMicroelectronics – STM32CubeIDE
- Development Toolchains: STM32CubeIDE

4. Safety Recommendations

For safe handling of the X-NUCLEO-WB05KN1 expansion board, please follow these safety recommendations:

- The product is intended for users with basic electronics or embedded software development knowledge.
- Avoid handling the board carelessly to prevent injury from sharp connection pins.
- Handle the board in an ESD-proof environment to prevent damage to static-sensitive devices.

FAQ

• **Q: Can the X-NUCLEO-WB05KN1 expansion board be used with other microcontrollers?**

A: The X-NUCLEO-WB05KN1 is designed for use with the STM32WB05KN device and may not be compatible with other microcontrollers.

• **Q: Is the X-NUCLEO-WB05KN1 expansion board suitable for beginners?**

A: The product is targeted towards users with basic electronics or embedded software development knowledge, such as engineers, technicians, or students.

• **Q: How can I order the X-NUCLEO-WB05KN1 expansion board?**

A: Refer to Table 1 in the user manual for ordering information or contact your local STMicroelectronics sales office.

UM3355

User manual

Bluetooth® Low Energy expansion board based on the STM32WB05KN for STM32 Nucleo boards

Introduction

- The X-NUCLEO-WB05KN1 expansion board provides Bluetooth® Low Energy connectivity for developer applications and can be plugged into an STM32 Nucleo development board (for example NUCLEO-U575ZI-Q) through its ARDUINO® Uno V3 connectors.
- The expansion board features Bluetooth® v5.4 compliant and FCC-certified STM32WB05KN. This SoC manages the complete Bluetooth® Low Energy stack and protocols on its Arm® Cortex®-M0+ core and programmable flash memory. STM32WB05KN supports central and peripheral modes and increased transfer rates with data length extension (DLE).
- X-NUCLEO-WB05KN1 interfaces with the STM32 Nucleo microcontroller via UART (default) with and without hardware flow control. Full duplex SPI with an interrupt line is also available. The firmware loaded on the module defines the host interface and, to modify it, simply change the firmware without modifying the hardware.
- Figure 1. X-NUCLEO-WB05KN1 global view

Figure 1. X-NUCLEO-WB05KN1 global view



Typical application

The X-NUCLEO-WB05KN1 expansion board can be used for the evaluation of the STM32WB05KN device in many applications, such as:

- Point-to-point communication
- Sensor application
- Home automation and lighting
- Direct test mode (DTM)

Features

- Based on STM32WB05KN with preloaded network coprocessor firmware with UART interface
 - Bluetooth® v5.4 compliant
 - Bluetooth® Low Energy data packet length extension
- Embedded MLPF-NRG-01D3 integrated impedance matching network with harmonics filter
- On-board PCB antenna
- SPI interface optional through dedicated firmware
- Compatible with STM32 Nucleo boards
- Equipped with ARDUINO® Uno V3 expansion connector
- Scalable solution, capable of cascading multiple boards for larger systems
- Free comprehensive development firmware library and examples, compatible with the X-CUBE-WB05N expansion software package for STM32Cube
- Note:
- For information on Bluetooth®, refer to the www.bluetooth.com website
- Note:
- Arm and Cortex are registered trademarks of Arm Limited (or its subsidiaries) in the US and/or elsewhere.

Ordering information

- To order the X-NUCLEO-WB05KN1 expansion board, refer to Table 1. Additional information is available from the datasheet and reference manual of the target STM32.

Table 1. Ordering information

Order code	Board references	Target STM32
X-NUCLEO-WB05KN1	<ul style="list-style-type: none"> MB2160(1) MB2032(2) 	STM32WB05KNV6

1. ARDUINO® interface board
2. MCU RF board

Codification

The meaning of the codification is explained in Table 2.

X-NUCLEO- XXY YZTN	Description	Example: X-NUCLEO-WB05KN1
X-NUCLEO	STM32 Nucleo expansion boards	STM32 Nucleo expansion boards
XX	MCU series in STM32 32-bit Arm Cortex MCUs	STM32WB0 series
YY	MCU product line in the series	STM32WB05 product line
Z	STM32 package pin count: <ul style="list-style-type: none"> K for 32 pins 	32 pins
T	Target application	Network coprocessor
N	Sequential number	First generation of Bluetooth® Low Energy expansion board based on the STM32WB05KN for STM32 Nucleo boards

Development environment

1. System requirements

- Multi-OS support: Windows® 10, Linux® 64-bit, or macOS®
- USB Type-A or USB Type-C® to USB Type-C® cable
- Note:**

macOS® is a trademark of Apple Inc., registered in the U.S. and other countries and regions. Linux® is a

registered trademark of Linus Torvalds.

- Windows is a trademark of the Microsoft group of companies.

2. Development toolchains

- IAR Systems® – IAR Embedded Workbench®(1)
- Keil® – MDK-ARM(1)
- STMicroelectronics – STM32CubeIDE
- On Windows® only.

Conventions

Table 3 provides the conventions used for the ON and OFF settings in the present document.

Table 3. ON/OFF convention

Convention	Definition
Jumper JPx ON	Jumper fitted
Jumper JPx OFF	Jumper not fitted
Jumper JPx [1-2]	Jumper fitted between Pin 1 and Pin 2
Solder bridge SBx ON	SBx connections closed by 0 Ω resistor
Solder bridge SBx OFF	SBx connections left open
Resistor Rx ON	Resistor soldered
Resistor Rx OFF	Resistor not soldered
Capacitor Cx ON	Capacitor soldered
Capacitor Cx OFF	Capacitor not soldered

Safety recommendations

• Targeted audience

This product targets users with at least basic electronics or embedded software development knowledge like engineers, technicians, or students.

This board is not a toy and is not suited for use by children.

• Handling the board

This product contains a bare printed circuit board. Like all products of this type, the user must pay attention to the following points:

- The connection pins on the board might be sharp. Be careful when handling the board to avoid hurting yourself
- This board contains static-sensitive devices. To avoid damaging it, handle the board in an ESD-proof environment.
- While powered, do not touch the electric connections on the board with your fingers or anything conductive. The board operates at voltage levels that are not dangerous, but components might be damaged when shorted.
- Do not put any liquid on the board and avoid operating the board close to water or at a high humidity

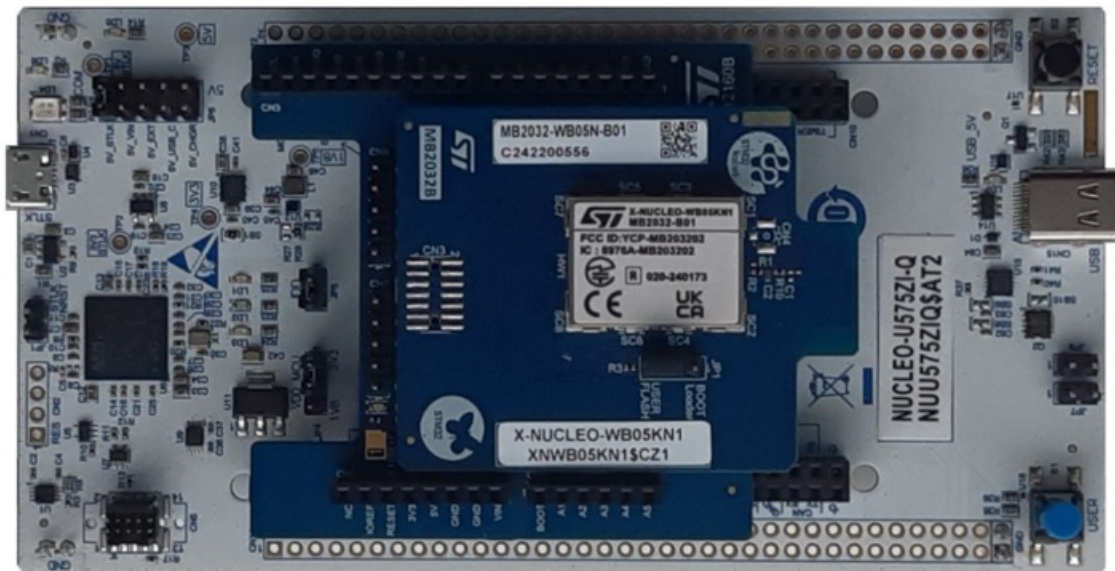
level.

- Do not operate the board if dirty or dusty.

Hardware requirements

- The X-NUCLEO-WB05KN1 expansion board is designed for use with any STM32 Nucleo development board equipped with an ARDUINO® Uno V3 connector. The expansion board must be plugged into the matching pins of the development board connector.
- Figure 2. X-NUCLEO-WB05KN1 plugged into NUCLEO-U575ZI-Q

Figure 2. X-NUCLEO-WB05KN1 plugged into NUCLEO-U575ZI-Q



To complete the system setup, the user needs:

- A PC/laptop with Microsoft Windows 7® or above to install the software package (X-CUBE-WB05N)
- DTM project to be flashed in the STM32WB05KN device
- A USB Type-A to USB Mini-B cable to connect the STM32 Nucleo to the PC/laptop
- A 5-pin connector programming wire connected to the SWD connector (CN3) of X-NUCLEO-WB05KN1 to program it using the STM32 Nucleo or an external ST-LINK

Board setup

1. Connect X-NUCLEO-WB05KN1 to the STM32 Nucleo board as shown in Figure 2.
2. Connect the STM32 Nucleo to the PC/laptop.
3. Program the STM32 Nucleo with the corresponding firmware to use X-NUCLEO-WB05KN1 as a network coprocessor.

The evaluation kit is ready to use.

Hardware description and configuration

1. Interconnection details

The X-NUCLEO-WB05KN1 expansion board and the NUCLEO-U575ZI-Q development board connection

details are listed in Table 4.c

Table 4. X-NUCLEO-WB05KN1 and NUCLEO-U575ZI-Q connection details

Left connectors				
X-NUCLEO connector	Pin number	Signal name	X-NUCLEO-WB05KN1 signal ⁽¹⁾	NUCLEO-U575ZI-Q MCU port ⁽¹⁾
CN5 Power	1	-	-	5V_IN test
	2	IOREF	IOREF	IOREF
	3	NRST	RSTN	NRST
	4	3V3	3V3	3V3
	5	5V	-	5V
	6	GND	GND	GND
	7	GND	GND	GND
	8	VIN	-	VIN
CN6 Analog	1	A0	PA0/BOOT/SPI_IRQ	PA3
	2	A1	-	PA2
	3	A2	-	PC3
	4	A3	-	PB0
	5	A4	-	PC1
	6	A5	-	PC0

Right connectors					
X-NUCLEO-WB05KN1 signal ⁽¹⁾	NUCLEO-U575ZI-Q MCU port ⁽¹⁾	Signal name	Pin number	X-NUCLEO connector	
-	PB6	D15	10	CN3 Digital	
-	PB7	D14	9		
-	-	AVDD	8		
GND	GND	GND	7		
PB3/SPI1_SCK	PA5/SPI_SCK	D13	6		
PA8/SPI1_MISO	PA6/SPI_MISO	D12	5		
PA11/SPI1_MOSI	PA7/SPI_MOSI	D11	4		
PA10/SPI1_NSS	PD14/SPI_NSS	D10	3		
PB0/UART_RX	PD15	D9	2	CN4 Digital	
PA1/UART_TX	PF12	D8	1		
RSTN	PF13	D7	8		
-	PE9	D6	7		
-	PE11	D5	6		
PA11/LED	PE14	D4	5		
-	PE13	D3	4		
PA1/UART_TX	PF15	D2	3		
PB0/UART_RX	PG7/UART_TX	D1	2		
PA1/UART_TX	PG8/UART_RX	D0	1		

Default connected signals are in bold.

2. SPI/UART connection options

- UART interface options:
- X-NUCLEO-WB05KN1 interfaces with the STM32 Nucleo microcontroller via UART (default) with and without hardware flow control.
- Several UART connection options between the STM32 Nucleo board and the X-NUCLEO-WB05KN1 expansion board can be used, depending on the STM32 Nucleo used, in case of signal conflict occurs when using other expansion boards, or else. To know which UART signals to connect, first look at the STM32 Nucleo schematics.
- SPI interface option
- X-NUCLEO-WB05KN1 can also interface with the STM32 Nucleo microcontroller via full duplex SPI with an interrupt line. For SPI connection, refer to Table 4.

3. X-NUCLEO-WB05KN1 description

- X-NUCLEO-WB05KN1 is designed around STM32WB05KN.
- X-NUCLEO-WB05KN1 includes two boards (one ARDUINO® interface board or shield board and one MCU RF board. The ARDUINO® interface board is called MB2160. It includes
- ARDUINO® Uno V3 expansion connectors, an SWD connector, a UART connector, one user LED, and connects to the MCU RF board via two 50-pin connectors. The MCU RF board is called
- MB2032 and embeds the STM32WB05KN application processor.
- Figure 3 and Figure 4 help users locate the components on X-NUCLEO-WB05KN1.
- Figure 3. X-NUCLEO-WB05KN1 PCB top view

Figure 3. X-NUCLEO-WB05KN1 PCB top view

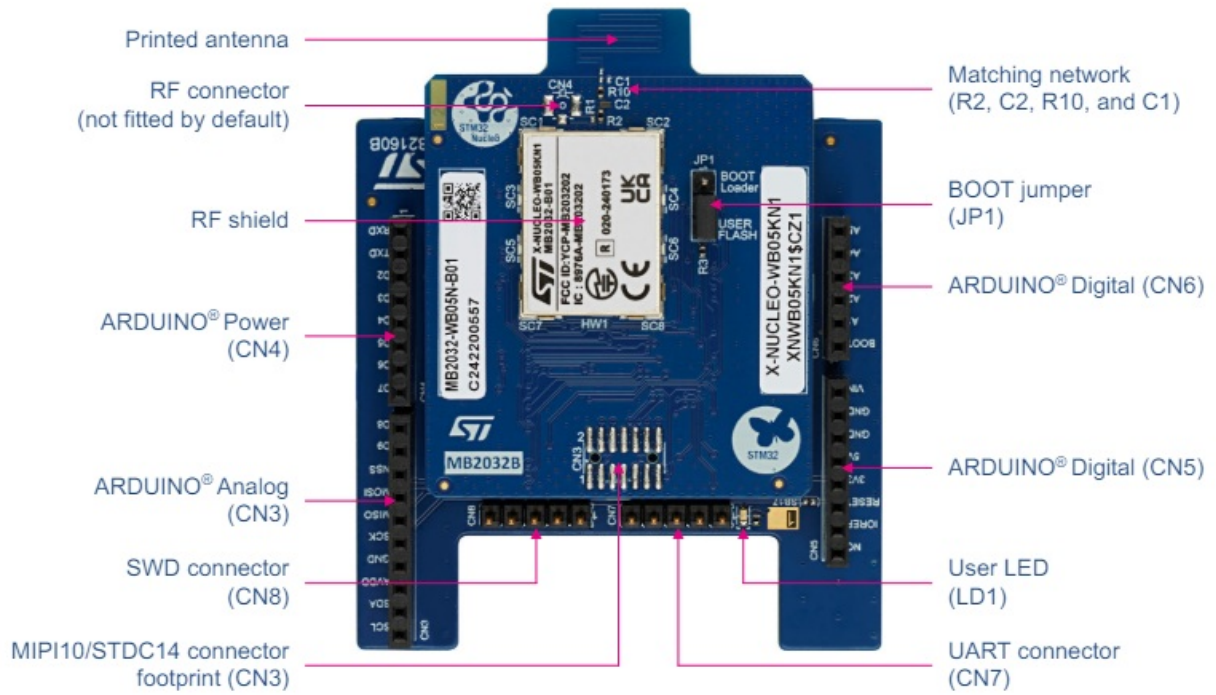
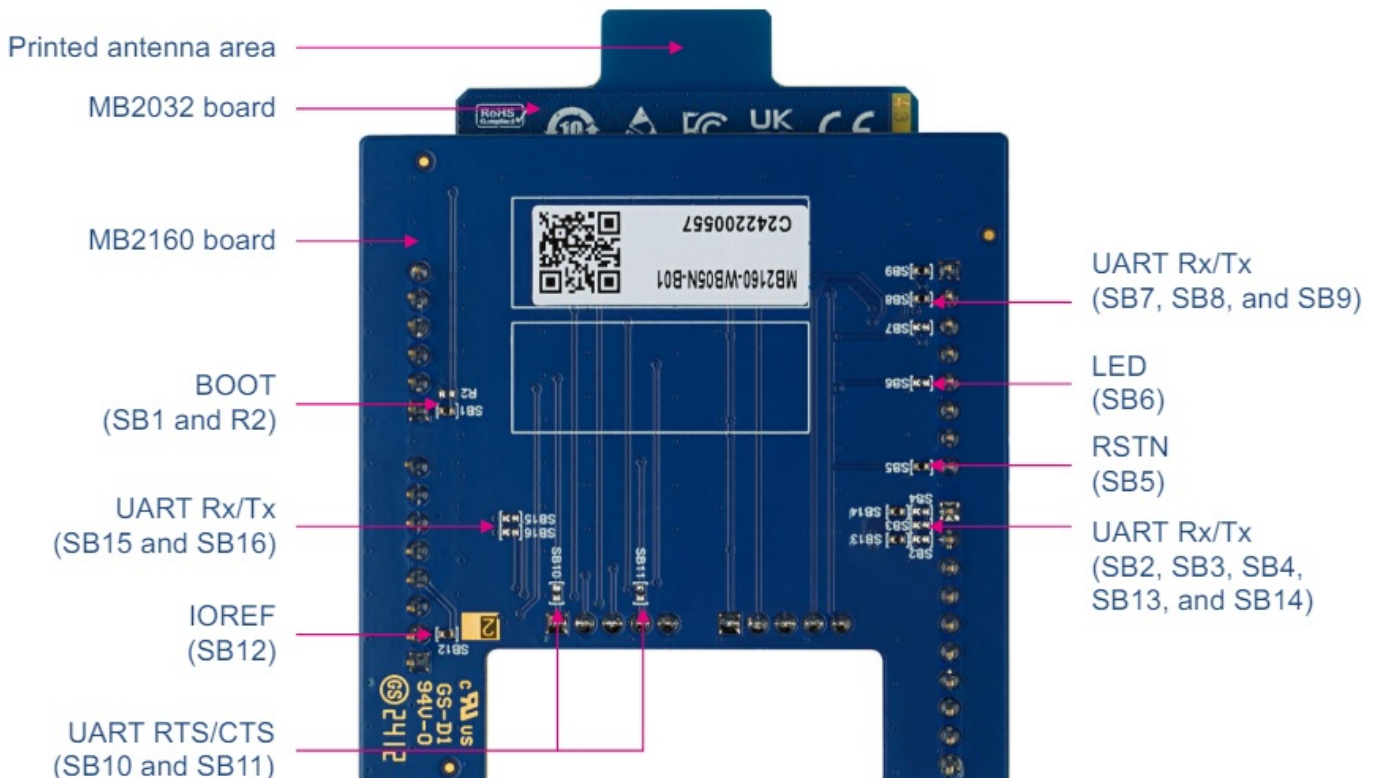


Figure 4. X-NUCLEO-WB05KN1 PCB bottom view



Power

X-NUCLEO-WB05KN1 is powered by 3V3 from the STM32 Nucleo board through the ARDUINO® Uno V3 expansion connector.

VDD supplies of the STM32WB05KN are directly connected to 3V3.

SWD connector

X-NUCLEO-WB05KN1 has an SWD connector (CN8) for debugging/programming STM32WB05KN. The table below describes the SWD header and what each pin does.

Table 5. Debugging/programming connector pinout (CN8)

Pin	CN8	Designation
1	3V3	VDD from application
2	SWCLK	Target SWD clock
3	GND	Ground
4	SWDIO	Target SWDIO data input/output
5	RSTN	RESET of target

UART connector

It is possible to interface X-NUCLEO-WB05KN1 with the STM32 Nucleo microcontroller via a UART connector (CN7) with hardware flow control.

The table below describes the UART connector pinout.

Table 6. UART connector pinout (CN7)

Pin	CN7	Designation
1	T_UART_CTS	Target UART_CTS (clear to send)
2	T_UART_TX	Target UART_TX
3	T_UART_RX	Target UART_RX
4	T_UART_RTS	Target UART_RTS (request to send)
5	GND	Ground

User LED

One general-purpose blue LED (LD1) is available for user applications. It is connected to pin 5 of CN4 of X-NUCLEO-WB05KN1 and it emits with a high level of the corresponding port of the host MCU connected to pin 5 of CN4.

X-NUCLEO-WB05KN1 product information

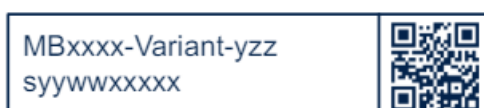
Product marking

The stickers located on the top or bottom side of all PCBs provide product information:

- First sticker: product order code and product identification, generally placed on the main board featuring the target device.
- Example:

Product order code
 Product identification

- Second sticker: board reference with revision and serial number, available on each PCB. Example:



- On the first sticker, the first line provides the product order code, and the second line the product identification.
- On the second sticker, the first line has the following format: “MBxxxx-Variant-yyz”, where “MBxxxx” is the board reference, “Variant” (optional) identifies the mounting variant when several exist, “y” is the PCB revision, and “zz” is the assembly revision, for example B01. The second line shows the board serial number used for traceability.
- Parts marked as “ES” or “E” are not yet qualified and therefore not approved for use in production. ST is not responsible for any consequences resulting from such use. In no event will ST be liable for the customer using any of these engineering samples in production. ST’s Quality department must be contacted prior to any decision to use these engineering samples to run a qualification activity.
- “ES” or “E” marking examples of location:
- On the targeted STM32 that is soldered on the board (for an illustration of STM32 marking, refer to the STM32 datasheet Package information paragraph at the www.st.com website).
- Next to the evaluation tool ordering part number that is stuck, or silk-screen printed on the board.
- Some boards feature a specific STM32 device version, which allows the operation of any bundled commercial stack/library available. This STM32 device shows a “U” marking option at the end of the standard part number and is not available for sales.
- To use the same commercial stack in their applications, the developers might need to purchase a part number specific to this stack/library. The price of those part numbers includes the stack/library royalties.
- X-NUCLEO-WB05KN1 product history

Table 7. Product history

Order code	Product identification	Product details	Product change description	Product limitations
X-N UCL EO- WB 05K N1	XNWB05KN1\$ CZ1	MCU: STM32WB05KNV6 silicon revision “Z”	Initial revision	No limitation
		MCU errata sheet: <i>STM32WB05xN device errata</i> (ES0633)		
		Boards: <ul style="list-style-type: none"> • MB2160-WB05N-B01 • (ARDUINO® interface board) • MB2032-WB05N-B01 • (MCU RF board) 		

Board revision history

Table 8. Board revision history

Board reference	Board variant and revision	Board change description	Board limitations
MB2160 (ARDUINO® interface board)	MB2160-WB05N-B01	Initial revision	No limitation
MB2032 (MCU RF board)	MB2032-WB05N-B01	Initial revision	No limitation

Federal Communications Commission (FCC) and ISED Canada Compliance Statements

- FCC Compliance Statement
- Identification of products: X-NUCLEO-WB05KN1
- FCC ID: YCP-MB203202
- Radio Frequency (RF) Exposure Compliance of Radio communication: To satisfy FCC RF Exposure requirements, a separation distance of 20cm or more should be maintained between the antenna of this device and persons during operation. To ensure compliance, operation at a closer distance than this is not recommended. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.
- Part 15.19
- This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.
- Part 15.21
- Any changes or modifications to this equipment not expressly approved by STMicroelectronics may cause harmful interference and void the user's authority to operate this equipment.

Part 15.105 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 instruction, 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 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 circuit different from that to which the receiver is connected.
 - Consult the dealer or an experienced radio/TV technician for help.
 - Responsible party (in the USA)
 - Francesco Doddo
 - STMicroelectronics, Inc.
 - 200 Summit Drive | Suite 405 | Burlington, MA 01803 USA
 - Telephone: +1 [781-472-9634](tel:781-472-9634)

ISED Compliance Statement

- Identification of products: X-NUCLEO-WB05KN1
- IC: 8976A-MB203202
- Identification du produit : X-NUCLEO-WB05KN1
- Contient sous-ensemble certifié IC : 8976A-MB203202
- Compliance Statement
- Notice: This device complies with ISED Canada licence-exempt RSS standard(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.
- **RF exposure statement**
This device complies with ISED radiation exposure limits set forth for general population. This device must be installed to provide a separation distance of at least 20cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

RED Compliance Statement

- Hereby, STMicroelectronics declares that the radio equipment type “X-NUCLEO-WB05KN1” is in compliance with Directive 2014/53/EU.
Frequency range used in transmission and maximal radiated power in this range:
 - Frequency range: 2400-2483.5 MHz (Bluetooth®)
 - Maximal power: 8 mW e.i.r.p


Table 9. Document revision history

Date	Revision	Changes
03-Jul-2024	1	Initial release.

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Documents / Resources

	<p>STMicroelectronics Bluetooth Low Energy Expansion Board Based on the STM32WB05KN [pdf] User Manual</p> <p>STM32WB05KN, Nucleo-64, Bluetooth Low Energy Expansion Board Based on the STM32WB05KN, Bluetooth Low Energy Expansion, Board Based on the STM32WB05KN, Board Based, Board, Based</p>
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References

- [User Manual](#)

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