STM32WBA Nucleo-64 board (MB1801 and MB2293)

Introduction

The Nucleo-64 board, based on the MB1801 mezzanine board and the MB2293 MCU RF board, is a wireless and ultralow-power board embedding a powerful and ultralow-power radio compliant with Bluetooth® LE and IEEE 802.15.4-2015 PHY and MAC, supporting Thread, Matter, and Zigbee®.

The board uses USB Type-C® for easy connection with other devices. The ARDUINO® Uno V3 connector and the ST morpho headers enable easy expansion of the STM32 Nucleo open development platform functionality with a wide range of specialized shields.

The NUCLEO-WBA25CE1 Nucleo-64 board board comes with the comprehensive free STM32 software libraries and examples available with the STM32CubeWBA MCU Package.

Figure 1. NUCLEO-WBA25CE1 top view

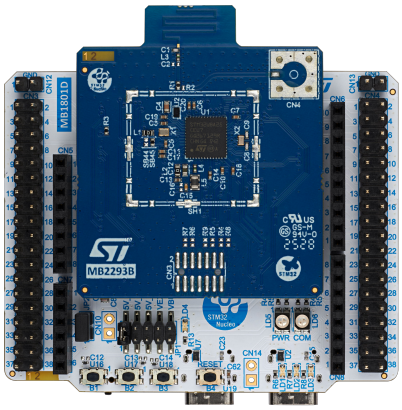
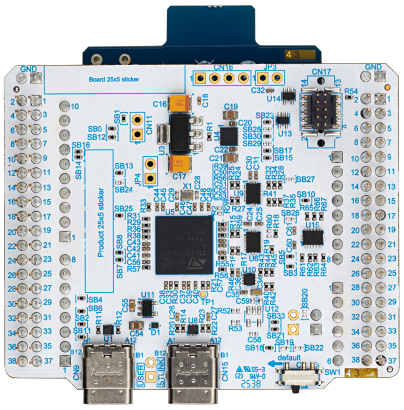


Figure 2. NUCLEO-WBA25CE1 bottom view



Pictures are not contractual.

1 Features

- STM32WBA25CEU7 microcontroller based on the Arm® Cortex®-M33 core, featuring 512 Kbytes of flash memory and 96 Kbytes of SRAM in a UFQFPN48 package
- MCU RF board (MB2293):
  - 2.4 GHz RF transceiver supporting Bluetooth® LE specification v6.0
  - Built-in PCB antenna
- 32.768 kHz LSE crystal oscillator
- 32 MHz HSE crystal oscillator
- Three user LEDs
- Three user push-buttons
- One reset push-button
- Board connectors:
  - USB Type-C®
  - ARDUINO® Uno V3 connector
  - ST morpho expansion connectors for full access to the STM32 I/Os
- Flexible power-supply options: ST-LINK USB V_{BUS}, USB connector, or external sources
- On-board STLINK-V3EC debugger/programmer with USB re-enumeration capability: mass storage, Virtual COM port, and debug port
- Comprehensive free software libraries and examples available with the STM32CubeWBA MCU Package
- Support of a wide choice of Integrated Development Environments (IDEs) including IAR Embedded Workbench®, MDK-ARM, and STM32CubeIDE

arm

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2 Ordering information

To order the NUCLEO-WBA25CE1 Nucleo-64 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
NUCLEO-WBA25CE1	• MB1801(1) • MB2293(2)	STM32WBA25CEU7

1. *Mezzanine board*
2. *MCU RF board*

2.1 Codification

The meaning of the codification is explained in Table 2.

Table 2. Codification explanation

NUCLEO-XXYYZTU	Description	Example: NUCLEO-WBA25CE1
XX	MCU series in STM32 32-bit Arm Cortex MCUs	STM32WBA series
YY	MCU product line in the series	STM32WBA25 product line
Z	STM32 package pin or ball count: • C for 48 pins	48 pins
T	STM32 flash memory size: • E for 512 Kbytes	512 Kbytes
U	Index	First generation of Bluetooth® LE Nucleo boards based on the STM32WBA25CE MCU

3 Development environment

3.1 System requirements

- Multi-OS support: Windows® 10 or 11, 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.

3.2 Development toolchains

- IAR Systems® - IAR Embedded Workbench®(1)
- Keil® - MDK-ARM(1)
- STMicroelectronics - STM32CubeIDE

1. *On Windows® only.*

3.3 Demonstration software

The demonstration software, included in the STM32Cube MCU Package corresponding to the on-board microcontroller, is preloaded in the STM32 flash memory for easy demonstration of the device peripherals in standalone mode. The latest versions of the demonstration source code and associated documentation can be downloaded from *www.st.com*.

3.4 EDA resources

All board design resources, including schematics, EDA databases, manufacturing files, and the bill of materials, are available from the NUCLEO-WBA25CE1 product page at *www.st.com*.

4 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

5 Safety recommendations

5.1 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.

5.2 Handling the board

This product contains a bare printed circuit board and like all products of this type, the user must be careful about the following points:

- The connection pins on the board might be sharp. Be careful when handling the board to avoid injury.
- 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 a voltage level that is not dangerous, but components might be damaged when shorted.
- Do not put any liquid on the board and avoid operating it close to water or at a high humidity level.
- Do not operate the board if it is dirty or dusty.
- The pins of the board are exposed and must not come into contact with a metal surface, as this can produce a short circuit and damage the board.

5.3 Delivery recommendations

Before the first use, inspect the board for any damage that may have occurred during shipment. Ensure that all socketed components are securely fixed in their sockets and that nothing is loose in the plastic bag.

5.4 Power supply

A power supply unit or auxiliary equipment complying with the EN 62368-1:2014+A11:2017 standard (or the one replacing it) and safety extralow voltage (SELV/ES1) with limited power capability (LPS/PS2) must power this equipment.

6 Quick start

The NUCLEO-WBA25CE1 board is a low-cost and easy-to-use development kit for quick evaluation and development with an STM32WBA25CEU7 microcontroller in a UFQFPN48 package.

Before installing and using the product, accept the evaluation product license agreement from the *www.st.com/epla* webpage. For more information on the NUCLEO-WBA25CE1 board and demonstration software, visit the *www.st.com/stm32nucleo* webpage.

6.1 Getting started

The NUCLEO-WBA25CE1 board is preloaded with the PulseOximeter application. Follow the sequence below to configure the board and launch the application (refer to Figure 5 and Figure 6 for component locations):

1. Check the jumper position on the board: JP2 ON, JP1 set to 5V_STLINK.
2. Make sure that the power switch (SW1) is in the default position.
3. Connect the NUCLEO-WBA25CE1 board ST-LINK USB connector (CN15) to a PC using a USB Type-A or USB Type-C® to USB Type-C® cable.
4. Go to the STM32WBA Web Bluetooth® App webpage.
5. Click on [**Connect**] to establish a Bluetooth® LE connection and launch Oximeter measurement. The application displays the heart rate and pulse oximeter charts.

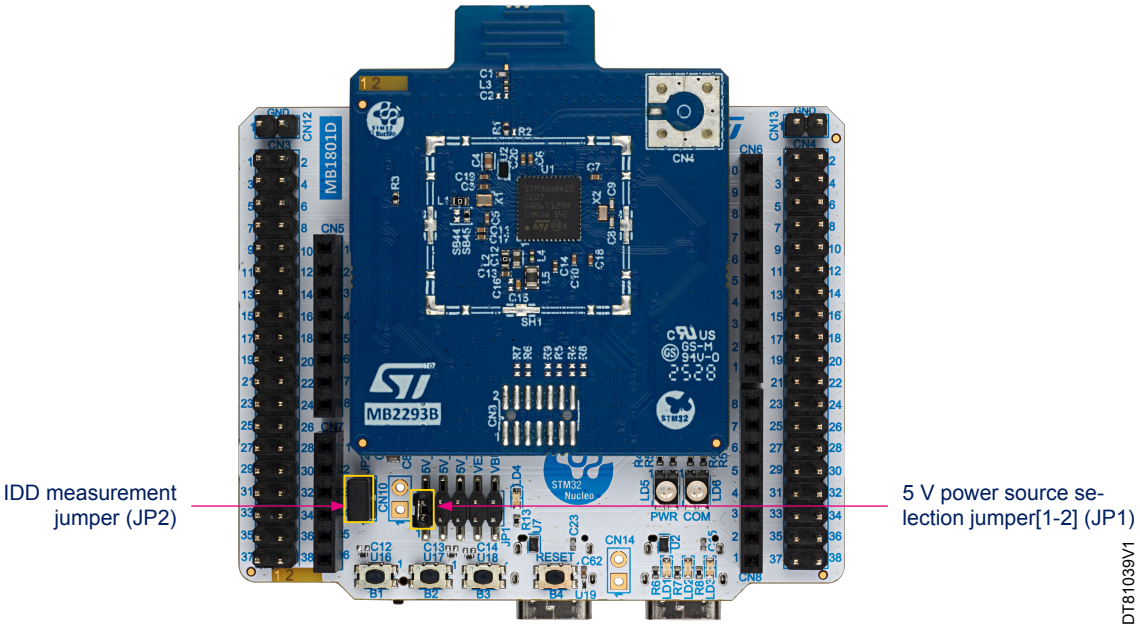
6.2 Default board configuration

By default, the NUCLEO-WBA25CE1 board is configured with STLINK-V3EC power. The default jumper configuration and voltage settings are shown in Table 4.

Table 4. Default jumper configuration

Jumper	Definition	Position	Comment
JP1	5 V power selection	[1-2]	5 V from STLINK-V3EC (5V_STLK)
JP2	IDD measurement	ON	VDD_MCU current measurement

Figure 3. Default board configuration



7 Hardware layout and configuration

The NUCLEO-WBA25CE1 board is designed around the STM32WBA25CEU7 microcontroller in an UFQFPN48 package. The design includes a mezzanine board (MB1801) and an MCU RF board(MB2293).

Figure 4 shows the connections between the STM32 and its peripherals. Figure 5 and Figure 6 show the location of these features on the NUCLEO-WBA25CE1 board.

The mechanical dimensions of the mezzanine board and the MCU RF board are shown in Figure 7 and Figure 8, respectively.

7.1 Hardware layout

Figure 4. NUCLEO-WBA25CE1 block diagram

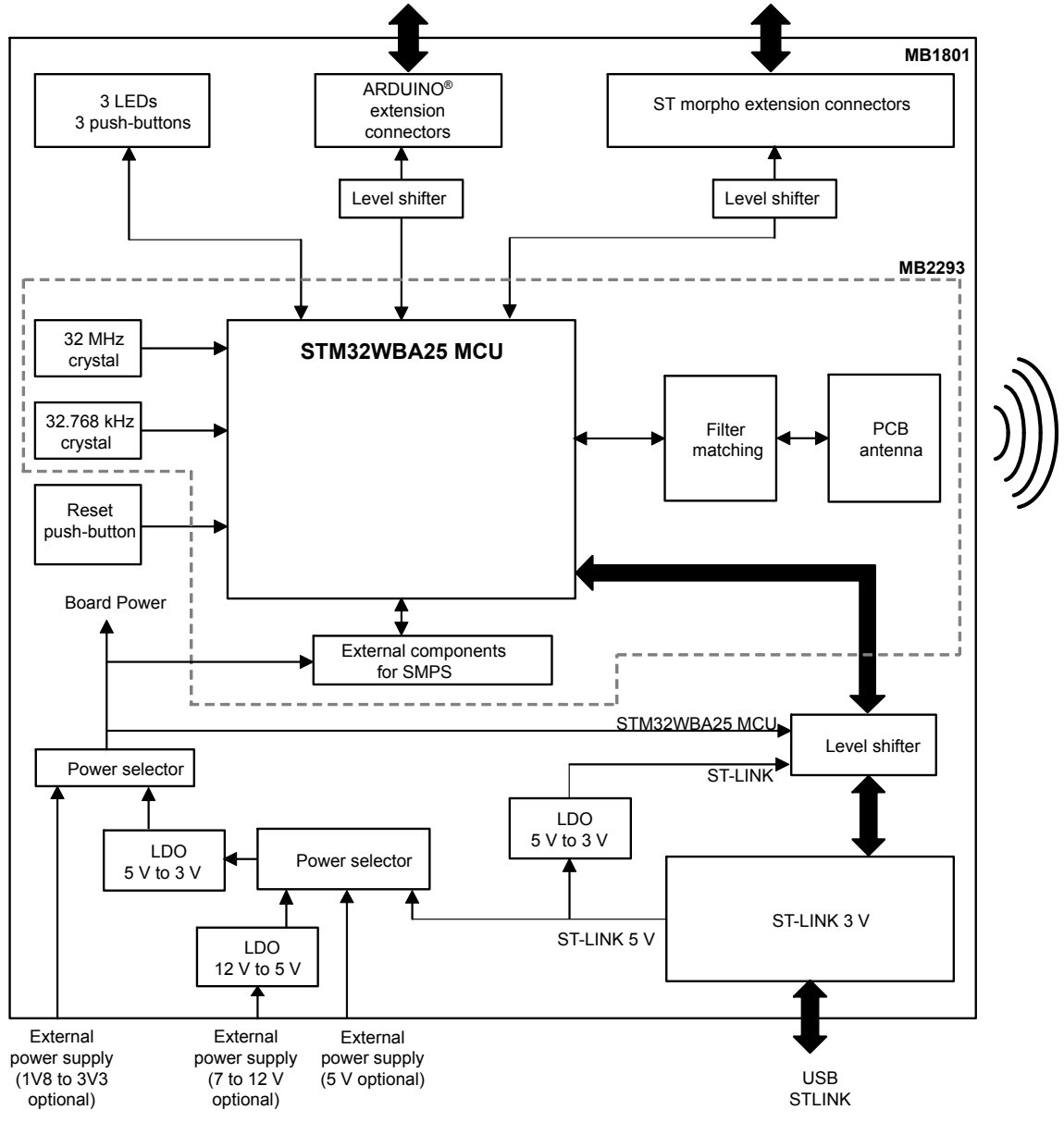


Figure 5. NUCLEO-WBA25CE1 top layout

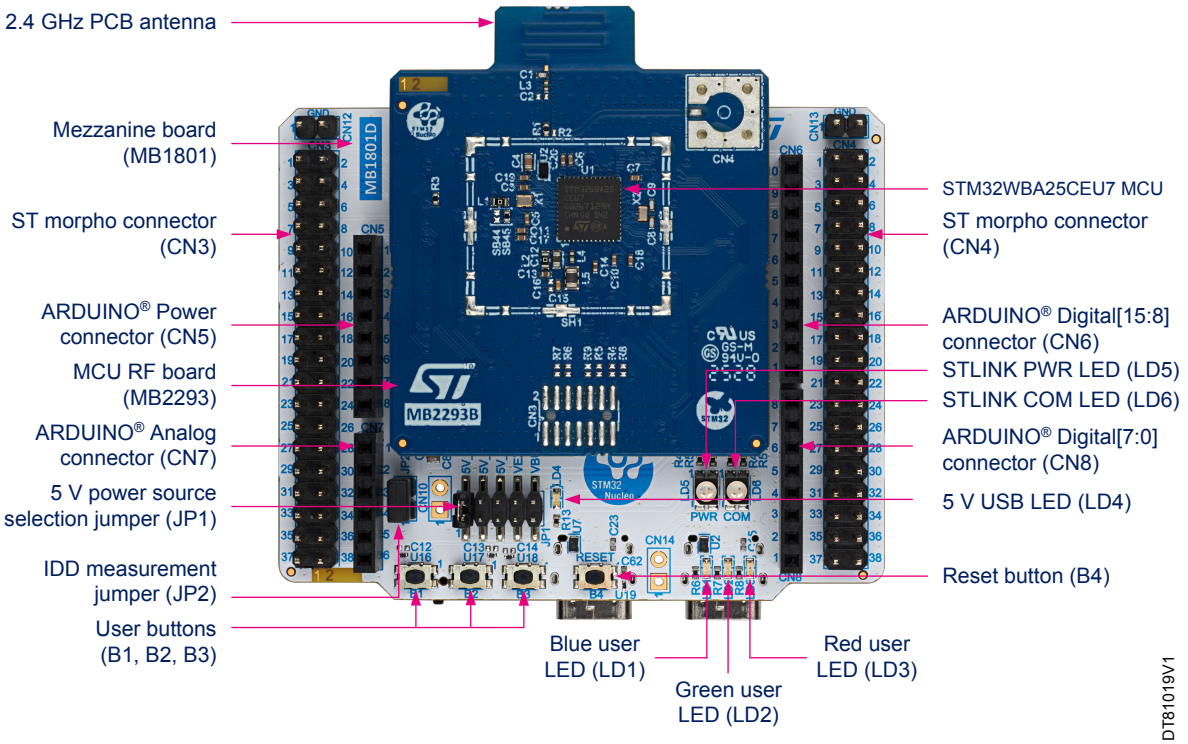
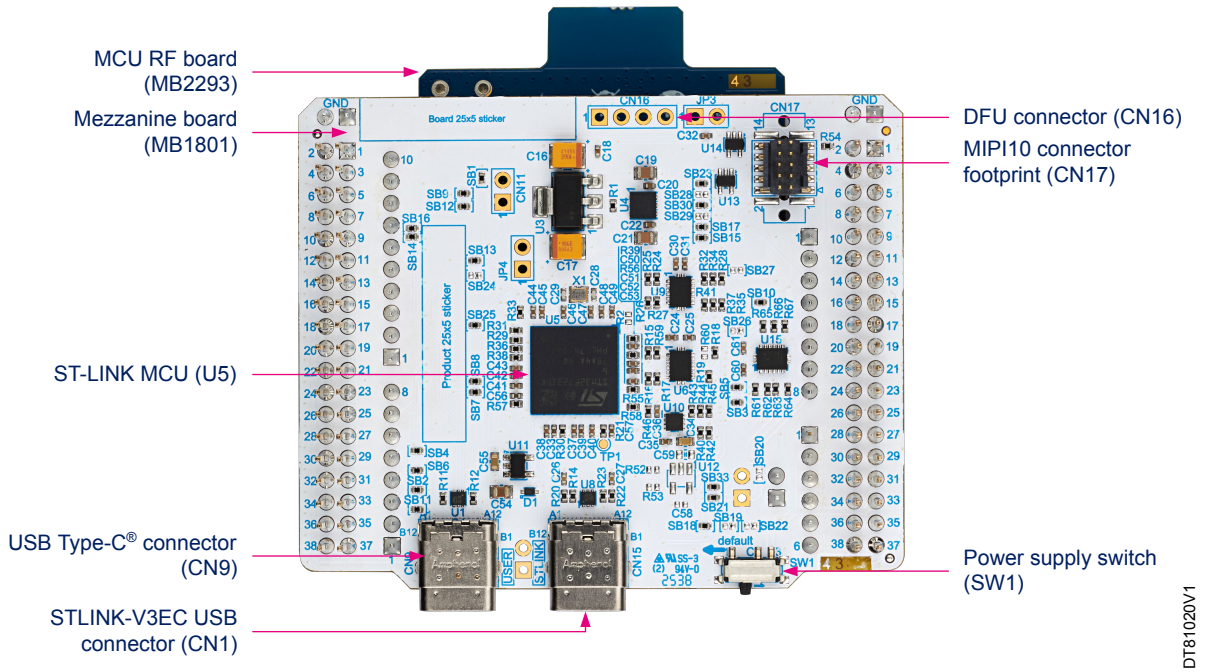


Figure 6. NUCLEO-WBA25CE1 bottom layout



7.2 Mechanical dimensions

Figure 7. **MB1801 mechanical drawing (in millimeters)**

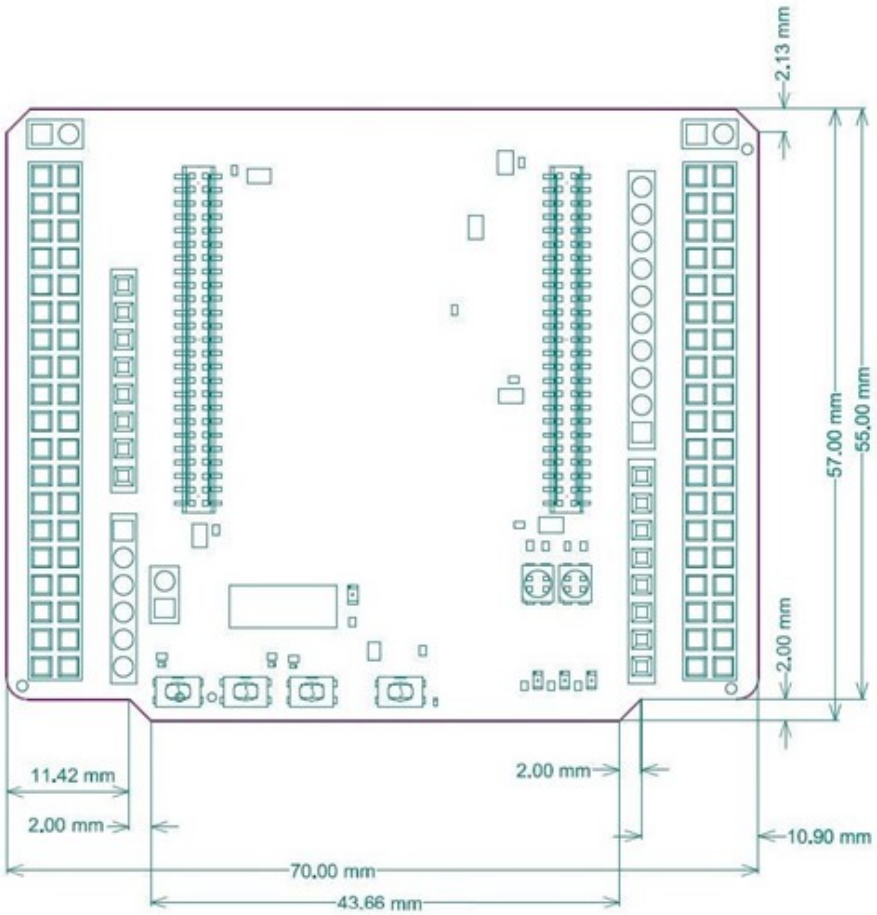
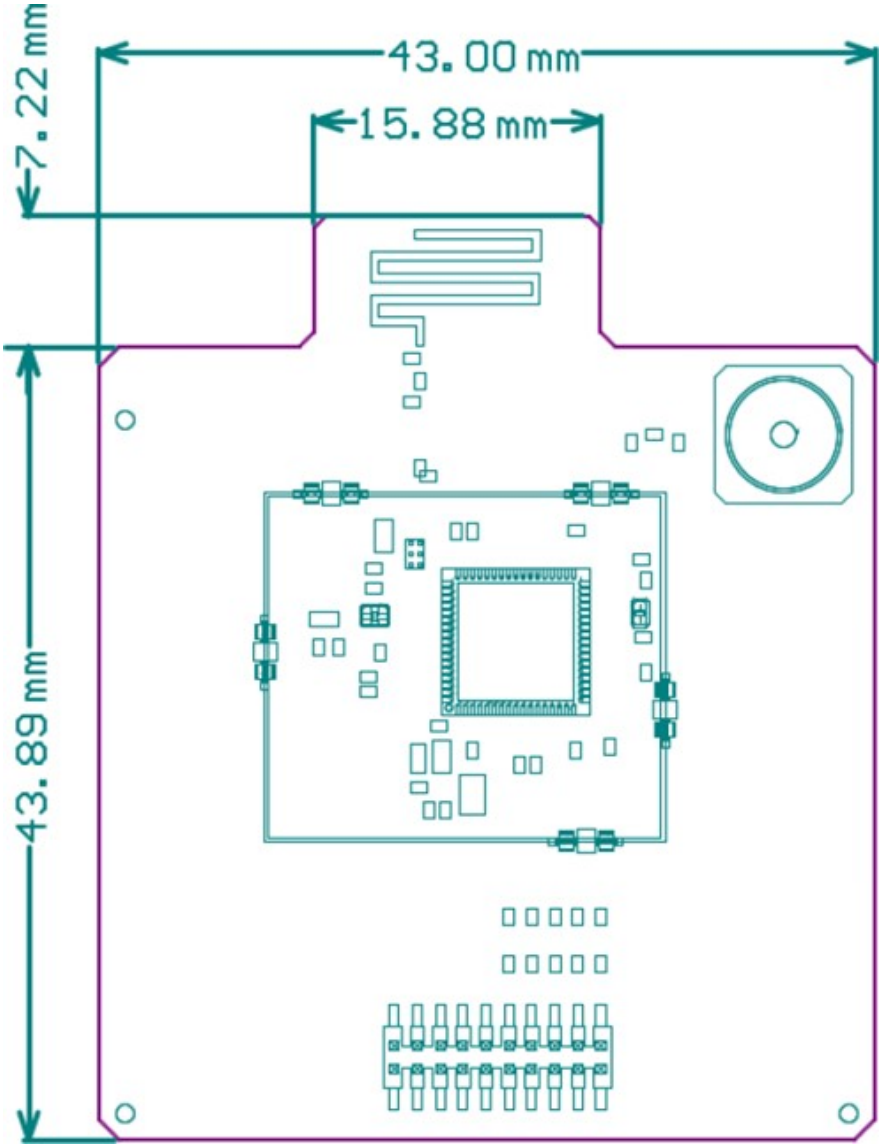


Figure 8. **MB2293 mechanical drawing (in millimeters)**



7.3 Embedded STLINK-V3EC

This chapter provides information about the implementation of the embedded STLINK-V3EC on this NUCLEO-WBA25CE1 Nucleo-64 board.

For further details on ST-LINK capabilities, LED management, and driver and firmware for STLINK-V3EC, refer to the technical note *Overview of ST-LINK derivatives* (TN1235).

For more information about the debugging and programming features of STLINK-V3EC, refer to the user manual *STLINK-V3SET debugger/programmer for STM8 and STM32* (UM2448).

7.3.1 Description

The STLINK-V3EC tool for debugging and programming is integrated into this NUCLEO-WBA25CE1 Nucleo-64 board. It provides the following features:

- USB 2.0 full speed interface
- Probe firmware update through USB
- JTAG communication support up to 21 MHz
- SWD and SWV communication support up to 24 MHz
- 3 to 3.6 V application voltage support and 5 V tolerant inputs
- Virtual COM port (VCP) up to 16 Mbps
- Optional drag-and-drop flash memory programming binary files
- Multipath bridge USB to SPI/UART/I^2C/GPIOs
- Status COM LED (LD5) that blinks during communication with the PC (red by default)
- Fault LED (LD6) alerting on USB overcurrent (green, orange, or red)
- USB-C® overvoltage protection (U10) with current limitation

7.3.2 Drivers

Driver installation is not required for Windows® 10 or later. However, installing the driver assigns an ST-specific name to the ST-LINK COM port in the system device manager.

7.3.3 Firmware upgrade

STLINK-V3EC includes a firmware upgrade mechanism (*stsw_link007*) through the USB port. The firmware can change during the STLINK-V3EC lifetime, to add new features, correct errors, and support new microcontroller families. Visit the www.st.com website regularly and before using this board to stay up to date with the latest firmware version.

7.3.4 Virtual COM port USART1 (VCP1)

STLINK-V3EC offers a USB Virtual COM port bridge. This feature allows access to the USART1 of NUCLEO-WBA25CE1 through the USB ST-LINK connector. By default, this USART1 interface of NUCLEO-WBA25CE1 is connected to the VCP1 of the STLINK-V3EC MCU (STM32F723IE).

Access is possible on the CN3 connector of the mezzanine board (MB1801). Both the Tx and Rx signals are available, and two solder bridges allow their disconnection from the UART coming from the SoC. By default, VCP1 is connected to the USART1 of NUCLEO-WBA25CE1.

Table 5. VCP1 interface pinout description

NUCLEO-WBA25CE1 (MB2293)	CN3 (MB1801)	STM32F723IE (MB1801)
USART1 Rx (PA12, pin 28)	Pin 35 (GPIO23) (SB5 ON)	STLK_VCP_TX: PG14, pin A7
USART1 Tx (PA6, pin 7; SB21 ON)	Pin 37 (GPIO24) (SB3 ON)	STLK_VCP_RX: PG9, pin C10

7.3.5 Virtual COM port USART2 (VCP2)

It is possible to replace the mass storage interface with a second Virtual COM port. This requires a firmware upgrade through STM32CubeProgrammer (refer to the technical note *Overview of ST-LINK derivatives* (TN1235) at *www.st.com*.

Access is possible on the CN3 and CN4 connectors of the mezzanine board (MB1801). All signals (Tx, Rx, RTS, and CTS) are available.

Table 6. VCP2 interface pinout description

NUCLEO-WBA25CE1 (MB2293)	CN3 and CN4 (MB1801)	STM32F723IE (MB1801)
LPUART1_RX (PA1) SB10 ON and SB4 OFF by default	CN4, pin 37 (GPIO55; SB7 ON)	T_VCP2_TX: PC10, pin B14
LPUART1_TX (PH3) SB8 ON and SB43 OFF by default	CN4, pin 35 (GPIO54; SB8 ON)	T_VCP2_RX: PB11, pin R13
LPUART1_CTS (PB15) SB16 OFF and SB38 OFF by default	CN4, pin26 (GPIO46; SB25 ON)	T_VCP2_RTS: PD12, pin N13
LPUART1_RTS (PA10) SB35 OFF by default	CN3, pin2 (GPIO2; SB23 ON)	T_VCP2_CTS: PD11, pin N14

7.3.6 Level shifter

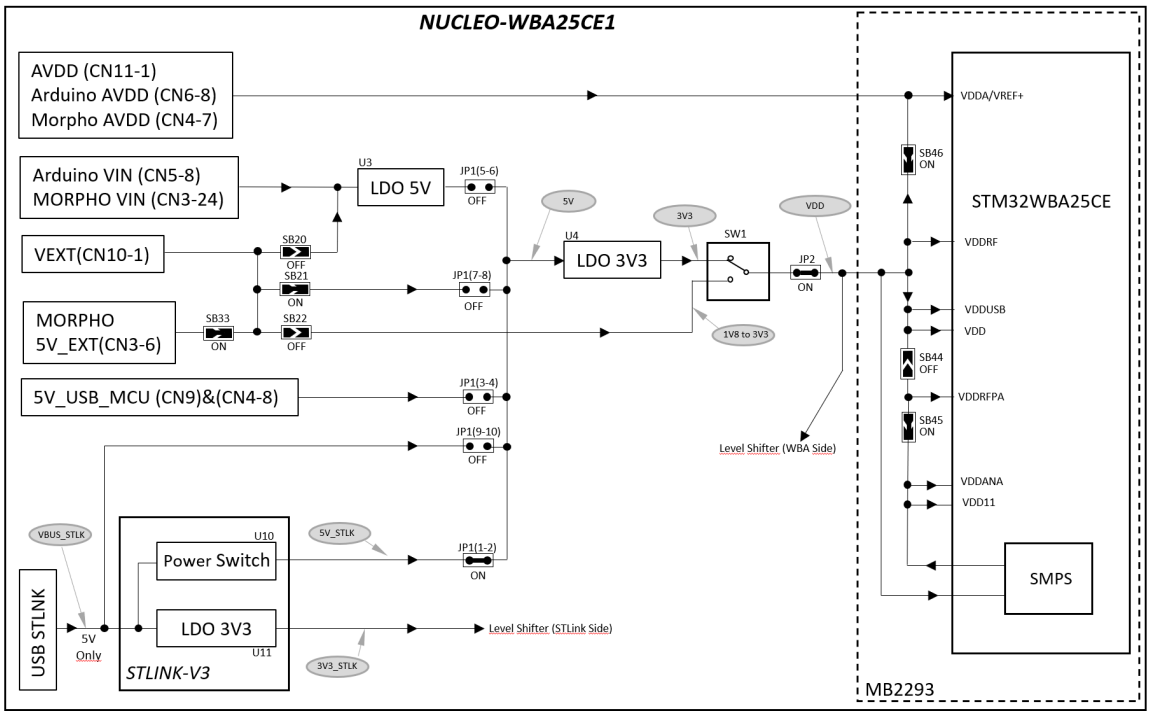
NUCLEO-WBA25CE1 Nucleo-64 board features a system to supply the STM32WBA25CEU7 MCU with a voltage that is different from the ST-LINK voltage (which is always provided by a 3V3 source). By default, the same voltage value supplies both the MCU and ST-LINK, but it is possible to supply the MCU with another value. It accepts a voltage range of 1.8 to 3.3 V trust to a specific component (level shifter).

This level shifter ensures the voltage conversion between ST-LINK and the MCU. It drives the SWD and UART signals connected to the VCP1 or VCP2 on the ST-LINK.

7.4 Power supply

By default, the STM32WBA25CEU7 MCU embedded on the NUCLEO-WBA25CE1 Nucleo-64 board is supplied with 3.3 V. However, the board offers several options to supply the module. The 3.3 V supply can originate from the ST-LINK USB, ARDUINO® Uno V3 connector, or ST morpho connector. Additionally, the MCU can be supplied by an external source between 1.8 and 3.3 V. Level shifters enable debugging with the embedded STLINK-V3EC even if the supply voltage of the target differs from the ST-LINK supply voltage (3.3 V). Figure 9 shows the power tree and the default state of the jumpers and solder bridges.

Figure 9. **NUCLEO-WBA25CE1 power tree**



7.4.1 7 to 12 V power supply

A 7 to 12 V DC power supply can power NUCLEO-WBA25CE1 Nucleo-64 board. There are three access points for this voltage level:

- Pin VIN of the ARDUINO® Uno V3 connector (CN5-8): apply up to 12 V to this pin, or use an ARDUINO® shield that delivers this voltage to the VIN pin.
- Pin VIN of the ST morpho connector (CN3-24): apply up to 12 V to this pin, as with the ARDUINO® Uno V3 connector.
- External input (CN10): in this case, the jumper and solder bridge states are critical; verify them in Table 7.

These sources connect to a linear low dropout regulator (U2). The output of this regulator (5 V) is a potential source for the 5 V signal.

7.4.2 5 V power supply

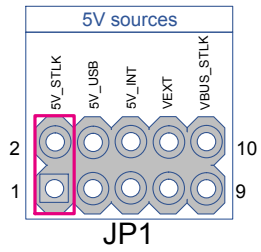
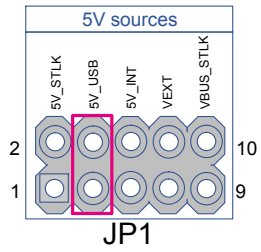
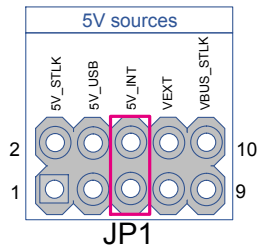
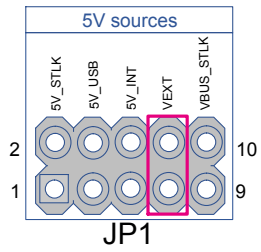
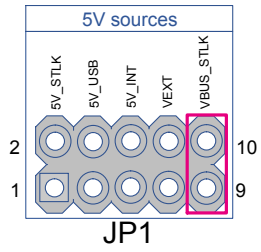
A 5 V DC power supply can power NUCLEO-WBA25CE1 Nucleo-64 board. The 5 V can come from several connectors:

- External input (VEXT, CN10). In this case, the states of the jumpers and solder bridge are critical. Refer to Table 7 for further details.
- 5V_EXT from the ST morpho connector (CN3, pin 6 of MB1801).
- VIN (7 - 12 V) input through the voltage regulator (U2). Refer to Section 7.4.1 for further details.
- ST-LINK USB can supply the board directly (VBUS_STLK) or through monitoring of STLINK-V3EC.
- 5V_USB from the user USB connector (CN9).

The jumper (JP1) selects the 5 V source. Table 7 shows the configuration to apply the selected source.

Depending on the current required by the devices connected to the USB port and the board itself, power limitations can prevent the system from operating as expected. It is mandatory to ensure that NUCLEO-WBA25CE1 is supplied with the correct power source according to the current requirement.

Table 7. Power supply selector jumper (JP1) description

JP1 setting	Configuration
	**Default setting** NUCLEO-WBA25CE1 is supplied through the ST-LINK USB Type-C® connector (CN15). ST-LINK controls this source. It enables this 5 V after the startup of STLINK-V3EC if all conditions are met.
	NUCLEO-WBA25CE1 is supplied through the user USB Type-C® connector (CN9).
	NUCLEO-WBA25CE1 is supplied through pin 8 of the ARDUINO® Uno V3 connector (CN5), pin 24 of the ST morpho connector (CN3), or CN10 (refer to the configuration details in the present section).
	NUCLEO-WBA25CE1 is supplied through CN10 or through pin 6 of the ST morpho connector (CN3). Refer to the configuration details in the present section.
	NUCLEO-WBA25CE1 is supplied through the ST-LINK USB Type-C® connector (CN15) without any control from STLINK-V3EC.

When 5V_STLK is used, JP1 is set to [1-2]. The sequence is specific. At the start, only STLINK-V3EC is supplied. If USB enumeration succeeds, 5V_STLK power is enabled by asserting the PWR_EN signal from STLINK-V3EC. This pin connects to a power switch (U10), which supplies the rest of the board. The power switch also features a current limitation to protect the PC if the current exceeds 300 mA.

7.4.3 Measurement of the microcontroller current consumption

As the MCU has low-power features, it can be useful to measure the current consumed by the NUCLEO-WBA25CE1 board. The following methods are available:

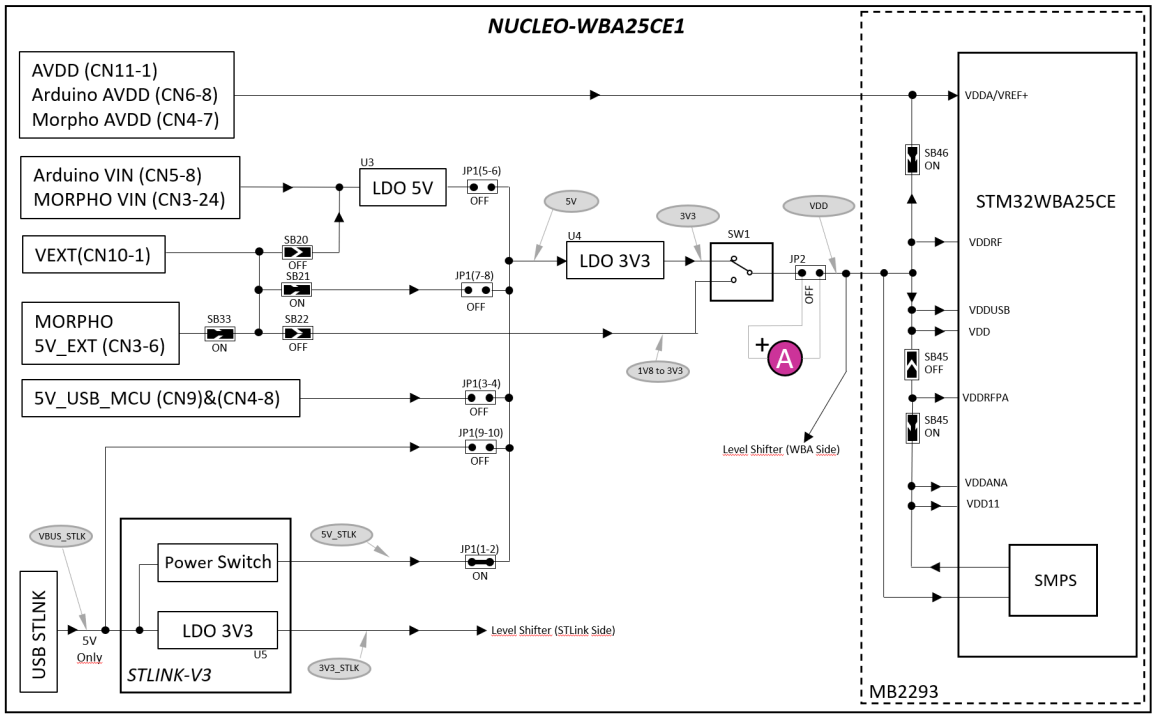
- Measuring the supply current using an ammeter
- Using an external power supply for current measurement
- Power consumption measurement during debugging with STLINK-V3PWR

Caution: *When measuring the MCU current consumption, ensure that the external QSPI flash memory (U3) is not supplied: SB47 must be OFF on the MCU RF board (MB2293).*

Measuring the supply current using an ammeter

Measure the supply current of the MCU using an ammeter in place of the jumper (JP2). In this case, all supply sources can be used except the AVDD from the ARDUINO® Uno V3 connector. Do not use the AVDD input during this measurement, and ensure SB46 is ON. Figure 10 shows the configuration.

Figure 10. Current measurement with an ammeter

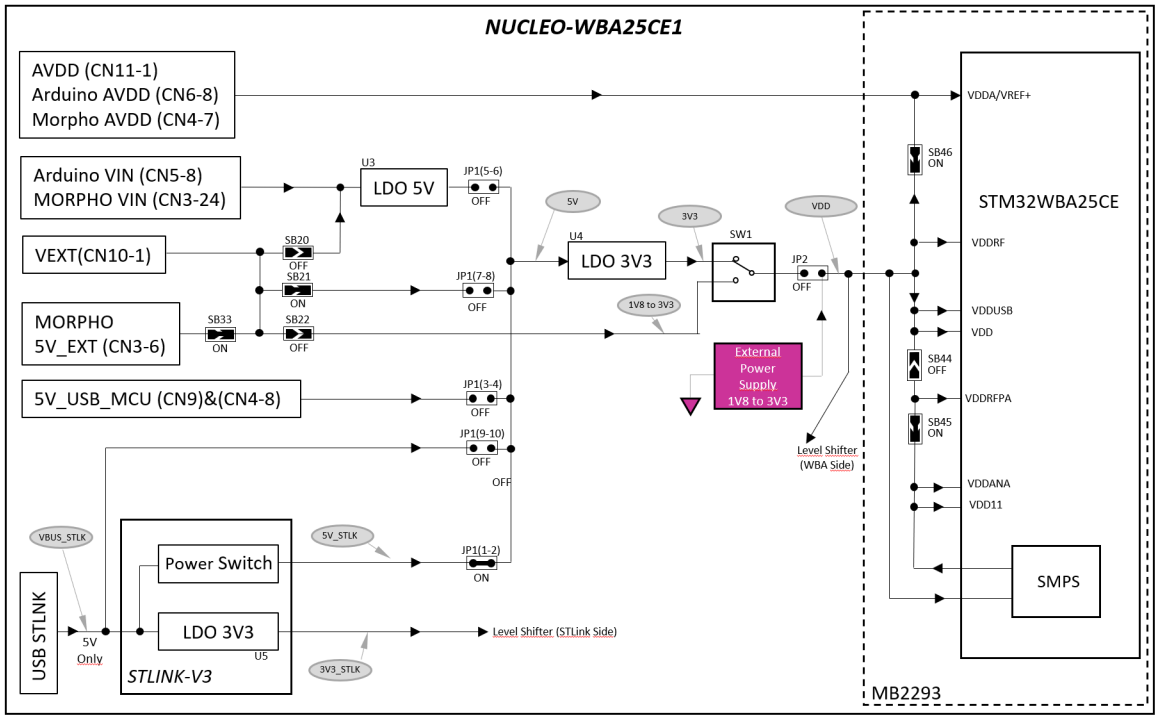


Using an external power supply for current measurement

Use an external power supply with current measurement capability. Remove the jumper (JP2) and connect the supply to pin 2 of JP2 (refer to Figure 11). The supply voltage must be between 1.8 and 3.3 V. Do not use the AVDD input, and ensure SB46 is ON during this measurement. Any source on JP1 can be selected; however, ST recommends the [1-2] position because it provides power switch protection.

Caution: *The supply voltage VDD must be between 1.8 and 3.3 V. The 3.3 V limit is due to level shifters, even though MCU supports up to 3.6 V.*

Figure 11. Current measurement with an external power supply

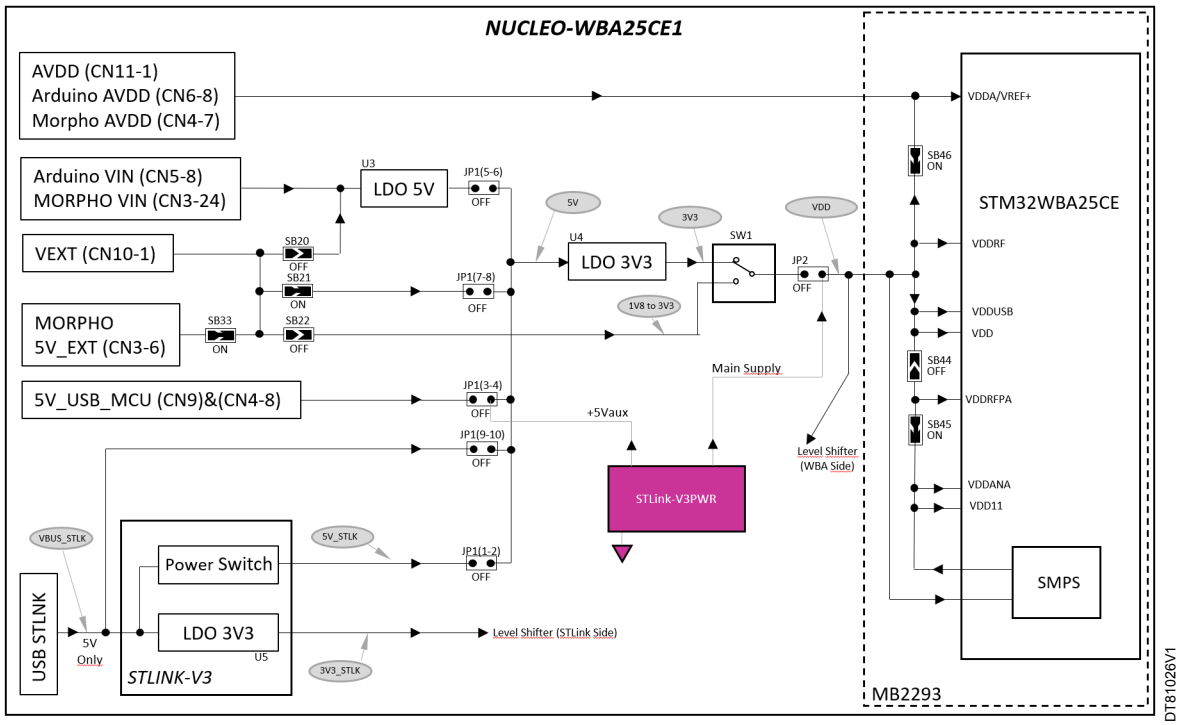


Power consumption measurement with STLINK-V3PWR

For power consumption measurement during debugging, STLINK-V3PWR can be used. This product allows two supply sources: one for current measurement on the MCU, and another for the rest of the board, such as LEDs. As in the previous case, remove the jumper (JP2), and connect the main supply for current measurement to pin 2 of JP2 (refer to Figure 12. Current measurement with STLINK-V3PWR). For the second source (+5 V), remove the jumper on JP1 and connect this source to the top side (pin 1, 3, 5, 7, or 9 of JP1).

Caution: *The supply voltage must be between 1.8 and 3.3 V. Do not use the AVDD input, and ensure SB46 is ON during this measurement.*

Figure 12. Current measurement with STLINK-V3PWR

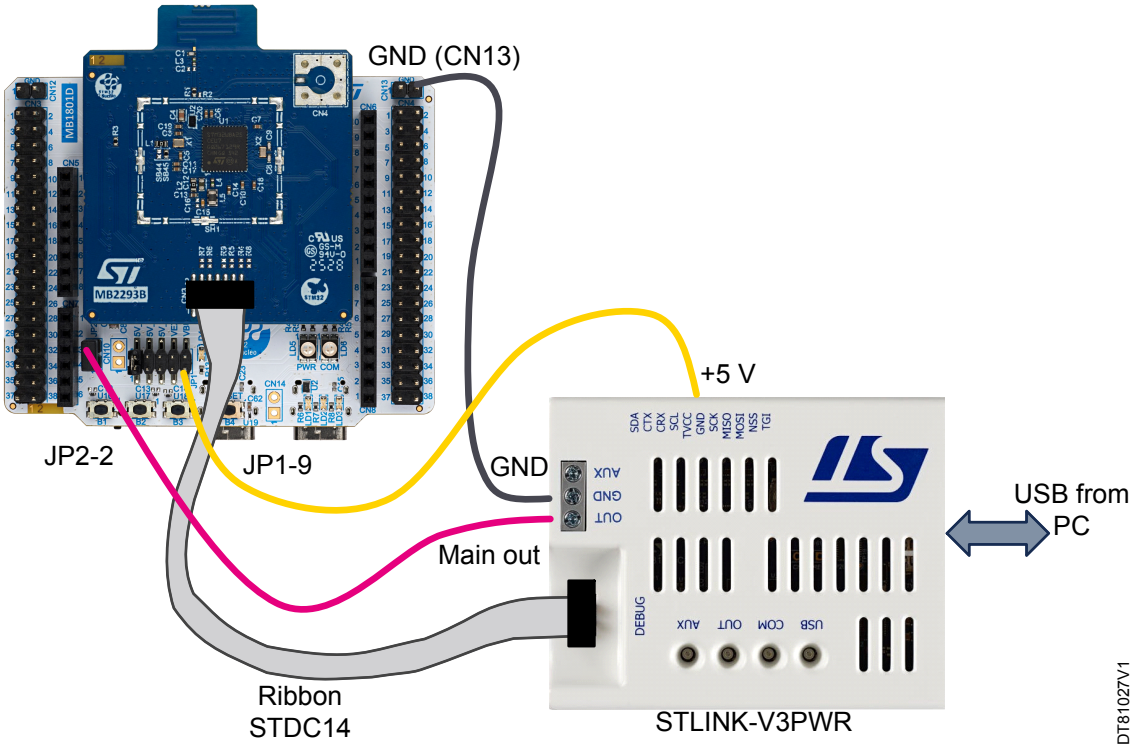


The details above concern supplying the board through STLINK-V3PWR. The debug feature of these tools also requires some modification.

By default, the MCU RF board (MB2293) is delivered without the option for debugging by an external tool. However, it is possible to solder a MIPI10 connector onto the CN3 footprint. For more details, refer to Section 8.1: MIPI10 connector (CN17).

Note: By default, the 10-pin MIPI10 connector (CN3) is not assembled because it prevents the use of an ARDUINO® shield. The connector height is not compatible with the ARDUINO® shield plug. However, it is always possible to connect an ST morpho shield on the bottom side of the mezzanine board (MB1801).

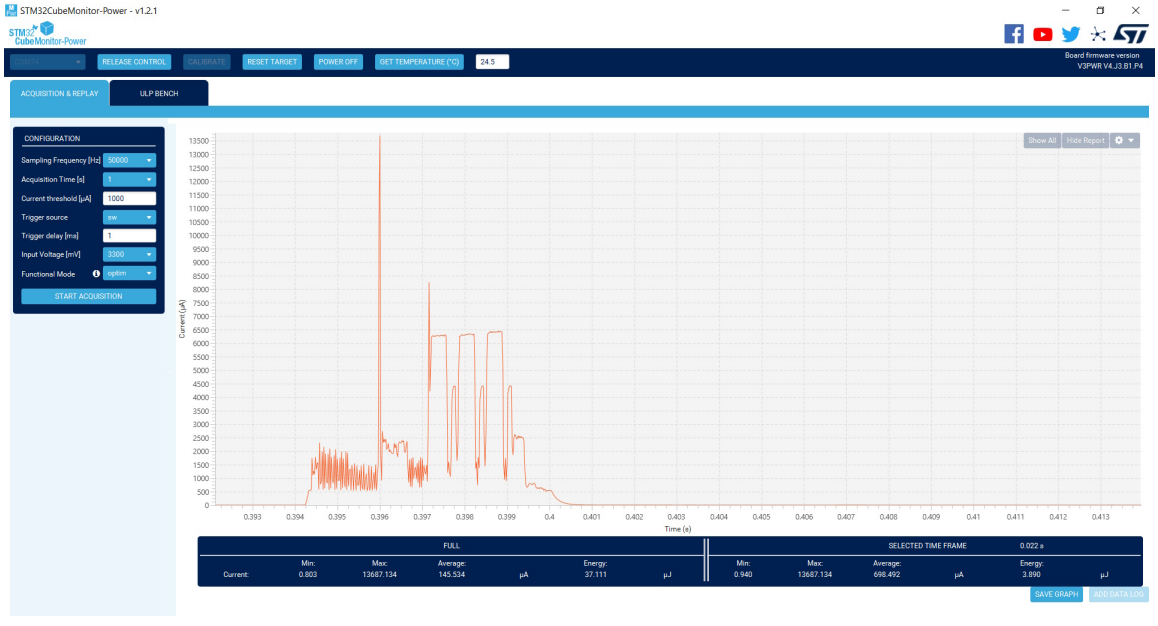
Figure 13. **Configuration for current measurement with STLINK-V3PWR**



Caution: *No VCP is available on the MIPI10 connector (CN17). To use VCP1, replace connector CN17 with a 14-pin STDC14 connector.*

After connection, download STM32CubeMonitor-Power (STM32CubeMonPwr) from *www.st.com* and install it. This software allows the user to carry out dynamic current measurements. Figure 14 shows an example of a current measurement (firmware: *Heart Rate* from the STM32CubeWBA firmware package). For more details on using STLINK-V3PWR, a dedicated page is available on the *www.st.com* website.

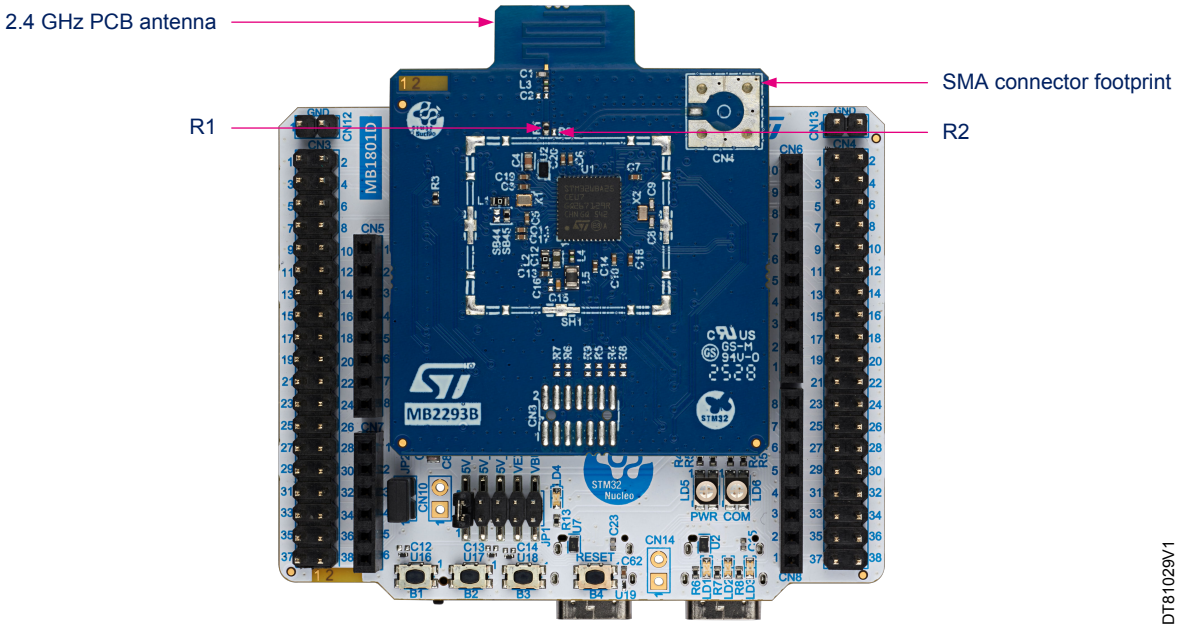
Figure 14. Example of current measurement with an external STLINK-V3PWR



7.5 Radio output configuration

By default, the board is configured with R1 ON and 23 OFF to use the PCB antenna. The configuration to use the SMA antenna is R1 OFF and R2 ON. The user must assemble the SMA connector not present by default.

Figure 15. Antenna elements on the MCU RF board (MB2293)



7.6 Clock sources

7.6.1 LSE clock references

The accuracy of the low-speed external oscillator (LSE) of the MCU RF board (MB2293) is committed to a 32.768 kHz crystal oscillator.

7.6.2 HSE clock references

The accuracy of the high-speed external oscillator (HSE) of the MCU RF board (MB2293) is committed to a 32 MHz crystal oscillator. The HSE oscillator is trimmed during board manufacturing.

7.7 Boot modes

Bootloader limitation

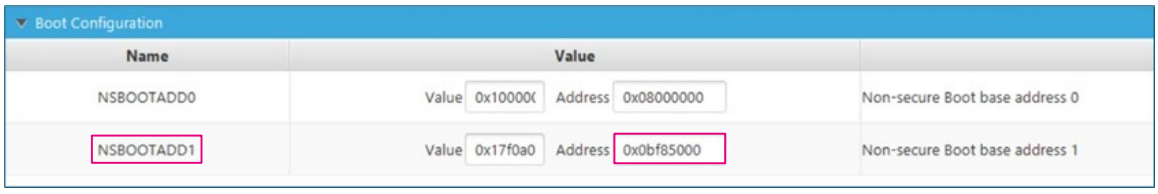
Due to incorrect programming of the MCU option bytes (NSBOOTADD1) during production, the bootloader address is not defined correctly. As a result, the device cannot boot using the bootloader, and the bootloader cannot be used to program the device. A workaround is available to correct this issue.

Workaround

The bootloader address issue can be corrected by reprogramming the NSBOOTADD1 option byte. The procedure is as follows:

1. Power on the NUCLEO-WBA25CE1 Nucleo-64 board using the ST-LINK USB connector (CN1).
2. Launch STM32CubeProgrammer.
3. Connect to the STM32WBA25CEU7 MCU via the SWD interface.
4. In the [**Boot Configuration**] menu, reprogram the NSBOOTADD1 option byte value to 0xBF85000, as illustrated by Figure 16.
5. Click on the [**Apply**] button.

Figure 16. NSBOOTADD1 option byte configuration



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BOOT control

There are two ways to boot using the bootloader:

- Boot through the PH3 BOOT pin (default option).
- Boot through the option bytes.

Boot through the PH3 BOOT pin (default option)

The PH3_BOOT0 GPIO of the MCU provides external hardware access to the bootloader. It is accessible on pin 7 of the CN3 connector of the mezzanine board (MB1801).

To activate bootloader mode and reprogram the NUCLEO-WBA25CE1 board, force the PH3_BOOT0 pin to a high level during hardware reset by connecting a 2.54 mm pitch jumper between the ST morpho connector BOOT0 (CN3, pin 7) and VDD (pin 5) pins, as indicated in Figure 17.

In this case, the nBOOT0 and nSWBOOT0 bits must be set to "1", as shown below:

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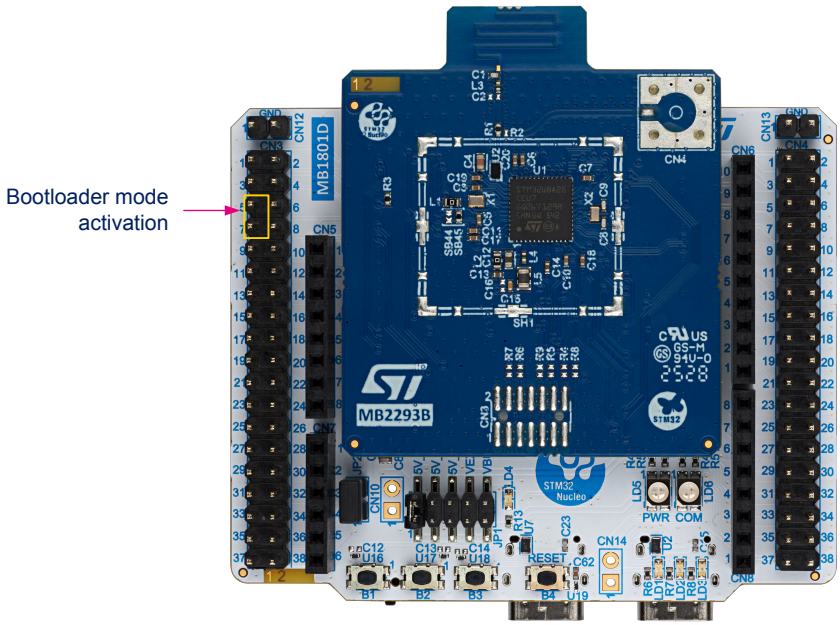
- Jumper not connected: the application residing in flash memory launches (default position).
- Jumper connects CN3 pins 5 and 7: the bootloader is activated and a new application can be programmed.

Figure 17. **Bootloader activation**



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Boot through the option bytes.

To boot using the option bytes, the nBOOT0 and nSWBOOT0 bits must be set to "0", as shown below:

nSWBOOT0	☐	Software BOOT0 Unchecked : BOOT0 taken from the option bit nBOOT0 Checked : BOOT0 taken from PH3/BOOT0 pin
nBOOT0	☐	nBOOT0 option bit Unchecked : nBOOT0 = 0 Checked : nBOOT0 = 1

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7.8 Reset sources

The reset signal of the NUCLEO-WBA25CE1 Nucleo-64 board is active LOW. The internal PU forces the RST signal to a high level. The reset sources include:

- Reset push-button (B4)
- Embedded STLINK-V3EC
- ARDUINO® connector (CN5, pin 3)
- ST morpho connector (CN3, pin 14)

7.9 LEDs

The NUCLEO-WBA25CE1 Nucleo-64 board contains six LEDs:

- Three user LEDs (LD1, LD2, LD3) are available for the user application:
  - LD1: blue user LED
  - LD2: green user LED
  - LD3: red user LED
- 5V_PWR LED (LD4). This green LED indicates that the STM32 part is powered by a 5 V source.
- Two STLINK-V3EC tricolor (green, orange, and red) LEDs (LD5 and LD6). These LEDs provide information about the STLINK-V3EC communication (LD6) and power (LD5) status. For detailed information about these LEDs, refer to the technical note *Overview of STLINK derivatives* (TN1235).

Figure 18. **LEDS on NUCLEO-WBA25CE1**

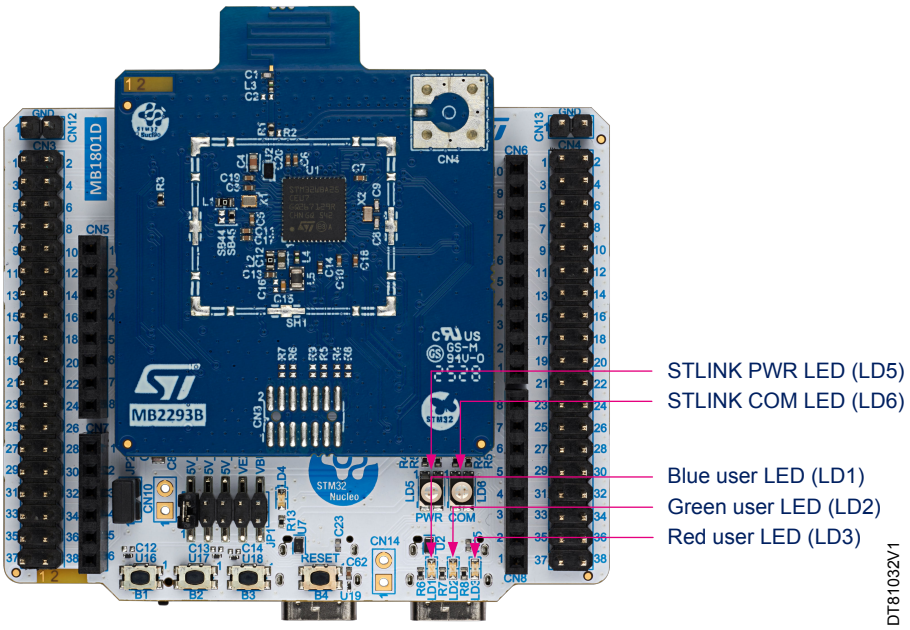


Table 8 provides the I/O configuration for the physical user interface of the user LEDs on the NUCLEO-WBA25CE1 Nucleo-64 board.

Table 8. **User LED I/O configuration**

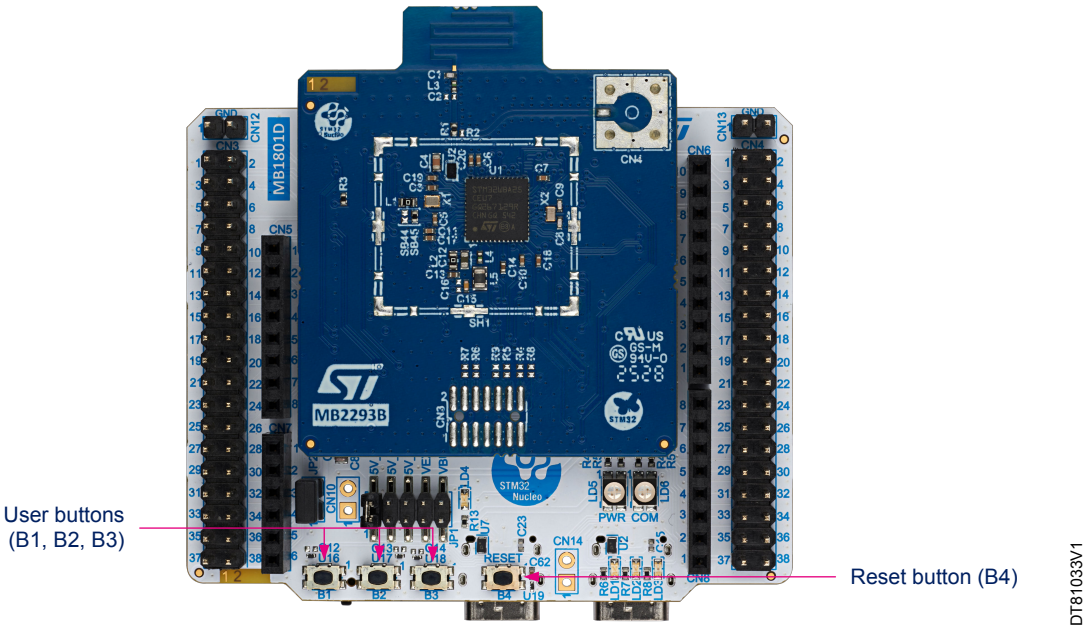
LED	I/O
User LED (LD1)	PA7
User LED (LD2)	PB12
User LED (LD3)	PB15

7.10 Push-buttons

Four push-buttons are available on the NUCLEO-WBA25CE1 Nucleo-64 board:

- Three black user push-buttons (B1, B2, and B3)
- One black reset push-button (B4)

Figure 19. **Push-buttons on NUCLEO-WBA25CE1**



User push-buttons

Three push-buttons are available for the user application. The push-buttons are connected to PA1, PA2, and PC13. The push buttons can be used with GPIO reading or to wake up the device.

Table 9. **User push-button I/O configuration**

Push-button	I/O	Available wake-up
User push-button (B1)	PA1	WKUP3
User push-button (B2)	PC13	WKUP2
User push-button (B3)	PA2	WKUP4

Reset button (B4)

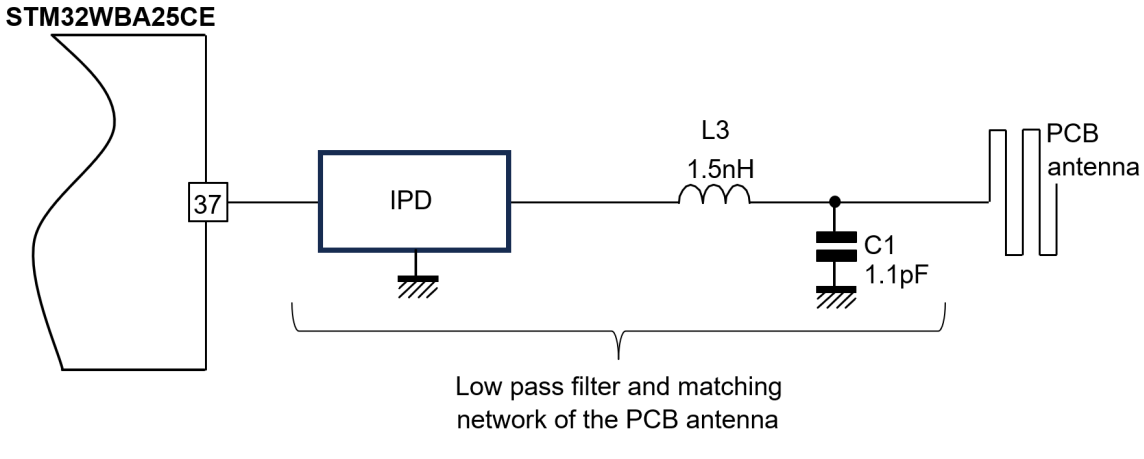
The reset button (B4) is dedicated to the hardware reset of the NUCLEO-WBA25CE1 Nucleo-64 board. It is connected to NRST and resets the microcontroller. When the button is pressed, the logic state is low; otherwise, the logic state is high.

7.11 RF I/O stage

Due to FCC and ISED constraints, the antenna is not removable. Therefore, the board is provided by default with a PCB antenna. This antenna is described in the application note *Guidelines for meander design using low-cost PCB antennae with 2.4 GHz radio for STM32WB/WB0 MCUs* (AN5129), available from www.st.com. An integrated passive device (IPD) is placed between the MCU and the antenna. The IPD significantly reduces harmonics and matches the output to 50 Ω, which facilitates compliance with certification requirements such as FCC, ISED, RED, and MIC. Two passive components at the IPD output provide antenna matching.

The antenna matching network consists of two components: L3 and C1. This design ensures a sufficient margin under all conditions. The study considers component drift (accuracy and temperature), PCB drift, and MCU variation. Depending on the component manufacturer and PCB specifications, these component values may change after optimization.

Figure 20. **RF I/O stage**



7.12 RF power management

The NUCLEO-WBA25CE1 board offers two methods of supplying the RF power amplifier, depending on the required Tx output power.

The first method uses the SMPS to reduce power consumption by connecting VDDRFPA to SMPS. This configuration drives up to 3 dBm.

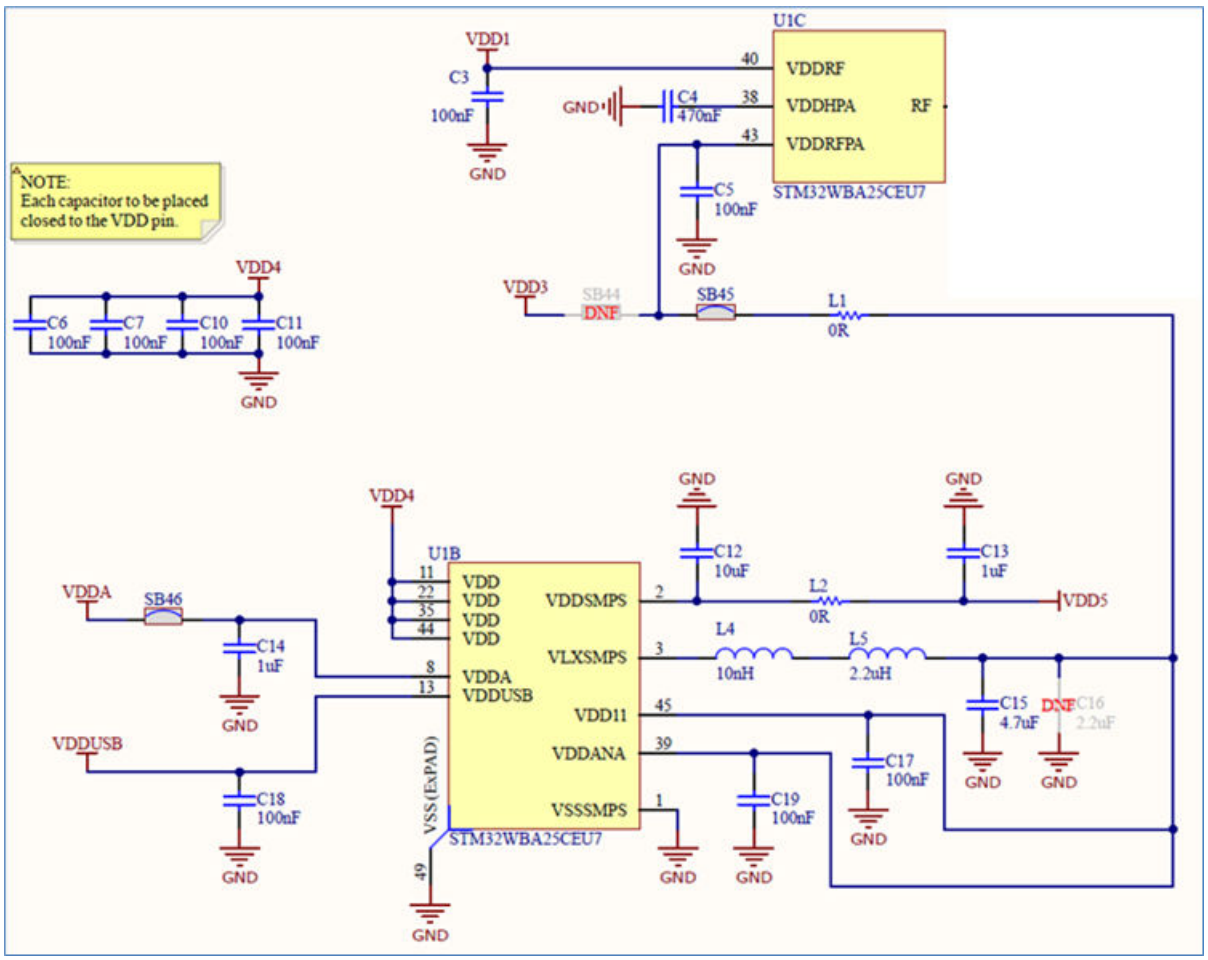
For higher Tx output power, up to 10 dBm, connect VDDRFPA to VDD3 (3.3 V).

Table 10 shows the Tx output power management configurations for NUCLEO-WBA25CE1. The default configuration is shown in bold.

Table 10. **Tx output power management**

TX output power	Solder bridge configuration	Comment
Output power ≤ 3 dBm	**SB45 ON** **SB44 OFF**	**VDDRFPA connected to SMPS (1.2 V)**
Output power > 3 dBm	SB45 OFF SB44 ON	VDDRFPA connected to VDD3 (3V3)

Figure 21. **MCU power schematic**



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8 Board connectors

Figure 22 and Figure 23 show the location of the different connectors available on the NUCLEO-WBA25CE1 Nucleo-64 board.

Figure 22. MIPI10 connector location

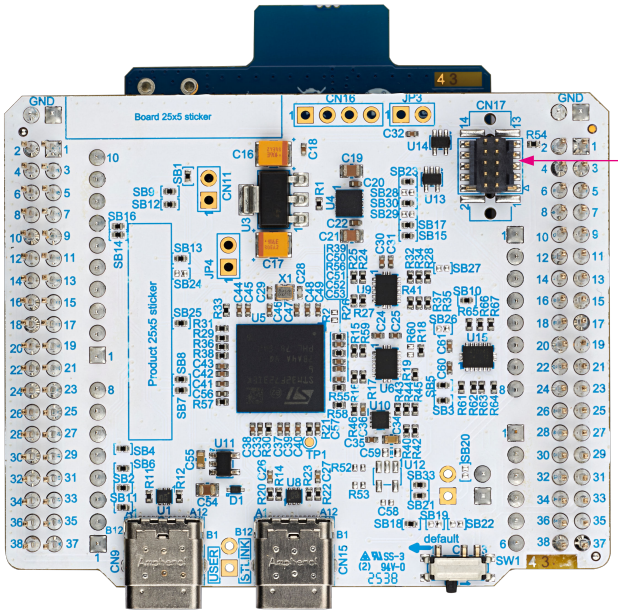
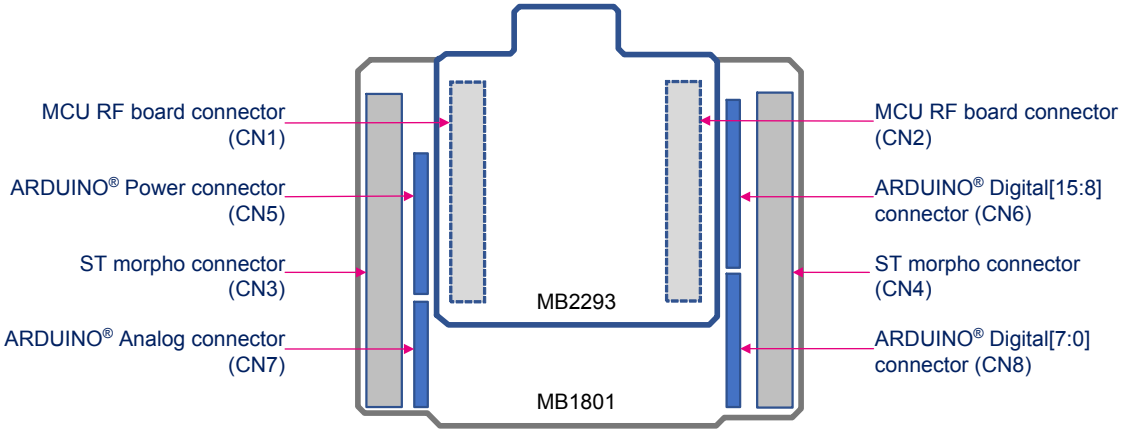


Figure 23. ARDUINO® Uno V3, ST morpho, and MCU RF board connector location



8.1 MIPI10 connector (CN17)

The mezzanine board (MB1801) has a MIPI10-compatible connector (CN17) available for direct debugging. The connector can be replaced or the missing signals can be connected to provide full STDC14 signals. To enable this configuration, set the on-board ST-LINK to reset mode by mounting JP3.

Table 11. Pinout of the MIPI10/STDC14 connector (MB1801, CN17)

STDC14 pin #	MIPI10 pin #	Pin description	Type
1	-	Reserved(1)	-
2	-	Reserved(1)	-
3	1	T_VCC(2)	I
4	2	T_JTMS/T_SWDIO	I/O
5	3	GND	S
6	4	T_JCLK/T_SWCLK	O
7	5	GND	S
8	6	T_JTDO/T_SWO(3)	I
9	7	T_JCLK	O
10	8	T_JTDI/NC(4)	O
11	9	GNDDetect	O
12	10	T_NRST	O
13	-	T_VCP_RX	O
14	-	T_VCP_TX	I

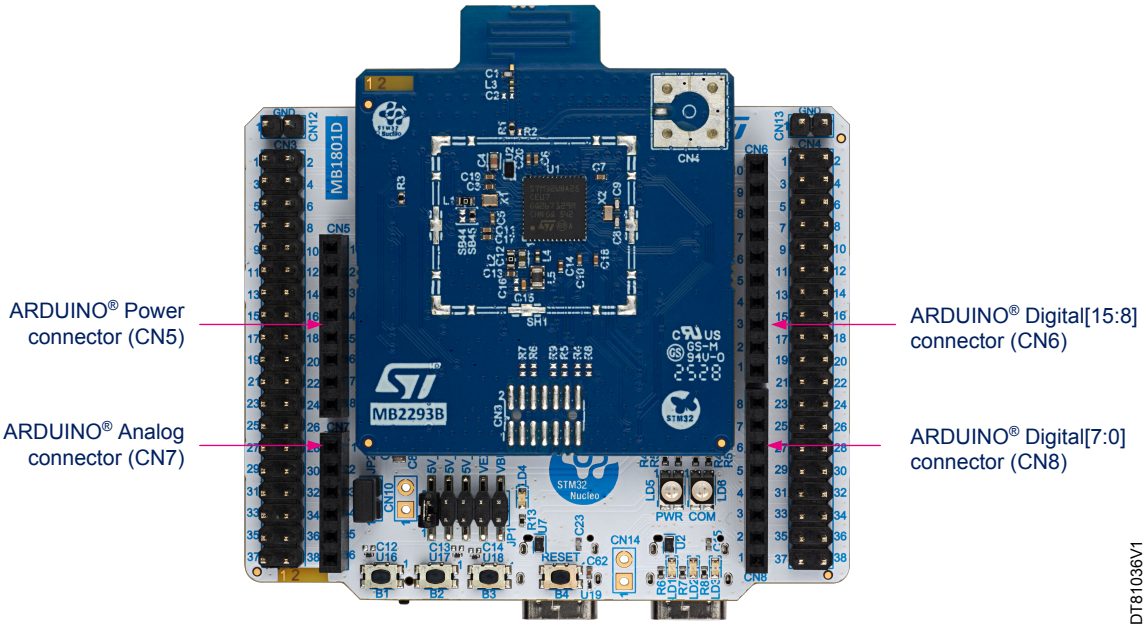
1. *Do not connect to the target.*
2. *Input for STLINK-V3EC.*
3. *SWO is optional, required only for Serial Wire Viewer (SWV).*
4. *NC means it is not required for the SWD connection.*

8.2 ARDUINO® Uno V3 connectors (CN5, CN6, CN7, CN8)

Description

The NUCLEO-WBA25CE1 board contains four ARDUINO® Uno V3 connectors (CN5, CN6, CN7, and CN8). These connectors fit most shields designed for ARDUINO® Uno V3 to provide flexibility in small form-factor applications. Figure 24 shows the location of these connectors on the board.

Figure 24. **ARDUINO® Uno V3 connector location**



Operating voltage

The ARDUINO® Uno V3 connectors support 5 V, 3.3 V, and VDD for I/O compatibility.

Caution: *Do not supply 3.3 or 5 V from the ARDUINO® shield, as doing so can damage the STM32 Nucleo board.*

Note: The STM32 Nucleo board can be supplied by the ARDUINO® Uno V3 connector. A dedicated VIN pin is available for this. For further details on this feature, refer to Section 7.4.1: 7 to 12 V power supply.

ARDUINO® Uno V3 connector pinout

Figure 25 shows the pinout for the ARDUINO® Uno V3 connectors. Table 12 shows the pinout including the correspondence with the STM32 MCU functions.

Figure 25. **pinout**

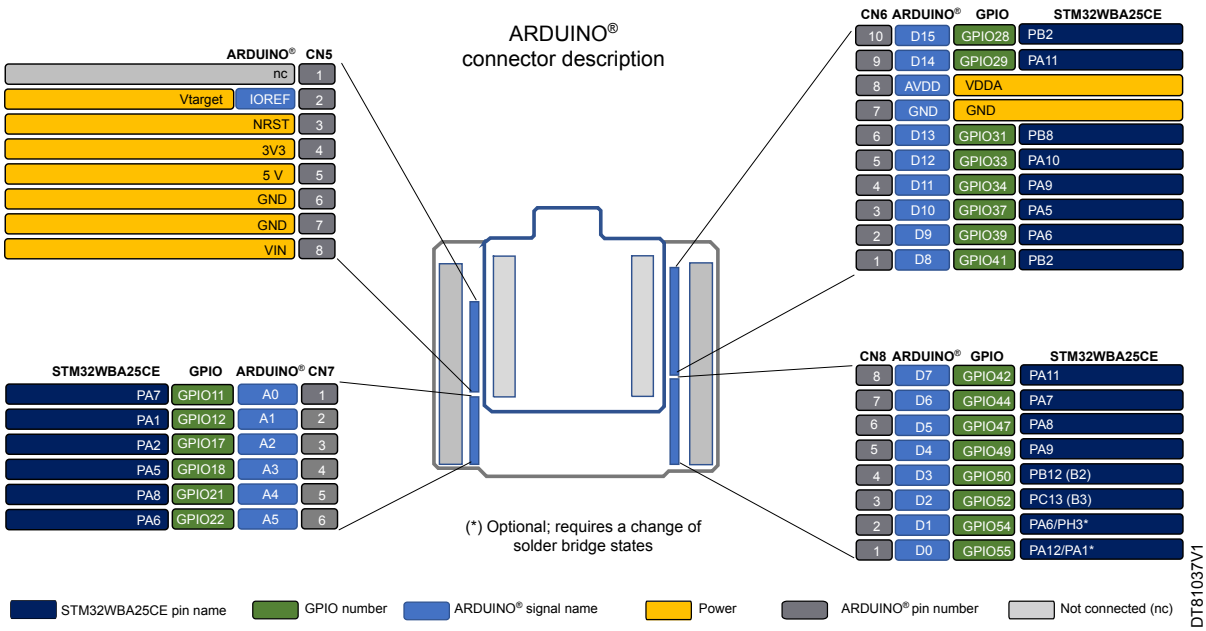


Table 12. **ARDUINO® connector pinout**

Left connectors					Right connectors				
Connector	Pin number	Pin name	MCU pin	Function	Function	MCU pin	Pin name	Pin number	Connector
					I2C1_SCL/I2C3_SCL	PB2	D15	10	CN6
					I2C1_SDA/I2C3_SDA	PA11	D14	9	
					VDDA	-	AVDD	8	
					GND	-	GND	7	
CN5	1	NC	-	NC (reserved for tests)	SPI3_SCK	PA8	D13	6	
	2	3V3 (IOREF)	-	IOREF	SPI3_MISO	PA9	D12	5	
	3	NRST	NRST	NRST	SPI3_MOSI	PA9	D11	4	
	-	3V3	-	3V3	SPI3_NSS/TIM2_CH1	PA5	D10	3	
	5	5V	-	5V	GPIO/TIM2_CH4	PA6	D9	2	
	6	GND	-	GND	GPIO/TIM2_CH4(1)	PB2	D8	1	
	7	GND	-	GND					
	8	VIN	-	External supply input (+12 V max)	GPIO	PA11	D7	8	CN8
					GPIO/TIM2_CH3	PA7	D6	7	
CN7	1	A0	PA7	ADC4_IN2	GPIO/TIM2_CH2	PA8	D5	6	
	2	A1	PA1	ADC4_IN8	GPIO	PA9	D4	5	
	3	A2	PA2	ADC4_IN7	GPIO/TIM2_CH1	PB12	D3	4	
	4	A3	PA5	ADC4_IN4	GPIO	PC13	D2	3	
	5	A4	PA8	ADC4_IN1	USART1_TX(1)	PA6/PH3	D1	2	
	6	A5	PA6	ADC4_IN3	USART1_RX(1)	PA12/PA1	D0	1	

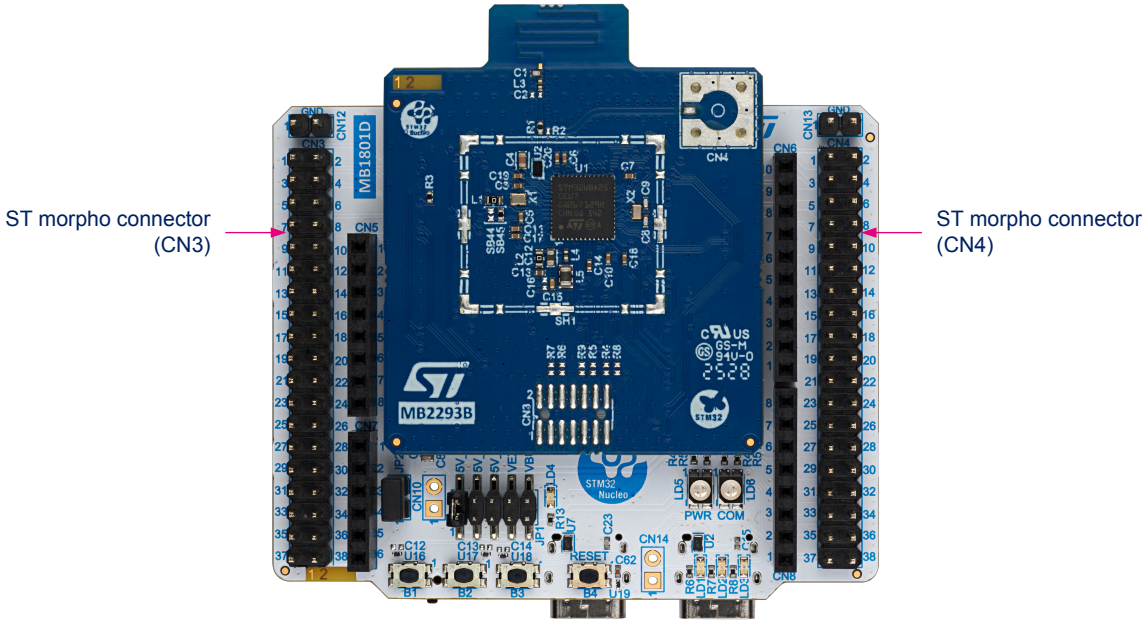
1. *Optional; requires a change of solder bridge states.*

8.3 ST morpho connectors (CN3, CN4)

Description

The ST morpho connectors (CN3 and CN4) are male pin headers accessible on both sides of the board. All signals and power pins of the MCU are available on the ST morpho connectors. An oscilloscope, logic analyzer, or voltmeter can probe these connectors. Figure 26. ST morpho connector location shows the location of the ST morpho connectors on the board.

Figure 26. ST morpho connector location



ST morpho connector pinout

Figure 27 shows the pinout for the ST morpho connectors. Table 13 shows the pinout including the correspondence with the STM32 MCU functions.

Figure 27. ST morpho pinout

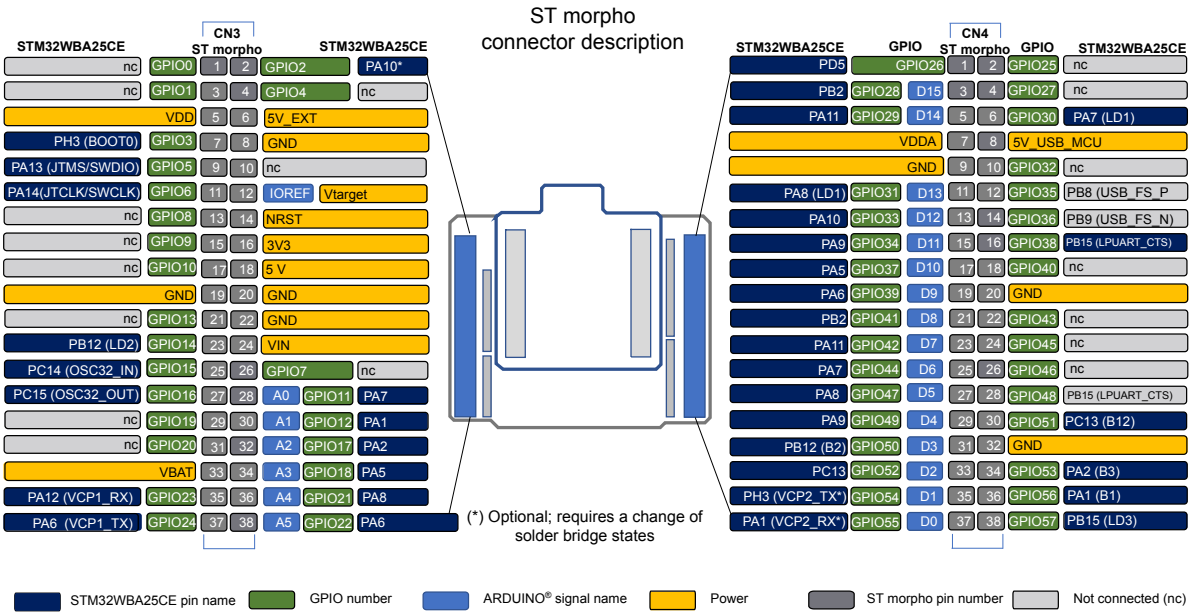


Table 13. **ST morpho pinout**

CN3				CN4			
Pin number	MCU pin name	Pin number	MCU pin name	Pin number	MCU pin name	Pin number	MCU pin name
1	NC	2	PA10	1	NC	2	NC
3	NC	4	NC	3	PB2	4	NC
5	VDD	6	5V_EXT	5	PA11	6	PA7
7	BOOT0	8	GND	7	VDDA	8	5V_USB_MCU
9	PA13	10	NC	9	GND	10	NC
11	PA14	12	IOREF	11	PA8	12	PB8 (USB_FS_P)
13	NC	14	NRST	13	PA10	14	PB9 (USB_FS_N)
15	NC	16	3V3	15	PA9	16	PB15
17	NC	18	5V	17	PA5	18	NC
19	GND	20	GND	19	PA6	20	GND
21	NC	22	GND	21	PB2	22	NC
23	PC4	24	VIN	23	PA11	24	NC
25	PC14	26	NC	25	PA7	26	PB15
27	PC15	28	PA7NC	27	PA8	28	NC
29	NC	30	PA1	29	PA9	30	PC13
31	NC	32	PA2	31	PB12	32	GND
33	VBAT	34	PA5	33	PC13	34	PA2
35	PA12	36	PA8	35	PH3 (VCP2_TX)(1)	36	PA1
37	PA6	38	PA6	37	PA1 (VCP2_RX)(1)	38	PB15

1. *Optional; requires a change of solder bridge states.*

8.4 MCU RF board connectors (CN1, CN2)

The MCU RF board connectors (CN1 and CN2) are accessible on the top side of the board. They are used to plug the MCU RF board (MB2293) into the mezzanine board (MB1801). Refer to Figure 23 to locate these connectors on the board.

Figure 28 shows the pinout for the MCU RF board connectors. Table 14 shows the pinout including the correspondence with the STM32 MCU functions.

Figure 28. connector pinout

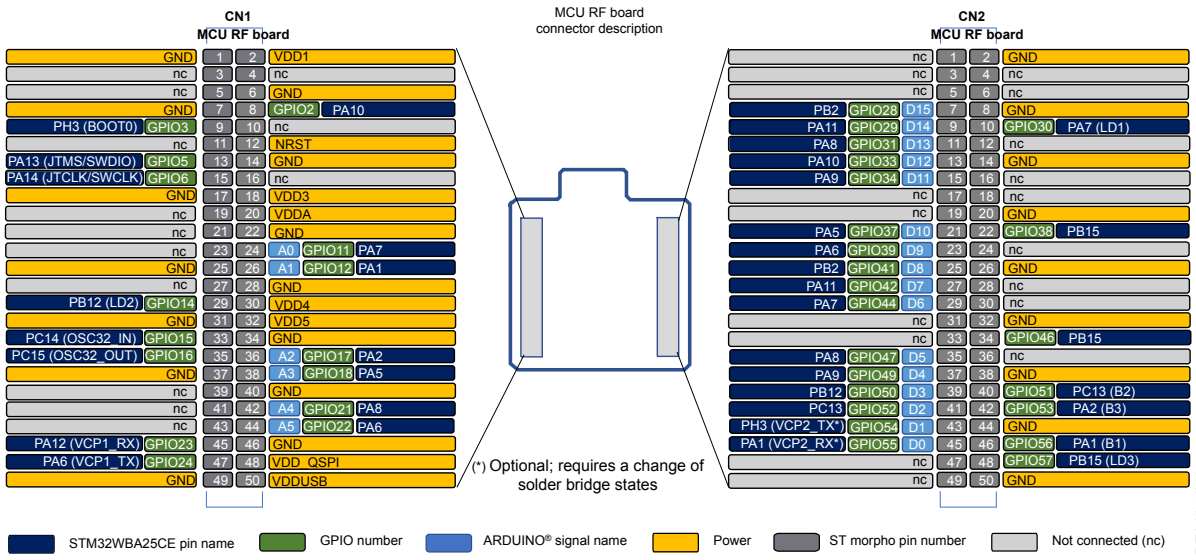


Table 14. ST morpho pinout

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CN1				CN2			
Pin number	MCU pin name	Pin number	MCU pin name	Pin number	MCU pin name	Pin number	MCU pin name
1	GND	2	VDD1	1	NC	2	GND
3	NC	4	NC	3	NC	4	NC
5	NC	6	GND	5	NC	6	NC
7	GND	8	PA10	7	PB2	8	GND
9	BOOT0	10	NC	9	PA11	10	PA7
11	NC	12	NRST	11	PA8	12	NC
13	PA13	14	GND	13	PA10	14	GND
15	PA14	16	NC	15	PA9	16	PB8
17	GND	18	VDD3	17	NC	18	PB9
19	NC	20	VDDA	19	NC	20	GND
21	NC	22	GND	21	PA5	22	PB15
23	NC	24	PA7	23	PA6	24	NC
25	GND	26	PA1	25	PB2	26	GND
27	NC	28	GND	27	PA11	28	NC
29	PB12	30	VDD4	29	PA7	30	NC
31	GND	32	VDD5	31	NC	32	GND
33	PC14	34	GND	33	NC	34	PB15

CN1				CN2			
Pin number	MCU pin name	Pin number	MCU pin name	Pin number	MCU pin name	Pin number	MCU pin name
35	PC15	36	PA2	35	PA8	36	NC
37	GND	38	PA5	37	PA9	38	GND
39	NC	40	GND	39	PB12	40	PC13
41	NC	42	PA8	41	PC13	42	PA2
43	NC	44	PA6	43	PH3(1)	44	GND
45	PA12	46	GND	45	PA1(1)	46	PA1
47	PA6	48	VDD_QSPI	47	NC	48	PB15
49	GND	50	VDDUSB	49	NC	50	GND

1. *Optional; requires a change of solder bridge states*

9 NUCLEO-WBA25CE1 product information

9.1 Product marking

The product and each board composing the product are identified with one or several stickers. The stickers, located on the top or bottom side of each PCB, provide product information:

- Main board featuring the target device: product order code, product identification, serial number, and board reference with revision.

  Single-sticker example:

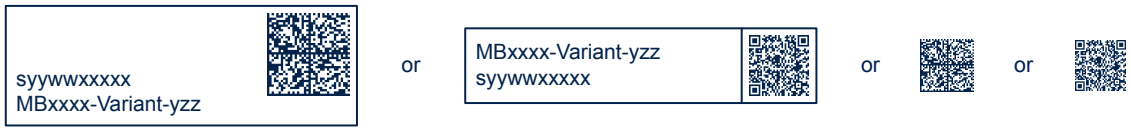
  

  Dual-sticker example:

- Other boards if any: board reference with revision and serial number.

  Examples:

On the main board sticker, the first line provides the product order code, and the second line the product identification.

On all board stickers, the line formatted as *"MBxxxx-Variant-yzz"* shows the board reference *"MBxxxx"*, the mounting variant *"Variant"* when several exist (optional), the PCB revision *"y"*, and the assembly revision *"zz"*, for example B01. The other line shows the board serial number used for traceability.

Products and parts labeled as *"ES"* or *"E"* are not yet qualified or feature devices that are not yet qualified. STMicroelectronics disclaims any responsibility for consequences arising from their use. Under no circumstances will STMicroelectronics be liable for the customer's use of these engineering samples. Before deciding to use these engineering samples for qualification activities, contact STMicroelectronics' quality department.

"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 ordering part number of the evaluation tool 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.

9.2 NUCLEO-WBA25CE1 product history

Table 15. Product history

Order code	Product identification	Product details	Product change description	Product limitations
NUCLEO-WBA25CE1	NUWBA25CE1$CR1	MPU: STM32WBA25CEU7 silicon revision "Z"	Initial revision	Due to incorrect programming of the MCU option bytes (NSBOOTADD1) during production, the bootloader address is not defined correctly. As a result, the device cannot boot using the bootloader, and the bootloader cannot be used to program the device. A workaround is available to correct this issue. Refer to Section 7.7: Boot modes for detailed instructions.
		MCU errata sheet: *STM32WBA2xxx device errata* (ES0673)		
		Boards: • MB1801-USB-D01 (mezzanine board) • MB2293-WBA2-B05 (MCU RF board)		

9.3 Board revision history

Table 16. Board revision history

Board reference	Board variant and revision	Board change description	Board limitations
MB1801 (mezzanine board)	USB-D01	Initial revision	No limitation
MB2293 (MCU RF board)	WBA2-B05	Initial revision	No limitation

10 Compliance statements and conformity declarations

10.1 Federal Communications Commission (FCC) compliance statement

Product identification

- Identification of the product: NUCLEO-WBA25CE1
  FCC ID: YCP-MB229300

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 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 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.

Note: Use only shielded cables.

To satisfy FCC RF exposure requirements, a separation distance of 20 cm 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 collocated or operating in conjunction with any other antenna or transmitter.

Responsible Party - U.S. Contact Information:

Francesco Doddo
STMicroelectronics, Inc.
200 Summit Drive | Suite 405 | Burlington, MA 01803
USA
Telephone: +1 781-472-9634

10.2 Innovation, Science and Economic Development Canada (ISED) compliance statement

Product identification

- Identification of the product: NUCLEO-WBA25CE1
  IC: 8976A-MB229300

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.

This device complies with ISED Canada RF radiation exposure limits set forth for general population for mobile application (uncontrolled exposure).

To satisfy ISED RF exposure requirements, a separation distance of 20 cm 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 collocated or operating in conjunction with any other antenna or transmitter.

This product complies with the ICES-003 standard class B of the ISED regulation.

ISED Canada ICES-003 Compliance Label: CAN ICES (B)/NMB (B).

Note: Use only shielded cables.

Identification du produit

- Identification du produit : NUCLEO-WBA25CE1
  IC : 8976A-MB229300

Déclaration de conformité

Avis : Le présent appareil est conforme aux CNR d'ISDE 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, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Cet appareil est conforme aux limites d'exposition aux rayonnements RF d'ISDE Canada établies pour la population générale pour les applications mobiles (exposition non contrôlée).

Pour satisfaire aux exigences d'ISDE en matière d'exposition aux RF, une distance de séparation de 20 cm ou plus doit être maintenue entre l'antenne de cet appareil et les personnes pendant son fonctionnement. Pour garantir la conformité, il n'est pas recommandé de l'utiliser à une distance plus proche que celle-ci. Cet appareil ne doit pas être placé à proximité ou fonctionner en conjonction avec une autre antenne ou un autre émetteur.

Ce produit est conforme à la norme NMB-003 classe B de la ISDE.

Étiquette de conformité à la NMB-003 d'ISDE Canada : CAN ICES (B) / NMB (B).

Note: Utiliser uniquement des câbles blindés.

10.3 UKCA conformity

Simplified UK declaration of conformity

Hereby, the manufacturer STMicroelectronics, declares that the radio equipment type NUCLEO-WBA25CE1 is in compliance with the UK Radio Equipment Regulations 2017 (UK S.I. 2017 No. 1206) and with the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012 (UK SI 2012 No. 3032).

The full text of the UK declaration of conformity is available at the following internet address: *www.st.com*.

Note: Use only shielded cables.

10.4 CE conformity

10.4.1 Simplified EU declaration of conformity

Hereby, STMicroelectronics declares that the radio equipment type NUCLEO-WBA25CE1 is in compliance with directives 2011/53/EU and 2015/863/EU (RoHS), and 2014/53/EU (RED).

Frequency range used in transmission and maximal radiated power in this range for NUCLEO-WBA25CE1:

- Frequency range: 2400 - 2483.5 MHz (Bluetooth®)
- Maximal power: 8 mW EIRP

The full text of the EU declaration of conformity is available on demand at the following internet address: *www.st.com*.

Note:
- *RoHS: Restriction of hazardous substances*
- *RED: Radio equipment directive*

Note: Use only shielded cables.

10.4.2 Déclaration de conformité UE simplifiée

STMicroelectronics déclare que l'équipement radioélectrique du type NUCLEO-WBA25CE1 est conforme aux directives 2011/53/UE et 2015/863/UE (LdSD), et à la directive 2014/53/UE (RED).

Plage de fréquences utilisée en transmission et puissance rayonnée maximale dans cette plage pour NUCLEO-WBA25CE1 :

- Plage de fréquences : 2400 - 2483,5 MHz (Bluetooth®)
- Puissance maximale : 8 mW PIRE

Le texte complet de la déclaration UE de conformité est disponible sur demande à l'adresse internet suivante : *www.st.com*.

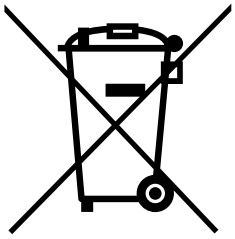
Note:
- *LdSD : directive sur la limitation de l'utilisation des substances dangereuses*
- *RED : directive sur les équipements radio-électriques*

Note: Utiliser uniquement des câbles blindés.

11 Product disposal

Disposal of this product: WEEE (Waste Electrical and Electronic Equipment)

(Applicable in Europe)



This symbol on the product, accessories, or accompanying documents indicates that the product and its electronic accessories must not be disposed of with household waste at the end of their working life.

To prevent possible harm to the environment and human health from uncontrolled waste disposal, separate these items from other types of waste and recycle them responsibly at a designated collection point to promote the sustainable reuse of material resources.

Household users:

Contact the retailer that you purchased the product from or your local authority for details of your nearest designated collection point.

Business users:

Contact your dealer or supplier for further information.

Revision history

Table 17. **Document revision history**

Date	Revision	Changes
24-Feb-2026	1	Initial release.
09-Apr-2026	2	Updated: • Section 7.7: Boot modes • Section 7.12: RF power management • Table 15. Product history

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