STM32H5 Nucleo-64 board (MB1814)

Introduction

The STM32H5 Nucleo-64 board based on the MB1814 reference board (order codes NUCLEO-H503RB and NUCLEO-H533RE) provides an affordable and flexible way for users to try out new concepts and build prototypes, by choosing from the various combinations of performance and power consumption features provided by the STM32H5 series microcontroller.

The ARDUINO® Uno V3 connectivity and the ST morpho headers provide easy expansion of the functionality of the STM32 Nucleo open development platform with a wide choice of specialized shields.

The STM32H5 Nucleo-64 board does not require any separate probe as it integrates the STLINK-V3EC debugger/programmer.

The STM32H5 Nucleo-64 board comes with the STM32 comprehensive free software libraries and examples available with the STM32CubeH5 MCU Package.

Figure 1. NUCLEO-64 top view

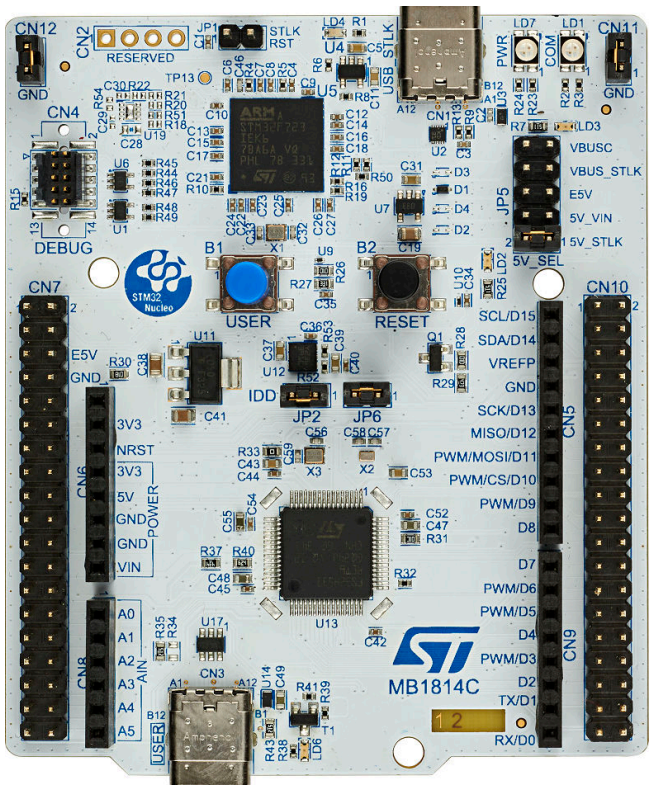
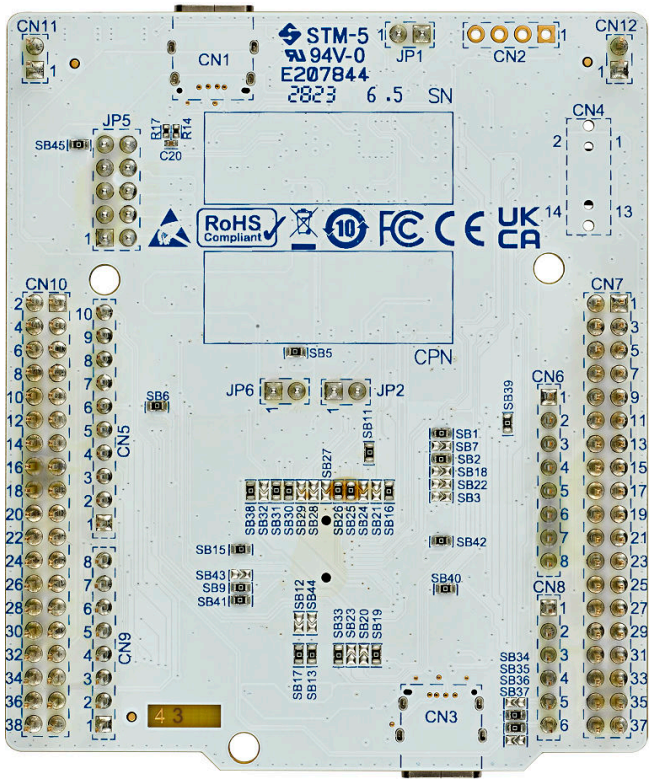


Figure 2. NUCLEO-64 bottom view



Pictures are not contractual.

1 Features

- STM32H5 microcontroller based on the Arm® Cortex®-M33 core in an LQFP64 package
- USB Type-C® (Device mode/Full speed)
- One user LED shared with ARDUINO® Uno V3
- Reset and user push-buttons
- 32.768 kHz LSE crystal oscillator
- 24 MHz HSE crystal oscillator
- Board connectors:
  - ST-LINK USB Type-C®
  - User USB Type-C®
  - MIPI10 for debugging (SWD/JTAG)
  - ARDUINO® Uno V3 expansion connector
  - ST morpho extension pin headers for full access to all STM32 I/Os
- Flexible power-supply options: ST-LINK USB V_{BUS}, user 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 STM32CubeH5 MCU Package
- Support of a wide choice of Integrated Development Environments (IDEs) including IAR Embedded Workbench®, MDK-ARM, and STM32CubeIDE

Note: Arm is a registered trademark of Arm Limited (or its subsidiaries) in the US and/or elsewhere.

2 Ordering information

To order the STM32H5 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 reference	Target STM32	Differentiating feature
NUCLEO-H503RB	MB1814(1)	STM32H503RBT6	-
NUCLEO-H533RE		STM32H533RET6	Cryptography

1. *Subsequently named main board in the rest of the document.*

2.1 Codification

The meaning of the codification is explained in Table 2.

Table 2. Codification explanation

NUCLEO-XXYYZT	Description	Example: NUCLEO-H503RB
XX	MCU series in STM32 32-bit Arm Cortex MCUs	STM32H5 series
YY	MCU product line in the series	STM32H503
Z	STM32 package pin count: • R for 64 pins	64 pins
T	STM32 flash memory size: • B for 128 Kbytes • E for 512 Kbytes	128 Kbytes

3 Development environment

3.1 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.

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*.

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 Quick start

The STM32H5 Nucleo-64 board is a low-cost and easy-to-use development kit, to evaluate and start development quickly with an STM32H5 series microcontroller in an LQFP64 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 STM32H5 Nucleo-64 board and demonstration software, visit the *www.st.com/stm32nucleo* webpage.

5.1 Getting started

Follow the sequence below to configure the STM32H5 Nucleo-64 board and launch the demonstration application (refer to Figure 5 for component location):

1. Check the jumper position on the board (refer to Figure 3).
2. Power the board by connecting the STM32H5 Nucleo-64 board to a PC with a USB cable (USB Type-A to USB Type-C® or USB Type-C® to USB Type-C®) through the USB connector (CN1) of the board.
3. Then, the 5V_PWR green (LD3), the COM (LD1), and the PWR (LD7) LEDs light up, and the user green LED (LD2) blinks.
4. Press the user blue button (B1).
5. Observe how the blinking of the green LED (LD2) changes according to the click on the button (B1).
6. The demonstration software and several software examples that allow exercising Nucleo features are available on the *www.st.com* website.
7. Develop your application using the available examples.

5.2 Default board configuration

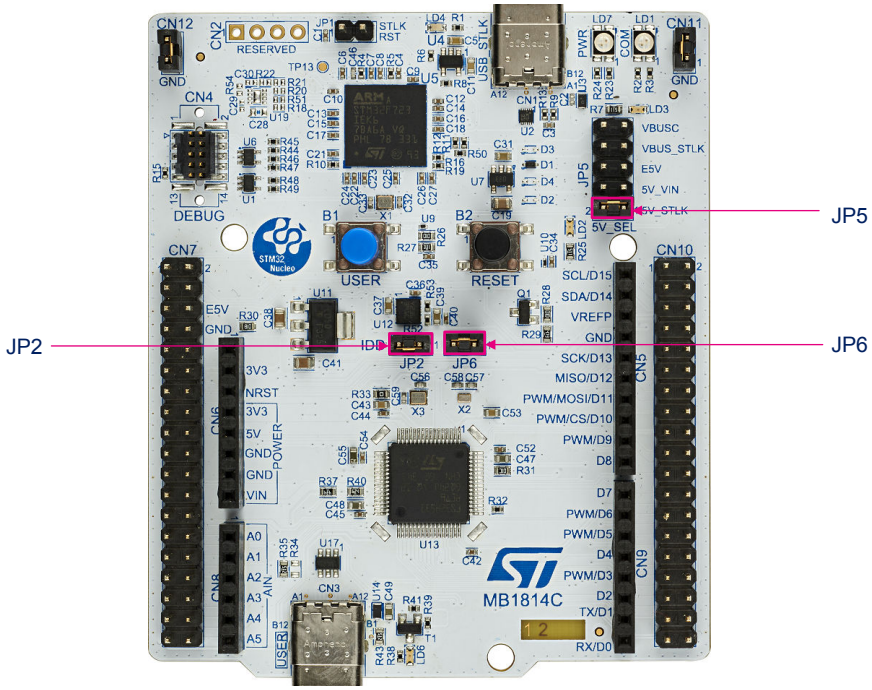
The default jumper configuration and voltage settings are shown in Table 4.

Table 4. Default jumper configuration

Jumper	Definition	Position	Comment
JP1	ST-LINK reset	OFF	STLINK-V3EC MCU is not under Reset mode
JP2	IDD measurement	ON	VDD_MCU current measurement
JP5	5 V power source selection	[1-2]	5 V from STLINK-V3EC (5V_STLK)
JP6	VDD	ON	VDD supplied with 3V3

Two additional jumpers are set on the GND header (CN11 and CN12) as spare jumpers for configuration usage (JP1).

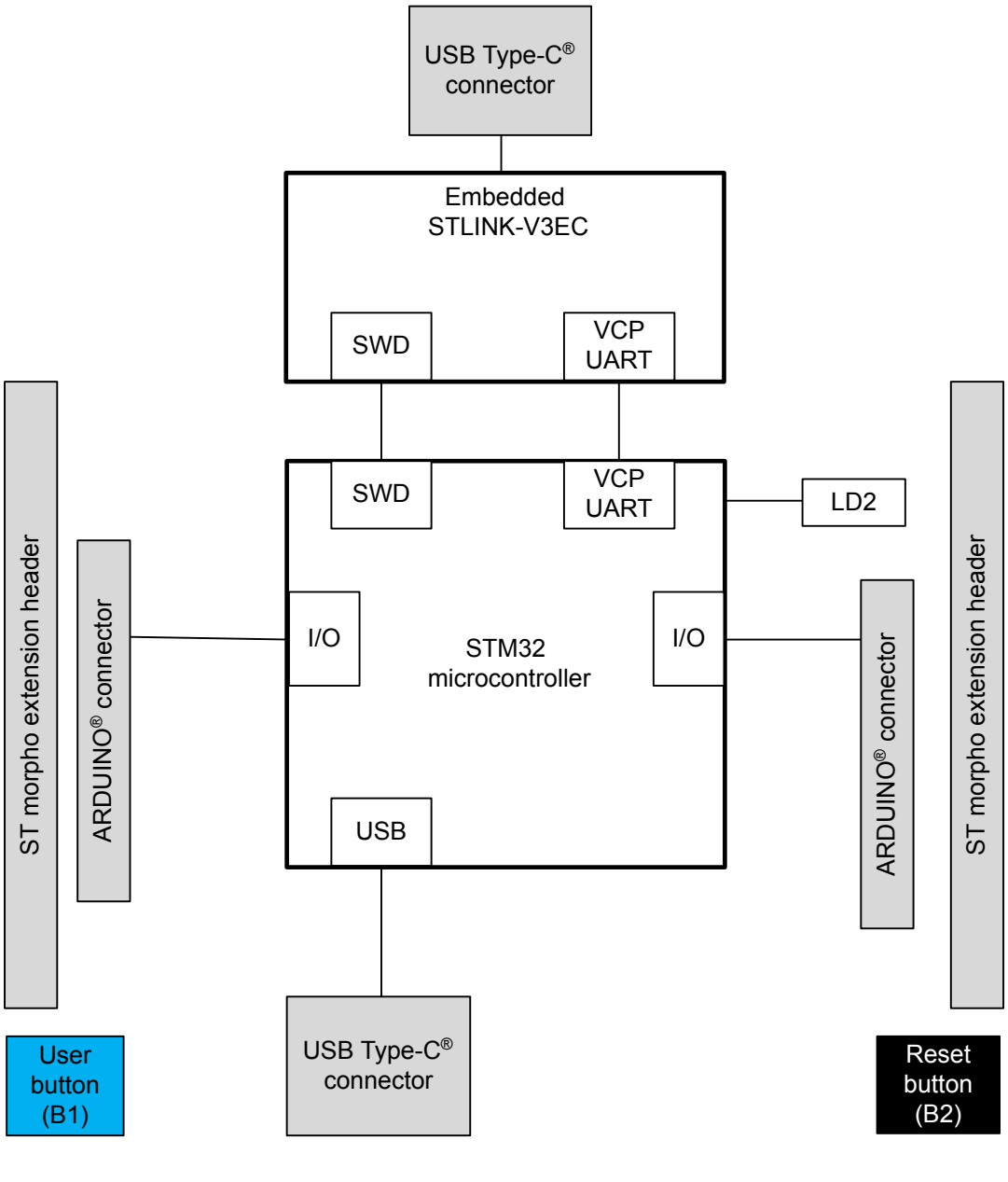
Figure 3. Default jumper settings



6 Hardware layout and configuration

The STM32H5 Nucleo-64 board is designed around an STM32H5 series microcontroller in an LQFP64 package. Figure 4 shows the connections between the STM32H5 and its peripherals (STLINK-V3EC, push-buttons, LEDs, USB, ARDUINO® connectors, and ST morpho headers).
Figure 5 and Figure 6 show the location of these features on the STM32H5 Nucleo-64 board.
The mechanical dimensions of the board are shown in Figure 7.

Figure 4. Hardware block diagram



Note: VCP: Virtual COM port
SWD: Serial Wire Debug

6.1 PCB layout

Figure 5. Top layout

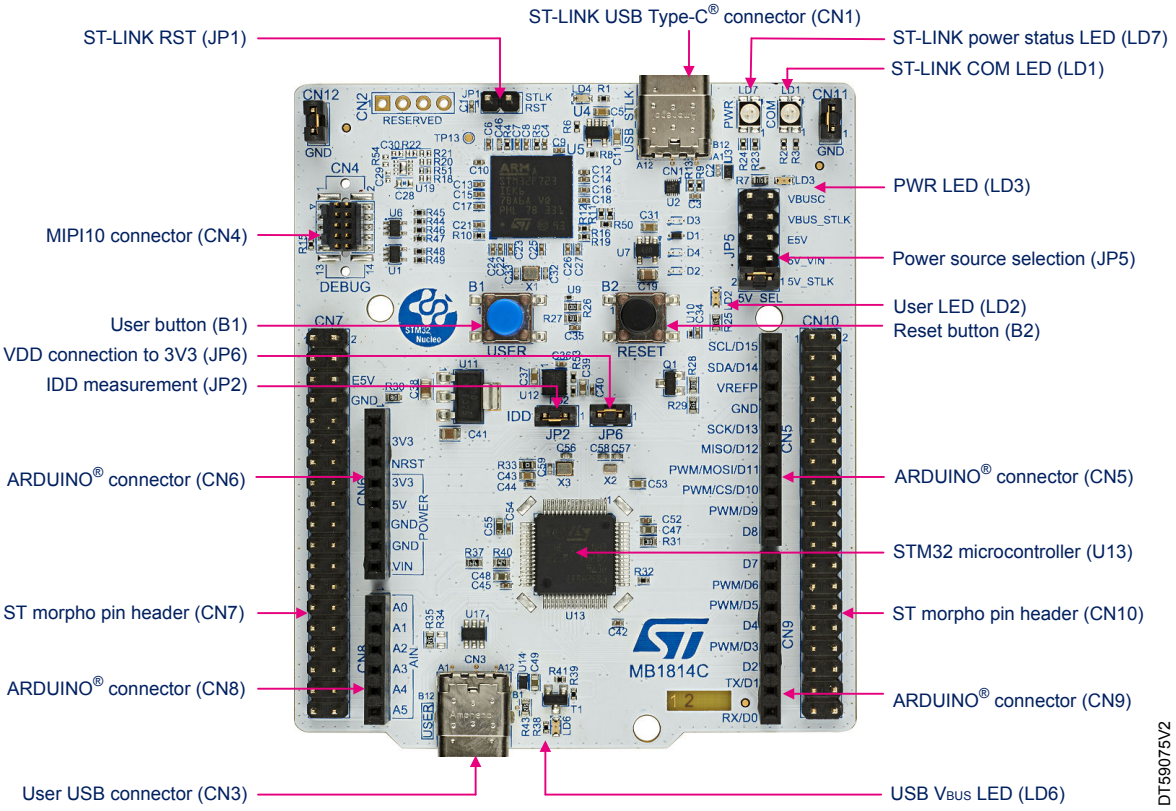
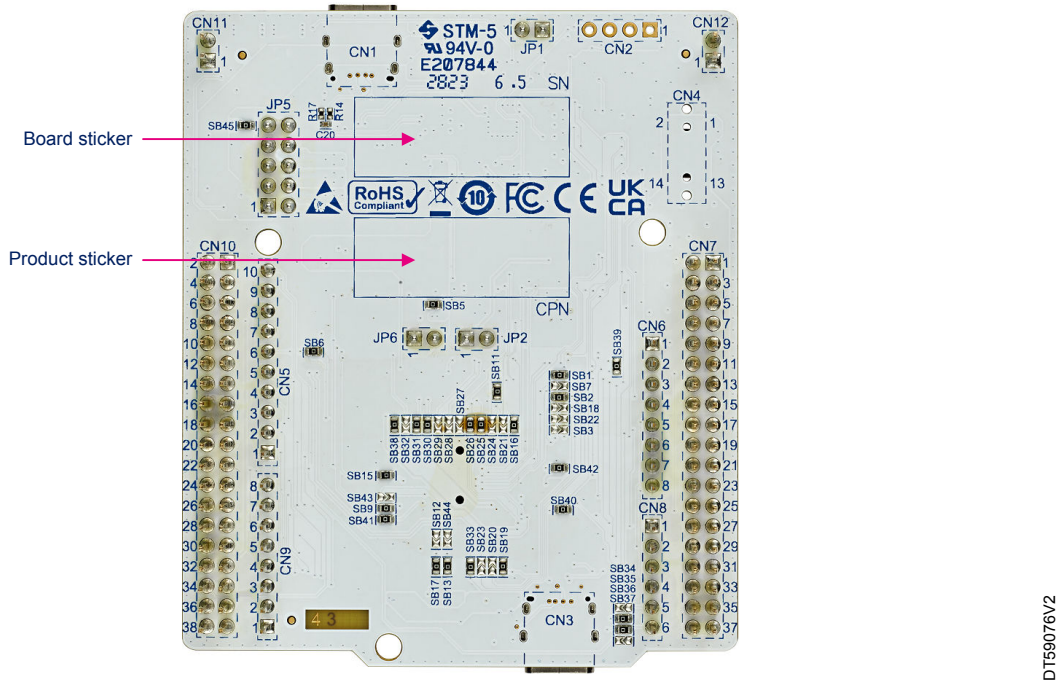
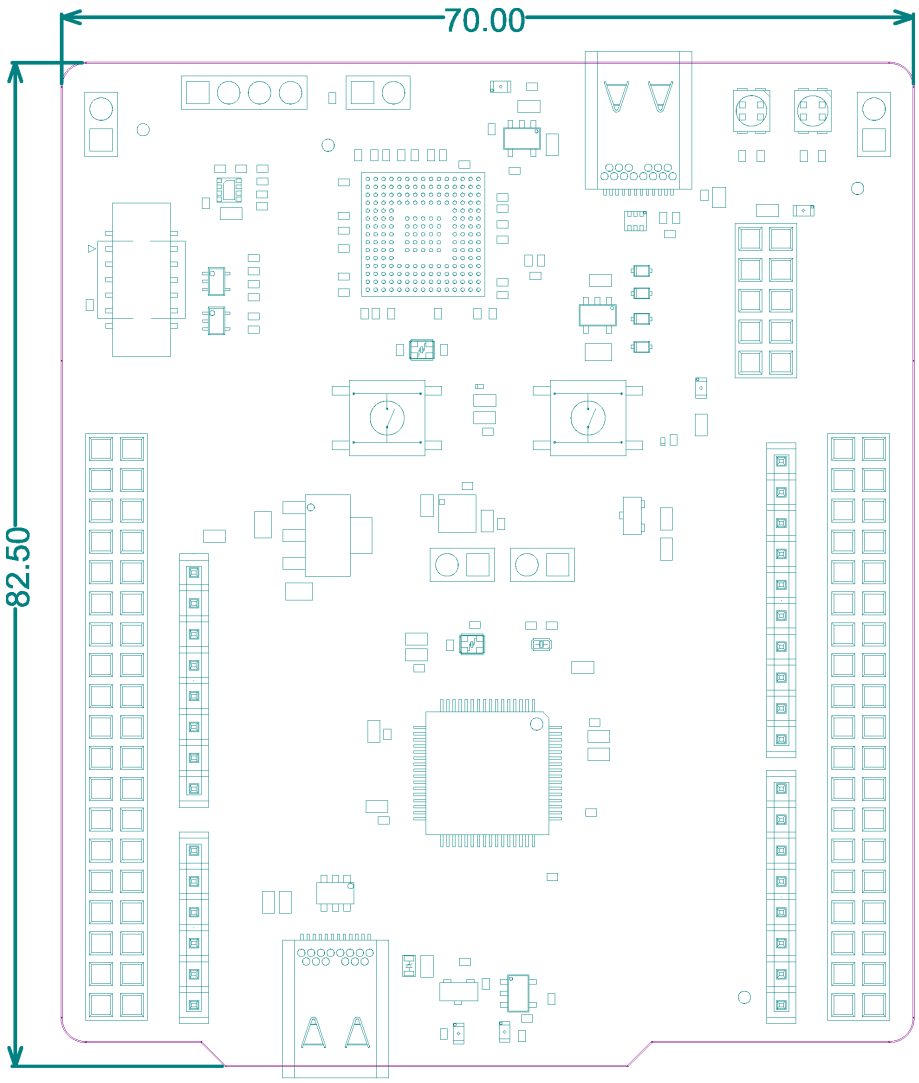


Figure 6. Bottom layout



6.2 Mechanical drawing

Figure 7. **STM32H5 Nucleo-64 board mechanical drawing (in millimeters)**



7 Embedded STLINK-V3EC

The chapter below gives some information about the implementation of STLINK-V3EC.

For more details on STLINK-V3EC such as LED management, drivers, and firmware, refer to the technical note *Overview of ST-LINK derivatives* (TN1235).

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

7.1 Description

There are two different ways to program and debug the onboard STM32 MCU.

- Using the embedded STLINK-V3EC
- Using an external debug tool connected to the CN4 STDC14/MIPI10 connector

Refer to Table 5 to switch between STLINK-V3EC and STDC14 configurations.

The STLINK-V3EC facility for debugging and flashing is integrated into the STM32H5 Nucleo-64 board.

Supported features in STLINK-V3EC:

- 5 V/500 mA power supply capability through the USB Type-C® connector (CN1)
- USB 2.0 high-speed-compatible interface
- JTAG and Serial Wire Debug (SWD) with Serial Wire Viewer (SWV)
- Virtual COM port (VCP)
- 3.3 V application voltage
- COM status LED, which blinks during communication with the PC
- Power status LED giving information about STLINK-V3EC target power
- USB-C® overvoltage protection (U5) with current limitation

Two tricolor LEDs (green, orange, and red) provide information about STLINK-V3EC communication status (LD1) and STLINK-V3EC power status (LD7).

For detailed information about the management of these LEDs, refer to the technical note *Overview of ST-LINK derivatives* (TN1235).

7.1.1 Drivers

The installation of drivers is not mandatory from Windows 10® but allocates an ST-specific name to the ST-LINK COM port in the system device manager.

For detailed information on the ST-LINK USB drivers, refer to the technical note *Overview of ST-LINK derivatives* (TN1235).

7.1.2 STLINK-V3EC firmware upgrade

STLINK-V3EC embeds a firmware upgrade (`stsw-link007`) mechanism through the USB-C® port. As the firmware might evolve during the lifetime of the STLINK-V3EC product (for example to add new functionalities, fix bugs, and support new microcontroller families), it is recommended to keep the STLINK-V3EC firmware up to date before starting to use the STM32H5 Nucleo-64 board. The latest version of this firmware is available from the *www.st.com* website.

For detailed information about firmware upgrades, refer to the technical note *Overview of ST-LINK derivatives* (TN1235).

7.1.3 Using an external debug tool to program and debug the on-board STM32

Before connecting any external debug tool, fit the jumper on JP1 to put STLINK-V3EC in Reset mode. Then connect the external debug tool through the STDC14/MIPI10 debug connector (CN4).

Table 5 explains the JP1 configuration.

Table 5. JP1 configuration

Jumper	Definition	Setting	Comment
JP1	Debugger selection	**OFF**	The embedded STLINK-V3EC is selected (**default configuration**).
		[1-2]	An external debugger connected to the STDC14/MIPI10 connector (CN4) can be used. STLINK-V3EC no longer drives the embedded STM32

When using the external debug connector (CN4), the USB ST-LINK connector (CN1) can be used to supply the STM32H5 Nucleo-64 board (JP5 on [7-8] 'VBUS_STLK'), or you can select another power supply source as described in Section 8: Power supply and power selection.

Figure 8. Connecting an external debug tool to program the on-board STM32

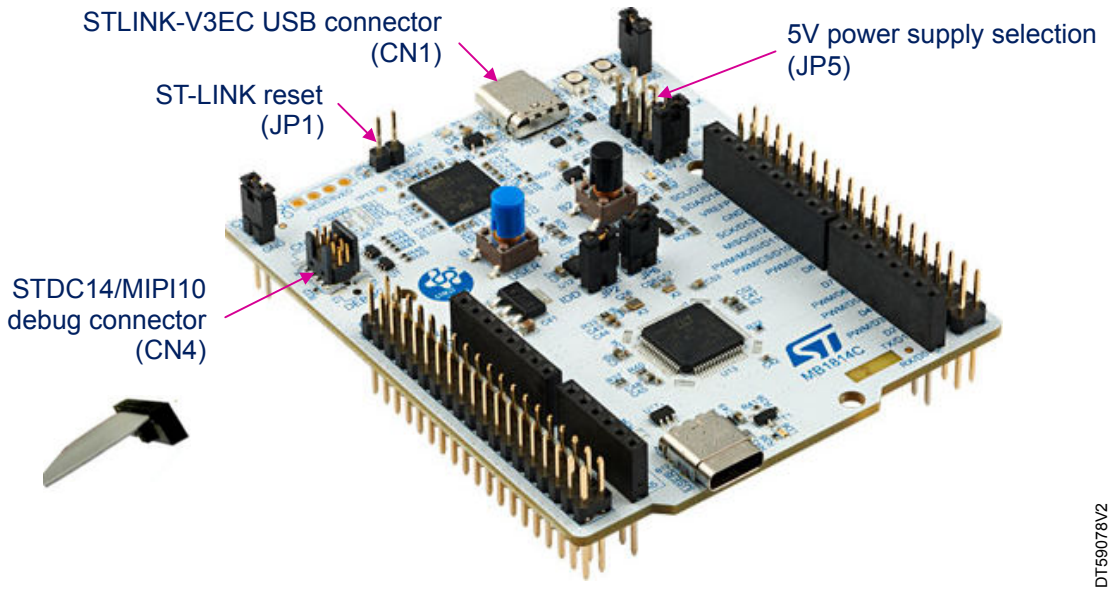
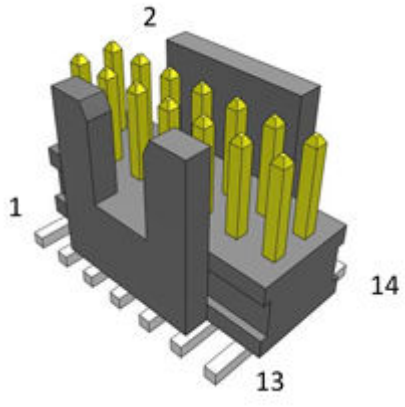


Figure 9. **STDC14/MIPI10 connector (CN4)**



DT52375V1

Table 6 describes the STDC14/MIPI10 connector (CN4) pinning.

Table 6. **STDC14/MIPI10 debug connector (CN4) pinning**

MIPI10 pin	STDC14 pin	CN5	Designation
-	1	NC	Reserved(1)
-	2	NC	Reserved(1)
1	3	VDD	Target VDD(2)
2	4	JTMS/SWDIO	Target SWDIO using SWD protocol or target JTMS using JTAG protocol (SB30 ON)
3	5	GND	Ground
4	6	JTCK/ SWCLK	Target SWCLK using SWD protocol or target JTCK using JTAG protocol (SB29 ON)
5	7	GND	Ground
6	8	JTDO/SWO	Target SWO using SWD protocol or target JTDO using JTAG protocol (SB28 ON)(3)
7	9	NC	T_JRCLK(4)/NC(5)
8	10	JTDI	Not used by SWD protocol. Target JTDI using JTAG protocol (SB41 ON)
9	11	GNDDetect	GND detection for plug indicator(6)
10	12	NRST	Target NRST
-	13	VCP_RX	Target RX used for VCP (with UART supporting bootloader)(7)
-	14	VCP_TX	Target TX used for VCP (with UART supporting bootloader)(2)

1. *Do not connect to the target. It is not connected to the STM32H5 Nucleo-64 board.*
2. *Input for the external debug tools. Output for the STM32H5 Nucleo-64 board*
3. *SWO is optional and required only for Serial Wire Viewer (SWV) trace.*
4. *Optional loopback of JTCK on the target side*
5. *NC means not required for the SWD connection. It is not connected to the STM32H5 Nucleo-64 board.*
6. *Tied to GND. The tool might use this signal for tool detection.*
7. *Output for the external debug tools, *input for the STM32H5 Nucleo-64 board*

8 Power supply and power selection

Six different sources can provide the power supply to the board:

- A host PC connected to CN1 through a USB cable (default configuration)
- An external 7 to 12 V power supply connected to CN6 pin 8 or CN7 pin 24 (VIN)
- An external 5 V power supply connected to CN7 pin 6 (E5V)
- An external 5 V USB charger (VBUS_STLK) connected to CN1
- A host PC connected to CN3 through a USB cable
- An external 3.3 V power supply (3V3) connected to CN6 pin 4 or CN7 pin 16

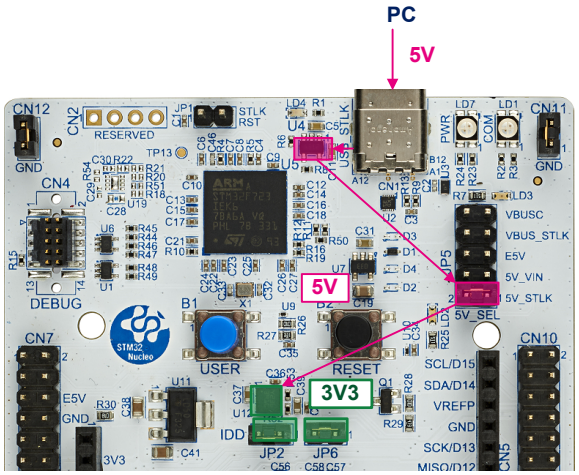
Either the host PC through the USB cable, or an external source VIN (7 to 12 V), E5V (5 V), or +3.3 V power supply pins on CN6 or CN7, provides the power supply. In case VIN, E5V, or +3.3 V is used to power the STM32H5 Nucleo-64 board. This power source must comply with the EN-60950-1: 2006+A11/2009 standard and must be SELV (safety extra low voltage) with limited power capability.

In case the power supply is +3.3 V, STLINK-V3EC is not powered and cannot be used.

Power supply input from STLINK-V3EC USB connector: 5V_STLK (default configuration)

The STM32H5 Nucleo-64 board and shield can be powered from STLINK-V3EC connector CN1 (5 V/500 mA). To select the 5V_STLK power source, JP5 must be fitted on [1-2] '5V_STLK' (refer to Figure 10). **This is the default configuration.**

Figure 10. Power supply input from STLINK-V3EC USB connector with PC (5 V, 500 mA maximum)



DT59079V2

If the USB enumeration succeeds, the ST-LINK power is enabled, by asserting the T_PWR_EN signal from STLINK-V3EC. This pin is connected to a power switch (U4), which powers the board. The power switch also features a current limitation to protect the PC in case of a short circuit onboard. If an overcurrent (more than 500 mA) happens onboard, the POWER status LED (LD7) is lit in red color.

The STLINK-V3EC USB connector (CN1) can power the STM32H5 Nucleo-64 board with its shield.

- If the Host can provide the required power, the power switch (U4) and the green LED (LD3) are turned ON. Thus, the STM32H5 Nucleo-64 board and its shield can consume up to 500 mA current, but not more.
- If the Host is not able to provide the requested current, the enumeration fails. Therefore, the power switch (U4) remains OFF and the MCU part including the extension board is not powered. As a consequence, the green LED (LD3) remains turned OFF. In this case, it is mandatory to use an external power supply.

Warning: *In case the maximum current consumption of the STM32H5 Nucleo-64 board and its shield boards exceed 500 mA, it is mandatory to power the STM32H5 Nucleo-64 board, using an external power supply connected to E5V, VIN, or +3.3 V.*

External power supply input from VIN (7 to 12 V, 800 mA maximum)

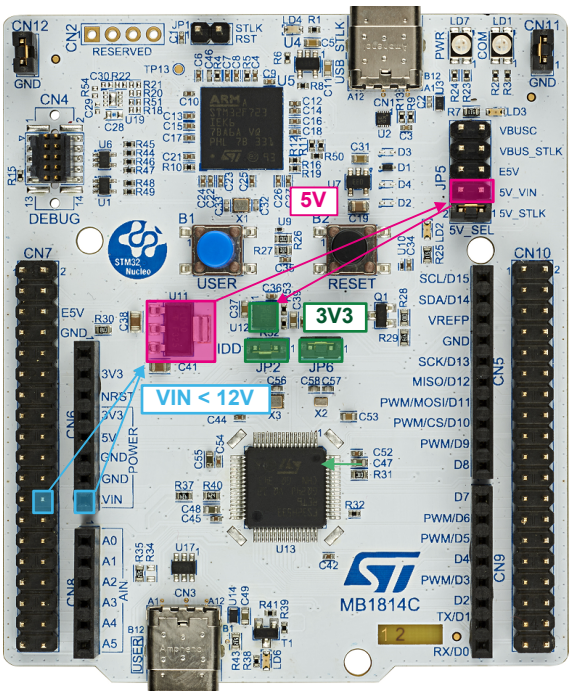
When the STM32H5 Nucleo-64 board is power supplied by VIN, the JP5 jumper must be fitted on [3-4] '5V_VIN' (refer to Figure 11 and Table 7.

The STM32H5 Nucleo-64 board and its shield boards can be powered in three different ways from an external power supply, depending on the used voltage. The three power sources are summarized in Table 7.

Table 7. External power sources VIN (7 to 12 V)

Input power name	Connector pins	Voltage	Maximum current	Limitation
VIN	CN6 pin 8 CN7 pin 24	7 to 12 V	800 mA	From 7 to 12 V only and input current capability is linked to input voltage: • 800 mA input current when VIN = 7 V • 450 mA input current when 7 V < VIN < 9 V • 250 mA input current when 9 V < VIN < 12 V

Figure 11. Power supply input from VIN (7 to 12 V, 800 mA maximum)



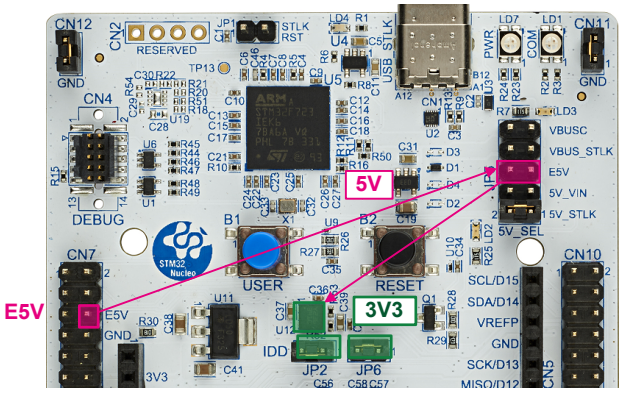
External power supply input E5V (5 V, 500 mA maximum)

When the STM32H5 Nucleo-64 board is power supplied by E5V, the JP5 jumper must be fitted on [5-6] (E5V) (refer to Figure 12. Power supply input from E5V (5 V, 500 mA maximum) and Table 8. Power supply input from E5V (5 V, 500 mA maximum).

Table 8. Power supply input from E5V (5 V, 500 mA maximum)

Input power name	Connector pins	Voltage	Max current
E5V	CN7 pin 6	4.75 to 5.25 V	500 mA

Figure 12. Power supply input from E5V (5 V, 500 mA maximum)



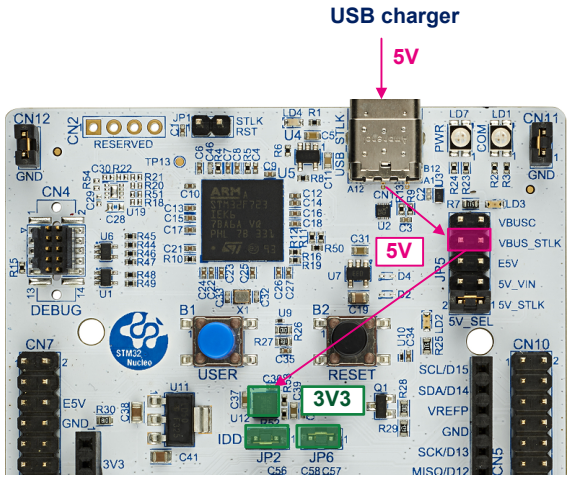
External power supply input from a USB charger (5 V, 500 mA)

When the STM32H5 Nucleo-64 board is power supplied by a USB charger on CN1, the JP5 jumper must be set on [7-8] 'VBUS_STLK' (refer to Figure 13 and Table 9).

Table 9. External power source VBUS_STLK (5 V, 500 mA)

Input power name	Connector pins	Voltage	Max current
VBUS_STLK	CN1	5 V	500 mA

Figure 13. Power supply input from STLINK-V3EC USB connector with a USB charger (5 V, 500 mA maximum)



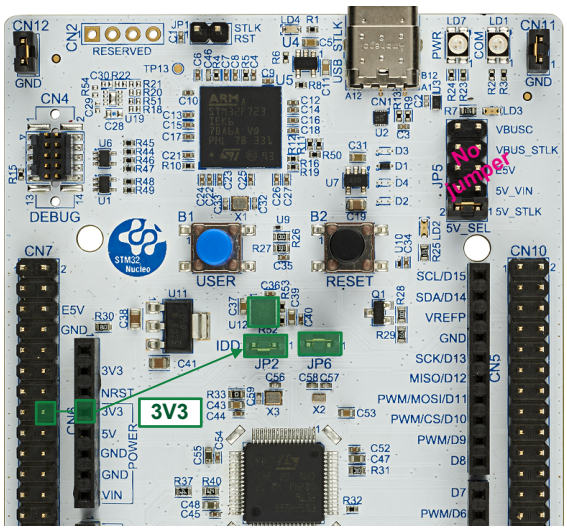
External power supply input 3V3

When the 3.3 V is provided by a shield board, it is interesting to use the 3V3 (CN6 pin4 or CN7 pin16) directly as power input (refer to Figure 14 and Table 10). In this case, the programming and debugging features are not available, since STLINK-V3EC is not powered.

Table 10. External power source 3V3

Input power name	Connector pins	Voltage range	Max current
3V3	CN6 pin 4 CN7 pin 16	3.0 to 3.6 V	1.3 A

Figure 14. Power supply input from external 3V3



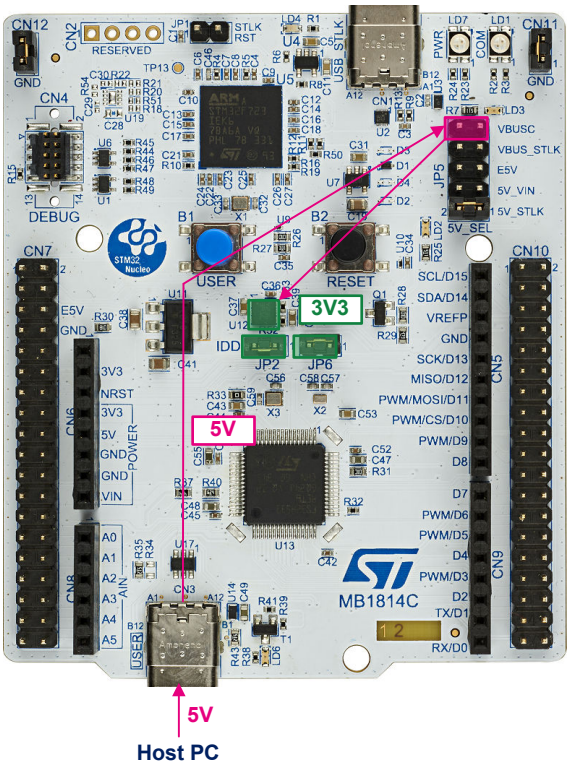
Power supply input from the USB user connector

The STM32H5 Nucleo-64 board and shield can be powered from USB user connector CN3 (5 V/500 mA). To select the VBUSC power source, JP5 must be fitted on [9-10] 'VBUSC' (refer to Figure 15 and Table 11).

Table 11. External power source VBUSC (5 V, 500 mA maximum)

Input power name	Connector pins	Voltage range	Max current
VBUSC	CN3	5 V	500 mA

Figure 15. Power supply input from USB user connector (5 V, 500 mA)



DT59084V2

9 Programming/debugging when the power supply is not from STLINK-V3EC (STLK)

When powered by VIN, E5V, or USB user, it is still possible to use STLINK-V3EC for VCP, programming, or debugging.

In this case, the following power sequence procedure must be respected:

1. Set the JP5 jumper according to the selected 5 V power source.
2. Connect the external power source according to JP5.
3. Power on the external power supply.
4. Check that the 5 V green LED (LD3) is turned ON.
5. Connect the PC to the USB ST-LINK connector (CN1).

If this sequence is not respected, the V_{BUS} from STLINK-V3EC might power the board first, and the following risks might be encountered:

- If the board needs more than 500 mA current, the PC might be damaged or the current limited by the PC. Therefore, the board is not powered correctly.
- 500 mA is requested at enumeration. So, there is a risk that the request is rejected and the enumeration does not succeed, as the PC cannot provide such a current. Consequently, the board is not power supplied and the 5 V green LED (LD3) remains OFF.

10 Clock sources

Three clock sources are available on the STM32H5 Nucleo-64 board:

- LSE: 32.768 kHz crystal for the STM32 embedded RTC
- MCO: 8 MHz clock from STLINK-V3EC for the STM32 microcontroller
- HSE: 24 MHz oscillator for the STM32 microcontroller.

10.1 LSE clock (low-speed external clock) - 32.768 kHz

There are three ways to configure the pins corresponding to the low-speed clock (LSE):

- On-board oscillator (default): X2 crystal. Refer to the application note *Oscillator design guide for STM8AF/AL/S, STM32 MCUs and MPUs* (AN2867). ST recommends using NX1610SE-32.768KHZ-EXS00A-MU01499 (32.768 kHz, 9 pF load capacitance, 20 ppm) from NDK. The configuration must be:
  - SB30 and SB31 ON
  - SB29 and SB32 OFF
- Oscillator from external PC14: From an external oscillator through pin 25 of the ST morpho connector (CN7). The configuration must be:
  - SB29 and SB32 ON
  - SB30 and SB31 OFF
- LSE not used: PC14 and PC15 are used as GPIOs instead of the low-speed clock. The configuration must be:
  - SB29 and SB32 ON
  - SB30 and SB31 OFF

10.2 HSE clock (high-speed external clock) - 24 MHz

There are four ways to configure the pins corresponding to the high-speed external clock (HSE):

- MCO from STLINK-V3EC: The MCO output of ST-LINK is used as an input clock. The MCO clock frequency cannot be changed. It is fixed at 8 MHz and connected to the PH0-OSC_IN pin of the STM32H5 series microcontroller. The configuration must be:
  - SB27 ON
  - SB25 and SB26 OFF
  - SB24 and SB28 OFF
- HSE on-board oscillator from X3 crystal (default): For typical frequencies and its capacitors and resistors, refer to the STM32H5 series microcontroller datasheet and the application note *Oscillator design guide for STM8AF/AL/S, STM32 MCUs and MPUs* (AN2867) for the oscillator design guide. The X3 crystal has the following characteristics: 24 MHz, 6 pF, and 20 ppm. ST recommends using NX2016SA-24MHz-EXS00A-CS10820 manufactured by NDK. The configuration must be:
  - SB25 and SB26 ON
  - SB24 and SB28 OFF
  - SB27 OFF
  - C56 and C59 ON with 5.6 pF capacitors
- Oscillator from external PF0: From an external oscillator through pin 29 of the CN7 connector. The configuration must be:
  - SB28 ON
  - SB24 OFF
  - SB25 and SB26 OFF
  - SB27 OFF.
- HSE not used: PF0 and PF1 are used as GPIOs instead of clocks. The configuration must be:
  - SB24 and SB28 ON
  - SB27 OFF
  - SB25 and SB26 OFF

11 Board functions

11.1 LEDs

STLINK-V3EC COM (LD1) and STLINK-V3EC POWER STATUS (LD7) LEDs

Two tri-color (green, orange, and red) LEDs provide information about the STLINK-V3EC communication status (LD1) and STLINK-V3EC power status (LD7). For detailed information about these two LEDs, refer to the technical note *Overview of ST-LINK derivatives* (TN1235).

User LED (LD2)

This green LED is a user LED connected to STM32H5 I/O PA5 (SB6 ON) corresponding to the ARDUINO® D13. To light LD2, a high logic state '1' must be written into the corresponding GPIO PA5. A transistor is used to drive the LD2.

The user can modify and program the function of the user LED (LD2) to give another status signal that might be relevant to the board.

LD2 consumption does not impact the VDD STM32H5 power measurement, since LD2 is isolated from it.

PWR LED (LD3)

The green LED (LD3) is used as a board power-on indicator and indicates that the STM32H5 Nucleo-64 is powered by a 5 V power source and +5V is available on CN6 pin 5 and CN7 pin 18.

USB power fault (OC, overcurrent) LED (LD4)

LD4 indicates that the board power consumption via the USB ST-LINK exceeds 500 mA. Consequently, the user must power the board using an external power supply.

USB power fault (OC, overcurrent) LED (LD5)

The red LED (LD5) indicates that the power consumption via the USB user exceeds 500 mA when the STM32H5 Nucleo-64 board works as a Host.

USB Type-C® LED (LD6)

The green LED (LD6) indicates the presence of VBUSC (5 V) on the USB user connector (CN3). Refer to the Power supply input from the USB user connector for more details.

Table 12. LED indicators

LED color	Reference	System element monitored
Green/orange/red	LD1	On-board STLINK-V3EC communication status
Green	LD2	Test status
Green	LD3	+5V power indicator
Red	LD4	Overcurrent indicator on USB ST-LINK connector (CN1)
Red	LD5	Overcurrent indicator on USB user connector (CN3)
Green	LD6	VBUS presence indicator on USB user connector (CN3)
Green/orange/red	LD7	On-board STLINK-V3EC power status

11.2 Push-buttons

Two buttons are available on the STM32H5 Nucleo-64 board.

Blue user button (B1)

The user button is connected to the PC13 I/O by default (tamper support: SB16 ON and SB21 OFF). The user button can also be connected to PA0 (wake-up support: SB21 ON and SB16 OFF) of the STM32H5 series microcontroller. When the button is pressed, the logic state is HIGH, otherwise, the logic state is LOW.

Black reset button (B2)

This push-button is connected to NRST and is used to reset the STM32H5 series microcontroller. When the button is pressed, the logic state is LOW, otherwise, the logic state is HIGH.

11.3 Current consumption measurement (IDD)

The JP2 jumper, labeled IDD, is used to measure the STM32H5 microcontroller consumption by removing the jumper and connecting an ammeter:

- JP2 must be ON when STM32H5 is powered with VDD (default).
- If JP2 is OFF, an ammeter must be connected to measure the STM32H5 current. If there is no ammeter, the STM32H5 is not powered.

11.4 Virtual COM port (VCP): USART1/USART2/USART3

Depending on the STM32H5 Nucleo-64 board, it is possible to choose between several USART interfaces (USART1, USART2, or USART3) to connect to STLINK-V3EC.

The selection between USART1, USART2, and USART3 is done by setting the related solder bridges as detailed in Table 13.

Table 13. USART configuration

Product identification	Solder bridge configuration(1)	Feature
NUH503RB$MR1 NUH503RB$MR2	**SB2 and SB3 ON** **SB18 and SB22 OFF** **SB19 and SB33 ON** **SB20 and SB23 OFF**	**USART3 (PA3/PA4) connected to the STLINK-V3EC Virtual COM port.** **(USART3 supports the Bootloader mode).**
		USART1 (PB14/PB15) connected to the ARDUINO® Uno V3 (D1 and D0) and ST morpho connectors (CN10 pins 35 and 37, and CN10 pins 26 and 28).
	SB2 and SB3 OFF SB18 and SB22 ON SB19 and SB33 OFF SB20 and SB23 ON	USART1 (PB14/PB15) connected to STLINK-V3EC Virtual COM port.
		USART3 (PA3/PA4) connected to the ARDUINO® Uno V3 (D1 and D0) and ST morpho connectors (CN10 pins 35 and 37, and CN10 pins 26 and 28).
NUH533RE$MR1	**SB1 and SB2 ON** **SB3, SB7, SB18, and SB22 OFF** **SB19 and SB33 ON** **SB20 and SB23 OFF**	**USART2 (PA2/PA3) connected to the STLINK-V3EC Virtual COM port.** **(USART2 supports the Bootloader mode).**
		USART1 (PB14/PB15) connected to the ARDUINO® Uno V3 (D1 and D0) and ST morpho connectors (CN10 pins 35 and 37, and CN10 pins 26 and 28).
	SB1, SB2, SB3, and SB22 OFF SB7 and SB18 ON SB19 and SB33 OFF SB20 and SB23 ON	USART1 (PB14/PB15) connected to STLINK-V3EC Virtual COM port.
		USART2 (PA2/PA3) connected to the ARDUINO® Uno V3 (D1 and D0) and ST morpho connectors (CN10 pins 35 and 37, and CN10 pins 26 and 28).

1. *The default configuration is in bold.*

11.5 USB full speed (Device mode)

The STM32H5 Nucleo-64 board supports USB full-speed (FS) communication via a USB Type-C® connector. It also supports USB Device mode and can be powered by the USB Type-C® connector (CN3) with a 500 mA current limitation.

The green LED (LD6) is lit when VBUSC (USB_VBUS signal name) is powered by a USB Host connected to CN3.

Warning: *The USB Host configuration is not recommended on the STM32H5 Nucleo-64 board because it is not USB-C® compliant.*

Device mode management.

Solder bridges manage manually the Device mode as described in Table 14.

Table 14. Host and Device configurations

Product identification	Solder bridge configuration(1)(2)	Supported mode
NUH503RB$MR1 NUH503RB$MR2	**SB1 and SB7 OFF** **SB14 OFF** **SB4 and SB8 ON**	**USB Device mode:** • **The STM32H5 Nucleo-64 board works as a Device (5.1 kΩ pull-down resistors exposed on CC1 and CC2 pins of CN3).**
NUH503RB$MR1	SB1 and SB7 ON SB14 ON SB4 and SB8 OFF	USB Host mode: • The STM32H5 Nucleo-64 board works as a Host (56 kΩ pull-up resistors exposed on CC1 and CC2 pins of CN3). This configuration is not recommended because it is not USB-C® compliant

1. *The recommended configuration is in bold.*
2. *The configuration depends on the product identification. Refer to Table 19 and Table 20 for details.*

Figure 16. USB Type-C® connector (CN3) front view

Table 15 describes the USB Type-C® connector (CN3) pinout.

Table 15. USB Type-C® connector (CN3) pinout

STM32 pin	Signal name	Pin name	Pin	Pin	Pin name	Signal name	STM32 pin
-	GND	GND	A1	B12	GND	GND	-
-	-	TX1+	A2	B11	RX1+	-	-
-	-	TX1-	A3	B10	RX1-	-	-
-	USB_VBUS	VBUS	A4	B9	VBUS	USB_VBUS	-
-	5.1 kΩ pull-down resistors exposed	CC1	A5	B8	SBU2	-	-
PA12	USB_FS_P	D+	A6	B7	D-	USB_FS_N	PA11
PA11	USB_FS_N	D-	A7	B6	D+	USB_FS_P	PA12
--	-	SBU1	A8	B5	CC2	5.1 kΩ pull-down resistors exposed	-
-	USB_VBUS	VBUS	A9	B4	VBUS	USB_VBUS	-
-	-	RX2-	A10	B3	TX2-	-	-
-	-	RX2+	A11	B2	TX2+	-	-
-	GND	GND	A12	B1	GND	GND	-

12 Expansion connectors

Six expansion connectors are implemented on the STM32H5 Nucleo-64 board:

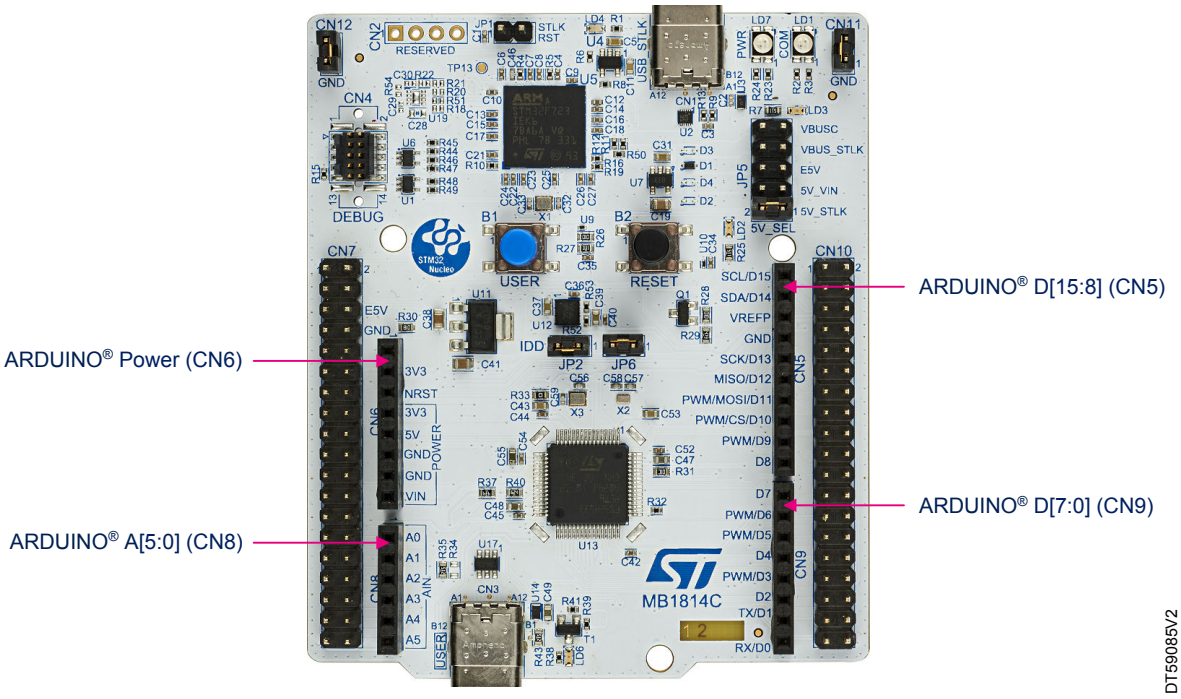
- CN5, CN6, CN8, and CN9 as the ARDUINO® Uno V3 connector
- CN7 and CN10 as the ST morpho expansion connectors.

12.1 ARDUINO® Uno V3

The ARDUINO® connectors CN5, CN6, CN8, and CN9 are female connectors compatible with the ARDUINO® standard. Most shields designed for ARDUINO® can fit the STM32H5 Nucleo-64 board.

The ARDUINO® connectors on the STM32H5 Nucleo-64 board support the ARDUINO® Uno V3.

Figure 17. ARDUINO® connectors



The related pinout for the ARDUINO® connectors is listed in Table 16.

Table 16. ARDUINO® connector pinout

Left connectors				
Connector	**Pin number**	**Pin name**	**MCU pin(1)**	**Function(1)**
CN6 Power	1	-	-	5V_IN test
	2	IOREF	-	3V3 ref
	3	NRST	NRST	Reset
	4	3V3	-	3V3 output
	5	5V	-	5V input/output
	6	GND	-	Ground
	7	GND	-	Ground
	8	VIN	-	Power input
CN8 Analog	1	A0	PA0	ADC1_INP0
	2	A1	PA1	ADC1_INP1
	3	A2	PA2(2)/PB1(3)	ADC1_INP14
	4	A3	PB0	ADC1_INP9
	5	A4	**PC1**/PB7	**ADC1_INP11**/I2C1_SDA
	6	A5	**PC0**/PB6	**ADC1_INP10**/I2C1_SCL

Right connectors				
Function(1)	**MCU pin(1)**	**Pin name**	**Pin number**	**Connector**
I2C1_SCL	PB6	D15	10	CN5 Digital
I2C1_SDA	PB7	D14	9	
AVDD	-	AVDD	8	
Ground	-	GND	7	
SPI1_SCK	PA5	D13	6	
SPI1_MISO	PA6	D12	5	
TIM3_CH2, SPI1_MOSI	PA7	D11	4	
TIM3_CH4, SPI1_NSS	PC9	D10	3	
TIM3_CH1	PC6	D9	2	
IO	PC7	D8	1	
IO	PA8	D7	8	CN9 Digital
TIM2_CH3	PB10	D6	7	
TIM1_CH2	PB4	D5	6	
IO	PB5	D4	5	
TIM2_CH2	PB3	D3	4	
IO	PA10(2)/ PC8(3)	D2	3	
UART1_TX/USART3_TX **UART1_TX**/USART2_TX	**PB14**/PA4(2) **PB14**/P2(3)	D1	2	
UART1_RX/USART3_RX **UART1_RX**/USART2_RX	**PB15**/PA3(2) **PB15**/PA3(3)	D0	1	

1. *The default configuration is in bold.*
2. *Valid for NUH503RB$MR1 and NUH503RB$MR2 only*
3. *Valid for NUH533RE$MR1 only*

12.2 ST morpho connector (CN7 and CN10)

The ST morpho connector consists of two 2.54 mm-pitch male pin headers (CN7 and CN10). They are used to connect the STM32H5 Nucleo-64 board to an extension board or a prototype/wrapping board placed on the top of the ST morpho connector. All signals and power pins of the STM32H5 are available on the ST morpho connector. An oscilloscope, logical analyzer, or voltmeter can also probe this connector.

Figure 18. ST morpho connectors (CN7 and CN10)

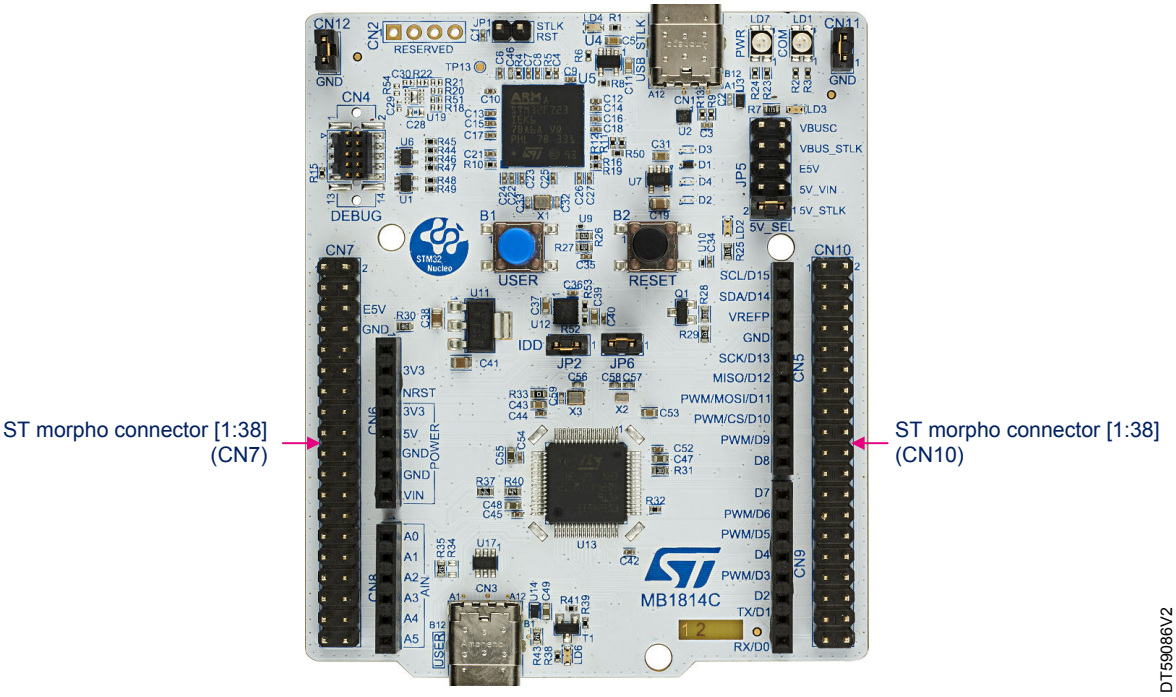


Table 17 shows the pin assignments for the STM32 on the ST morpho connector.

Table 17. Pin assignment of the ST morpho connector

CN7 odd pins		CN7 even pins		CN10 odd pins		CN10 even pins	
1	PC10	2	PC11	1	-	2	PC8(7)/PA9(8)
3	PC12	4	PD2	3	PB6	4	PA12(8)
5	VDD	6	E5V	5	PB7	6	PC5
7	BOOT0(1)	8	GND	7	AVDD(2)	8	VBUS_STLK(3)
9	-	10	-	9	GND	10	-
11	-	12	IOREF	11	PA5	12	PA12(4)
13	PA13(5)	14	NRST	13	PA6	14	PA11(4)
15	PA14(5)	16	3V3	15	PA7	16	PB12
17	PA15	18	5V	17	PC9	18	-
19	GND	20	GND	19	PC6	20	GND
21	-	22	GND	21	PC7	22	PB2
23	PC13	24	VIN	23	PA8	24	PB1(7)
25	PC14	26	-	25	PB10	26	PB15
27	PC15	28	PA0	27	PB4	28	PB14
29	PF0	30	PA1	29	PB5	30	PB13
31	PF1	32	PA2(7)/PB1(8)	31	PB3	32	AGND
33	VBAT	34	PB0	33	PA10(7)/PC8(8)	34	PC4
35	PC2	36	**PC1**(6)/PB7	35	PB14	36	PB8
37	PC3	38	**PC0**(6)/PB6	37	PB15	38	-

1. *BOOT0 is set to '0' by default. It can be set to '1' with a jumper plugged between pin5 (VDD) and pin7 (BOOT0) of CN7.*
2. *AVDD is connected to VDD_MCU by default (R33 fitted).*
3. *VBUS_STLK is the 5 V power from the STLINK-V3EC USB connector. It rises before the 5 V of the STM32H5 Nucleo-64 board.*
4. *PA11 and PA12 are shared with USB signals connected to a USB Type-C® connector. It is not recommended to use them as I/O pins. By default, they are connected to D+/D- signals (SB13 and SB17 ON).*
5. *PA13 and PA14 are shared with SWD signals connected to STLINK-V3EC. It is not recommended to use them as I/O pins. By default, they are used as SWD signals (SB40 and SB41 ON).*
6. *The default configuration is in bold.*
7. *Valid for NUH503RB$MR1 and NUH503RB$MR2 only*
8. *Valid for NUH533RE$MR1 only*

13 STM32H5 Nucleo-64 I/O assignment

Table 18. STM32H5 Nucleo-64 I/O assignment

Pin	Pin name	Signal or label	Main feature/optional feature/SB[1][2]
1	VBAT	VBAT	Power supply for RTC when VDD is not present
2	PC13	PC13	**USER button**/IO
3	PC14-OSC32_IN	OSC32_IN/PC14	**LSE CLK**/IO
4	PC15-OSC32_OUT	OSC32_OUT/PC15	**LSE LCK**/IO
5	PF0-OSC_IN	OSC_IN/PF0	**HSE CLK/I**
6	PF1-OSC_OUT	OSC_OUT/PF1	**HSE LCK/O**
7	NRST	T_NRST	STM32H5 RESET
8	PC0	PC0	ARD_A5–ADC1_INP10
9	PC1	PC1	ARD_A4–ADC1_INP11
10	PC2	PC2	IO
11	PC3	PC3	IO
12	VSSA/VREF-	AGND	AGND
13	VDDA/VREF+	VREFP	External analog power supply for ADCs and DACs/Reference voltage supply for ADCs and DACs
14	PA0	PA0	**ARD_A0–ADC1_INP0/User** button
15	PA1	PA1	ARD_A1–ADC1_INP1
16	PA2	PA2[4]/USART2_TX[5]	ARD_A2–ADC1_INP14[4]/**STLINK_TX (T_VCP_TX)**[5]
17	PA3	USART3_RX[4]/ USART2_RX[5]	ARD_D0/**T_VCP_RX**
18	VSS	GND	PWR GND
19	VDD	VDD	VDD voltage supply
20	PA4	USART3_TX	ARD_D1/**STLINK_TX (T_VCP_TX)**
21	PA5	PA5	ARD_D13–SPI1_SCK
22	PA6	PA6	ARD_D12–SPI1_MISO
23	PA7	PA7	ARD_D11–SPI1_MOSI/TIM3_CH2
24	PC4	PC4	IO[4]/VBUS_DET[5]
25	PC5	PC5	IO
26	PB0	PB0	ARD_A3–ADC1_INP9
27	PB1	PB1	IO
28	PB2	PB2	IO
29	PB10	PB10	ARD_D6–TIM2_CH3
30	VCAP1	VCAP	VCORE supply voltage
31	VSS	GND	PWR GND
32	VDD	VDD	VDD voltage supply
33	PB12	PB12	IO
34	PB13	PB13	IO
35	PB14	USART1_TX	**ARD_D1**/STLINK_TX (T_VCP_TX)[3]
36	PB15	USART1_RX	**ARD_D0**/STLINK_RX (T_VCP_RX)[3]
37	PC6	PC6	ARD_D9–TIM3_CH1

Pin	Pin name	Signal or label	Main feature/optional feature/SB[1][2]
38	PC7	PC7	ARD_D8 - IO
39	PC8	PC8	IO[4]/ARD_D2[5]
40	PC9	PC9	ARD_D10–SPIx_CS/TIM3_CH4
41	PA8	PA8	ARD_D7 - IO
42	PA9	PA9	USB_VBUS[4]/IO[5]
43	PA10	PA10	ARD_D2 - IO
44	PA11	PA11	**USB_FS_N**/IO
45	PA12	PA12	**USB_FS_P**/IO
46	PA13	T_SWDIO	T_SWDIO
47	VSS	GND	PWR GND
48	VDD	VDD	VDD voltage supply
49	PA14	T_SWCLK	T_SWCLK
50	PA15	T_JTDI	T_JTDI
51	PC10	PC10	USB_FS_PWR_EN[4]/USB_Disconnect[5]
52	PC11	PC11	IO
53	PC12	PC12	IO
54	PD2	PD2	USB_FS_OVCR
55	PB3	PB3	ARD_D3 - TIM2_CH2/T_SWO
56	PB4	PB4	ARD_D5–TIM3_CH1
57	PB5	PB5	ARD_D4–IO
58	PB6	PB6	**ARD_D15–I2C1_SCL/I3C1_SCL**
59	PB7	PB7	**ARD_D14–I2C1_SDA/I3C1_SDA**
60	BOOT0	BOOT0	BOOT0
61	PB8	PB8	IO
62	VCAP3	VCAP	VCORE supply voltage
63	VSS	GND	PWR GND
64	VDD	VDD	VDD voltage supply

1. *The default configuration is in bold.*
2. *All Nucleo-64 products are delivered with solder bridges configured according to the target MCU supported.*
3. *For pins 35 and 36, refer to Section 11.4: Virtual COM port (VCP): USART1/USART2/USART3.*
4. *Valid for NUH503RB$MR1 and NUH503RB$MR2 only*
5. *Valid for NUH533RE$MR1 only*

14 STM32H5 Nucleo-64 product information

14.1 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:

  MBxxxx-Variant-yzz
  syywwxxxxx

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-yzz"*, 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.

14.2 STM32H5 Nucleo-64 product history

Table 19. Product history

Order code	Product identification	Product details	Product change description	Product limitations
NUCLEO-H503RB	NUH503RB$MR1	MCU: • STM32H503RBT6 silicon revision "Z"	Initial revision	Limitations linked to MCU silicon revision "Z" (refer to *STM32H503CB/EB/KB/RB device errata* (ES0561)
		MCU errata sheet: • *STM32H503CB/EB/KB/RB device errata* (ES0561)		
		Board: • MB1814-H503RB-B01 (main board)		
	NUH503RB$MR2	MCU: • STM32H503RBT6 silicon revision "Y"	• USB Host feature not connected • MCU silicon revision updated	No limitation
		MCU errata sheet: • *STM32H503CB/EB/KB/RB device errata* (ES0561)		
		Board: • MB1814-H503RB-B02 (main board)		
NUCLEO-H533RE	NUH533RE$MR1	MCU: • STM32H533RET6 silicon revision "Z"	Initial revision	No limitation
		MCU errata sheet: • *STM32H523xx and STM32H533xx device errata* (ES0621)		
		Board: • MB1814-H533RE-C02 (main board)		

14.3 Board revision history

Table 20. **Board revision history**

Board reference	Board variant and revision	Board change description	Board limitations
MB1814 (main board)	H503RB-B01	Initial revision	• Host mode is not recommended on the user's USB connector (CN3) as the hardware implementation is not USB-C® compliant. • Use only the Device mode. For details on the hardware configuration, refer to Table 14.
	H503RB-B02	Bill of material changes: • USB Host mode not connected: R36, R37, R40, R34, R42, U15, LD5, SB1, SB7, and SB14 OFF • USB Device mode connected by default: R35, R43, SB4, and SB8 ON • STLINK-V3EC: D2, D3, and D4 OFF	No limitation
	H533RE-C02	Initial revision	No limitation

15 Federal Communications Commission (FCC) and ISED Canada Compliance Statements

15.1 FCC Compliance Statement

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.

Note: Use only shielded cables.

Responsible party (in the USA)

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

15.2 ISED Compliance Statement

ISED Canada ICES-003 Compliance Label: *CAN ICES-3 (B) / NMB-3 (B)*.
Étiquette de conformité à la NMB-003 d'ISDE Canada: *CAN ICES-3 (B) / NMB-3 (B)*.

Revision history

Table 21. **Document revision history**

Date	Revision	Changes
24-Feb-2023	1	Initial release.
27-Jul-2023	2	Added a second product identification and board revision to *Table 14*, *Table 19*, and *Table 20*.
20-Feb-2024	3	Updated document with new NUCLEO-H533RE order code, including Table 16 to Table 20.

Contents

List of tables

List of figures