STM32N6 Nucleo-144 board (MB1940)

Introduction

The STM32N6 Nucleo-144 board based on the MB1940 reference board (order code NUCLEO-N657X0-Q) 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 STM32N6 microcontroller.

The STM32 Nucleo-144 board offers easy means to expand the functionality of the Nucleo open development platform with a wide choice of specialized shields through several expansion connectors:

- ARDUINO® Uno V3 connector
- ST morpho headers providing access to the microcontroller's I/O pins

The STM32N6 Nucleo-144 board does not require any separate probe as it integrates the STLINK-V3EC debugger/ programmer.

The STM32N6 Nucleo-144 board comes with the STM32 comprehensive free software libraries and examples available with the STM32CubeN6 MCU Package.

Figure 1. NUCLEO-N657X0-Q top view

Figure 2. NUCLEO-N657X0-Q bottom view

Pictures are not contractual.

1 Features

- STM32N657X0H3Q Arm® Cortex®-M55-based microcontroller featuring ST Neural-ART Accelerator, H264 encoder, Neo-Chrom 2.5D GPU, and 4.2 Mbytes of contiguous SRAM, in a VFBGA264 package
- USB Type-C® DRP with USB 2.0 high-speed interface, dual-role-power (DRP)
- 512-Mbit Octo-SPI flash memory
- Three user LEDs
- Reset and user push-buttons
- 48 MHz and 32.768 kHz crystal oscillators
- Board connectors:
  - USB Type-C®
  - Ethernet RJ45
  - Camera module
  - MIPI20 compatible connector with trace signals
  - ARDUINO® Uno V3 connector
  - ST morpho extension pin headers for full access to most of 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 STM32CubeN6 MCU Package
- Support of a wide choice of Integrated Development Environments (IDEs) including IAR Embedded Workbench®, MDK-ARM, and STM32CubeIDE
- Handled by STM32CubeMonitor-UCPD (STM32CubeMonUCPD) software tool

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

2 Ordering information

To order the STM32N6 Nucleo-144 board, refer to Table 1. Additional information is available from the datasheet and reference manual of the target STM32.

Table 1. List of available products

Order code	Board reference	Target STM32
NUCLEO-N657X0-Q	MB1940(1)	STM32N657X0H3Q

1. *Subsequently called main board in the rest of the documentation.*

2.1 Codification

The meaning of the codification is explained in Table 2.

Table 2. Codification explanation

NUCLEO-XXYYZT-Q	Description	Example: NUCLEO-N657X0-Q
XX	MCU series in STM32 32-bit Arm Cortex MCUs	STM32N6 series
YY	MCU product line in the series	STM32N6x7
Z	STM32 package pin count: • X for 264 pins	264 pins
T	STM32 flash memory size: • 0 for 0-1 Kbyte	0 Kbyte
-Q	STM32 has an internal SMPS function	Internal SMPS

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*.

3.4 CAD resources

All board design resources, including schematics, CAD databases, manufacturing files, and the bill of materials, are available from the NUCLEO-N657X0-Q 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 such as 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 hurting yourself
- This board contains static-sensitive devices. To avoid damaging it, handle the board in an ESD-proof environment.
- While powered, do not touch the electric connections on the board with your fingers or anything conductive. The board operates at 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 the board close to water or at a high humidity level.
- Do not operate the board if dirty or dusty.

6 Quick start

The STM32N6 Nucleo-144 board is a low-cost and easy-to-use development kit, to evaluate quickly and start development with an STM32N657X0H3Q microcontroller in a VFBGA264 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 STM32N6 Nucleo-144 board and demonstration software, visit the *www.st.com/stm32nucleo* webpage.

6.1 Getting started

Follow the sequence below to configure the STM32N6 Nucleo-144 board and launch the demonstration application (refer to Figure 5 for component location):

1. Check the jumper position on the board (refer to Section 6.2 for default board configuration).
2. To identify the device interfaces from the host PC, before connecting the board, install the STLINK-V3EC USB driver available on the *www.st.com* website.
3. Connect the STM32N6 Nucleo-144 board to a PC with a USB cable (USB Type-A or USB Type-C® to USB Type-C®) through the USB connector (CN10) to power the board.
4. The 5V_PWR (LD1), COM (LD9), and PWR status (LD4) LEDs light up and the red LED (LD5) blinks.
5. Press the blue user button (B1). The LED (LD5) changes blinking at three speeds.
6. Download the demonstration software and several software examples that help to use the STM32 Nucleo features. These are available on the *www.st.com* website.
7. Develop your application using the available examples.

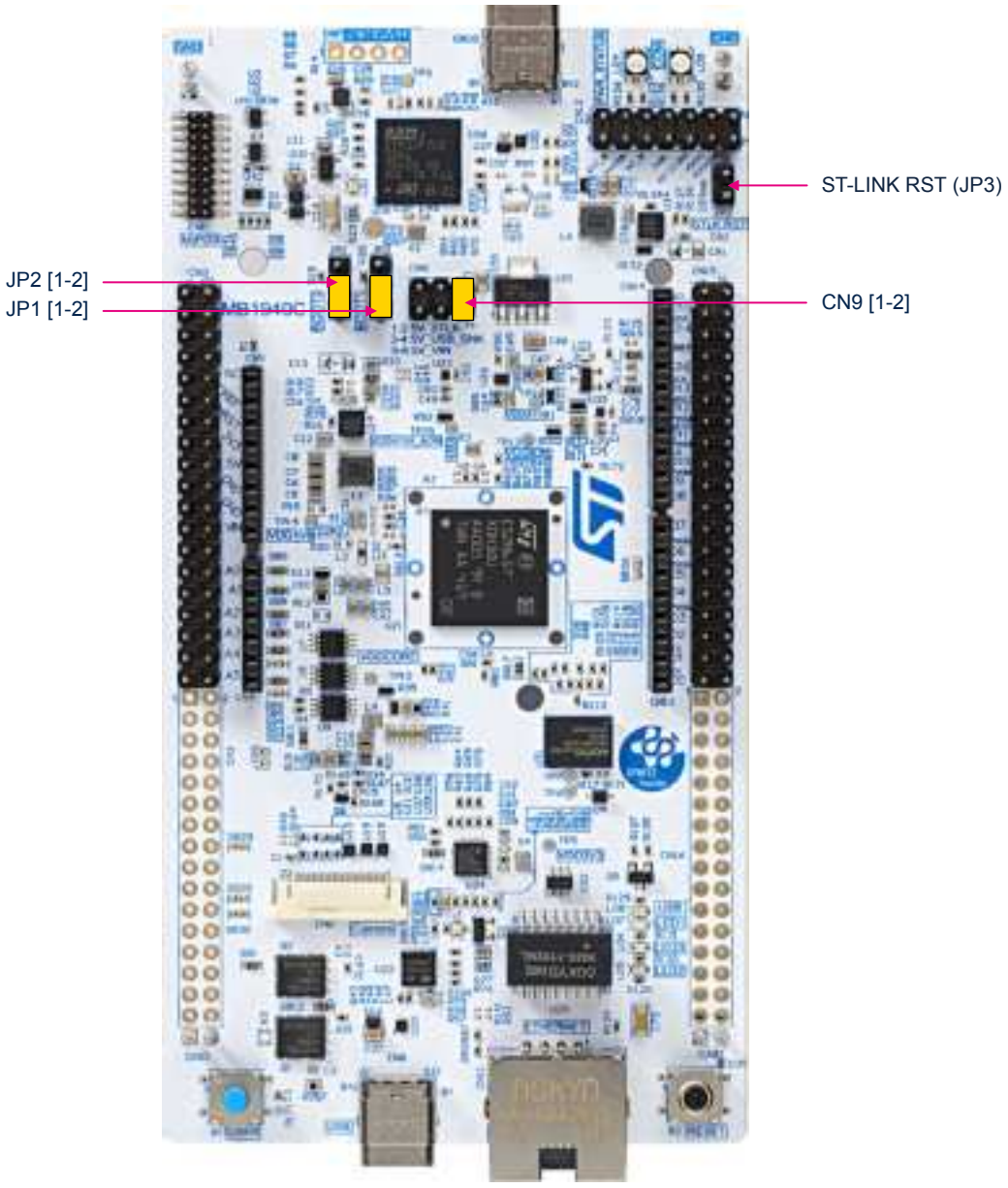
6.2 Default board configuration

By default, the STM32N6 Nucleo-144 board is configured with ST-LINK power.
The default jumper configuration and voltage setting are shown in Table 4.

Table 4. Default jumper configuration

Jumper	Definition	Default position	Comment
CN9	5V power selection (user USB power source selection)	[1-2]	5V from STLINK-V3EC
JP1	BOOT0 selection	[1-2]	Boot pin flash/serial selection
JP2	BOOT1 selection	[1-2]	Boot in flash mode
JP3	STLK_RST	OFF	-

Figure 3. Default board configuration



7 Hardware layout and configuration

The STM32N6 Nucleo-144 board is designed around the STM32N657X0H3Q microcontroller in a VFBGA264 package.

Figure 4 shows the connections between the STM32 and its peripherals (STLINK-V3EC, flash memory, push-buttons, LEDs, USB, ST morpho headers). Figure 5 shows the location of these features on the STM32N6 Nucleo-144 board.

The mechanical dimensions of the board are shown in Figure 7.

7.1 Hardware board diagram and layout

Figure 4. Hardware block diagram

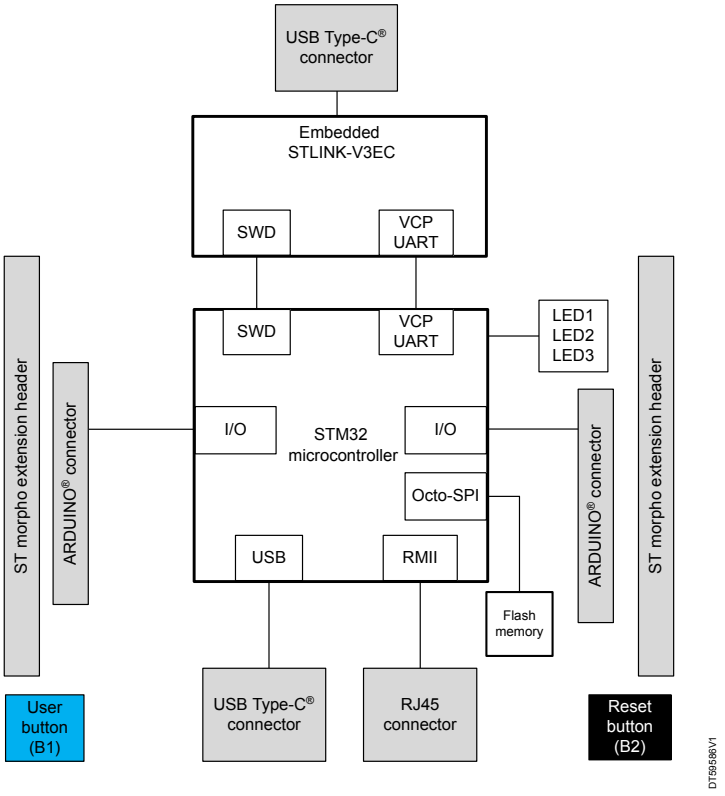


Figure 5. NUCLEO-N657X0-Q board top layout

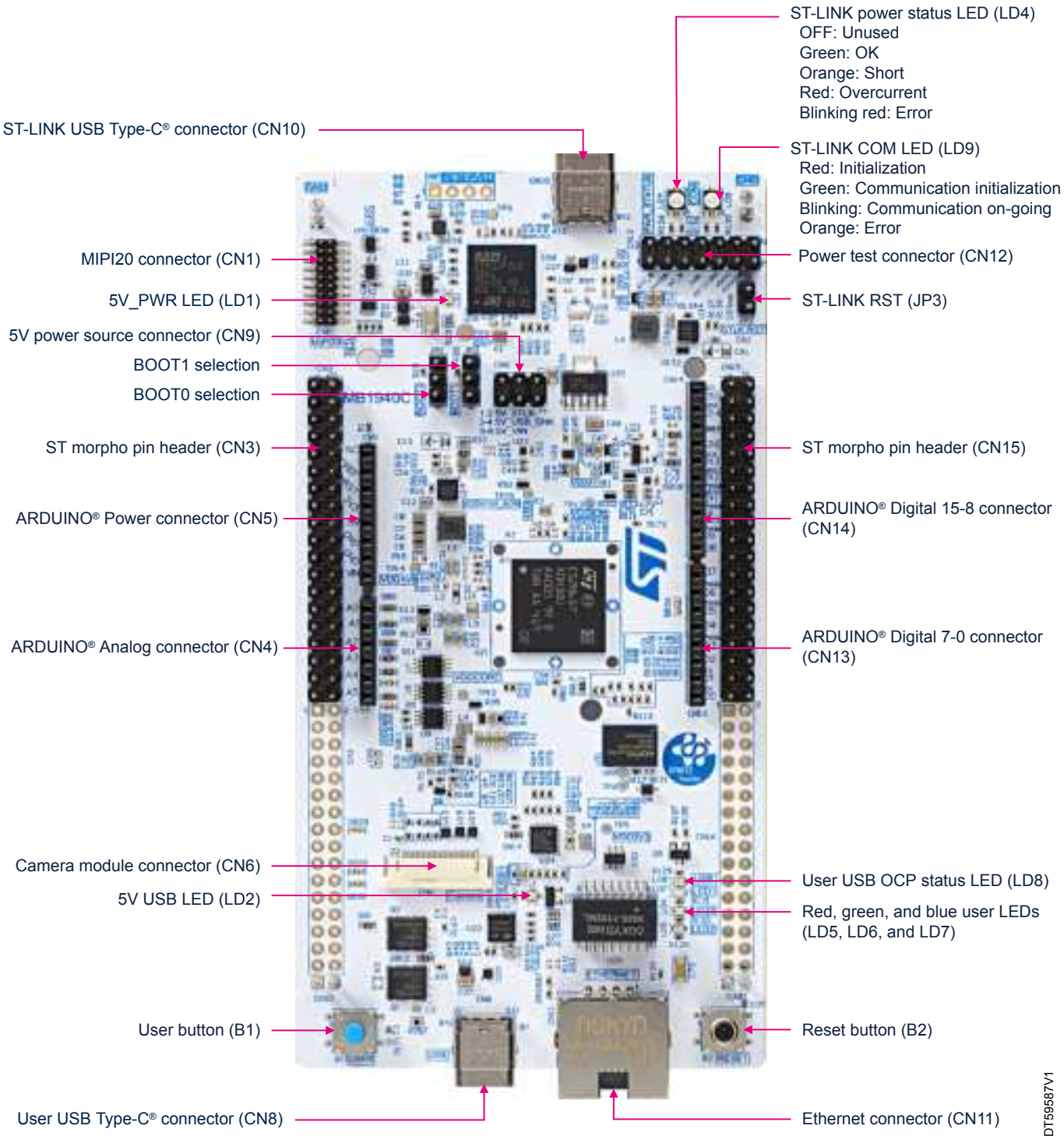
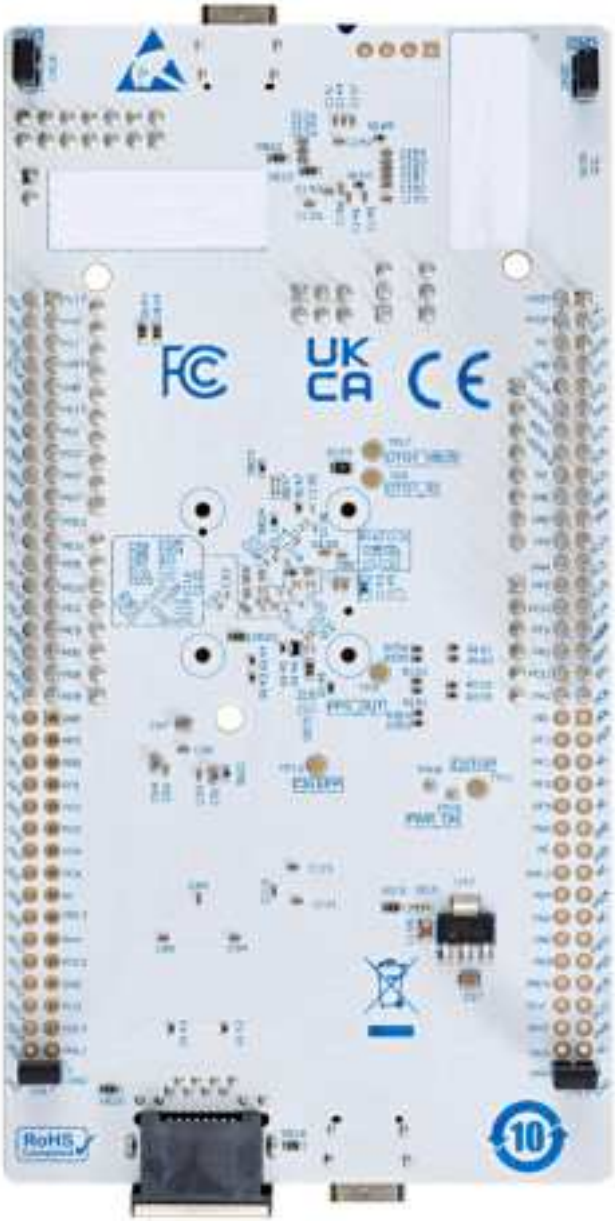


Figure 6. **NUCLEO-N657X0-Q board bottom layout**



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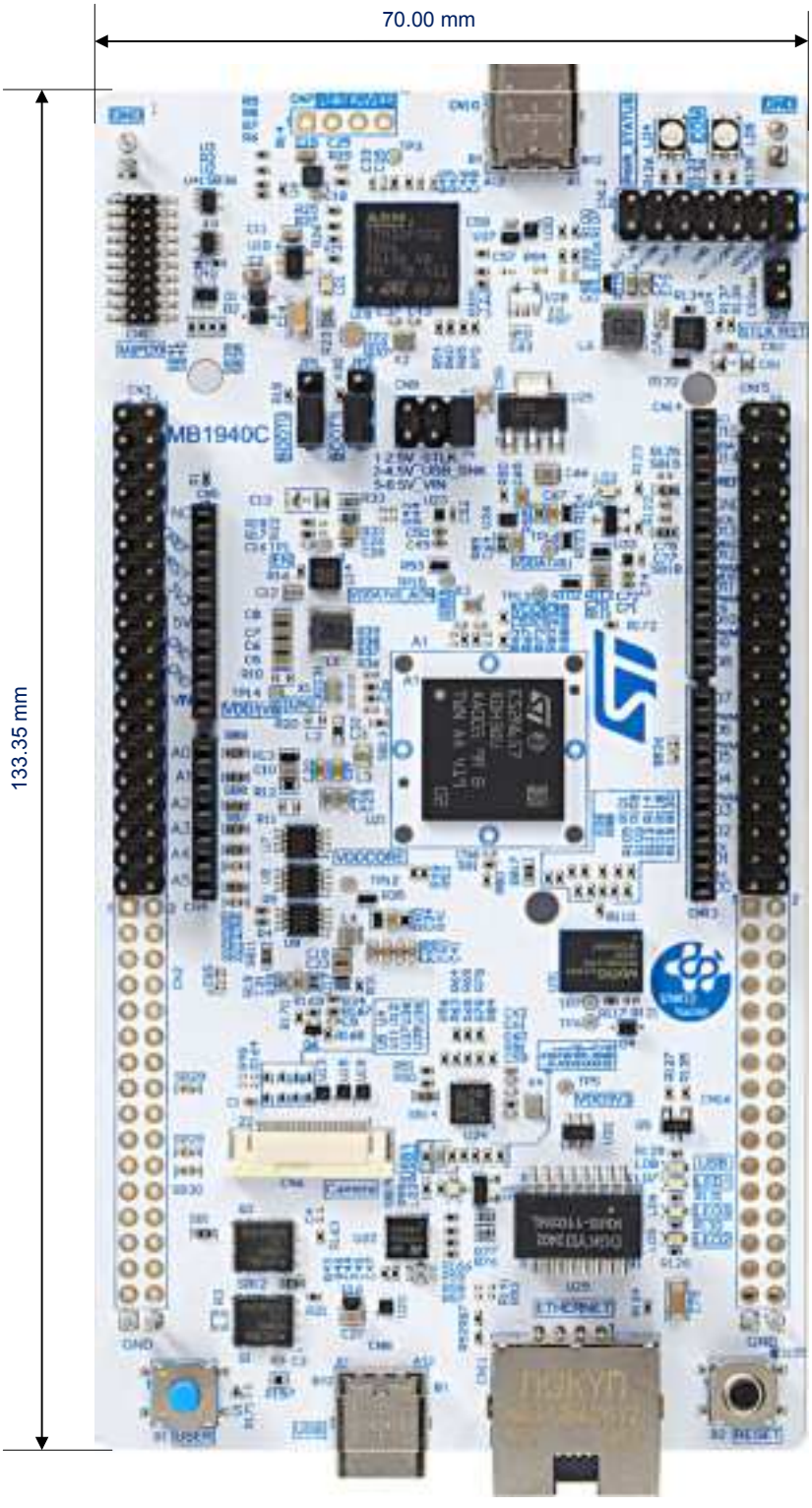
7.2 Mechanical drawing

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



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7.3 Embedded STLINK-V3EC

STLINK-V3EC is the embedded version of the STLINK-V3 included in the design of the STM32N6 Nucleo-144 board. It allows access to the programming, debugging; and monitoring functions of the STM32 through the USB STLK connector (CN10).

The STLINK-V3EC facility for debugging and programming is integrated into the STM32N6 Nucleo-144. The embedded STLINK-V3EC supports SWD and VCP/JTAG for STM32 devices.

Features supported in STLINK-V3EC

- 5V power supplied by the USB Type-C® connector (CN10)
- USB 2.0 high-speed-compatible interface
- JTAG and SWD protocols compatible with 1.7 to 3.6 V application voltage and 5 V tolerant input I/Os
- MIPI20 compatible connector (CN1)
- COM status LED (LD9) which blinks during communication with the PC
- Power status LED (LD4) power which identifies the status of current output to the board

7.3.1 Drivers

Before connecting the STM32N6 Nucleo-144 board to a Windows® PC via USB, the user must install a driver for STLINK-V3EC (not required for Windows® 10). It is available on the *www.st.com* website.

In case the STM32N6 Nucleo-144 board is connected to the PC before the driver is installed, some board interfaces might be declared as *Unknown* in the PC device manager. In this case, the user must install the dedicated driver files, and update the driver of the connected device from the device manager as shown in Figure 8.

Note: It is preferable to use the USB Composite Device to handle a full recovery.

Figure 8. USB Composite Device

Note: 37xx

- *374E for STLINK-V3EC without bridge functions*
- *374F for STLINK-V3EC with bridge functions.*

7.3.2 Firmware upgrade

STLINK-V3EC embeds a firmware upgrade (stsw-link007) mechanism for in-place upgrades through the USB port. The firmware might evolve during the lifetime of the STLINK-V3EC product (for example new functionalities, bug fixes, support for new microcontroller families). It is recommended to visit the *www.st.com* website before using the STM32N6 Nucleo-144 board and periodically, to stay up to date with the latest firmware version.

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

The STM32N6 Nucleo-144 board supports an external debug tool through the CN1 connector for SWD/JTAG and trace debugging. Keep the embedded STLINK-V3EC running. Power on the STLINK-V3EC at first until the COM LED turns red. Then connect the external debug tool through the MIPI20 debug connector (CN1).

Table 5 describes the MIPI20 connector (CN1) pinout.

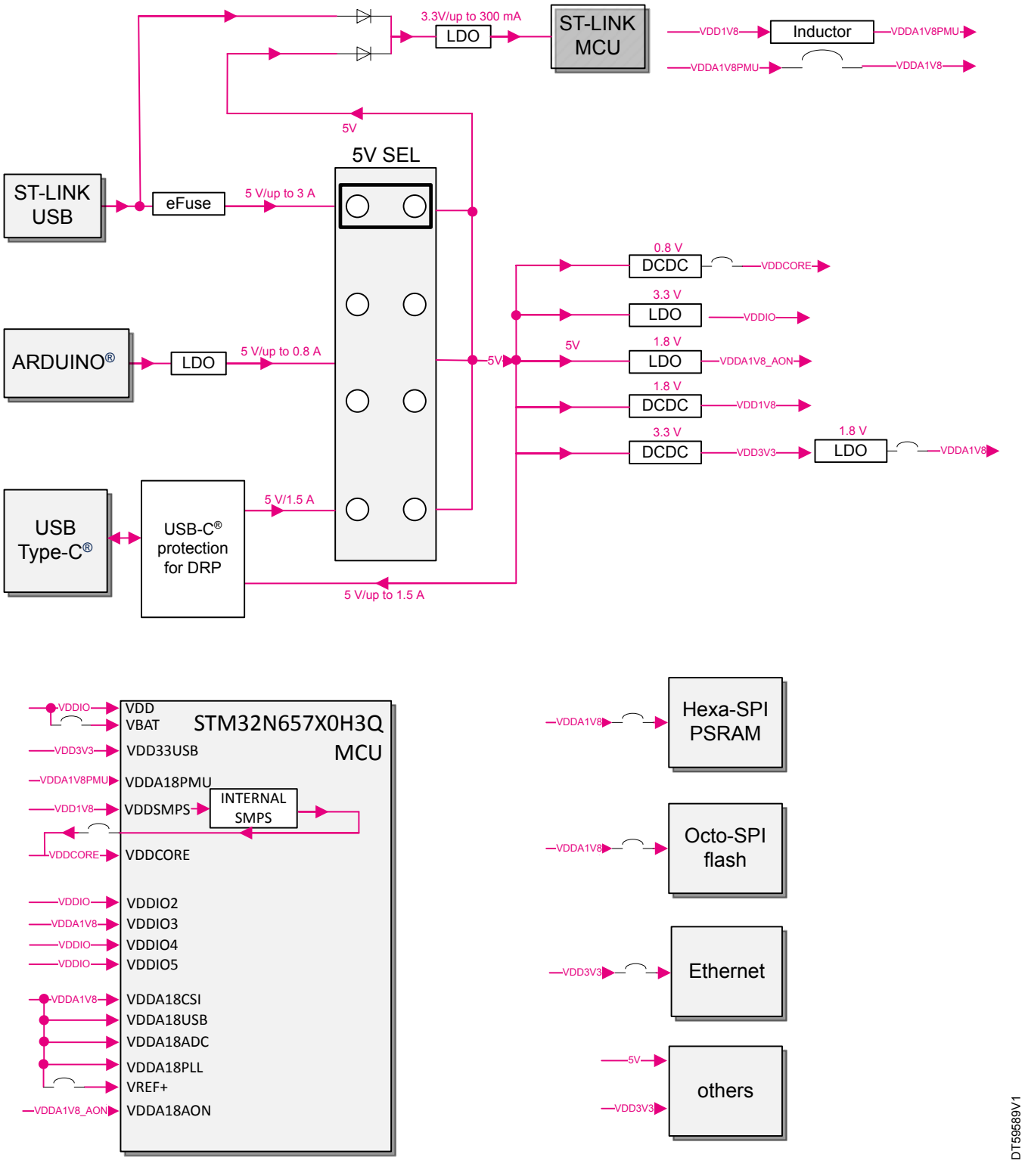
Table 5. MIPI20 debug connector (CN1) pinout

MIPI20 pin number	Signal name	STM32 pin	Function
1	VDD	-	Target VDD
2	MCU.SWDIO	PA13	Target SWDIO using SWD protocol or target JTMS (T_JTMS) using JTAG protocol
4	MCU.SWCLK	PA14	Target SWCLK using SWD protocol or target JTCK (T_JTCK) using JTAG protocol
6	MCU.SWO	PB5	Target SWO using SWD protocol or target JTDO (T_JTDO) using JTAG protocol
7	KEY	-	NC
8	MCU.JTDI	PA15	Not used by SWD protocol, target JTDI (T_JTDI) using JTAG protocol (SB22 ON)
10	NRST	NRST	Target NRST
12	TRACE_CLK	PB3	Trace clock signal
14	TRACE_D0	PE3	Trace data0 signal
16	TRACE_D1	PB0	Trace data1 signal
18	TRACE_D2	PB6	Trace data2 signal
20	TRACE_D3	PB7	Trace data3 signal
11 and 13	-	-	Through SB35 to GND. By default, SB35 is OFF.
3, 5, 9, 15, 17, and 19	GND	-	Ground

7.4 Power supply

Figure 9 describes the power architecture and the maximum voltage and current limits, under which functions can be safely used on the NUCLEO-N657X0-Q product. In any case, ensure the total power budget of the application always conforms to the selected 5 V power source mode, if not malfunction can occur. For detailed configuration, refer to the relevant function description and technical application notes.

Figure 9. Power supply architecture



7.4.1 External power supply input

The Nucleo board is designed to be powered by several DC power supplies. It is possible to configure the Nucleo board to use any of the following sources for the power supply:

- 5V_STLK from STLINK-V3EC USB Type-C® connector (CN10)
- VIN (7 to 12 V) from the ARDUINO® connector (CN5) or ST morpho connector (CN3)
- 5V_UCPD from the USB Type-C® connector (CN8)

If VIN is used to power a Nucleo-144 board, this power source must comply with the standard EN 62368-1:2014+A11:2017 and be safety extralow voltage (SELV) with limited power capability.

The power supply capabilities are summarized in Table 6.

Table 6. Power source capability

Input power name	Connector pins	Voltage range	Max. current	Limitation
5V_STLK	CN9 [1-2]	4.75 to 5.25 V	500mA/ 1.5A/3A	ST-LINK manages the maximum current.
VIN (5V_VIN)	CN5 pin 8 CN3 pin 24 CN9 [5-6]	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
5V_UCPD	CN9 [3-4]	4.75 to 5.25 V	Up to 1.5 A	The maximum current depends on the USB Host used to power the Nucleo board when the user USB connector CN8 is used as a sink port

5V_STLK is a DC power with the limitation of the STLINK-V3EC USB Type-C® connector (CN10). In this case, the CN9 jumper must be on pin [1-2] to select the 5V_STLK power source.

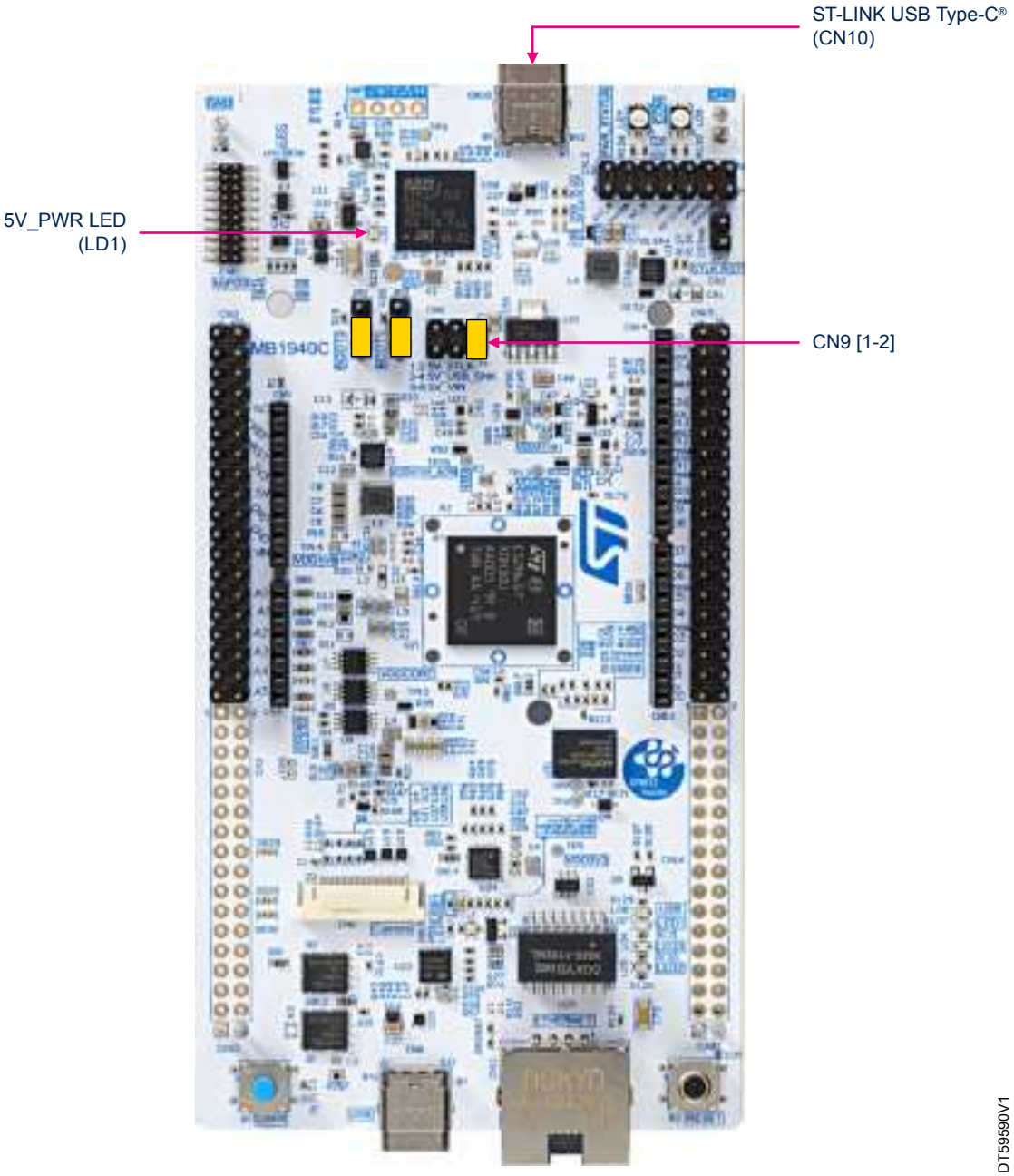
This is the default setting. If the USB enumeration succeeds, the 5V_STLK power is enabled, by asserting the T_PWR_EN signal from the STLINK-V3EC MCU (U18). This pin is connected to the power eFuse (U6), which powers the board. This power eFuse also features a fast overvoltage current limitation, to protect the PC in case of an onboard short-circuit. The STLINK-V3EC MCU (U18) determines the maximum current.

The NUCLEO-N657X0-Q Nucleo board with its shield can be powered from the STLINK-V3EC USB connector (CN10), but only the STLINK-V3EC circuit has the power before USB enumeration because the host PC only provides 100 mA to the board at that time. During the USB enumeration, the Nucleo board requires a 500 mA or more current to the USB Host.

If the host can provide the required power, the enumeration finishes with a *SetConfiguration* command. Then, the power eFuse (U6) is switched ON and the green LED (LD1) is turned ON, thus the Nucleo board with its shield can consume 500 mA or more current determined by ST-LINK.

5V_STLK configuration: The CN9 jumper is set on [1-2] as shown in Figure 10.

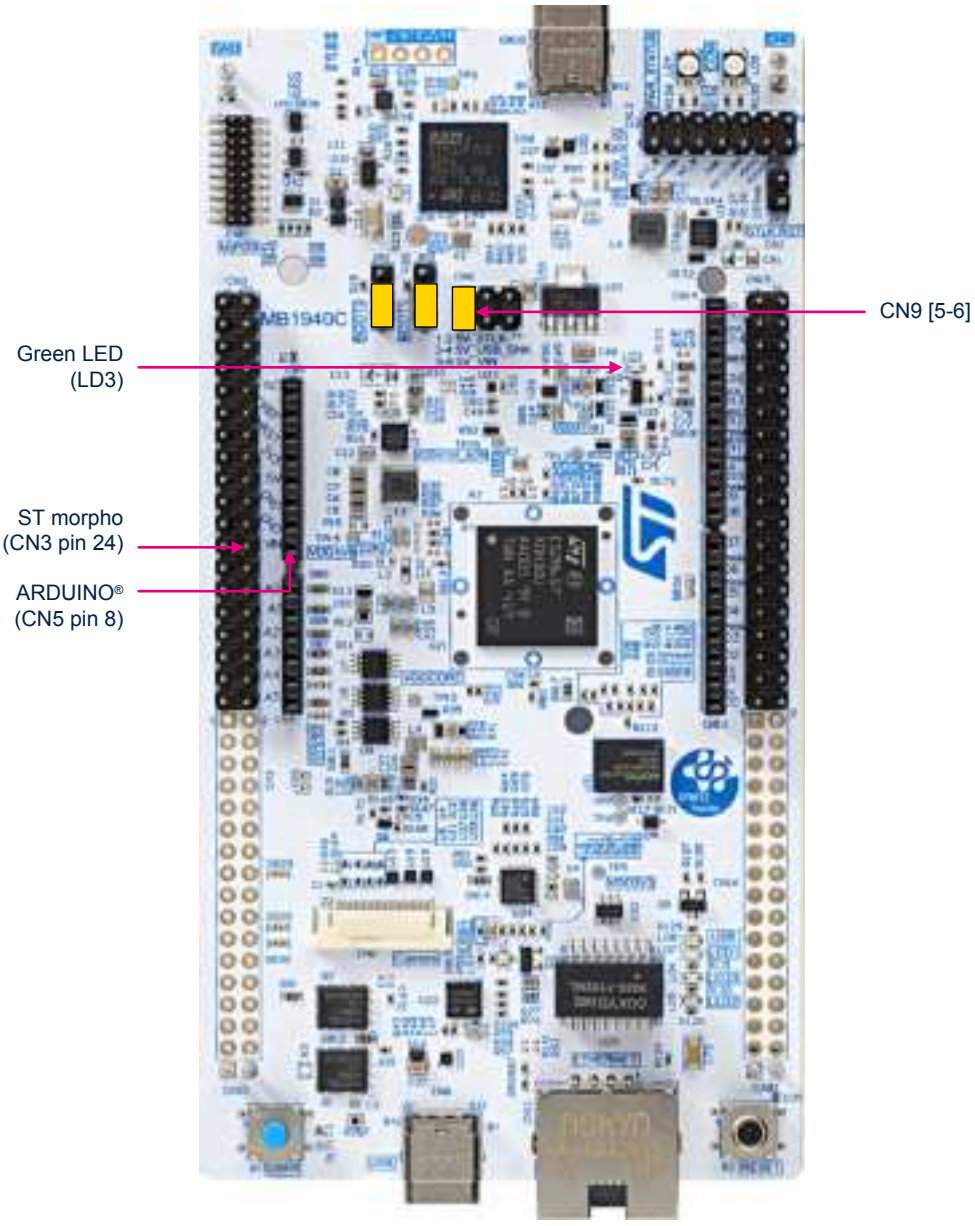
Figure 10. CN9 [1-2]: 5V_STLK power source



VIN (5V_VIN) is the 7 to 12 V DC power from the ARDUINO® connector CN5 pin 8 named VIN on the connector silkscreen or from the ST morpho connector CN3 pin 24. In this case, the CN9 jumper must be on pin [5-6] to select the 5V_VIN power source. In that case, the DC power comes from the power supply through the ARDUINO® Uno V3 battery shield (compatible with Adafruit® PowerBoost 500 shield).

5V_VIN configuration: The CN9 jumper must be set on [5-6] as shown in Figure 11.

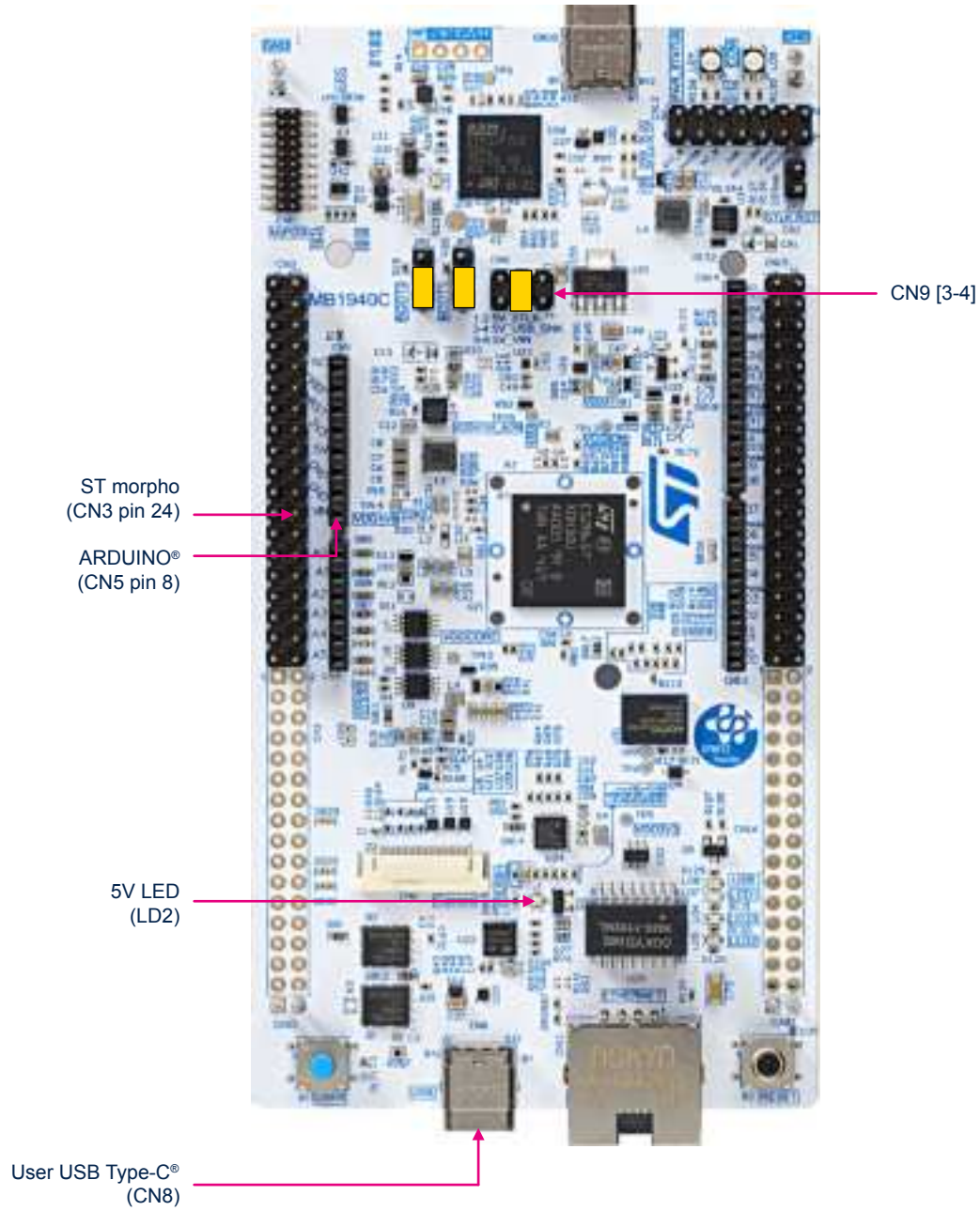
Figure 11. CN9 [5-6]: 5V_VIN power source



5V_USB_SNK is the DC power supply connected to the USB Type-C® user connector (CN8) when it is used as sink port. In this case, the CN9 jumper must be [3-4] to select the USB PD power source. The green LED (LD2) is turned ON. The power to the Nucleo board can be from CN8.

5V_USB_SNK configuration: The CN9 jumper must be on [3-4] as shown in Figure 12.

Figure 12. CN9 [3-4]: 5V_USB_SNK power source



7.4.2 Programing/debugging when the power supply is not from STLINK-V3EC (5V_STLK)

VIN or 5V_UCPD can be used as an external power supply in case the current consumption of the Nucleo with expansion boards exceeds the allowed current on USB. In such a condition, it is still possible to use USB for communication, programming, or debugging only.

In this case, it is mandatory to power the board using VIN, 5V_EXT, or 5V_UCPD then connect the USB cable to the PC. Proceeding this way the enumeration succeeds, thanks to the external power source.

The following power sequence procedure must be respected:

- Connect the CN9 jumper according to the 5V selected external power source.
- Connect the external power source according to CN9.
- Power on the external power supply.
- Check that the 5V_PWR LED (LD1) or 5V LED (LD2) is turned ON.
- Connect the PC to the USB connector (CN8).

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

- If the board needs more than 500 mA current, the PC might be damaged or limit the current. Therefore, the board is not powered correctly.
- Enumeration requires 500 mA. Thus, there is a risk that the request is rejected if the PC does not provide such a current. Consequently, the board is not powered and the LD1 LED remains OFF.

7.4.3 MCU power supply: Internal or external SMPS

Internal SMPS configuration: Using the internal SMPS

External SMPS default configuration: Using an external SMPS. The output power might be configured to two modes:

- Nominal mode: PWR_LP(PB12) = 0, VDDCORE = 0.81 V
- Overdrive mode: PWR_LP(PB12) = 1, VDDCORE = 0.89 V

Table 7. Power source capability

Solder bridges	Internal SMPS	External SMPS (default configuration)
R22	ON	**OFF**
R20	ON	**OFF**
R11	ON	**OFF**
R10	ON	**OFF**
R103	OFF	**ON**
R35	OFF	**ON**

7.4.4 Consumption measurement

Use CN12 to measure the current of the MCU powers:

- Pin pair 1/2 can measure the input current for external SMPS(R28 OFF).
- Pin pair 3/4 can measure the current of VDDCORE when in external SMPS mode (R40 OFF).
- Pin pair 5/6 can measure the input current for the internal SMPS (R32 OFF).
- Pin pair 9/10 can measure the current of VDDCORE when in internal SMPS mode (R13 OFF).
- Pin pair 11/12 can measure the current of VDDIO (R112 OFF).
- Pin pair 13/14 can measure the current of VDDA1V8 (R104 OFF).

The users can measure the current of VDD33USB through R149.

The users can measure the current of VDDA18AON through R53.

7.5 LEDs

5V_PWR LED (LD1)

The green LED (LD1) indicates that the STM32 part is powered by a 5V source. It also shows the power source of the user USB CN2 when it is used as a source port.

USB Type-C® 5V LED (LD2)

The green LED (LD2) shows the presence of V_{BUS} on CN8. Refer to Section 7.11: USB Type-C® (HS, DRP) for more details.

User green LED (LD3)

The user green LED (LD3) is connected to PB15 (ARDUINO® D13).

PWR status tricolor LED (LD4)

The tricolor (green, orange, and red) LED (LD4) provides information about STLINK-V3EC target power status:

- LED OFF: The target is not powered by STLINK-V3EC.
- Green LED ON: The Nucleo board power request is less or equal to the USB port power capability.
- Orange LED ON: The Nucleo board power request is higher than the USB port power capability. It is recommended to connect to another USB port for full functionality of the board.
- Red LED ON: The Nucleo board power has been automatically switched off after detection of an overcurrent. Switch to a more powerful USB port, and if the issue persists, investigate what might cause an overconsumption of the board.
- Slow blinking red: Internal error due to wrong hardware environment. STLINK-V3EC is not functional.

The three following user LEDs (LD5, LD6, and LD7) are OFF when the I/O is in the HIGH state, and are ON when the I/O is in the LOW state.

User red LED (LD5)

The user red LED (LD5) is connected to PG10.

User green LED (LD6)

The user green LED (LD6) is connected to PG0.

User blue LED (LD7)

The user blue LED (LD7) is connected to PG8.

USB OCP red LED (LD8)

The red LED (LD8) indicates that an overcurrent is detected on the user USB.

COM tricolor LED (LD9)

The tricolor (green, orange, and red) LED (LD9) provides information about the STLINK-V3EC communication status. The LD9 default color is red. LD9 turns green to indicate that the communication is in progress between the PC and STLINK-V3EC, with the following setup:

- Red LED ON: When the initialization between the PC and STLINK-V3EC is complete
- Green LED ON: After a successful target communication initialization
- Blinking red/green: During communication with the target
- Orange ON: Communication failure

7.6 Push-buttons

Two buttons are available on the Nucleo board.

Reset button (B2)

The black button connected to NRST is used to reset the STM32 microcontroller. When the button is pressed the logic state is LOW, otherwise, the logic state is HIGH.

User button (B1)

The blue button for user and wake-up functions is connected to PC13 to support the default tamper and wake-up functions of the STM32 microcontroller. When the button is pressed the logic state is HIGH, otherwise, the logic state is LOW.

7.7 OSC clock sources

Three clock sources are described below:

- LSE is the 32.768 kHz crystal for the STM32 embedded RTC.
- MCO is the 8 MHz clock from STLINK-V3EC for the STM32 microcontroller.
- HSE is the 48 MHz oscillator for the STM32 microcontroller.

7.7.1 LSE clock supply

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

LSE on-board oscillator X1 crystal (default configuration)

Refer to the application note *Oscillator design guide for STM8AF/AL/S, STM32 MCUs and MPUs* (AN2867), with the following characteristics: 32.768 kHz, 6 pF, and 20 ppm. The following configuration is needed:

- R37 and R38 ON
- R36 and R39 OFF

External oscillator on PC14

The input clock comes from an external oscillator via the PC14 signal on the ST morpho connector (CN3 pin 29). The following configuration is needed:

- R37 and R38 OFF
- R36 ON

LSE not used

PC14 and PC15 are used as GPIOs instead of low-speed clocks. The following configuration is needed:

- R37 and R38 OFF
- R36 and R39 ON

7.7.2 HSE clock supply

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

HSE on-board oscillator X3 crystal (default configuration)

For typical frequencies, capacitors, and resistors, refer to the STM32 microcontroller datasheet. Refer to the application note *Oscillator design guide for STM8AF/AL/S, STM32 MCUs and MPUs* (AN2867). The X3 crystal has the following characteristics: 48 MHz, 7 pF, and 20 ppm. The following configuration applies:

- R72 and R67 ON are connected to external HSE.
- SB37 (MCO) OFF, MCO is not connected to PH0.
- R83 and R62 OFF. ST morpho headers are disconnected

MCO from STLINK-V3EC

The MCO output of the STLINK-V3EC MCU is used as an input clock. This frequency cannot be changed. It is fixed at 8 MHz, and connected to the PH0 OSC_IN pin of the STM32 microcontroller. The following configuration is needed:

- SB37 ON. MCO is connected to PH0 and R45 on the STLINK-V3EC side must be connected to provide the MCO to STLINK-V3EC output.
- R72 and R67 OFF. The external crystal is not connected to HSE.
- R83 and R62 OFF. ST morpho headers are disconnected.

External oscillator

The input clock comes from an external oscillator through PH0, CN3 pin 9. The following configuration is needed:

- R83 ON. The ST morpho connector is connected to PH0.
- SB37 OFF. MCO is not connected to PH0.
- R72 and R67 OFF. The external crystal is not connected to HSE.

HSE not used

PH0 and PH1 are used as GPIOs instead of clocks. The following configuration is needed:

- SB37 OFF. MCO is not connected to PH0.
- R72 and R67 OFF. The external crystal is not connected to HSE.
- R83 and R62 ON. ST morpho headers are connected as GPIOs.

7.8 Reset sources

The reset signal of the Nucleo board is active LOW and the reset sources include:

- Reset button (B2)
- Embedded STLINK-V3EC (CN10)
- ARDUINO® connector (CN5 pin 3)
- ST morpho connector (CN3 pin 14)

7.9 Virtual COM port (VCP)

The serial interface USART1 (PE5/PE6) is directly available as a Virtual COM port of the PC connected to the STLINK-V3EC USB connector (CN10). The VCP configuration is the following:

- 115200 bit/s
- 8-bit data
- No parity
- One-stop bit
- No flow control

7.10 Octo-SPI flash memory

The Octo-SPI flash memory has the following characteristics: 512 Mbits, 1.8 V, 200 MHz, DTR, read while writing. It is connected to the Octo-SPI interface of the STM32N657X0H3Q microcontroller. The embedded footprint is also compatible with many other references in the BGA24 package. Check the compatibility of the memory datasheet versus MB1940 schematics.

Note: Since the NRST (system reset) is at 3.3 V level, while the reset of the Octo-SPI flash memory is 1.8 V in this design, a diode(D4) is used to adapt the reset signals.

7.11 USB Type-C® (HS, DRP)

The STM32N6 Nucleo-144 board supports a USB HS 2.0 interface on the USB Type-C® receptacle connector (CN8). It offers compatibility with USB Type-C® revision 1.3, USB PD 3.0, PPS, and USB BC 1.2 on the USB Type-C® receptacle connector (CN8).

CN8 can be used as a DRP (dual-role port). Its V_{BUS} can be managed for supplying other platforms as a Provider or being supplied as a Consumer. The USB-C® PD protection device is used to manage DRP functions. It is compatible with V_{BUS} current up to 1.5 A and V_{BUS} 5 V only.

The red LED (LD8) indicates the USB OCP status.

By default, the USB-C® PD protection device manages the dead battery (DB) feature of this USB connector.

The green LED (LD2) lights on when one of the following events occurs:

- Source path is open and NUCLEO-N657X0-Q provides up to 1.5 A/5 V power to CN8.
- V_{BUS} is powered by another USB Host when the NUCLEO-N657X0-Q works as a sink device.

Table 8 describes the pinout of the USB function.

Table 8. USB pinout

STM32 pin	Signal name	USB connector (CN8) pin	Remark
OTG1_HSDM	USB_HS_N	A7/B7	-
OTG1_HSDP	USB_HS_P	A6/B6	-
UCPD1_CC1	CC1	A5	-
UCPD1_CC2	CC2	B5	-
PD2	INT	-	Interrupt pin, open drain
PA7	PWR_EN	-	PD chip enable pin
PA5	ISENSE	-	-
PA11	VSENSE	-	-
PB11	I2C2_SDA	-	-
PB10	I2C2_SCL	-	-

7.12 Ethernet

The STM32N6 Nucleo-144 board supports 10/100-Mbit Ethernet communication with a PHY and integrates an RJ45 connector (CN11). The Ethernet PHY is connected to the STM32N657X0H3Q microcontroller via an RMII interface.

Table 9 describes the pinout of the Ethernet function.

Table 9. Ethernet pinout

STM32 pin	Signal name
PF7	RMII reference clock
PF4	RMII MDIO
PG11	RMII MDC
PF10	RMII Rx data valid
PF14	RMII RXD0
PF15	RMII RXD1
PF11	RMII Tx enable
PF12	RXII TXD0
PF13	RMII TXD1

7.13 Boot options

The BOOT0 and BOOT1 pins determine the boot mode as shown in Table 10. For more details, refer to the reference manual *STM32N647/657xx Arm®-based 32-bit MCUs* (RM0486).

Table 10. Boot modes

BOOT0	BOOT1	Boot source
-	1	Development boot
0	0	Flash boot
1	0	Serial boot

On the board, BOOT0 and BOOT1 might be configured manually by pushing the mechanical parts: JP1 (BOOT0) and JP2 (BOOT1).

8 Connectors

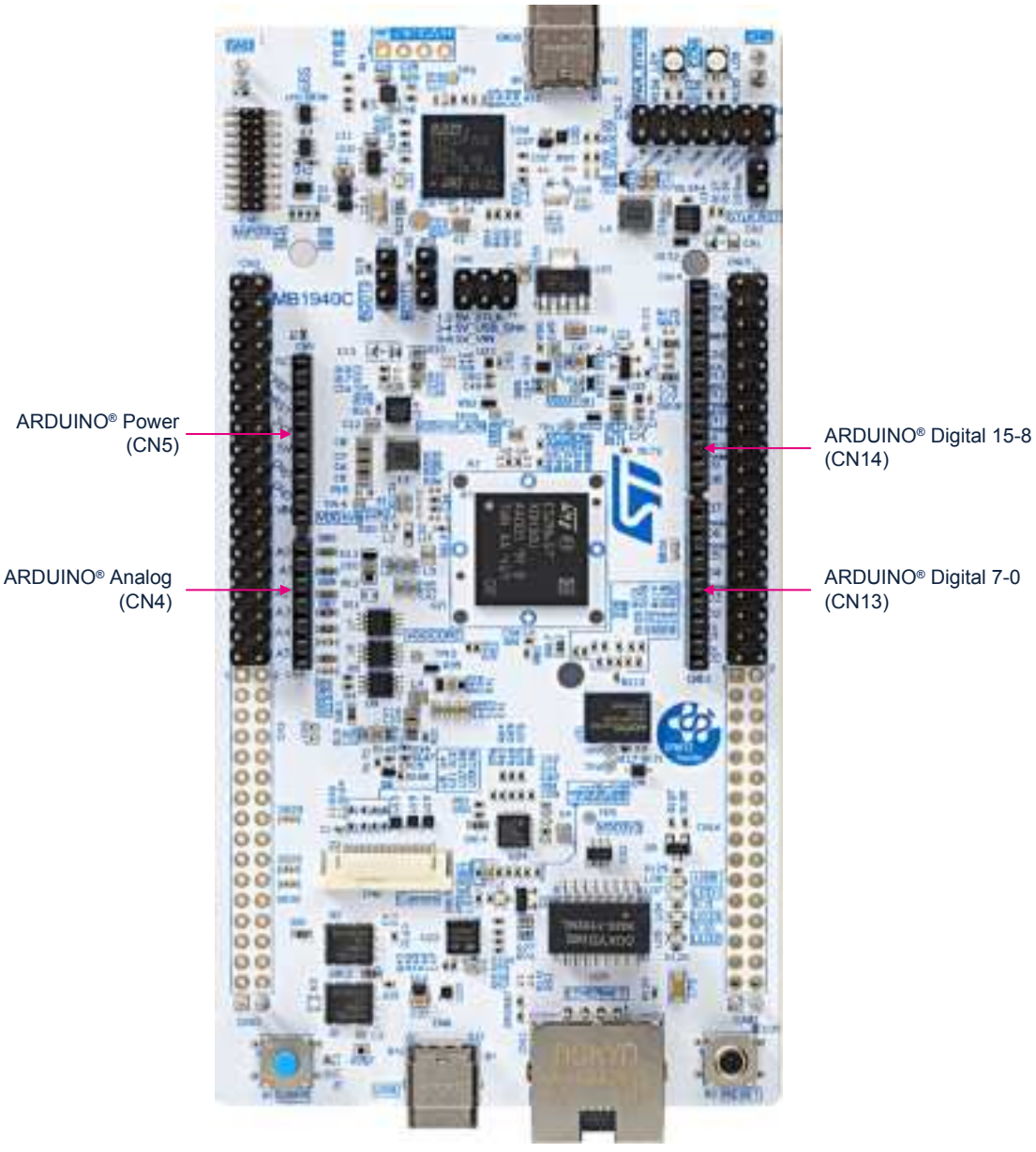
Several connectors are implemented on the STM32N6 Nucleo-144 board:

- ARDUINO® Uno V3 connectors (CN4, CN5, CN13, and CN14)
- ST morpho connectors (CN2, CN3, CN15, and CN16)
- Camera module connector (CN6)
- STLINK-V3EC USB Type-C® connector (CN10)
- User USB Type-C® connector (CN8)
- Ethernet RJ45 connector (CN11)

8.1 ARDUINO® Uno V3 connectors

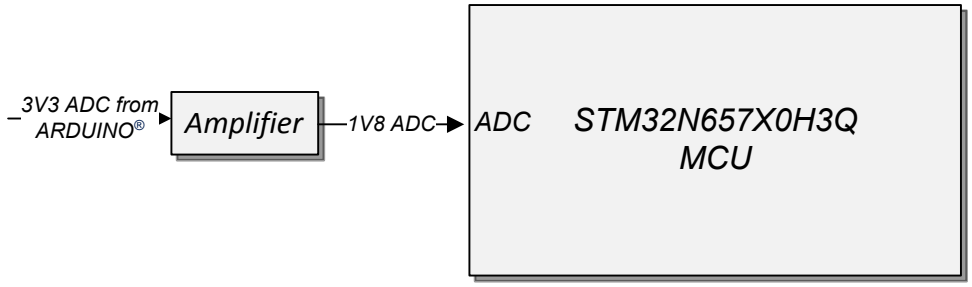
The ARDUINO® connectors (CN4, CN5, CN13, and CN14) are female connectors supporting the ARDUINO® Uno V3 standard.

Figure 13. ARDUINO® Uno V3 connectors



Note: The analog level limit is 1.8 V while the digital I/O level is up to 3.3 V in the pins of the MCU. To avoid any risk of damaging the pins of the MCU, an amplifier is used to down the voltage level for each analog pin and implement two functions (both analog and digital) in the ARDUINO® pins (A0–A5), connecting two pins (one analog and one digital I/O) to each ARDUINO® pin (A0–A5). The basic logic is as the below picture shows:

Figure 14. ADC/ARDUINO® input voltage adaptation



The related pinout for the ARDUINO® connector is listed in Table 11.

Table 11. **ARDUINO® Uno V3 connectors pinout**

Left connectors					Right connectors				
Connector	Pin number	Pin name	MCU pin	Function	Function	MCU pin	Pin name	Pin number	Connector
					I2/3C1_SCL	PH9	D15	10	CN14 Digital 15-8
					I2/3C1_SDA	PC1	D14	9	
					AVDD	-	AREF	8	
					Ground	-	GND	7	
CN5 Power	1	-	-	5V_IN test	SPI5_SCK	PE15	D13	6	
	2	IOREF	-	3V3 ref	SPI5_MISO	PG1	D12	5	
	3	RESET	NRST	Reset	TIM14_CH1 or SPI5_MOSI	PG2	D11	4	
	4	+3V3	-	3.3 V output	TIM16_CH1 or SPI5_CS	PA3	D10	3	
	5	+5V	-	5 V output	TIM1_CH2	PD7	D9	2	
	6	GND	-	Ground	-	PD12	D8	1	
	7	GND	-	Ground					
	8	VIN	-	Power input	-	PE11	D7	8	CN13 Digital 7-0
					TIM1_CH4N	PD5	D6	7	
CN4 Analog	1	A0	PF5 or PA8[1]	ADC12_INP5(PA8)	TIM1_CH2N	PE10	D5	6	
	2	A1	PC10 or PA9[1]	ADC12_INP10(PA9)	-	PE0	D4	5	
	3	A2	PF6 or PA10[1]	ADC12_INP11(PA10)	TIM1_CH1	PE9	D3	4	
	4	A3	PA2 or PA12[1]	ADC12_INP13(PA12)	-	PD0	D2	3	
	5	A4	PC12/PF3[1] or PC1[2]	ADC1_INP16 (PF3) or I2C1_SDA (PC1)	USART3_TX	PD8	D1	2	
	6	A5	PH2/PG15[1] or PH9[2]	ADC12_INP7 (PG15) or I2C1_SCL (PH9)	USART3_RX	PD9	D0	1	

1. *Since for ADC, the level of MCU pins is 1.8 V, while for digital I/Os the level of MCU pins is 3.3 V.*
2. *By default, the I2C1 function is disabled with the configuration: SB2 and SB4 OFF, SB3 and SB5 ON. To get the I2C1 function, the configuration must be: SB2 and SB4 ON, SB3 and SB5 OFF.*

8.2 ST morpho headers (CN2, CN3, CN15, and CN16)

The ST morpho consists of CN2, CN3, CN15, and CN16 male pin header footprints (CN2 and CN16 are not soldered by default). They can be used to connect the STM32 Nucleo-144 board to an extension board or a prototype/wrapping board placed on top of it. Most of the signals and power pins of the STM32 are available on the ST morpho connector. An oscilloscope, a logic analyzer, or a voltmeter can also probe this connector.

Figure 15. ST morpho connector

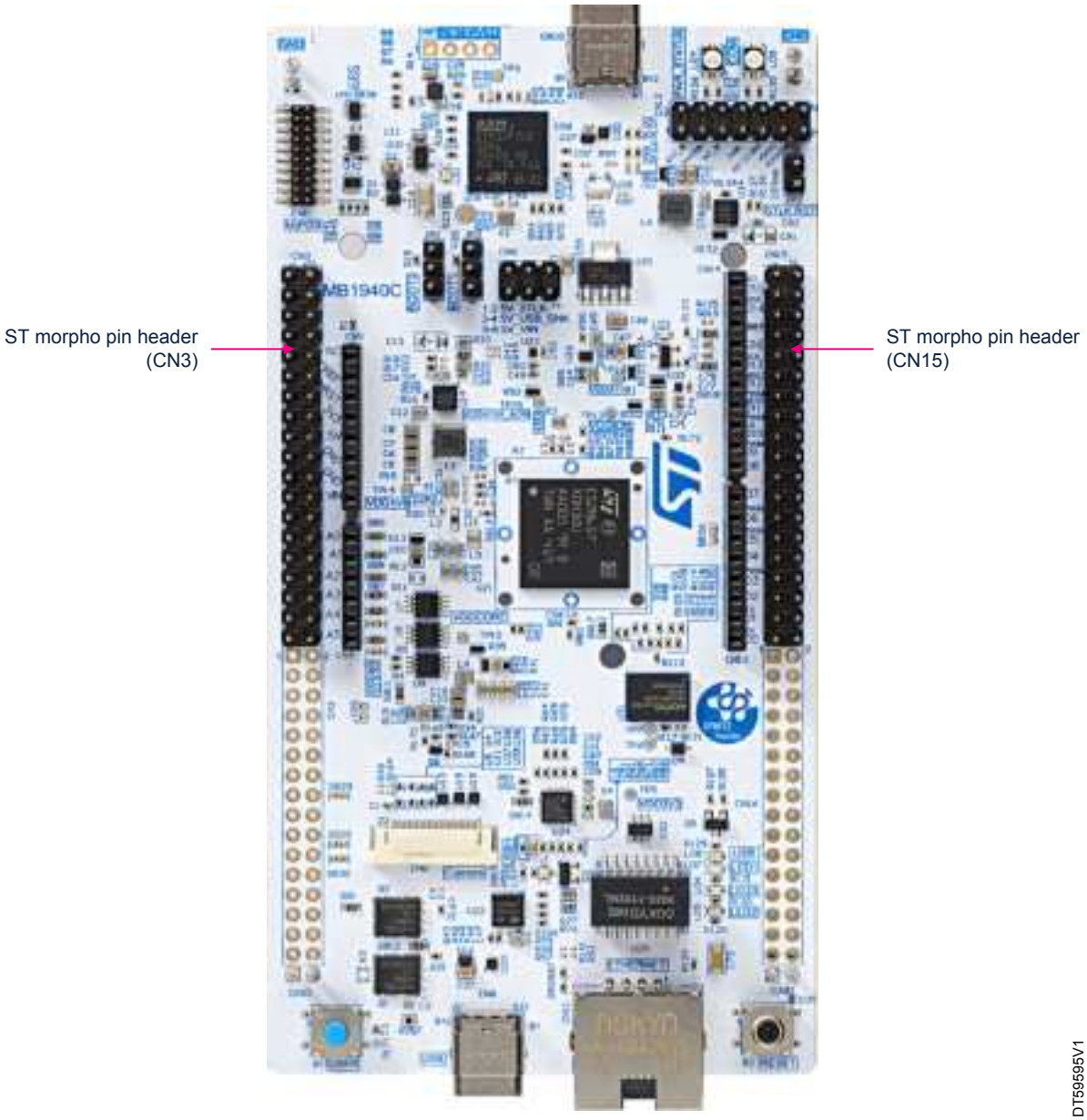


Table 12 and Table 13 show the pin assignments for the STM32 on the ST morpho connector.

Table 12. ST morpho connector (CN3, CN15) pin assignment

CN3 odd pins		CN3 even pins		CN15 odd pins		CN15 even pins	
Pin number	Pin name	Pin number	Pin name	Pin number	Pin name	Pin number	Pin name
1	NC	2	OTG1_HSDM_CON	1	PE12	2	PE6
3	PC2	4	OTG1_HSDP_CON	3	PH9	4	PE5
5	VDDIO	6	5V	5	PC1	6	PD6
7	BOOT0	8	GND	7	VREFP	8	5V_STLK(2)
9	PH0	10	VDDIO4	9	GND	10	PB2
11	PH1	12	IOREF	11	PE15	12	NC/PB3(1)
13	PC4	14	NRST	13	PG1	14	PB8
15	PC5	16	3V3	15	PG2	16	PB9
17	PC0	18	5V	17	PA3	18	PB14
19	GND	20	GND	19	PD7	20	GND
21	PE4	22	GND	21	PD12	22	PE7
23	PC13	24	VIN	23	PE11	24	PE1
25	PC3	26	PH4	25	PD5	26	PE14
27	PC15	28	PF5	27	PE10	28	PE13
29	PC14	30	PC10	29	PE0	30	PE2
31	VDDIO5	32	PF6	31	PE9	32	AGND
33	VBAT	34	PA2	33	PD0	34	PD10
35	BOOT1	36	PC12	35	PD8	36	PD11
37	PC8	38	PH2	37	PD9	38	PA1

Table 13. ST morpho connector (CN2, CN16) pin assignment

CN2 odd pins		CN2 even pins		CN16 odd pins		CN16 even pins	
Pin number	Pin name	Pin number	Pin name	Pin number	Pin name	Pin number	Pin name
1	PF8	2	NC/PB1(1)	1	GND	2	PP1
3	PG7	4	PF2	3	PP0	4	PP2
5	NC	6	PF1	5	PO0	6	PP3
7	NC	8	PF0	7	PO1	8	PP4
9	NC	10	PF9	9	PO2	10	PP5
11	GND	12	PH5	11	PO3	12	PP6
13	PG5	14	NC	13	PO4	14	PP7
15	NC	16	NC/PB13(1)	15	PE8	16	GND
17	PG14	18	PG4	17	NC	18	PP8
19	NC	20	PG6	19	PD13	20	PP9
21	NC/PG12(1)	22	GND	21	PA4	22	PP10
23	PG3	24	NC/PG9(1)	23	PD15	24	PP11
25	PC9	26	PB15	25	GND	26	PP12
27	PC11	28	PC6	27	PD3	28	PP13
29	PH8	30	PH7	29	PG13	30	PP14
31	NC	32	PH3	31	PN12	32	PP15

1. *PG12, PB1, PB13, PG9, PB3 are disconnected by default.*
2. *ST_STLK is 5V power, coming from the STLINK-V3EC USB connector. It rises before the 5V signal of the board.*

8.3 Camera module connector (CN6)

A CSI camera module is supported thanks to the 22-pin dedicated ZIF connector (CN6). The camera module with RPI0 standard can be connected to the Nucleo board through a flexible cable.

Table 14 describes the camera module connector (CN6) pinout.

Table 14. Camera module connector (CN6) pinout

MIPI20 pin number	Signal name	STM32 pin	Function
1	GND	-	-
2	CSI_D0_N	CSI_D0N	MIPI-CSI receiver 1 data Lane 1 negative
3	CSI_D0_P	CSI_D0P	MIPI-CSI receiver 1 data Lane 1 positive
4	GND	-	-
5	CSI_D1_N	CSI_D1N	MIPI-CSI receiver 1 data Lane 2 negative
6	CSI_D1_P	CSI_D1P	MIPI-CSI receiver 1 data Lane 2 positive
7	GND	-	-
8	CSI_CLK_N	CSI_CKN	clock Lane negative
9	CSI_CLK_P	CSI_CKP	clock Lane positive
10	GND	-	-
11	TOF_LPn	PG9	Time-of-Flight low power
12	TOF_INT	PB13	Time-of-Flight interruption
13	GND	-	-
14	IMU_INT1	PG12	Inertial motion unit interruption
15	IMU_INT2	PB1	Inertial motion unit interruption
16	GND	-	-
17	NRST_CAM	PO5	Camera module reset
18	PWR_EN	PA0	Camera module enable
19	GND	-	-
20	I2C2_SCL	PB10	I2C2 SCL
21	I2C2_SDA	PB11	I2C2 SDA
22	VDD_CAM	-	3V3

8.4 STLINK-V3EC USB Type-C® connector (CN10)

The USB Type-C® connector (CN10) is used to connect the embedded STLINK-V3EC to the PC for programming and debugging purposes.

Figure 16. USB Type-C® connector (CN10) front view

The related pinout for the USB STLINK-V3EC connector is listed in Table 15.

Table 15. STLINK-V3EC USB Type-C® connector (CN10) pinout

Connector	Pin number	Pin name	Signal name	STM32 pin	Function
CN10	A1	GND	GND	-	Ground
	A4	VBUS	VBUS_STLK	-	Power
	A5	CC1	STLK_UCPD_CC1_C	PC3	USB PD controller side for the CC1 pin
	A6	D+	STLK_USB_P	PB15	USB differential pair P
	A7	D-	STLK_USB_N	PB14	USB differential pair M
	A8	SBU1	-	-	-
	A9	VBUS	VBUS_STLK	-	Power
	A12	GND	GND	-	Ground
	B1	GND	GND	-	Ground
	B4	VBUS	VBUS_STLK	-	Power
	B5	CC2	STLK_UCPD_CC2_C	PC4	USB PD controller side for the CC2 pin
	B6	D+	STLK_USB_P	PB15	USB differential pair P
	B7	D-	STLK_USB_N	PB14	USB differential pair M
	B9	VBUS	VBUS_STLK	-	Power
	B12	GND	GND	-	Ground

8.5 User USB Type-C® connector (CN8)

Figure 17. **USB Type-C® connector (CN8) front view**

The related pinout for the user USB connector is listed in Table 16.

Table 16. **User USB Type-C® connector (CN8) pinout**

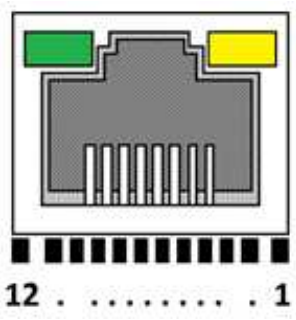
Connector	Pin number	Pin name	Signal name	STM32 pin	Function
CN8	A1	GND	GND	-	Ground
	A4	VBUS	VBUSc	-	Power
	A5	CC1	UCPD_CC1	UCPD1_CC1	USB PD controller side for the CC1 pin
	A6	D+	USB_P	OTG1_HSDP	USB differential pair P
	A7	D-	USB_N	OTG1_HSDM	USB differential pair M
	A8	SBU1	-	-	-
	A9	VBUS	VBUSc	-	Power
	A12	GND	GND	-	Ground
	B1	GND	GND	-	Ground
	B4	VBUS	VBUSc	-	Power
	B5	CC2	UCPD_CC2	UCPD1_CC2	USB PD controller side for the CC2 pin
	B6	D+	USB_FS_P	OTG1_HSDP	USB differential pair P
	B7	D-	USB_FS_N	OTG1_HSDM	USB differential pair M
	B9	VBUS	VBUSc	-	Power
	B12	GND	GND	-	Ground

8.6 Ethernet RJ45 connector (CN11)

The STM32N6 Nucleo-144 board supports 10 Mbps/100 Mbps Ethernet communication with a PHY (U15) and integrated RJ45 connector (CN11). The Ethernet PHY is connected to the MCU via the RMII interface.

The X4 oscillator generates the 25 MHz clock for the PHY. The 50 MHz clock for the MCU (derived from the 25 MHz crystal oscillator) is provided by the RMII_REF_CLK of the PHY.

Figure 18. Ethernet RJ45 connector (CN11) front view



1. *Green LED: Ethernet traffic*
2. *Amber LED: Ethernet connection*

The related pinout for the Ethernet connector is listed in Table 17.

Table 17. Ethernet connector (CN11) pinout

Connector	Pin number	Description	MCU pin	Pin number	Description	MCU pin
CN11	1	TX+	-	7	NC	-
	2	TX-	-	8	NC	-
	3	RX+	-	9	Yellow LED cathode	-
	4	NC	-	10	Yellow LED anode	-
	5	NC	-	11	Green LED cathode	-
	6	RX-	-	12	Green LED anode	-

8.7 Solder bridge configuration for connectors

Table 18 details the solder bridges of the STM32N6 Nucleo-144 board for the expansion connector.

Table 18. Solder bridge configuration

Definition	Solder bridge	Setting[1]	Comment
ST morpho (CN2 pin 21)	SB29	ON	PG12 is connected to ST morpho CN2 pin 21
		OFF	**PG12 is connected to CN6 camera module board IMU_INT1**
ST morpho (CN2 pin 2)	SB27	ON	PB1 is connected to ST morpho CN2 pin 2
		OFF	**PB1 is connected to CN6 camera module board IMU_INT2**
ST morpho (CN2 pin 16)	SB28	ON	PB13 is connected to ST morpho CN2 pin 16
		OFF	**PB13 is connected to CN6 camera module board TOF_INT**
ST morpho (CN2 pin 24)	SB30	ON	PG9 is connected to ST morpho CN2 pin 24
		OFF	**PG9 is connected to CN6 camera module board TOF_LPn**
OSC32_IN PC14	R36	ON	PC14 is connected to ST morpho CN3 pin 29
		OFF	**PC14 is disconnected to ST morpho CN3 pin 29**
OSC32_OUT PC15	R39	ON	PC15 is connected to ST morpho CN3 pin 27
		OFF	**PC15 is disconnected to ST morpho CN3 pin 27**
OSC_IN PH0	R83	ON	PH0 is connected to ST morpho CN3 pin9
		OFF	**PH0 is disconnected to ST morpho CN3 pin9**
OSC_OUT PH1	R62	ON	PH1 is connected to ST morpho CN3 pin 11
		OFF	**PH1 is disconnected to ST morpho CN3 pin 11**
TRACE_CLK PB3	SB26	ON	PH0 is connected to ST morpho CN15 pin 12
		OFF	**PB3 is not connected to ST morpho CN15 pin 12**
	SB36	**ON**	**PB3 is connected to MIPI20 connector CN1 pin 12**
		OFF	PB3 is not connected to MIPI20 connector CN1 pin 12

1. *The default configuration is in bold.*

9 NUCLEO-N657X0-Q 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-N657X0-Q product history

Table 19. Product history

Order code	Product identification	Product details	Product change description	Product limitations
NUCLEO-N657X0-Q	NUN657X0Q$CR1	MCU: • STM32N657X0 silicon revision "B"	Initial revision	No limitation
		MCU errata sheet: • *STM32N6xxx device errata* (ES0620)		
		Board: • MB1940-N657X0Q-C02 (main board)		

9.3 Board revision history

Table 20. Board revision history

Board reference	Board variant and revision	Board change description	Board limitations
MB1940 (main board)	N657X0Q-C02	Initial revision	No limitation

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

10.1 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 A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

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 ISED Compliance Statement

ISED Canada ICES-003 Compliance Label: CAN ICES-3 (A) / NMB-3 (A).

Étiquette de conformité à la NMB-003 d'ISDE Canada : CAN ICES-3 (A) / NMB-3 (A).

11 CE conformity

11.1 Warning

EN 55032 / CISPR32 (2012) Class A product

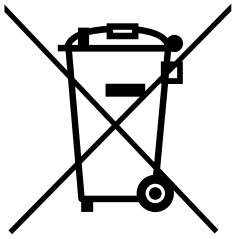
Warning: this device is compliant with Class A of EN55032 / CISPR32. In a residential environment, this equipment may cause radio interference.

Avertissement : cet équipement est conforme à la Classe A de la EN55032 / CISPR 32. Dans un environnement résidentiel, cet équipement peut créer des interférences radio.

12 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 should 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, please separate these items from other type of waste and recycle them responsibly to the designated collection point to promote the sustainable reuse of material resources.

Household users:

You should contact either the retailer where you buy the product or your local authority for further details of your nearest designated collection point.

Business users:

You should contact your dealer or supplier for further information.

Revision history

Table 21. **Document revision history**

Date	Revision	Changes
03-Jan-2025	1	Initial release.

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