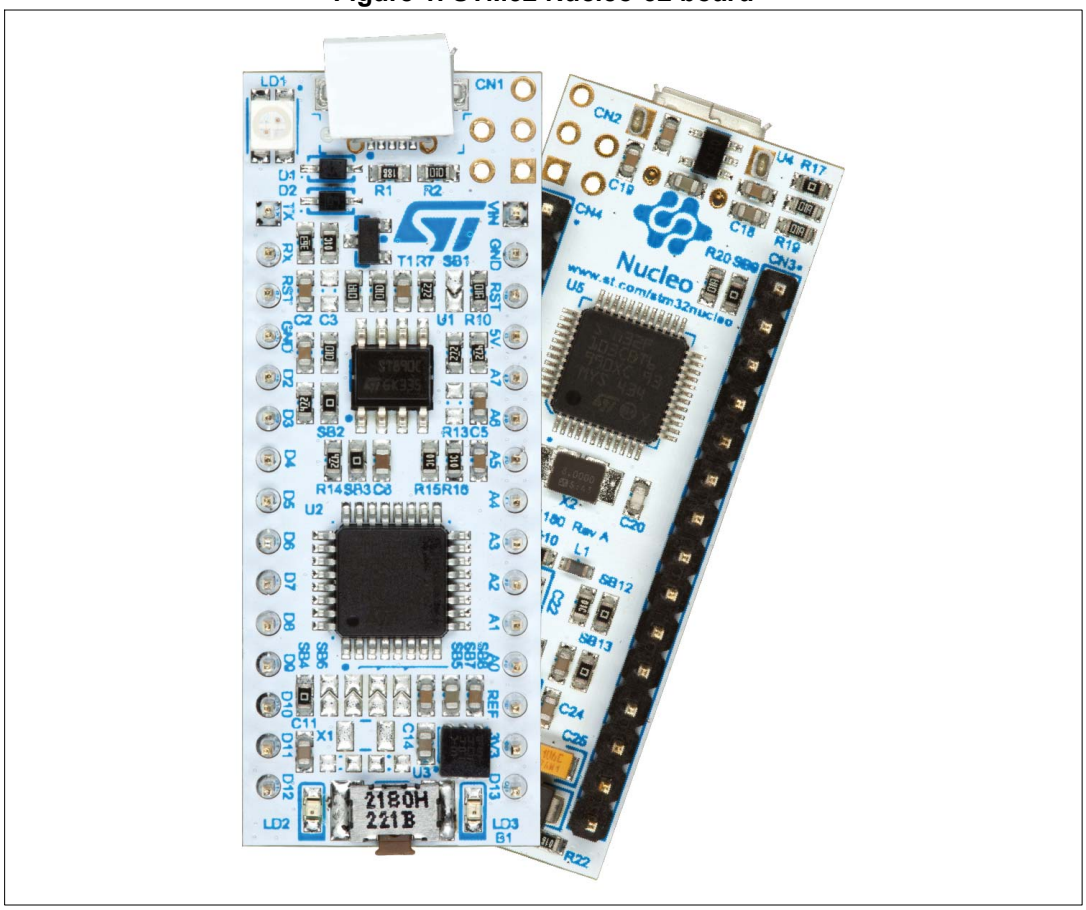
UM1956
User manual

STM32 Nucleo-32 boards (MB1180)

Introduction

The STM32 Nucleo-32 boards based on the MB1180 reference board (NUCLEO-F031K6, NUCLEO-F042K6, NUCLEO-F301K8, NUCLEO-F303K8, NUCLEO-L011K4, NUCLEO-L031K6, NUCLEO-L412KB, and NUCLEO-L432KC) provide an affordable and flexible way for users to try out new concepts and build prototypes with STM32 microcontrollers, choosing from the various combinations of performance, power consumption, and features. The ARDUINO® Nano connectivity support makes it easy to expand the functionality of the Nucleo-32 open development platform with a wide choice of specialized shields. The STM32 Nucleo-32 boards do not require any separate probe as they integrate the ST-LINK/V2-1 debugger/programmer and come with the STM32 comprehensive software HAL library, together with various packaged software examples.

Figure 1. STM32 Nucleo-32 board



Picture is not contractual.

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- Three LEDs:
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  - Power LED (LD2)
  - User LED (LD3)
- Reset push-button
- Board connectors:
  - ST-LINK USB Micro-AB
  - ARDUINO® Nano expansion
- Flexible board power supply options:
  - ST-LINK USB V_{BUS}
  - External sources
- On-board ST-LINK/V2-1 debugger/programmer with USB re-enumeration capability: mass storage, Virtual COM port, and debug port
- Comprehensive free software libraries and examples available with the STM32Cube MCU Package
- Support of a wide choice of Integrated Development Environments (IDEs) including IAR Embedded Workbench®, MDK-ARM, and STM32CubeIDE

arm

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

2 Ordering information

To order the STM32 Nucleo-32 board, refer to *Table 1*.

Table 1. Ordering information

Order code	Reference board	Target STM32
NUCLEO-F031K6	MB1180(1)	STM32F031K6T6
NUCLEO-F042K6		STM32F042K6T6
NUCLEO-F301K8		STM32F301K8T6
NUCLEO-F303K8		STM32F303K8T6
NUCLEO-L011K4		STM32L011K4T6
NUCLEO-L031K6		STM32L031K6T6
NUCLEO-L412KB		STM32L412KBU6
NUCLEO-L432KC		STM32L432KCU6

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-L412KB
XX	MCU series in STM32 32-bit Arm Cortex MCUs	STM32L4 series
YY	MCU product line in the series	STM32L412
Z	STM32 package pin count: – K for 32 pins	32 pins
T	STM32 flash memory size: – 4 for 16 Kbytes – 6 for 32 Kbytes – 8 for 64 Kbytes – B for 128 Kbytes – C for 256 Kbytes	128 Kbytes

3 Development environment

3.1 System requirements

- Multi-OS support: Windows®(a) 10, Linux®(b) 64-bit, or macOS® (c)
- USB Type-A or USB Type-C® to Micro-B cable

3.2 Development toolchains

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

4 Conventions

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

Table 3. ON/OFF conventions

Convention	Definition
Jumper JPx ON	Jumper fitted
Jumper JPx OFF	Jumper not fitted
Solder bridge SBx ON	SBx connections closed by solder or 0-ohm resistor
Solder bridge SBx OFF	SBx connections left open

In this document, the reference is the *STM32 Nucleo-32 board* for all information common to all sale types.

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

b. Linux® is a registered trademark of Linus Torvalds.

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

d. On Windows® only.

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 STM32 Nucleo-32 board is a low-cost and easy-to-use development kit used to quickly evaluate and start a development with an STM32 microcontroller in an LQFP32 or UFQFPN32 package.

Before installing and using the product, accept the evaluation product license agreement that can be found at www.st.com/epla.

For more information on the STM32 Nucleo-32 board and to access the demonstration software, visit the www.st.com/stm32nucleo webpage.

6.1 Getting started

Follow the sequence below, to configure the STM32 Nucleo-32 board and launch the demonstration software:

- Check solder bridge position on the board, SB1 OFF, SB14 ON (internal regulator), JP1 ON (IDD) selected.
- To correctly identify all device interfaces from the host PC before connecting the board, install the Nucleo USB driver, available at the www.st.com/stm32nucleo webpage.
- To power the board, connect the STM32 Nucleo-32 board to a PC through the USB connector CN1 with a USB Type-A or USB Type-C® to Micro-B cable. The red LED LD2 (PWR) and LD1 (COM) light up and the green LED LD3 blinks.
- Remove the jumper placed between D2 (CN3 pin 5) and GND (CN3 pin 4).
- Observe how the blinking frequency of the green LED LD3 changes when the jumper is in place or when it is removed.
- The demonstration software and several software examples on the STM32 Nucleo-32 board features, are available at the www.st.com/stm32nucleo webpage.
- Develop an application using the available examples.

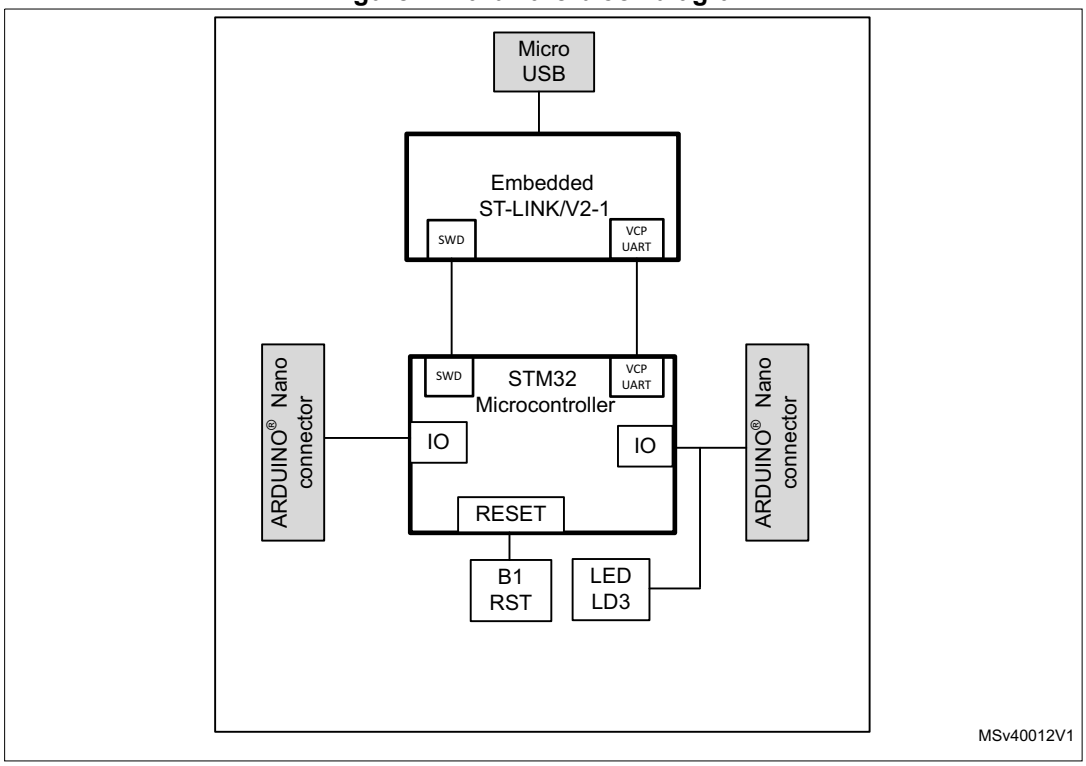
7 Hardware layout and configuration

The STM32 Nucleo-32 board is based on a 32-pin STM32 microcontroller in an LQFP or UFQFPN package.

Figure 2 illustrates the connections between the STM32 and its peripherals (ST-LINK/V2-1, push-button, LED, and ARDUINO® Nano connectors).

Figure 3: STM32 Nucleo-32 board top layout and *Figure 4: STM32 Nucleo-32 board bottom layout* show the location of these connections on the STM32 Nucleo-32 board.

Figure 2. Hardware block diagram



7.1 STM32 Nucleo-32 board layout

Figure 3. STM32 Nucleo-32 board top layout

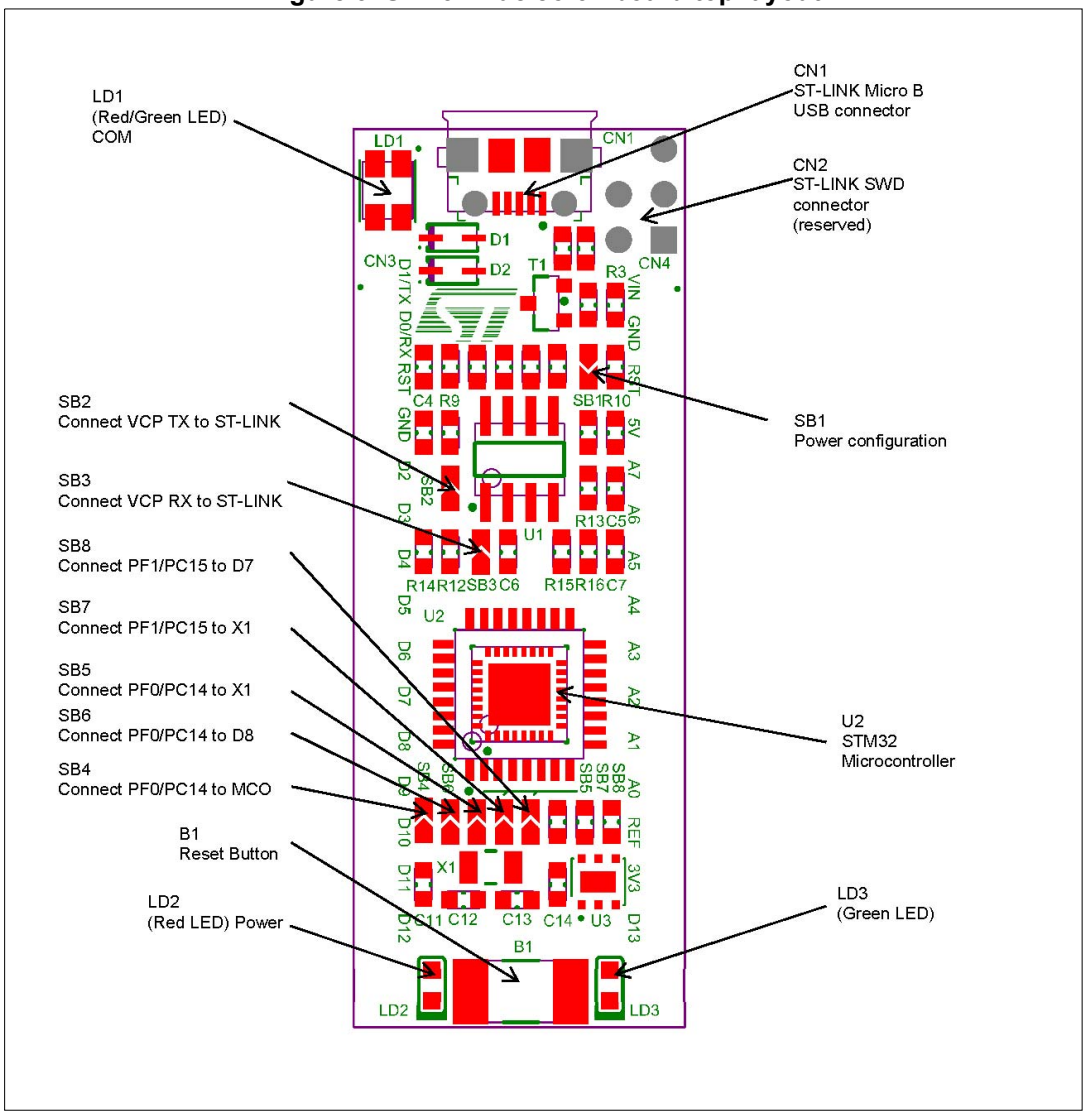
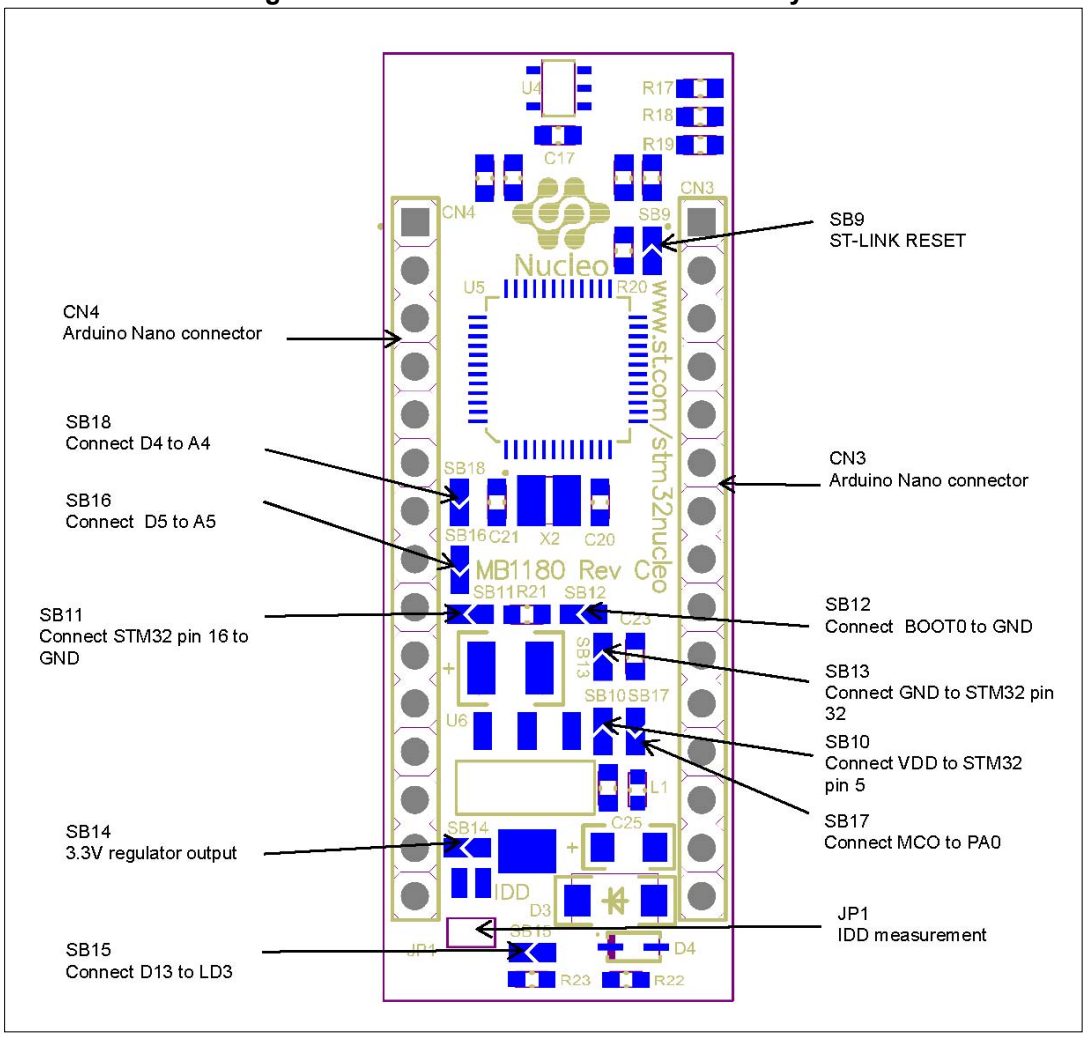
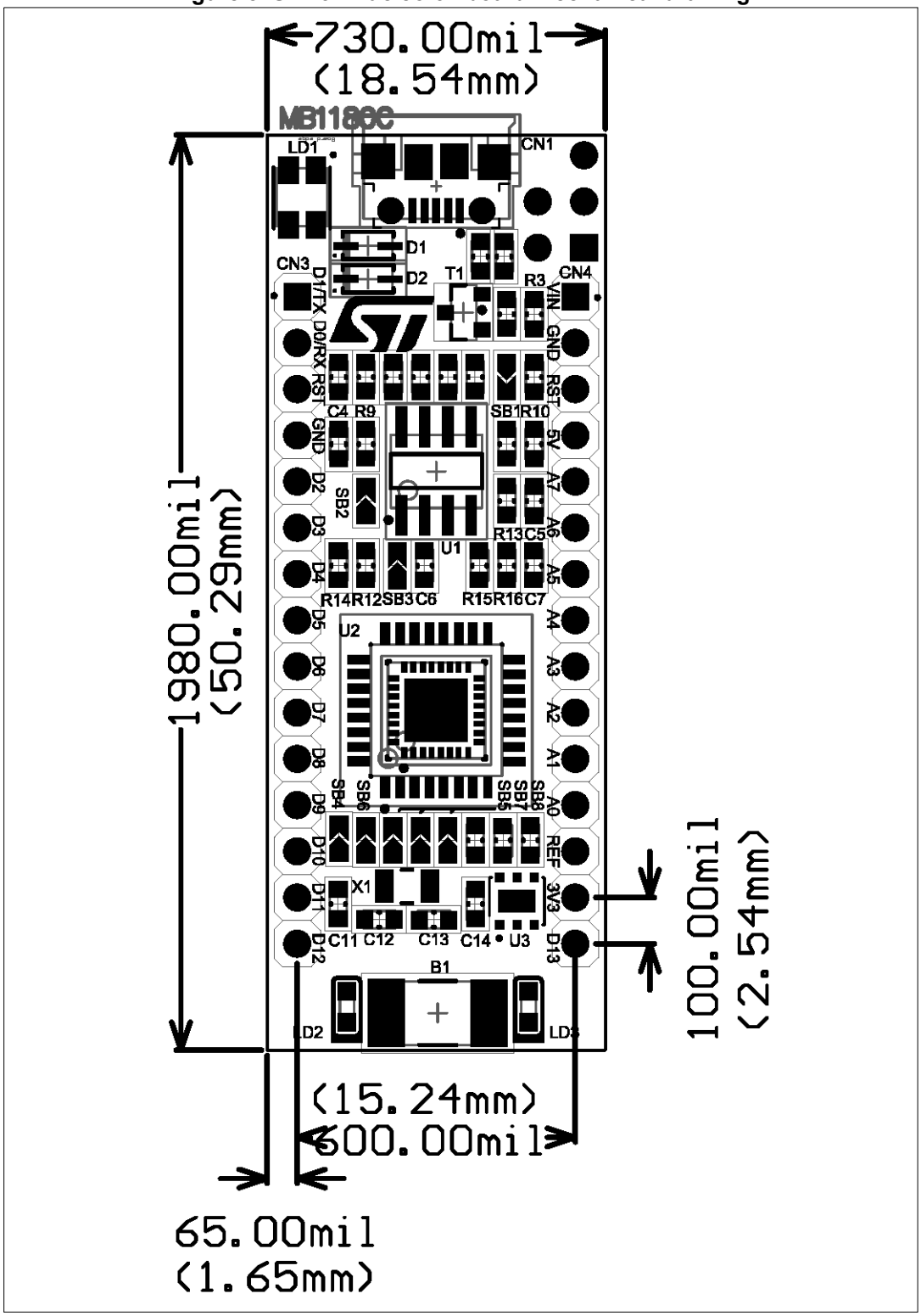


Figure 4. STM32 Nucleo-32 board bottom layout



7.2 STM32 Nucleo-32 board mechanical drawing

Figure 5. STM32 Nucleo-32 board mechanical drawing



7.3 Embedded ST-LINK/V2-1

The ST-LINK/V2-1 programming and debugging tool is integrated into the STM32 Nucleo-32 board.

The embedded ST-LINK/V2-1 supports only the SWD for STM32 devices. For information about debugging and programming features refer to: *ST-LINK/V2 in-circuit debugger/programmer for STM8 and STM32* user manual (UM1075), which describes in detail all the ST-LINK/V2 features.

The new features supported by ST-LINK/V2-1 compared with ST-LINK/V2 are:

- USB software re-enumeration
- Virtual COM port interface on USB
- Mass storage interface on USB
- USB power management request for more than 100 mA power on USB

The features not supported on ST-LINK/V2-1 are:

- SWIM interface
- Minimum supported application voltage limited to 3 V

Known limitation:

- Activating the readout protection on the STM32 target, prevents the target application from running afterwards. The target readout protection must be kept disabled on ST-LINK/V2-1 boards.

The embedded ST-LINK/V2-1 is directly connected to the SWD port of the target STM32.

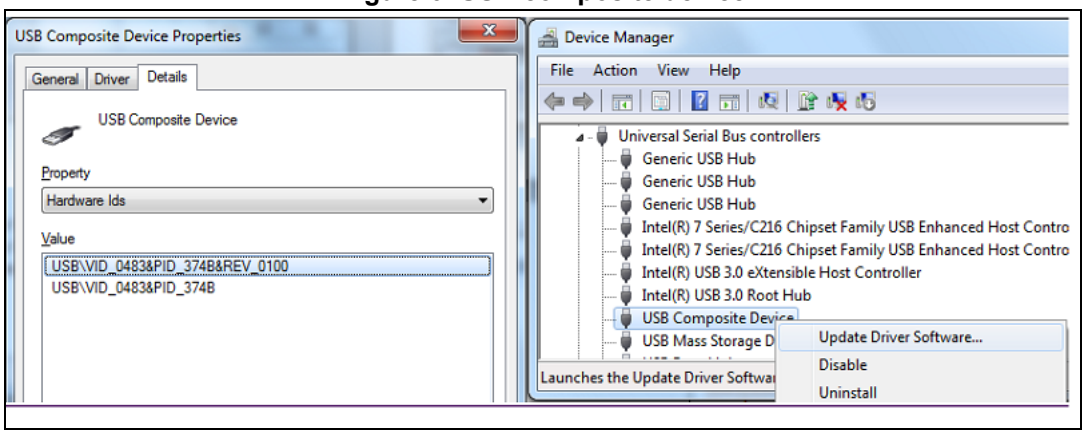
7.3.1 Drivers

The ST-LINK/V2-1 requires a dedicated USB driver, which, for Windows® 7, 8, and 10, can be found at *www.st.com*.

In case the STM32 Nucleo-32 board is connected to the PC before the driver is installed, some Nucleo interfaces may be declared as *Unknown* in the PC device manager. In this case, the user must install the driver files (refer to *Figure 6*) and from the device manager update the driver of the connected device.

Note: Prefer using the USB Composite Device handle for a full recovery.

Figure 6. USB composite device



7.3.2 ST-LINK/V2-1 firmware upgrade

The ST-LINK/V2-1 embeds a firmware upgrade mechanism for in-place upgrade through the USB port. The firmware might evolve during the lifetime of the ST-LINK/V2-1 product (for example new functionalities added, bug fixes, and support for new microcontroller families). It is recommended to visit *www.st.com* before using the STM32 Nucleo-32 board and periodically, to stay updated with the latest firmware version.

7.4 Power supply and power selection

The power supply is provided either by the host PC through the USB cable, or by an external source: VIN (7 V-12 V), +5 V (5 V), or +3V3 power supply pins on CN4. If VIN, +5V, or +3V3 powers the STM32 Nucleo-32 board, this power source must comply with EN 62368-1:2014+A11:2017 or the standard that replaces it. It must also be a safety extralow voltage (SELV) with limited power capability.

If the power supply is +3V3, the ST-LINK is not powered and cannot be used.

7.4.1 Power supply input from USB connector

The STM32 Nucleo-32 board and shield board can be powered by the ST-LINK USB connector CN1. Only the ST-LINK part is power supplied before the USB enumeration phase, as the host PC only provides 100 mA to the boards. During the USB enumeration, the STM32 Nucleo-32 board requires 300 mA of current to the host PC. If the host can provide the required power, the targeted STM32 microcontroller is powered and the red LED LD2 is turned on, thus the STM32 Nucleo-32 board and its shield consume a maximum of 300 mA current and not more. If the host cannot provide the required current, the targeted STM32 microcontroller and the shield board are not power supplied. As a consequence, the red LED LD2 stays turned off. In such a case, it is mandatory to use an external power supply as explained in the next *Section 7.4.2: External power supply inputs*.

SB1 is configured according to the maximum current consumption of the board. SB1 can be set to on to inform the host PC that the maximum current consumption does not exceed 100 mA (even when ARDUINO® Nano shield is plugged). In such a condition, USB enumeration always succeeds since no more than 100 mA is requested from the host PC. Possible configurations of SB1 are summarized in *Table 4*.

Table 4. SB1 configuration

Solder bridge state	Power supply	Allowed current
SB1 OFF (default)	USB power through CN1	300 mA max
SB1 ON		100 mA max
SB1 (ON/OFF)	VIN, +3V3 or +5 V power	For current limitation refer to *Table 5*

Warning: If the maximum current consumption of the STM32 Nucleo-32 board and its shield board exceeds 300 mA, it is mandatory to power the STM32 Nucleo-32 board using an external power supply connected to VIN, +5V, or +3V3.

Note: If the board is powered by a USB charger, there is no USB enumeration. Thus, the LED LD2 remains off permanently and the target STM32 is not powered. In this specific case the SB1 must be set to on, to allow the target STM32 to be powered anyway.

7.4.2 External power supply inputs

The STM32 Nucleo-32 board and its shield boards can be powered in three different ways from an external power supply, depending on the voltage used. The three power sources are summarized in *Table 5*.

Table 5. External power sources

Input power name	Connector pin	Voltage range	Max current	Limitation
VIN	CN4 pin 1	7 V to 12 V	800 mA	From 7 V 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 300 mA input current when 10 V > VIN > 9 V less than 300 mA input current when VIN > 10 V
+5 V	CN4 pin 4	4.75 V to 5.25 V	500 mA	ST-LINK not powered
+3V3	CN4 pin 14	3 V to 3.6 V	-	ST-LINK not powered and SB14 and SB9 must be off.

VIN or +5 V power supply

When powered from VIN or +5 V, it is still possible to use ST-LINK for communication for programming or debugging only, but it is mandatory to power the board first, using VIN or +5 V, then connect the USB cable to the PC. This way, the enumeration always succeeds, thanks to the external power source.

The following power sequence procedure must be respected:

1. Check that SB1 is off
2. Connect the external power source to VIN or +5 V
3. Power on the external power supply 7 V < VIN < 12 V to VIN, or 5 V for +5 V
4. Check that the red LED LD2 is turned on
5. Connect the PC to USB connector CN1

If this order is not respected, VBUS might power the board first, then by VIN or +5 V, and the following risks may be encountered:

1. If the board needs more than 300 mA current, the PC might be damaged or limit the supplied current. As a consequence, the board is not powered correctly.
2. 300 mA is requested at enumeration (since SB1 must be off) so there is the risk that the request is rejected and the enumeration does not succeed if the PC cannot provide such current. Consequently, the board is not power supplied (LED LD2 remains off).

To use the +5 V power supply without the USB connected, the SB9 must be removed to release the NRST pin.

+3V3 power supply

Using the +3V3 (CN4 pin 14) directly as a power input can be interesting, for instance, if 3.3 V is provided by a shield board. In this case, ST-LINK is not powered, thus programming and debugging features are unavailable. When the board is powered by +3V3 (CN4 pin 14), the solder bridge SB14 and SB9 (NRST) must be off.

7.4.3 External power supply output

When powered by USB or VIN, the +5 V (CN4 pin 4) can be used as the output power supply for an ARDUINO® Nano shield. In this case, the maximum current of the power source specified in *Table 5: External power sources* must be respected.

The +3.3 V (CN4 pin 14) can also be used as a power supply output. The current is limited by the maximum current capability of the regulator U3 (500 mA max).

7.5 LEDs

The tricolor LED (green, orange, red) LD1 (COM) provides information about ST-LINK communication status. LD1 default color is red. LD1 turns to green to indicate that the communication is in progress between the PC and the ST-LINK/V2-1, with the following setup:

- Slow blinking red/off: at power-on before USB initialization
- Fast blinking red/off: after the first correct communication between PC and ST-LINK/V2-1 (enumeration)
- Red on: when initialization between PC and ST-LINK/V2-1 is completed
- Green on: after a successful target communication initialization
- Blinking red/green: during communication with the target
- Green on: communication finished and successful
- Orange on: communication failure

User LD3: the green LED is a user LED connected to ARDUINO® Nano signal D13 corresponding to the STM32 I/O PB3 (pin 26). Refer to *Table 9, Table 10*, *Table 12*, *Table 13*, *Table 14*, *Table 15*, and *Table 16* for concerned STM32:

- When the I/O is HIGH value, the LED is on
- When the I/O is LOW, the LED is off

PWR LD2: the red LED indicates that the STM32 part is powered and +5 V power is available.

7.6 Push-button

B1 RESET: the push-button is connected to NRST, and it is used to reset the STM32.

7.7 JP1 (IDD)

Labeled IDD JP1 is used to measure the STM32 microcontroller consumption by removing the jumper and connecting an ammeter:

- JP1 on: STM32 is powered (default)
- JP1 off: an ammeter must be connected to measure the STM32 current

If there is no ammeter, the STM32 is not powered.

7.8 OSC clock

U2 pin 2 and pin 3 can be used as OSC clock input or as ARDUINO® Nano D8 and D7 GPIO. There are four ways to configure the pins corresponding to different STM32 and clock usage (refer to *Table 6*).

Table 6. OSC clock configurations

Solder bridge					STM32	Clock configuration
SB4	SB17	SB6	SB8	SB5 and SB7		
ON	OFF	OFF	ON	OFF	STM32Fxxx	MCO from ST-LINK connected to OSCIN (PF0) (1)
OFF	OFF	ON	ON	OFF		HSI configuration (default configuration)
OFF	ON	OFF	OFF	OFF	STM32Lxxx	MCO from ST-LINK connected to CKIN (PA0)(1)
OFF	OFF	OFF	OFF	ON		32K LSE mounted on X1 (default configuration)
OFF	OFF	ON	ON/OFF	OFF	All	ARDUINO® Nano D7 connected to PF0/PC14
OFF	OFF	ON/OFF	ON	OFF		ARDUINO® Nano D8 connected to PF1/PC15

1. In applications where VCP is used for communication at a speed higher than 9600 bauds, it might be needed to use this solder bridge configuration, to use an 8 MHz clock (MCO from ST-LINK) and get a better precise frequency.

Boards with STM32Lxxx are delivered with 32.768 kHz crystal (X1). Associated capacitors and solder bridges (C12, C13, and SB4 to SB8) are configured to support LSE by default.

Boards with STM32Fxxx are delivered without crystal (X1). Associated capacitors (C12, C13) are not populated and SB4 to SB8 are configured to support HSI by default.

7.9 USART virtual communication

Thanks to SB2 and SB3, the USART interface of STM32 available on PA2 (TX) and PA15 (Rx), can be connected to ST-LINK/V2-1. When USART is not used, it is possible to use PA2 as ARDUINO® Nano A7. Refer to *Table 7*.

Table 7. Virtual communication configuration

Bridge	State(1)	Description
SB2	OFF	PA2 is connected to CN4 pin 5 as ARDUINO® Nano analog input A7 and disconnected from ST-LINK USART.
	ON	PA2 is connected to ST-LINK as Virtual COM TX (default).
SB3	OFF	PA15 is not connected.
	ON	PA15 is connected to ST-LINK as Virtual COM RX (default).

1. The default configuration is reported in bold style.

7.10 Solder bridges

Table 8. Solder bridges

Bridge	State(1)	Description
SB10 (VREF+)	**ON**	VREF+ on STM32 is connected to VDD.
	OFF	VREF+ on STM32 is not connected to VDD and it is provided by pin 13 of CN4.
SB15 (LD3-LED)	**ON**	Green user LED LD3 is connected to D13 of ARDUINO® Nano signal.
	OFF	Green user LED LD3 is not connected.
SB9 (NRST)	**ON**	The NRST signal of ST-LINK is connected to the NRST pin of the STM32.
	OFF	The NRST signal of ST-LINK is not connected to the NRST pin of the STM32, when using external power (+3V3, +5 V) as power supply.
SB11 (PB2/VSS)	**ON**	Pin 16 of STM32 (U2) is connected to VSS.
	OFF	Pin 16 of STM32 (U2) is not connected to VSS and is used as GPIO PB2 for STM32F031.
SB13 (PB8/VSS)	**ON**	Pin 32 of STM32 (U2) is connected to VSS.
	OFF	Pin 32 of STM32 (U2) is not connected to VSS and is used as GPIO PB8 for STM32F031.
SB12 (PB8/BOOT0)	**ON**	Pin 31 of STM32 (U2) is connected to GND via 10K pull-down and used as BOOT0.
	OFF	Pin 16 of STM32 (U2) is not connected and is GPIO PB8 for STM32F042.
SB16	**ON**	STM32 PB6 is connected to CN4 pin 7 for I^2C SCL support on ARDUINO® Nano A5. In such case, STM32 PB6 does not support ARDUINO® Nano D5 and PA6 must be configured as input floating.
SB16	OFF	CN4 pin 7 is used as ARDUINO® Nano analog input A5 without I^2C support and CN3 pin 8 is available as ARDUINO® Nano D5.

Table 8. Solder bridges (continued)

Bridge	State(1)	Description
SB18	**ON**	STM32 PB7 is connected to CN4 pin 8 for I^2C SDA support on ARDUINO® Nano A4. In such case, STM32 PB7 does not support ARDUINO® Nano D4 and PA5 must be configured as input floating.
	OFF	CN4 pin 8 is used as ARDUINO® Nano analog input A4 without I^2C support and CN3 pin 7 is available as ARDUINO® Nano D4.

1. The default configuration is reported in bold style.

7.11 ARDUINO® Nano connectors

CN3 and CN4 are male connectors compatible with the ARDUINO® Nano standard. Most shields designed for ARDUINO® Nano can fit the STM32 Nucleo-32 board.

Caution: The I/Os of STM32 are 3.3 V compatible instead of 5 V for ARDUINO® Nano.

Table 9, *Table 10*, *Table 12, Table 13, Table 14, Table 15,* and *Table 16* show the pin assignments of each STM32 on ARDUINO® Nano connectors.

Figure 7 and *Figure 8* show ARDUINO® Nano connectors and pin assignments for NUCLEO-F031K6, NUCLEO-F042K6, NUCLEO-F303K8, NUCLEO-L011K4, NUCLEO-L031K6, and NUCLEO-L432KC.

Table 9. ARDUINO® Nano connectors on NUCLEO-F031K6

Connector	Pin number	Pin name	STM32 pin	Function
Left connector				
CN3	1	D1	PA9	USART1_TX(1)
	2	D0	PA10	USART1_RX(1)
	3	RESET	NRST	RESET
	4	GND	-	Ground
	5	D2	PA12	-
	6	D3	PB0	TIM3_CH3
	7	D4(5)	PB7	-
	8	D5(5)	PB6	TIM16_CH1N(2)
	9	D6	PB1	TIM14_CH1
	10	D7(3)	PF0	-
	11	D8(3)	PF1	-
	12	D9	PA8	TIM1_CH1
	13	D10	PA11	SPI_CS(4) || TIM1_CH4
	14	D11	PB5	SPI1_MOSI || TIM3_CH2
	15	D12	PB4	SPI1_MISO

Table 9. ARDUINO® Nano connectors on NUCLEO-F031K6 (continued)

Connector	Pin number	Pin name	STM32 pin	Function
Right connector				
CN4	1	VIN	-	Power input
	2	GND	-	Ground
	3	RESET	NRST	RESET
	4	+5V	-	5 V input/output
	5	A7	PA2	ADC_IN2
	6	A6	PA7	ADC_IN7
	7	A5(5)	PA6	ADC_IN6 || I2C1_SCL
	8	A4(5)	PA5	ADC_IN5 || I2C1_SDA
	9	A3	PA4	ADC_IN4
	10	A2	PA3	ADC_IN3
	11	A1	PA1	ADC_IN1
	12	A0	PA0	ADC_IN0
	13	AREF	-	AVDD
	14	+3V3	-	3.3 V input/output
	15	D13	PB3	SPI1_SCK

1. Only one USART is available and shared between ARDUINO® Nano and VCP. The selection is done by remapping (no need to change the hardware configuration).
2. D5 PWM on inverted channel timer 16.
3. D7/D8 shared with OSC_IN/OSC_OUT.
4. SPI_CS is made by GPIO.
5. Limitations on A4 and A5, D4, and D5, related to I^2C configuration, are explained in *Section 7.10: Solder bridges* according to SB16/SB18 setting.

Table 10. ARDUINO® Nano connectors on NUCLEO-F042K6

Connector	Pin number	Pin name	STM32 pin	Function
Left connector				
CN3	1	D1	PA9	USART1_TX
	2	D0	PA10	USART1_RX
	3	RESET	NRST	RESET
	4	GND	-	Ground
	5	D2	PA12	-
	6	D3	PB0	TIM3_CH3
	7	D4(1)	PB7	-
	8	D5(1)	PB6	TIM16_CH1N(2)
	9	D6	PB1	TIM14_CH1
	10	D7(3)	PF0	-
	11	D8(3)	PF1	-
	12	D9	PA8	TIM1_CH1
	13	D10	PA11	SPI_CS(4) || TIM1_CH4
	14	D11	PB5	SPI1_MOSI || TIM3_CH2
	15	D12	PB4	SPI1_MISO
Right connector				
CN4	1	VIN	-	Power input
	2	GND	-	Ground
	3	RESET	NRST	RESET
	4	+5V	-	5 V input/output
	5	A7	PA2	ADC_IN2(5)
	6	A6	PA7	ADC_IN7
	7	A5(1)	PA6	ADC_IN6 || I2C1_SCL
	8	A4(1)	PA5	ADC_IN5 || I2C1_SDA
	9	A3	PA4	ADC_IN4
	10	A2	PA3	ADC_IN3
	11	A1	PA1	ADC_IN1
	12	A0	PA0	ADC_IN0
	13	AREF	-	AVDD
	14	+3V3	-	3.3 V input/output
	15	D13	PB3	SPI1_SCK

1. Limitations on A4 and A5, D4, and D5, related to I^2C configuration, are explained in *Section 7.10: Solder bridges* according to SB16/SB18 setting.
2. D5 PWM on inverted channel timer 16.
3. D7/D8 shared with OSC_IN/OSC_OUT.
4. SPI_CS is made by GPIO.
5. A7 exclusive with VCP_TX.

Table 11. ARDUINO® Nano connectors on NUCLEO-F301K8

Connector	Pin number	Pin name	STM32 pin	Function
Left connector				
CN3	1	D1	PA9	USART1_TX
	2	D0	PA10	USART1_RX
	3	RESET	NRST	RESET
	4	GND	-	Ground
	5	D2	PA12	-
	6	D3	PB0	TIM1_CH2N(1)
	7	D4(2)	PB7	-
	8	D5(2)	PB6	TIM16_CH1N(1)
	9	D6	PB1	TIM1_CH3N(1)
	10	D7(3)	PF0	-
	11	D8(3)	PF1	-
	12	D9	PA8	TIM1_CH1
	13	D10	PA11	SPI_CS(4) || TIM1_CH4
	14	D11	PB5	SPI3_MOSI || TIM17_CH1
	15	D12	PB4	SPI3_MISO
Right connector				
CN4	1	VIN	-	Power input
	2	GND	-	Ground
	3	RESET	NRST	RESET
	4	+5V	-	5 V input/output
	5	A7	PA2	ADC1_IN3(5)
	6	A6	PA7	ADC1_IN5
	7	A5(2)	PA6	ADC1_IN10 || I2C1_SCL
	8	A4(2)	PA5	ADC(6) || I2C1_SDA
	9	A3	PA4	ADC1_IN5
	10	A2	PA3	ADC1_IN4
	11	A1	PA1	ADC1_IN2
	12	A0	PA0	ADC1_IN1
	13	AREF	-	AVDD
	14	+3V3	-	3.3 V input/output
	15	D13	PB3	SPI3_SCK

1. D3, D5, and D6 PWM on inverted channel.
2. Limitations on A4 and A5, D4, and D5, related to I^2C configuration, are explained in *Section 7.10: Solder bridges* according to SB16/SB18 setting.
3. D7/D8 shared with OSC_IN/OSC_OUT.
4. SPI_CS is made by GPIO.
5. PA2 exclusive with VCP_TX.
6. No ADC on A4.

Table 12. ARDUINO® Nano connectors on NUCLEO-F303K8

Connector	Pin number	Pin name	STM32 pin	Function
Left connector				
CN3	1	D1	PA9	USART1_TX
	2	D0	PA10	USART1_RX
	3	RESET	NRST	RESET
	4	GND	-	Ground
	5	D2	PA12	-
	6	D3	PB0	TIM3_CH3
	7	D4(1)	PB7	-
	8	D5(1)	PB6	TIM16_CH1N(2)
	9	D6	PB1	TIM3_CH4
	10	D7(3)	PF0	-
	11	D8(3)	PF1	-
	12	D9	PA8	TIM1_CH1
	13	D10	PA11	SPI_CS(4) || TIM1_CH4
	14	D11	PB5	SPI1_MOSI || TIM17_CH1
	15	D12	PB4	SPI1_MISO
Right connector				
CN4	1	VIN	-	Power input
	2	GND	-	Ground
	3	RESET	NRST	RESET
	4	+5V	-	5 V input/output
	5	A7	PA2	ADC1_IN3(5)
	6	A6	PA7	ADC2_IN4
	7	A5(1)	PA6	ADC2_IN3 || I2C1_SCL
	8	A4(1)	PA5	ADC2_IN2 || I2C1_SDA
	9	A3	PA4	ADC2_IN1
	10	A2	PA3	ADC1_IN4
	11	A1	PA1	ADC1_IN2
	12	A0	PA0	ADC1_IN1
	13	AREF	-	AVDD
	14	+3V3	-	3.3 V input/output
	15	D13	PB3	SPI1_SCK

1. Limitations on A4 and A5, D4, and D5, related to I^2C configuration, are explained in *Section 7.10: Solder bridges* according to SB16/SB18 setting.
2. D5 PWM on inverted channel timer 16.
3. D7/D8 shared with OSC_IN/OSC_OUT.
4. SPI_CS is made by GPIO.
5. A7 exclusive with VCP_TX.

Table 13. ARDUINO® Nano connectors on NUCLEO-L011K4

Connector	Pin number	Pin Name	STM32 pin	Function
Left connector				
CN3	1	D1	PA9	USART2_TX(1)
	2	D0	PA10	USART2_RX(1)
	3	RESET	NRST	RESET
	4	GND	-	Ground
	5	D2	PA12	-
	6	D3	PB0	TIM2_CH3(2)
	7	D4(3)	PB7	
	8	D5(3)	PB6	TIM2_CH3(2)
	9	D6	PB1	TIM2_CH4
	10	D7(4)	PC14	-
	11	D8(4)	PC15	-
	12	D9	PA8	TIM(5)
	13	D10	PA11	SPI_CS(6) || TIM(5)
	14	D11	PB5	SPI1_MOSI || TIM(5)
	15	D12	PB4	SPI1_MISO
Right connector				
CN4	1	VIN	-	Power input
	2	GND	-	Ground
	3	RESET	NRST	RESET
	4	+5V	-	5 V input/output
	5	A7	PA2	ADC_IN2(7)
	6	A6	PA7	ADC_IN7
	7	A5(3)	PA6	ADC_IN6 || I2C1_SCL
	8	A4(3)	PA5	ADC_IN5 || I2C1_SDA
	9	A3	PA4	ADC_IN4
	10	A2	PA3	ADC_IN3
	11	A1	PA1	ADC_IN1
	12	A0	PA0	ADC_IN0
	13	AREF	-	AVDD
	14	+3V3	-	3.3 V input/output
	15	D13	PB3	SPI1_SCK

1. Only one USART is available and shared between ARDUINO® Nano and VCP. The selection is done by remapping (no hardware configuration to change).
2. D3 and D5 PWM are using the same channel of TIM2_CH3.
3. Limitations on A4 and A5, D4, and D5, related to I^2C configuration, are explained in *Section 7.10: Solder bridges* according to SB16/SB18 setting.
4. D7/D8 shared with OSC_IN/OSC_OUT.
5. No PWM on D9, D10, D11.
6. SPI_CS is made by GPIO.
7. PA2 exclusive with VCP_TX.

Table 14. ARDUINO® Nano connectors on NUCLEO-L031K6

Connector	Pin number	Pin name	STM32 pin	Function
Left connector				
CN3	1	D1	PA9	USART2_TX(1)
	2	D0	PA10	USART2_RX(1)
	3	RESET	NRST	RESET
	4	GND	-	Ground
	5	D2	PA12	-
	6	D3	PB0	TIM2_CH3
	7	D4(2)	PB7	-
	8	D5(2)	PB6	TIM21_CH1
	9	D6	PB1	TIM2_CH4
	10	D7(3)	PC14	-
	11	D8(3)	PC15	-
	12	D9	PA8	TIM2_CH1
	13	D10	PA11	SPI_CS(4) || TIM21_CH2
	14	D11	PB5	SPI1_MOSI || TIM22_CH2
	15	D12	PB4	SPI1_MISO
Right connector				
CN4	1	VIN	-	Power input
	2	GND	-	Ground
	3	RESET	NRST	RESET
	4	+5V	-	5 V input/output
	5	A7	PA2	ADC_IN2(5)
	6	A6	PA7	ADC_IN7
	7	A5(2)	PA6	ADC_IN6 || I2C1_SCL
	8	A4(2)	PA5	ADC_IN5 || I2C1_SDA
	9	A3	PA4	ADC_IN4
	10	A2	PA3	ADC_IN3
	11	A1	PA1	ADC_IN1
	12	A0	PA0	ADC_IN0
	13	AREF	-	AVDD
	14	+3V3	-	3.3 V input/output
	15	D13	PB3	SPI1_SCK

1. Only one USART is available and shared between ARDUINO® Nano and VCP. The selection is done by remapping (no hardware configuration to change).
2. Limitations on A4 and A5, D4, and D5, related to I^2C configuration, are explained in *Section 7.10: Solder bridges* according to SB16/SB18 setting.
3. D7/D8 shared with OSC32_IN/OSC32_OUT.
4. SPI_CS is made by GPIO.
5. PA2 exclusive with VCP_TX.

Table 15. ARDUINO® Nano connectors on NUCLEO-L412KB

Connector	Pin number	Pin name	STM32 pin	Function
Left connector				
CN3	1	D1	PA9	USART1_TX
	2	D0	PA10	USART1_RX
	3	RESET	NRST	RESET
	4	GND	-	Ground
	5	D2	PA12	-
	6	D3	PB0	TIM1_CH2N(1)
	7	D4(2)	PB7	-
	8	D5(2)	PB6	TIM16_CH1N(1)
	9	D6	PB1	TIM1_CH3N(1)
	10	D7(3)	PC14	-
	11	D8(3)	PC15	-
	12	D9	PA8	TIM1_CH1
	13	D10	PA11	SPI_CS(4) || TIM1_CH4
	14	D11	PB5	SPI1_MOSI || TIM(5)
	15	D12	PB4	SPI1_MISO
Right connector				
CN4	1	VIN	-	Power input
	2	GND	-	Ground
	3	RESET	NRST	RESET
	4	+5V	-	5 V input/output
	5	A7	PA2	ADC1_IN7(6)
	6	A6	PA7	ADC1_IN12
	7	A5(2)	PA6	ADC1_IN11 || I2C1_SCL
	8	A4(2)	PA5	ADC1_IN10 || I2C1_SDA
	9	A3	PA4	ADC1_IN9
	10	A2	PA3	ADC1_IN8
	11	A1	PA1	ADC1_IN6
	12	A0	PA0	ADC1_IN5
	13	AREF	-	AVDD
	14	+3V3	-	3.3 V input/output
	15	D13	PB3	SPI1_SCK

1. D3, D5, and D6 PWM on inverted channel.
2. Limitations on A4 and A5, D4, and D5, related to I^2C configuration, are explained in *Section 7.10: Solder bridges* according to SB16/SB18 setting.
3. D7/D8 shared with OSC32_IN/OSC32_OUT.
4. SPI_CS is made by GPIO.
5. No PWM on D11.
6. PA2 exclusive with VCP_TX.

Table 16. ARDUINO® Nano connectors on NUCLEO-L432KC

Connector	Pin number	Pin name	STM32 pin	Function
Left connector				
CN3	1	D1	PA9	USART1_TX
	2	D0	PA10	USART1_RX
	3	RESET	NRST	RESET
	4	GND	-	Ground
	5	D2	PA12	-
	6	D3	PB0	TIM1_CH2N(1)
	7	D4(2)	PB7	
	8	D5(2)	PB6	TIM16_CH1N(1)
	9	D6	PB1	TIM1_CH3N(1)
	10	D7(3)	PC14	-
	11	D8(3)	PC15	-
	12	D9	PA8	TIM1_CH1
	13	D10	PA11	SPI_CS(4) || TIM1_CH4
	14	D11	PB5	SPI1_MOSI || TIM(5)
	15	D12	PB4	SPI1_MISO
Right connector				
CN4	1	VIN	-	Power input
	2	GND	-	Ground
	3	RESET	NRST	RESET
	4	+5V	-	5 V input/output
	5	A7	PA2	ADC12_IN7(6)
	6	A6	PA7	ADC12_IN12
	7	A5(2)	PA6	ADC12_IN11 || I2C1_SCL
	8	A4(2)	PA5	ADC12_IN10 || I2C1_SDA
	9	A3	PA4	ADC12_IN9
	10	A2	PA3	ADC12_IN8
	11	A1	PA1	ADC12_IN6
	12	A0	PA0	ADC12_IN5
	13	AREF	-	AVDD
	14	+3V3	-	3.3 V input/output
	15	D13	PB3	SPI1_SCK

1. D3, D5, and D6 PWM on inverted channel.
2. Limitations on A4 and A5, D4, and D5, related to I^2C configuration, are explained in *Section 7.10: Solder bridges* according to SB16/SB18 setting.
3. D7/D8 shared with OSC32_IN/OSC32_OUT.
4. SPI_CS is made by GPIO.
5. No PWM on D11.
6. PA2 exclusive with VCP_TX.

Figure 7. NUCLEO-F031K6, NUCLEO-F042K6, NUCLEO-F303K8, and NUCLEO-F301K8 pin assignment

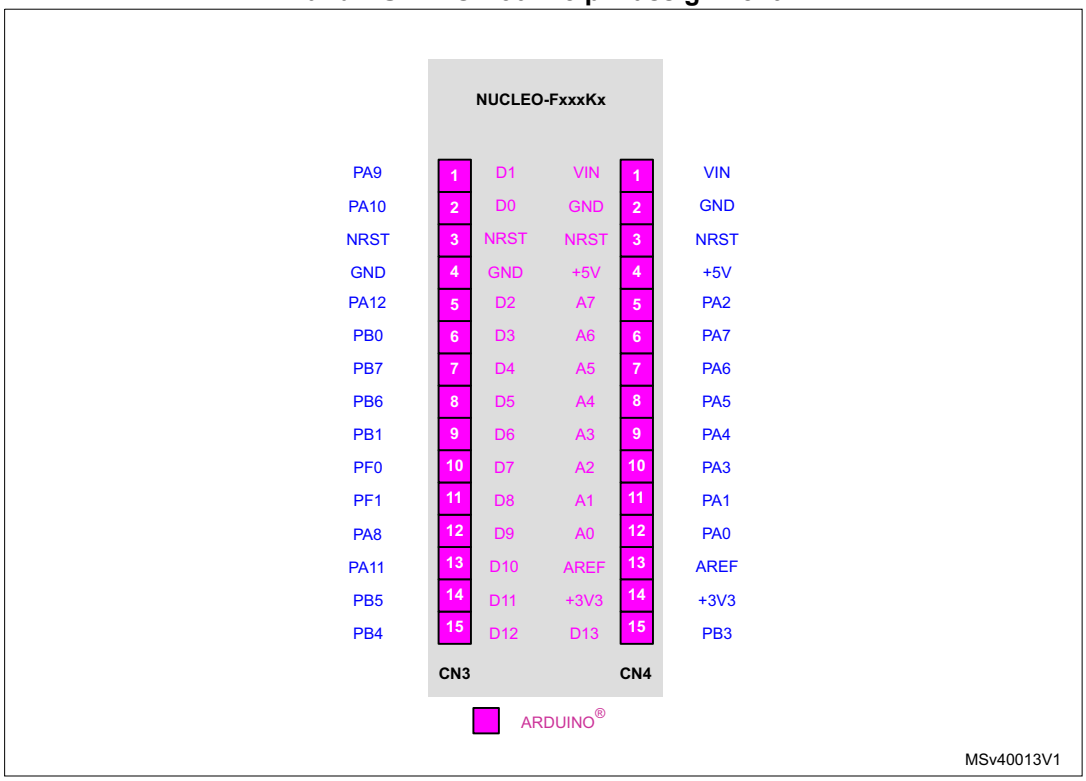
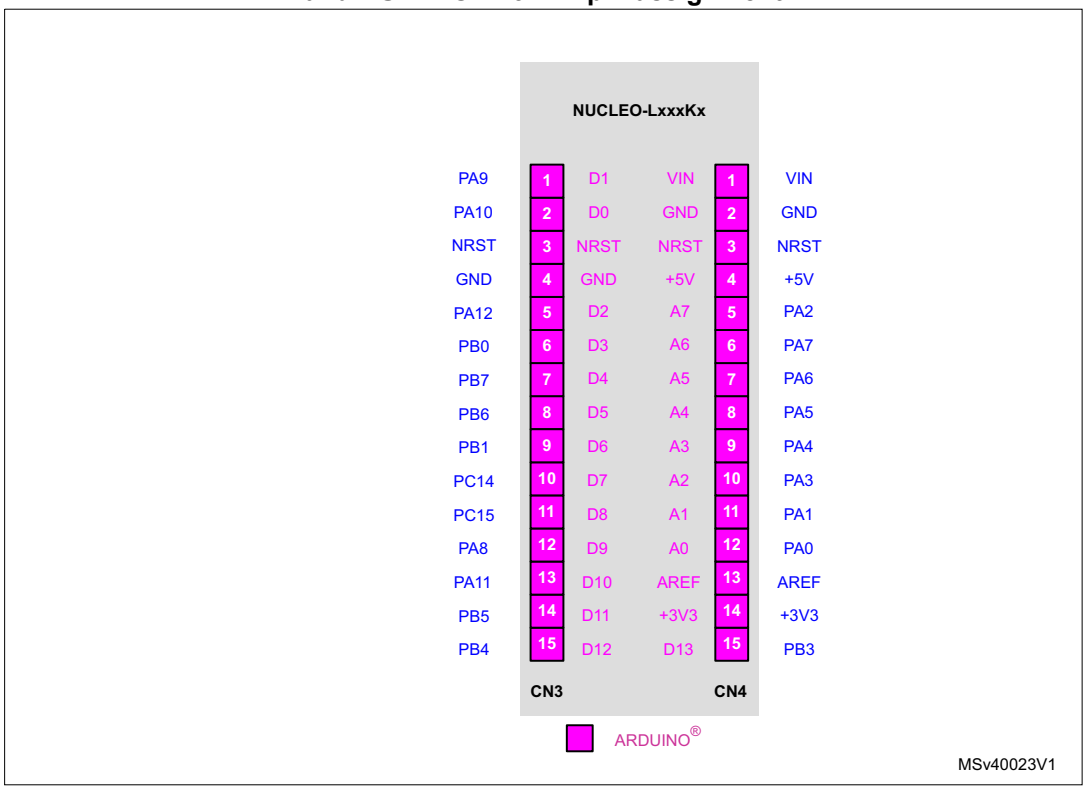


Figure 8. NUCLEO-L011K4, NUCLEO-L031K6, NUCLEO-L412KB, and NUCLEO-L432KC pin assignment

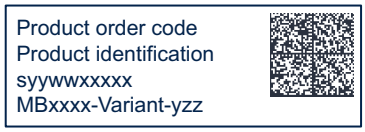


8 Nucleo-32 (MB1180) information

8.1 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 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.

8.2 Nucleo-32 (MB1180) product history

Table 17. Product history

Order code	Product identification	Product details	Product change description	Product limitations
NUCLEO-F031K6	NUCLEOF031K6/	MCU: – STM32F031K6T6 revision “A”, “1”, or “2”	Initial revision	No limitation
		MCU errata sheet: – *STM32F031x4/x6 device errata* (ES0236)		
		Board: – MB1180-F031K6-B01 (main board)		
	NUF031K6$AU1	MCU: – STM32F031K6T6 revision “A”, “1”, or “2”	Packaging: plastic blister replaced by a carton box	No limitation
		MCU errata sheet: – *STM32F031x4/x6 device errata* (ES0236)		
		Board: – MB1180-F031K6-B01 (main board)		
NUCLEO-F042K6	NUCLEOF042K6/	MCU: – STM32F042K6T6 revision “A”	Initial revision	No limitation
		MCU errata sheet: – *STM32F042x4/x6 device errata* (ES0243)		
		Board: – MB1180-F042K6-C02 (main board)		
	NUF042K6$AU1	MCU: – STM32F042K6T6 revision “A”	Packaging: plastic blister replaced by a carton box	No limitation
		MCU errata sheet: – *STM32F042x4/x6 device errata* (ES0243)		
		Board: – MB1180-F042K6-C02 (main board)		

Table 17. Product history (continued)

Order code	Product identification	Product details	Product change description	Product limitations
NUCLEO-F301K8	NUF301K8$AU1	MCU: – STM32F301K8T6 revision “Z”	Initial revision	No limitation
		MCU errata sheet: – *STM32F301x6/x8 device errata* (ES0237)		
		Board: – MB1180-F301K8-C02 (main board)		
NUCLEO-F303K8	NUCLEOF303K8/	MCU: – STM32F303K8T6 revision “Z”	Initial revision	No limitation
		MCU errata sheet: – *STM32F303x6/x8 Rev Z device limitations* (ES0246)		
		Board: – MB1180-F303K8-C02 (main board)		
	NUF303K8$AU1	MCU: – STM32F303K8T6 revision “Z”	Packaging: plastic blister replaced by a carton box	No limitation
		MCU errata sheet: – *STM32F303x6/x8 Rev Z device limitations* (ES0246)		
		Board: – MB1180-F303K8-C02 (main board)		

Table 17. Product history (continued)

Order code	Product identification	Product details	Product change description	Product limitations
NUCLEO-L011K4	NUCLEOL011K4/	MCU: – STM32L011K4T6 revision “A”	Initial revision	No limitation
		MCU errata sheet: – *STM32L011xx/L021xx device errata* (ES0332)		
		Board: – MB1180-L011K4-C02 (main board)		
	NUL011K4$AU1	MCU: – STM32L011K4T6 revision “A”	Packaging: plastic blister replaced by a carton box	No limitation
		MCU errata sheet: – *STM32L011xx/L021xx device errata* (ES0332)		
		Board: – MB1180-L011K4-C02 (main board)		
NUCLEO-L031K6	NUCLEOL031K6/	MCU: – STM32L031K6T6 revision “X” or “Y”	Initial revision	No limitation
		MCU errata sheet: – *STM32L031xx/L041xx device errata* (ES0322)		
		Board: – MB1180-L031K6-C02 (main board)		
	NUL031K6$AU1	MCU: – STM32L031K6T6 revision “X” or “Y”	Packaging: plastic blister replaced by a carton box	No limitation
		MCU errata sheet: – *STM32L031xx/L041xx device errata* (ES0322)		
		Board: – MB1180-L031K6-C02 (main board)		

Table 17. Product history (continued)

Order code	Product identification	Product details	Product change description	Product limitations
NUCLEO-L412KB	NUL412KB$AU1	MCU: – STM32L412KBU6 revision “A”	Initial revision	No limitation
		MCU errata sheet: – *STM32L412xx device errata* (ES0456)		
		Board: – MB1180-L412KB-C02 (main board)		
	NUL412KB$AU2	MCU: – STM32L412KBU6 revision “A”	Packaging: plastic blister replaced by a carton box	No limitation
		MCU errata sheet: – *STM32L412xx device errata* (ES0456)		
		Board: – MB1180-L412KB-C02 (main board)		
NUCLEO-L432KC	NUCLEOL432KC/	MCU: – STM32L432KCU6 revision “A” or “Z”	Initial revision	No limitation
		MCU errata sheet: – *STM32L432KB/KC and STM32L442KC device errata* (ES0319)		
		Board: – MB1180-L432KC-C02 (main board)		
	NUL432KC$AU1	MCU: – STM32L432KCU6 revision “A” or “Z”	Packaging: plastic blister replaced by a carton box	No limitation
		MCU errata sheet: – *STM32L432KB/KC and STM32L442KC device errata* (ES0319)		
		Board: – MB1180-L432KC-C02 (main board)		

8.3 Board revision history

Table 18. Board revision history

Board reference	Board variant and revision	Board change description	Board limitations
MB1180 (main board)	F031K6-B01 F042K6-C02	Initial revision	No limitation
	F301K8-C02 F303K8-C02	Initial revision	No limitation
	L011K4-C02 L031K6-C02	Initial revision	No limitation
	L412KB-C02 L432KC-C02	Initial revision	No limitation

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

9.1 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 a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Responsible party (in the USA)

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

9.2 ISED Compliance Statement

Compliance Statement

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

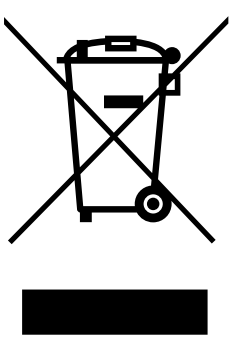
Déclaration de conformité

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

10 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 19. Document revision history

Date	Revision	Revision Details
14-Oct-2015	1	Initial version.
21-Mar-2016	2	Update to introduce NUCLEO-L011K4. Updated *Introduction*, *Chapter 1: Features*, *Chapter 3: Ordering information*, *Chapter 6: Hardware layout and configuration*. Added *Appendix A: Compliance statements*.
30-Jun-2016	3	Updated *Introduction*, *Chapter 3: Ordering information* and *Table 14: ARDUINO® Nano connectors on NUCLEO-L432KC* to add NUCLEO-L432KC.
23-Aug-2018	4	Extended document scope to NUCLEO-L412KB: – Updated *Introduction* – Updated *Chapter 3: Ordering information* – Added *Table 14: ARDUINO® Nano connectors on NUCLEO-L412KB* – Extended *Figure 8* description Updated *Chapter 1: Features*, *Chapter 2: Product marking*, and *Section 5.2: System requirements*
12-Nov-2018	5	Updated document title with reference board identifier. Extended document scope to NUCLEO-F301K8: – Updated *Introduction* – Updated *Chapter 2: Product marking* and *Chapter 3: Ordering information* – Added *Table 11: ARDUINO® Nano connectors on NUCLEO-F301K8* – Extended *Figure 7* description
26-Mar-2025	6	Specific document updates: – Added a note for +5V power supply without the USB connected to *External power supply inputs* – Updated SB16 and SB18 descriptions in *Solder bridges* Global document updates: – Removed *Electrical schematics* – Updated *Features*, *Ordering information*, and *Development environment* – Added *Safety recommendations*, *Nucleo-32 (MB1180) information*, and *Product disposal* – Updated *Federal Communications Commission (FCC) and ISED Canada Compliance Statements*. Removed the references to Arm® Mbed™.