STM32G0 Nucleo-32 board (MB1455)

Introduction

The STM32G0 Nucleo-32 board based on the MB1455 reference board (NUCLEO-G031K8) 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 STM32G0 microcontroller.

The Arduino™ Nano V3 connectivity support allows the easy expansion of the functionality of the STM32 Nucleo open development platform with a wide choice of specialized shields.

The STM32G0 Nucleo-32 board does not require any separate probe as it integrates the ST-LINK/V2-1 debugger/programmer.

The STM32G0 Nucleo-32 board comes with the STM32 comprehensive free software libraries and examples available with the STM32CubeG0 MCU Package.

Figure 1. NUCLEO-G031K8 top view

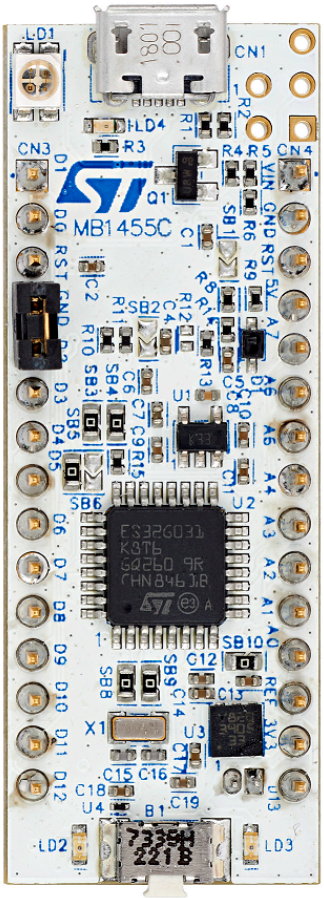
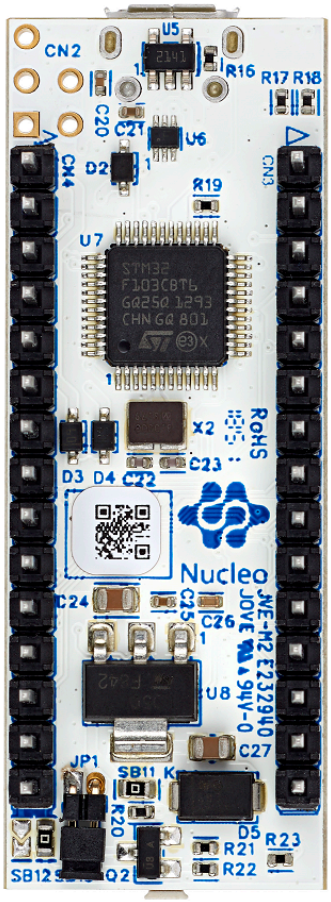


Figure 2. NUCLEO-G031K8 bottom view



Pictures are not contractual.

1 Features

- STM32G031K8T6U microcontroller (Arm® Cortex®-M0+ at 64 MHz) in LQFP32 package, featuring 64 Kbytes of Flash memory and 8 Kbytes of SRAM
- 1 user LED
- 1 RESET or user push-button
- Board connectors:
  - Arduino™ Nano V3 expansion connector
  - USB with Micro-B
- Flexible power-supply options: ST-LINK USB V_{BUS} or 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 STM32CubeG0 MCU Package
- Support of a wide choice of Integrated Development Environments (IDEs) including IAR™, Keil®, GCC-based IDEs

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

2 Ordering information

To order the STM32G0 Nucleo-32 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	Reference board	Target STM32
NUCLEO-G031K8	MB1455	STM32G031K8T6U

2.1 Product marking

Evaluation tools marked as “ES” or “E” are not yet qualified and therefore not ready to be used as reference design or in production. Any consequences deriving from such usage will not be at ST charge. In no event, ST will be liable for any customer usage of these engineering sample tools as reference design or in production.

“E” or “ES” marking examples of location:

- On the targeted STM32 that is soldered on the board (for 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.

This board features 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.

In order to use the same commercial stack in his application, a developer may need to purchase a part number specific to this stack/library. The price of those part numbers includes the stack/library royalties.

2.2 Products and codification

The meaning of the codification is explained in Table 2.

Table 2. Codification explanation

NUCLEO-XXYYKT	Description	Example: NUCLEO-G031K8
XX	MCU series in STM32 Arm Cortex MCUs	STM32G0 Series
YY	MCU product line in the series	STM32G031
K	STM32 package pin count	32 pins
T	STM32 Flash memory size: • 8 for 64 Kbytes	64 Kbytes

The order code is mentioned on a sticker placed on the top side of the board.

3 Development environment

3.1 System requirements

- Windows® OS (7, 8 and 10), Linux® 64-bit, or macOS®
- USB Type-A to Micro-B cable

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

3.2 Development toolchains

- Keil® **free** MDK-ARM (see note)
- IAR™ EWARM (see note)
- GCC-based IDEs

Note: 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 should be 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

5 Quick start

The STM32G0 Nucleo-32 board is a low-cost and easy-to-use development kit, used to evaluate and start a development quickly with an STM32G0 Series microcontroller in LFQFP 32-pin 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 STM32G0 Nucleo-32 and for demonstration software, visit the www.st.com/stm32nucleo webpage.

5.1 Getting started

Follow the sequence below to configure the STM32G0 Nucleo-32 board and launch the demonstration application (refer to Figure 4 for component location):

1. Check the jumper position on the board (refer to Table 4)
2. For the correct identification of the device interfaces from the host PC and before connecting the board, install the ST-LINK/V2-1 USB driver available on the *www.st.com* website
3. To power the board, connect the STM32G0 Nucleo-32 board to a PC with a USB cable (Type-A to Micro-B) through the USB connector CN1 of the board
4. Then, red LED LD1 (COM) and green LED LD2 (5V_PWR) light up, green LED LD3 blinks
5. Remove the jumper placed between D2 (CN3 pin 5) and GND (CN3 pin 4)
6. Observe how the blinking of the green LED LD3 changes, when the jumper is in place or removed
7. Download the demonstration software and several software examples that help to use the STM32 Nucleo features. These are available on the NUCLEO-G031K8 webpage
8. Develop your own application using the available examples

Table 4. Jumper configuration

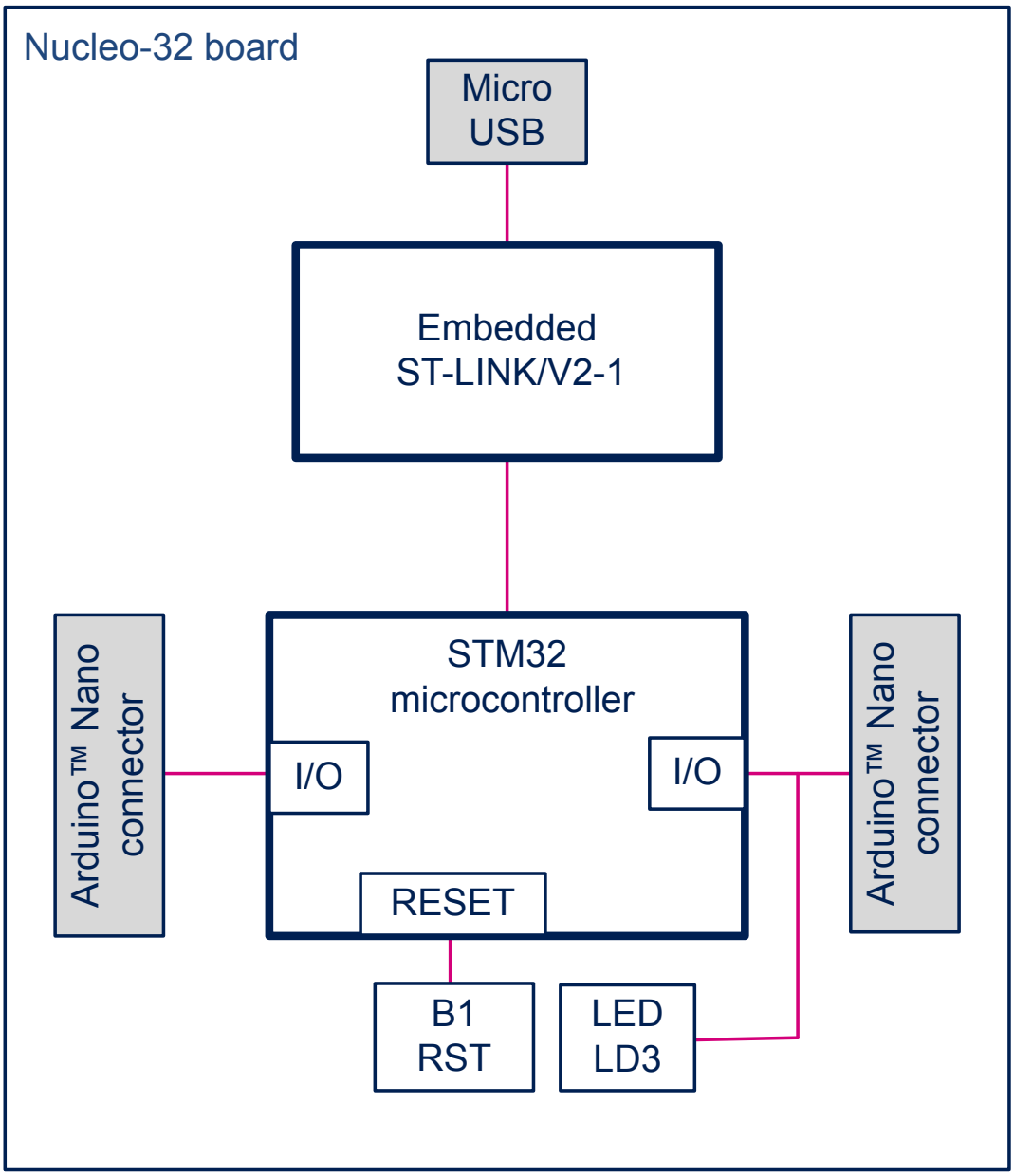
Jumper	Definition	Position[1]	Comment[1]
JP1	IDD	**ON**	**For STM32G0 current measurement**

1. *Default jumper state is shown in bold.*

6 Hardware layout and configuration

The STM32G0 Nucleo-32 board is designed around an STM32G031 microcontroller in an LFQFP 32-pin package. Figure 3 shows the connections between the STM32 and its peripherals (ST-LINK/V2-1, push-button, LEDs, USB, and Arduino™ Nano). Figure 4. Top layout and Figure 5. Bottom layout show the location of these features on the STM32G0 Nucleo-32 board. The mechanical dimensions of the board are shown in Figure 6.

Figure 3. Hardware block diagram



6.1 PCB layout

Figure 4. **Top layout**

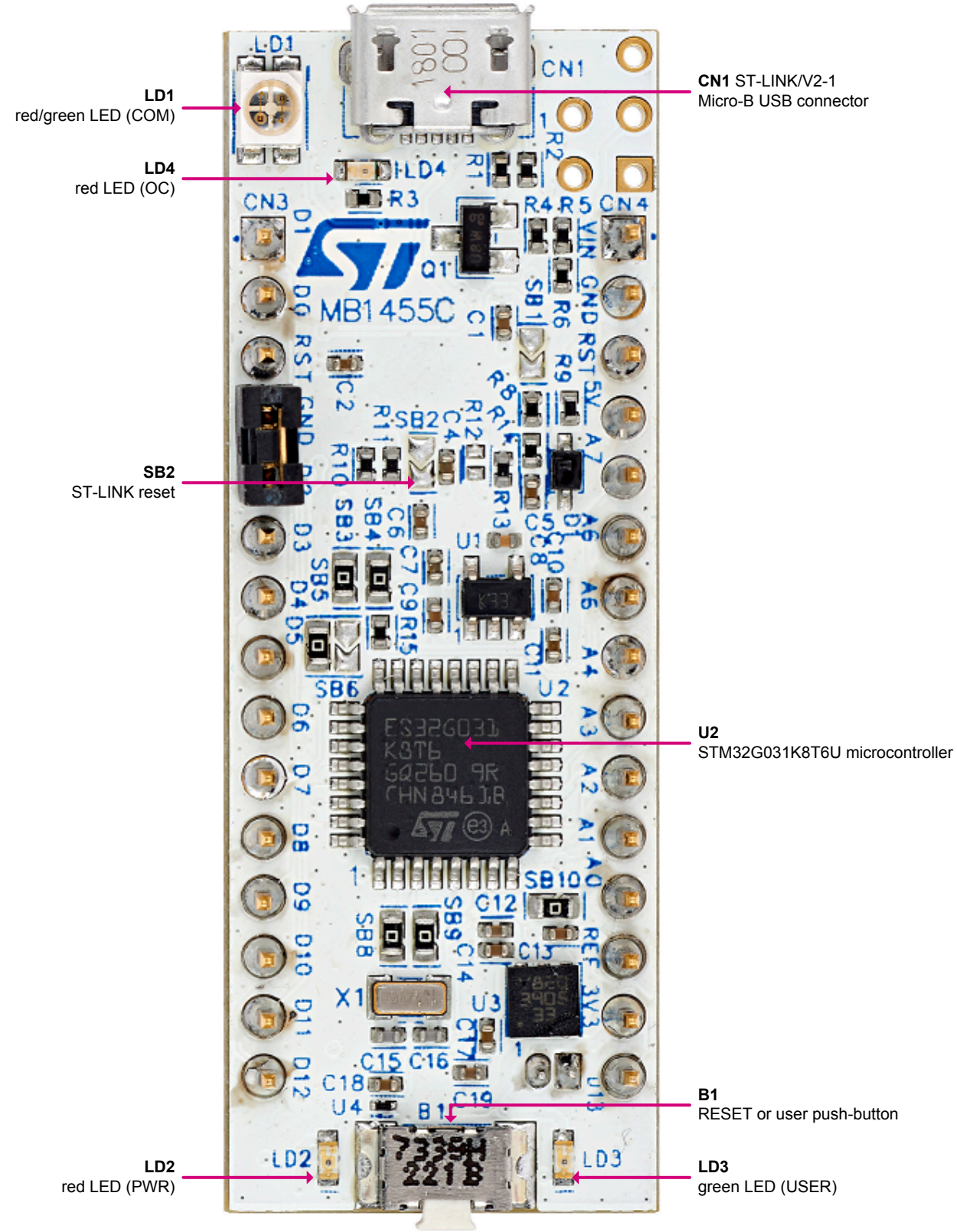
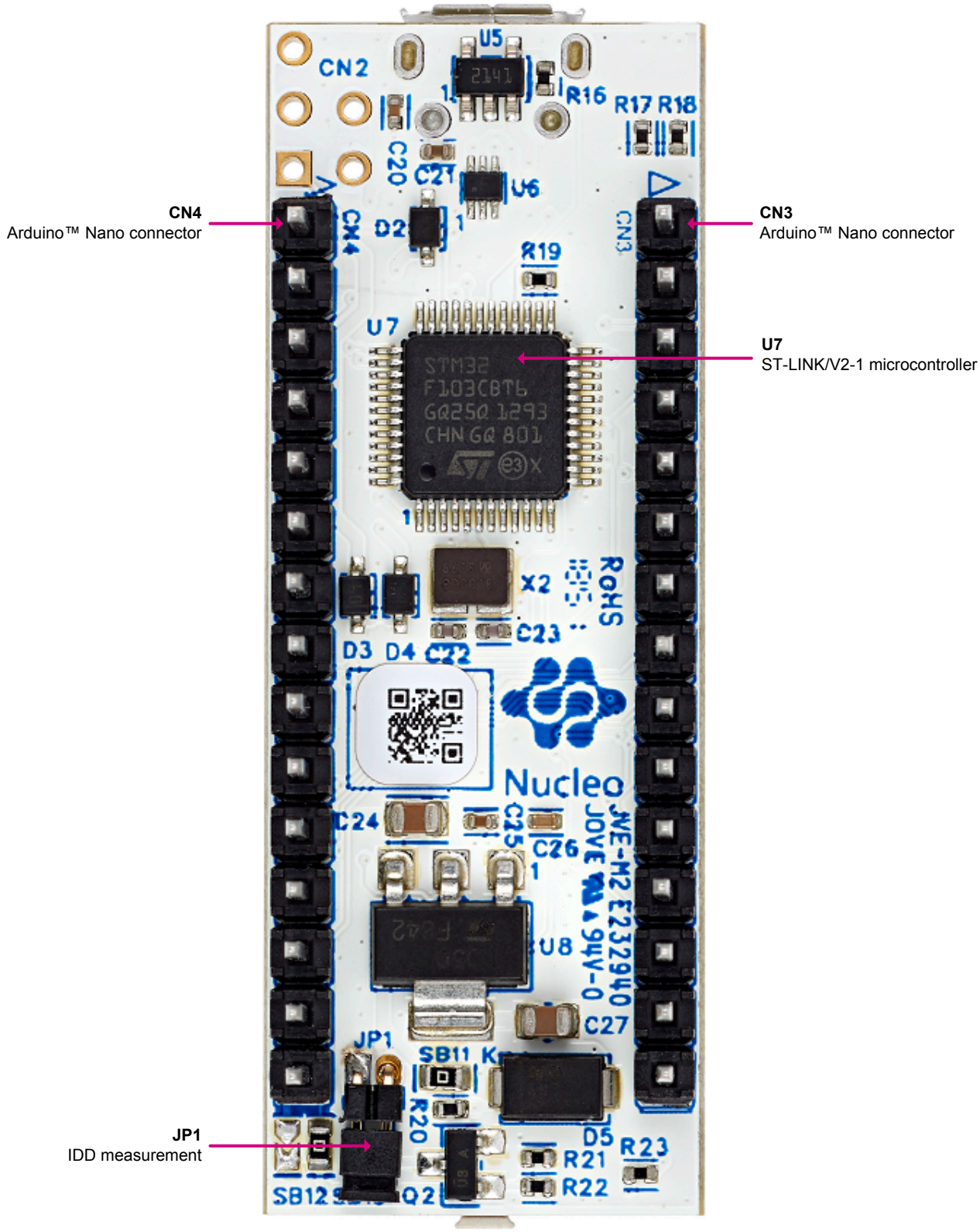
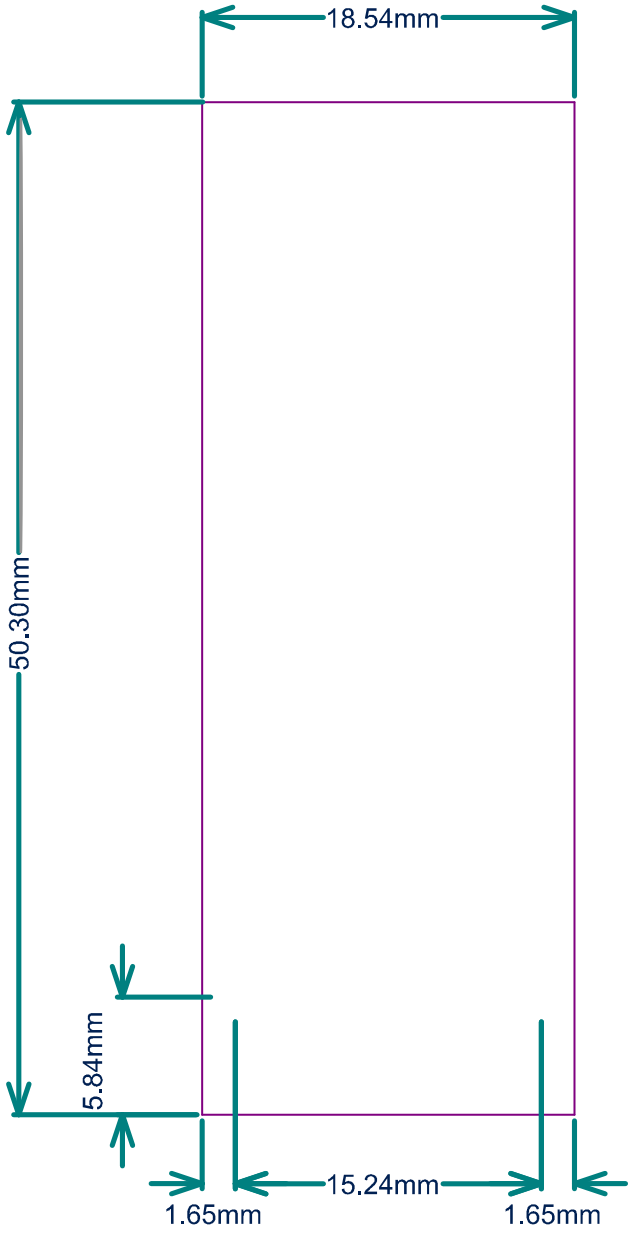


Figure 5. **Bottom layout**



6.2 Mechanical drawing

Figure 6. **STM32G0 Nucleo-32 board mechanical drawing (in millimeter)**



6.3 Embedded ST-LINK/V2-1

The ST-LINK/V2-1 programming and debugging tool is integrated in the STM32G0 Nucleo-32 board.

For detailed information about the debugging and programming features of ST-LINK/V2-1, refer to the *ST-LINK/V2 in-circuit debugger/programmer for STM8 and STM32* user manual (UM1075) and *Overview of ST-LINK derivatives* technical note (TN1235).

Features supported by the ST-LINK/V2-1:

- 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

Features not supported on ST-LINK/V2-1:

- 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.

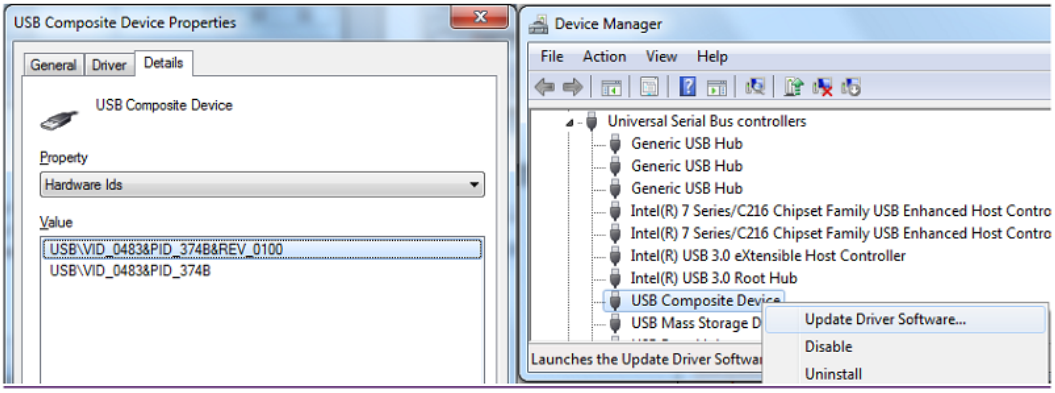
6.3.1 Drivers

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

In case the STM32G0 Nucleo-32 board is connected to the PC before the driver is installed, some STM32G0 Nucleo-32 interfaces may 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 a shown in .

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

Figure 7. USB composite device



6.3.2 ST-LINK/V2-1 firmware upgrade

The ST-LINK/V2-1 embeds a firmware upgrade mechanism for in-situ upgrade through the USB port. As the firmware may evolve during the lifetime of the ST-LINK/V2-1 product (for example new functionalities, bug fixes, support for new microcontroller families), it is recommended to visit the *www.st.com* website before starting to use the STM32G0 Nucleo-32 board and periodically, to stay up-to-date with the latest firmware version.

6.4 Power supply

The power supply is provided either by the host PC through the USB cable, or by an external source: VIN (7 V - 12 V), +5V (5 V) or +3V3 (3.3 V) power supply pins on CN4. In case VIN, +5V or +3V3 is used to power the STM32G0 Nucleo-32 board, this power source must comply with the standard *EN-60950-1: 2006+A11/2009*, and must be Safety Extra Low Voltage (SELV) with limited power capability. In case the power supply is +3V3, the ST-LINK is not powered and cannot be used.

6.4.1 Power supply input from the USB connector

The STM32G0 Nucleo-32 board and shield board can be powered from 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 at that time. During the USB enumeration, the STM32G0 Nucleo-32 board requires 300 mA of current to the host PC. If the host is able to provide the required power, the target STM32 microcontroller is powered and red LED LD2 is turned on, thus the STM32G0 Nucleo-32 board and its shield consume a maximum of 300 mA current and not more. If the host is not able to provide the required current, the target STM32 microcontroller and the shield board are not power supplied. As a consequence the red LED LD2 stays turned off. In such case, it is mandatory to use an external power supply as explained in Section 6.4.2 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 the Arduino™ Nano shield is plugged). In such condition, USB enumeration always succeeds since not more than 100 mA is requested to the host PC. Possible configurations of SB1 are summarized in Table 5.

Table 5. 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 +5V power	For current limitation, refer to Table 6

Attention: *If the maximum current consumption of the STM32G0 Nucleo-32 board and its shield board exceeds 300 mA, it is mandatory to power the STM32G0 Nucleo-32 board by means of an external power supply connected to VIN, +5V or +3V3.*

Note: In case the board is powered by a USB charger, there is no USB enumeration. 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.

6.4.2 External power supply inputs

The STM32G0 Nucleo-32 board and its shield board can be powered in three different ways from an external power supply, depending on the voltage used. The three power sources are summarized in the Table 6.

Table 6. External power sources

Input power name	Connector pin	Voltage range	Max current	Limitation
VIN	CN4 pin 1	7 V to 12 V	800mA	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
+5V	CN4 pin 4	4.75 V to 5.25 V	500mA	-
+3V3	CN4 pin 14	3 V to 3.6 V	-	ST-LINK not powered and SB2 and SB3 must be OFF.

VIN or +5V 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 to connect the USB cable to the PC. By this way the enumeration succeeds anyway, because of 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 +5V
3. Power on the external power supply 7 V < VIN < 12 V to VIN, or 5 V for +5V
4. Check that red LED LD2 is turned on
5. Connect the PC to USB connector CN1

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

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

+3V3 power supply

Using the +3V3 (CN4 pin 14) directly as power input is interesting, for instance if the 3.3 V is provided by a shield board. In this case, the ST-LINK is not powered, thus programming and debugging features are not available. When the board is powered by +3V3 (CN4 pin 14), solder bridges SB2 (NRST) and SB3 must be OFF.

6.4.3 External power supply output

When powered by USB or VIN, +5V (CN4 pin 4) can be used as output power supply for an Arduino™ Nano shield. In this case, the maximum current of the power source specified in Table 6 must be respected.

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

6.5 Board functions

6.5.1 LEDs

LD1 ST-LINK COM LED

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

- Blinking red: the first USB enumeration with the PC is taking place
- Red on: the initialization between the PC and ST-LINK is complete
- Blinking red or green: programming and debugging with target
- Green on: communication finished and successful
- Orange on: communication failure

LD2 PWR

The red LED indicates that the STM32G0 part is powered and 5 V power is available on CN4 pin 4.

LD3 USER

The LD3 USER green LED is connected to the following STM32G031K8T6 I/O:

- PB3, if the configuration is SB12 ON, and SB13 OFF
- PC6, if the configuration is SB12 OFF, and SB13 ON (default configuration)

It is also connected to the Arduino™ D13 signal when SB12 is ON. To light this LED, a high-logic state “1” must be written in the corresponding GPIO PB3 or PC6. A transistor drives the LED, therefore its consumption does not affect the STM32G0 power measurement.

LD4 USB power fault (OC, overcurrent)

The LD4 red LED indicates that the board power consumption on USB ST-LINK exceeds 500 mA. Therefore, the user must check the root cause of the overconsumption, and consequently power the STM32G0 Nucleo-32 board with an external power supply if needed.

6.5.2 Push-button

B1 RESET/USER

This push-button is connected to NRST (PF2-NRST) and is used to reset the STM32G0 microcontroller or to generate a USER event.

6.5.3 Current consumption measurement (IDD)

Jumper JP1, labeled IDD, is used to measure the STM32G0 microcontroller consumption by removing the jumper and connecting an ammeter.

- JP1 ON: STM32G0 is powered by the +3V3 voltage (default)
- JP1 OFF: an ammeter must be connected to measure the STM32G0 current. If there is no ammeter, the STM32G0 is not powered.

6.5.4 Virtual COM port (VCP): USART

The STM32G0 Nucleo-32 board offers the possibility to connect a USART interface to the ST-LINK/V2-1.

Table 7. USART connection

Solder bridge configuration(1)	Feature(1)
SB3, SB4: ON	**USART2 (PA2/PA3) connected to ST-LINK/V2-1 Virtual COM port.**

1. *The default configuration is in bold.*

The communication between the target and the MCU is enabled on USART2 to support the Virtual COM port.

6.6 Solder bridges

Table 8 details the solder bridges of the STM32G0 Nucleo-32 board.

Table 8. Solder bridge configuration

Solder bridge control	Solder bridge (SB)	State(1)	Description(1)
USB power	SB1	ON	USB power limited to 100 mA max
		OFF	**USB power limited to 300 mA max**
ST-LINK reset	SB2	ON	ST-LINK in RESET state
		OFF	**ST-LINK normal operation**
VCP_TX	SB3	**ON**	**VCP_TX is connected to STM32G0 I/O PA3**
		OFF	VCP_TX is not connected to STM32G0 I/O PA3
VCP_RX	SB4	**ON**	**VCP_RX is connected to STM32G0 I/O PA2**
		OFF	VCP_RX is not connected to STM32G0 I/O PA2
SWCLK	SB5	**ON**	**SWCLK is connected to STM32G0 I/O PA14**
		OFF	SWCLK is not connected to STM32G0 I/O PA14
BOOT0 pull-down resistor	SB6	ON	10 kΩ pull-down resistor not present on STM32G0 BOOT0 pin
		OFF	**10 kΩ pull-down resistor not present on STM32G0 BOOT0 pin**
MCO	SB7	ON	MCO from ST-LINK connected to STM32G0 PC14
		OFF	**MCO from ST-LINK not connected to STM32G0 PC14**
32 kHz LSE quartz	SB8	**ON**	**32 kHz LSE quartz enabled**
		OFF	32 kHz LSE quartz disabled (useful when using MCO function from ST-LINK)
	SB9	**ON**	**32 kHz LSE quartz enabled**
		OFF	32 kHz LSE quartz disabled (useful when using MCO function from ST-LINK)

Solder bridge control	Solder bridge (SB)	State[1]	Description[1]
AREF	SB10	**ON**	**AREF Arduino™ signal connected to 3.3 V**
		OFF	AREF Arduino™ signal not connected to 3.3 V
3.3 V voltage regulator	SB11	**ON**	**3.3 V main voltage regulator output enabled**
		OFF	3.3 V main voltage regulator output disabled (useful when powering the STM32G0 Nucleo-32 with a 3.3 V applied on CN4 pin 14)
USER LED	SB12	ON	USER LED driven by STM32G0 PB3 also connected to Arduino™ D13 pin
		OFF	**USER LED not driven by STM32G0 PB3**
	SB13	**ON**	**USER LED driven by STM32G0 PC6**
		OFF	USER LED not driven by STM32G0 PC6

1. *The default SB state is in bold.*

7 Board connectors

Several connectors are implemented on the STM32G0 Nucleo-32 board.

7.1 Arduino™ Nano V3 connectors CN3 and CN4

The Arduino™ connectors CN3 and CN4 are male connectors compatible with the Arduino™ Nano V3 standard. Most shields designed for Arduino™ can fit with the STM32G0 Nucleo-32 board.
The related pinout for Arduino™ connectors is shown in Figure 8 and listed in Table 9.

Figure 8. Arduino™ connectors pinout

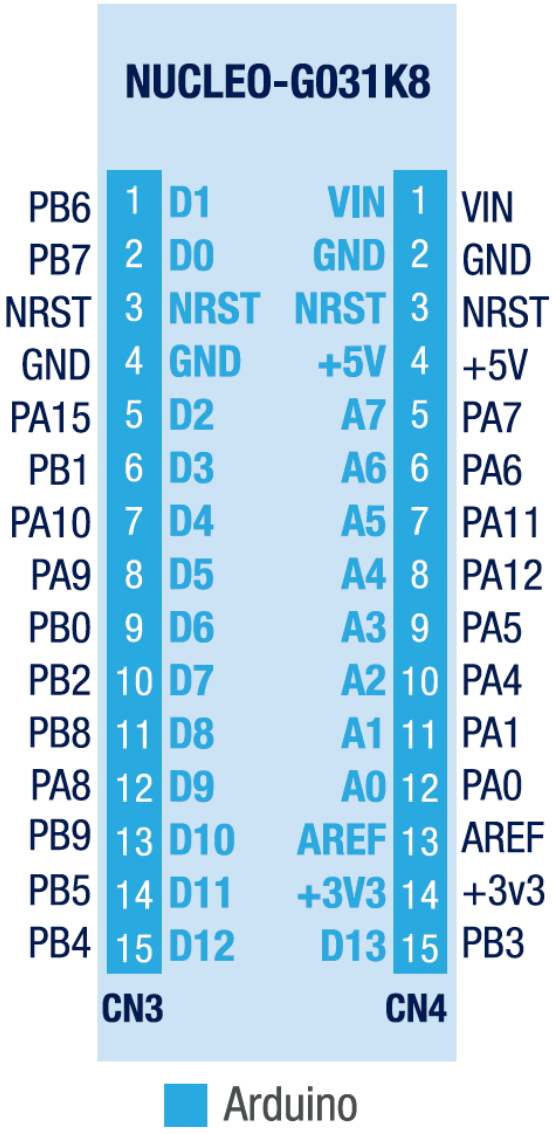


Table 9. Arduino™ connectors pinout

Connector	Pin number	Pin name	STM32G0 MCU pin	Function
CN3	1	D1	PB6	USART1_TX
	2	D0	PB7	USART1_RX
	3	NRST	PF2/NRST	RESET or USER button
	4	GND	-	Ground
	5	D2	PA15	-
	6	D3	PB1	TIM3_CH4
	7	D4	PA10	TIM1_CH3 / I2C1_SDA
	8	D5	PA9	TIM1_CH2 / I2C1_SCL
	9	D6	PB0	TIM3_CH2
	10	D7	PB2	-
	11	D8	PB8	-
	12	D9	PA8	TIM1_CH1
	13	D10	PB9	SPI1_CS(1) / TIM17_CH1
	14	D11	PB5	SPI1_MOSI / TIM3_CH2
	15	D12	PB4	SPI1_MISO
CN4	1	VIN	-	Power input
	2	GND	-	Ground
	3	NRST	PF2/NRST	RESET or USER button
	4	+5V	-	5V input/output
	5	A7	PA7	ADC_IN7
	6	A6	PA6	ADC_IN6
	7	A5	PA11	ADC_IN15 / I2C2_SCL
	8	A4	PA12	ADC_IN16 / I2C2_SDA
	9	A3	PA5	ADC_IN5
	10	A2	PA4	ADC_IN4
	11	A1	PA1	ADC_IN1
	12	A0	PA0	ADC_IN0
	13	AREF	-	AVDD
	14	+3V3	-	3V3 input/output
	15	D13	PB3	SPI1_SCK

1. *SPI_CS is made by GPIO.*

8 STM32G0 Nucleo-32 I/O assignment

Table 10. Nucleo-32 I/O assignment

Pin	Pin name	Main feature / optional feature
1	PB9	ARD_D10: SPI1_CS(2) / TIM1_CH4
2	PC14-OSC32_IN	LSE clock input
3	PC15-OSC32_OUT	LSE clock output
4	VDD	VDD voltage supply
5	VSS	Ground ARD_A4: DC2_IN13
6	PF2-NRST	RESET – USER button
7	PA0	ARD_A0: ADC_IN0
8	PA1	ARD_A1: ADC_IN1
9	PA2	VCP_TX: USART1_Tx
10	PA3	VCP_RX: USART1_Rx
11	PA4	ARD_A2: ADC_IN4
12	PA5	ARD_A3: ADC_IN5
13	PA6	ARD_A6: ADC_IN6
14	PA7	ARD_A7: ADC_IN7
15	PB0	ARD_D6: PWM: TIM3_CH2
16	PB1	ARD_D3 - PWM: TIM3_CH4
17	PB2	ARD_D7: I/O
18	PA8	ARD_D9: PWM: TIM1_CH1
19	PA9	ARD_D5: TIM1_CH2 / I2C1_SCL
20	PC6	USER LED
21	PA10	ARD_D4: TIM1_CH3 / I2C1_SDA
22	PA11 [PA9]	ARD_A5: ADC_IN15 / I2C2_SCL
23	PA12 [PA10]	ARD_A4: ADC_IN16 / I2C2_SDA
24	PA13	SWDIO
25	PA14-BOOT0	SWCLK
26	PA15	ARD_D2: I/O
27	PB3	ARD_D13: SPI1_SCK
28	PB4	ARD_D12: SPI1_MISO
29	PB5	ARD_D11: SPI1_MOSI / TIM3_CH2
30	PB6	ARD_D0: USART1_RX
31	PB7	ARD_D1: USART1_TX
32	PB8	ARD_D8: I/O

9 Federal Communications Commission (FCC) and Industry Canada (IC) 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 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)

Terry Blanchard
Americas Region Legal | Group Vice President and Regional Legal Counsel, The Americas
STMicroelectronics, Inc.
750 Canyon Drive | Suite 300 | Coppell, Texas 75019
USA
Telephone: +1 972-466-7845

9.2 IC Compliance Statement

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

10 CE conformity

10.1 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.

Revision history

Table 11. **Document revision history**

Date	Version	Changes
25-Jun-2019	1	Initial release.

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