Discovery kit with STM32C031C6 MCU

Introduction

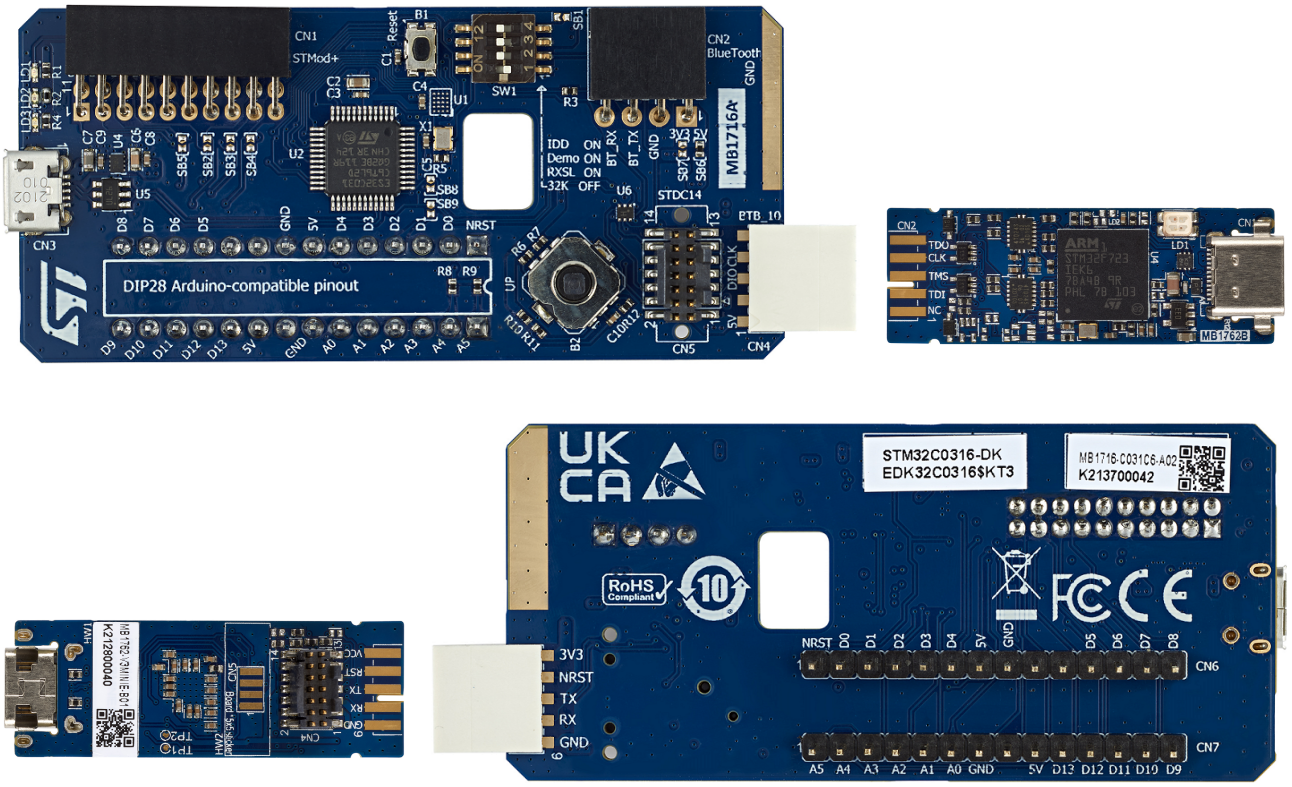
The goal of the STM32C0316-DK Discovery kit is to provide alternative features to the corresponding NUCLEO-C031C6 board.

All 20 pins common to all STM32C0 Series microcontrollers are user-accessible. The user can override the SWD debug pins by disconnecting the debug probe. The 5-way analog rock switch and LED can be overridden with a slide switch to be taken over by the user. All the pins are accessible through the DIP28 connector. Headers are not provided to let the user choose the header type. The 32768 Hz on-board 1-pin clock generator for RTC can be cut with a slide switch.

The kit helps migrate from 8-bit to STM32C0 Series microcontrollers, and between STM32C0 Series and STM32G0 Series microcontrollers. The DIP28 pinout is designed to be as compatible as possible with the ATMEGA328 8-bit microcontroller. The LQFP48 footprint is compatible with STM32G031/071/0B1 Series microcontrollers. The UFQFPN20 footprint is compatible with STM32C01 Series microcontrollers. The WLCSP20 footprint is compatible with STM32G051 Series microcontrollers.

The STM32C031C6 Series microcontroller can be tested over its operating range. The 5.0 to 3.3 V regulator bypass itself when its source goes lower than 3.3 V. The debug probe level shifters adjust the debug signal levels to the target microcontroller supply voltage.

Figure 1. STM32C0316-DK boards top and bottom views



Pictures are not contractual.

1 Features

- STM32C031C6 Arm® Cortex®-M0+ core-based microcontroller with 32 Kbytes of Flash memory and 12 Kbytes of RAM, in an LQFP48 package
- Board reference design triple STM32 package footprints: LQFP48, UFQFPN20, and WLCSP20
- 32768 Hz on-board clock generator
- 1 user LED and 2 power LEDs
- Reset push-button
- 5-way joystick using a single ADC input pin
- Slide switch to conveniently disconnect embedded user demonstration components
- Board connectors:
  - USB Micro-B for 5 V power
  - STMod+ connector
  - Bluetooth® (HC05, 115200 bps) as a simple wireless serial adapter
  - Not-fitted DIP28 compatible extension connectors
  - STDC14 debug connector for third-party debug probes
  - On-board both side pads for BTB card edge connector
  - Standalone STLINK-V3MINIE debugger/programmer tiny probe for STM32 microcontrollers
- 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

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

2 Ordering information

To order the STM32C0316-DK Discovery kit, refer to Table 1. Additional information is available from the datasheet and reference manual of the target microcontroller.

Table 1. List of available products

Order code	Board reference	Target STM32
STM32C0316-DK	• MB1716(1) • MB1762(2)	STM32C031C6T6

1. *Mother board*
2. *STLINK-V3MINIE tiny probe*

2.1 Codification

The meaning of the codification is explained in Table 2.

Table 2. Codification explanation

STM32C0XXY-DK	Description	Example: STM32C0316-DK
STM32C0	MCU series in STM32 32-bit Arm Cortex MCUs	STM32C0 Series
XX	MCU product line in the series	STM32C0x1 product line
Y	STM32 Flash memory size: • 6 for 32 Kbytes	32 Kbytes
DK	Discovery kit	Discovery kit

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 Micro-B 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.
All other trademarks are the property of their respective owners.

3.2 Development toolchains

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

1. *On Windows® only.*

3.3 Demonstration software

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

4 Conventions

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

Table 3. ON/OFF convention

Convention	Definition
Jumper JPx ON	Jumper fitted
Jumper JPx OFF	Jumper not fitted
Jumper JPx [1-2]	Jumper fitted between Pin 1 and Pin 2
Solder bridge SBx ON	SBx connections closed by 0 Ω resistor
Solder bridge SBx OFF	SBx connections left open
Resistor Rx ON	Resistor soldered
Resistor Rx OFF	Resistor not soldered
Capacitor Cx ON	Capacitor soldered
Capacitor Cx OFF	Capacitor not soldered

5 Quick start

Before installing and using the product, accept the Evaluation Product License Agreement from the *www.st.com/epla* webpage. For more information on the STM32C0316-DK Discovery kit and demonstration software, visit the STM32C0316-DK product webpage.

5.1 Getting started

Follow the sequence below to configure the STM32C0316-DK Discovery kit and launch the demonstration application (Refer to Figure 2 and Figure 3 in UM2910 for component location):

1. Check the position of the SW1 slide switch 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 STLINK-V3MINIE tiny probe USB driver, available on the *www.st.com* website.
3. Connect the stand-alone tiny probe CN2 connector and the STM32C0316-DK mother board CN4 connector by BTB card edge connector.
4. To power the tiny probe, connect it to a PC with a USB Type-A USB Type-C® cable through the CN1 USB connector of this board.
5. To power the STM32C0316-DK mother board, connect it to a PC or a 5V adapter with a Type-A to Micro-B USB cable through the CN3 USB power connector of the board.
6. Then, the LD1 COM red LED on the tiny probe lights up and the LD2 red LED on the mother board lights up.
7. Press the B2 joystick and observe the blinking of the LD1 green LED.
8. The demonstration software, as well as other software examples for exploring STM32C0 features, is available on the STM32C0316-DK product webpage.

Table 4. Jumper configuration

Jumper	Definition	Position(1)	Comment
SW1	IDD	**ON**	For STM32C0 current measurement
	Demo	**ON**	Connect demonstration 3.3 V power
	RXSL	**ON**	Connect VCP_RX
	32K	**OFF**	32 KHz oscillator enable

1. *Default jumper state is in bold.*

6 Hardware layout and configuration

Figure 2 and Figure 3 show the location of the features. The mechanical dimensions of the board are shown in Figure 4.

6.1 PCB layout

Figure 2. PCB layout (Top view)

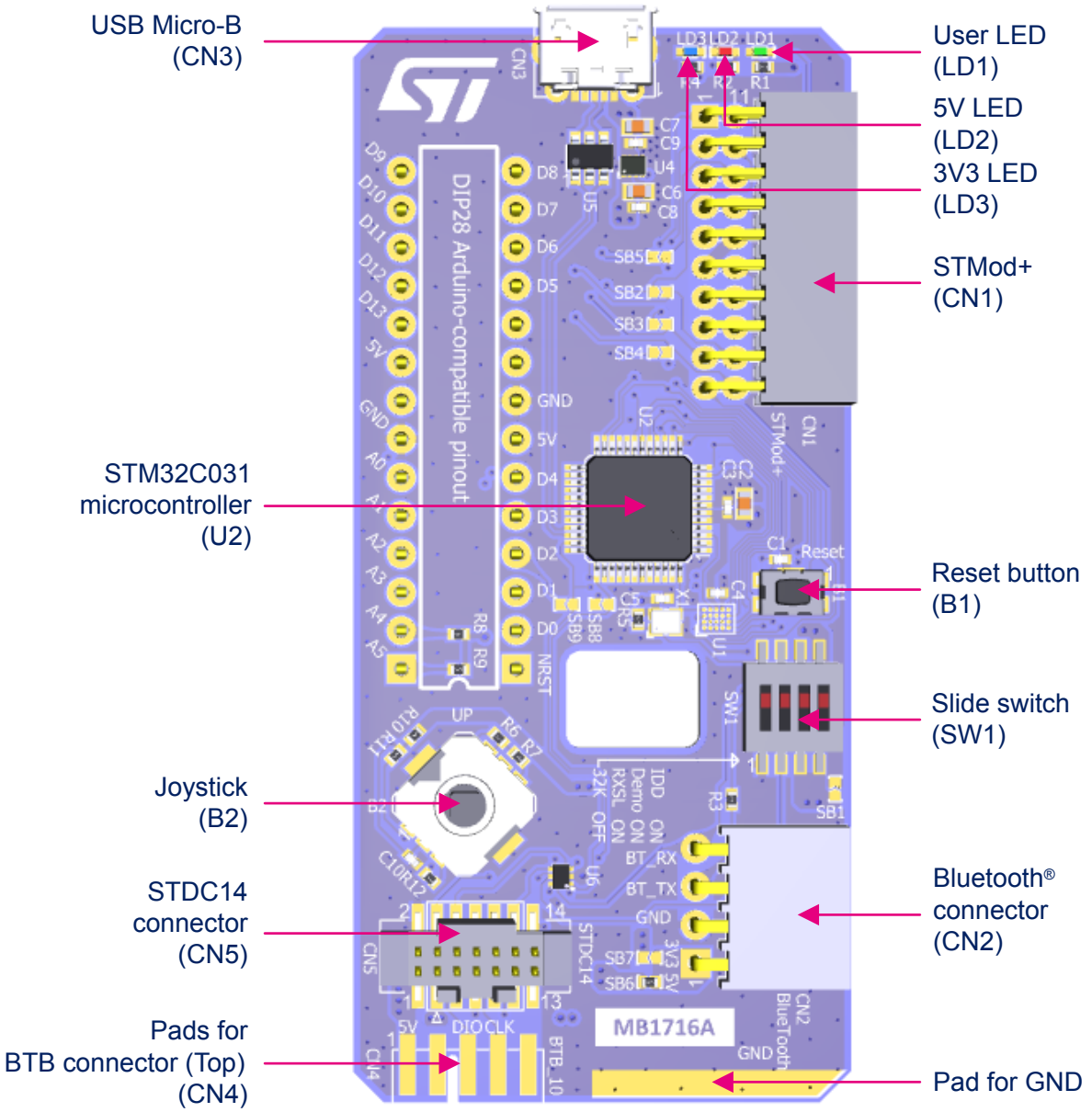
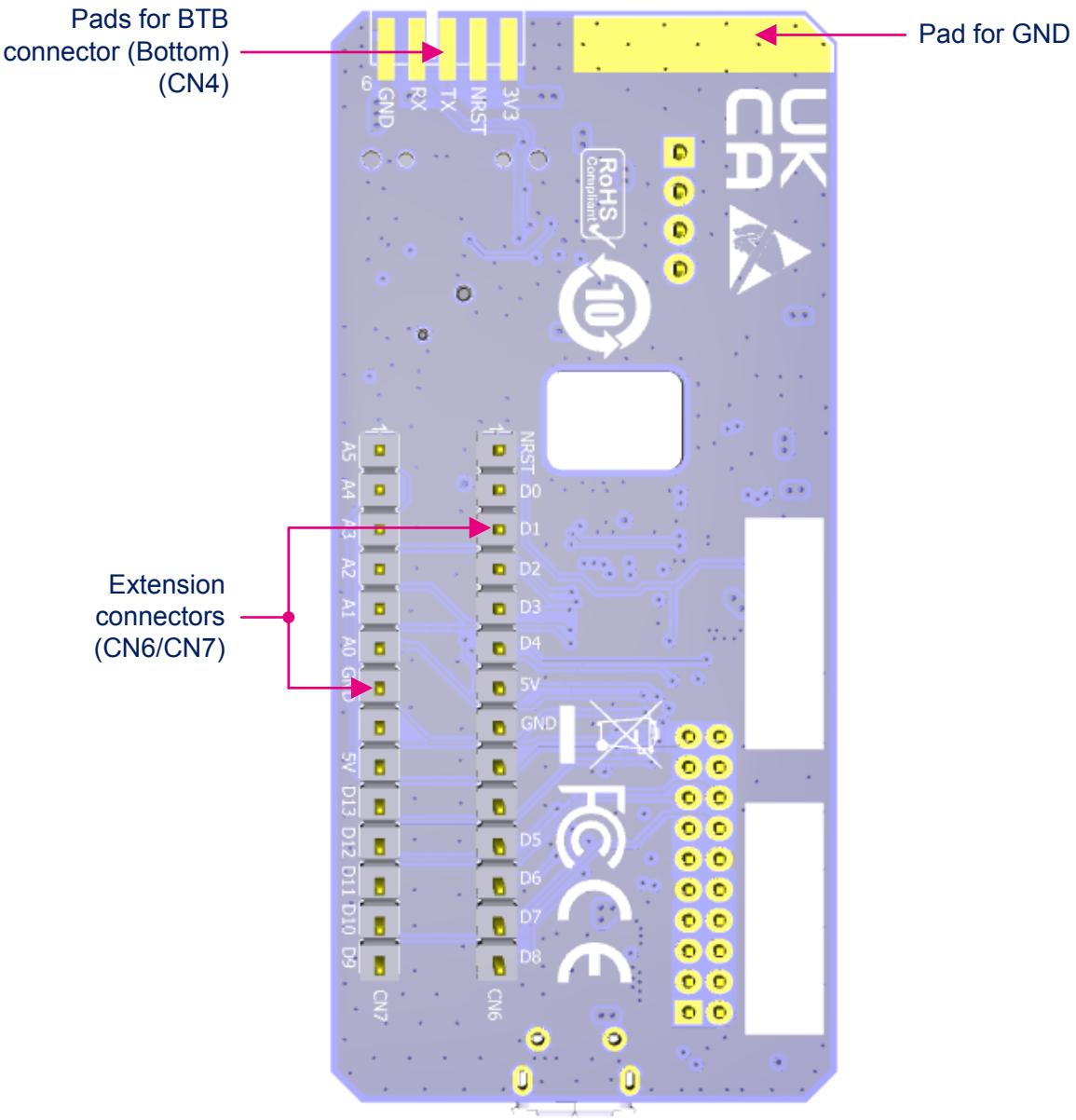
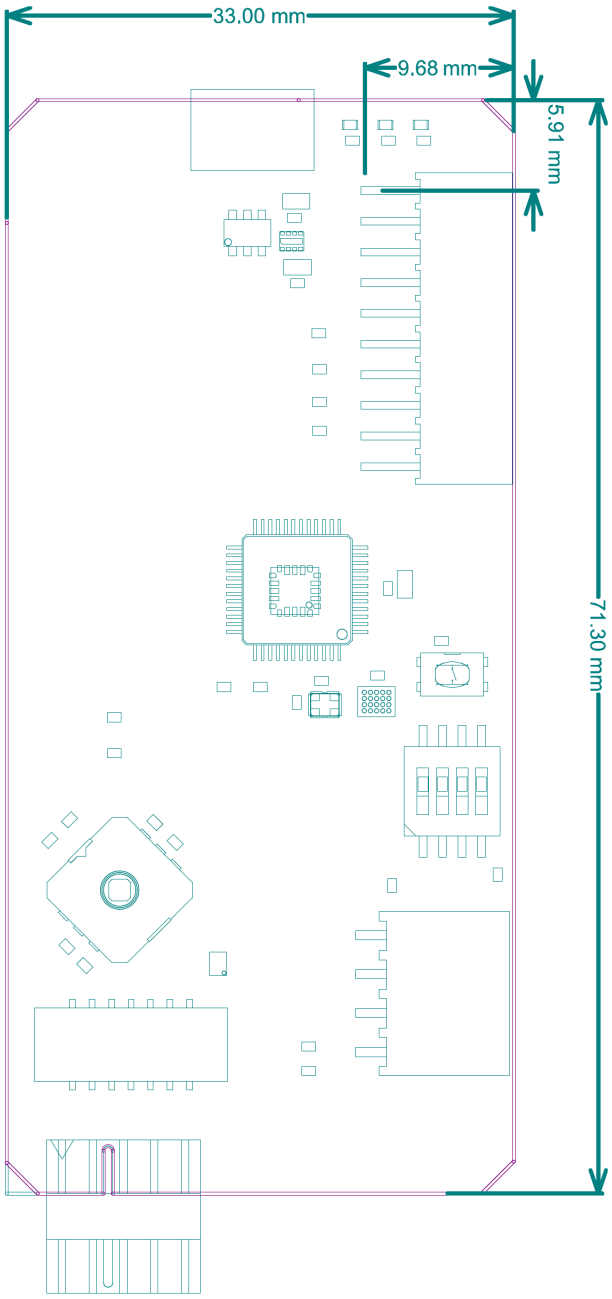


Figure 3. **PCB layout (Bottom view)**



6.2 Mechanical drawing

Figure 4. Board mechanical drawing (In millimeters)



6.3 STLINK-V3MINIE

STLINK-V3MINIE is a standalone debugging and programming tiny probe with an extended voltage range for STM32 microcontrollers. The board number is MB1762.

The STLINK-V3MINIE can connect to the target STM32 through:

- STDC14 connectivity with a flat cable (ref. SAMTEC # FFSD-07-D-05.90-01-N-R)
- AVX10 provided BTB (board-to-board) card edge connector. (ref. 009159010061911)

For further details, refer to the user manual *STLINK-V3MINIE debugger/programmer tiny probe for STM32 microcontrollers* (UM2910).

6.4 Power supply

The STM32C0316-DK Discovery kit is designed to be powered using the CN3 USB power connector.

The input voltage is a 5V power rail from the CN3 USB power connector. The LD56100DPU33R power regulator output voltage is 3.3 V. If a supply input voltage lower than 3.3V is provided on the 5V rail, the LD56100DPU33R LDO goes in bypass mode.

It is also possible to access the same 5V power rail through the DIP28 or STMod+ connectors.

6.5 Board functions

6.5.1 LEDs

The onboard LED functions are described in Table 5.

Table 5. LED functions

LED	LD1 green user LED	LD2 red 5 V power trail LED	LD3 blue 3.3 V power trail monitor LED
Function1	ON if PA5 = 0	ON if 5V present	ON if 3.3V present
Function 2	OFF if PA5 = 1	OFF otherwise	OFF otherwise
Function 3	LED cut if SW1 Demo is OFF	Brightness varies with voltage [2.0~5V]	-
Function 4	PA5 = TIM1.CH1 (AF5)	-	-

6.5.2 Push-buttons

B1 Reset/user button

This push-button is connected to NRST (PF2-NRST) and is used to reset the STM32C0 Series microcontroller or to generate a user event.

B2 joystick

This joystick is a 5-way rock switch using a single ADC input pin (PA4). Push-in “Select” can be used as a digital user button and EXTI wakeup interrupt. The joystick position for the ADC value refers to Table 6.

Table 6. Joystick position versus ADC value

Joystick position	Measurement ratio	ADC value (In volts)
Select	0	0
Down	0.20	0.67
Left	0.40	1.32
Right	0.61	2.01
Up	0.80	2.65
No key pressed	1.0	3.3

6.5.3 Slide switch

The SW1 slide switch is used to connect or disconnect the STM32C0 microcontroller consumption (IDD), demo 3.3 V power (Demo), VCP_RX (RXSL), and 32 KHz on-board oscillator (32K).

Table 7. Slide-switch configuration

Slide switch	Definition	Position[1]	Comment[1]
SW1	IDD	**ON**	**STM32C0 is powered by 3V3 voltage.**
		OFF	An ammeter must be connected on SB1 to measure the STM32C0 current and power the MCU.
	Demo	**ON**	**Connect the demo 3.3 V power (User LED and key connected).**
		OFF	Disconnect demo 3.3 V power.
	RXSL	**ON**	**Connect VCP_RX (STLink and BT share the same STM32C0 RX).**
		OFF	Disconnect VCP_RX.
	32K	**OFF**	**Oscillator 32768 Hz enable**
		ON	Oscillator 32768 Hz disable

1. *Default slide switch state is in bold*

6.5.4 MCU package

The STM32C0316-DK Discovery kit supports 3 different packages as crossover or migration facility. It includes U2 STM32C031C6T6 in TQFP48 package (Default soldered), U3 STM32C011F6U6 in UFQFPN20 package, and U1 STM32G051F8Y6 in WLCSP20 package.

6.5.5 Solder bridges

The solder bridges (SBx) are located on the top layer of the STM32C0316-DK mother board. Their configuration appears in Table 8. Package SB is used in the 20-pin configuration.

Table 8. Solder bridge configuration

Solder bridge control	Solder bridge	State[1]	Description[1]
Package selection	SB2	ON	CN6 pin 12 is connected to PC15 for the 20-pin package.
		OFF	**CN6 pin 12 is connected to PD1 for the 48-pin package.**
	SB3	ON	CN6 pin 13 is connected to PA5 for the 20-pin package.
		OFF	**CN6 pin 13 is connected to PD2 for the 48-pin package.**
	SB4	ON	CN6 pin 11 is connected to PC14 for the 20-pin package.
		OFF	**CN6 pin 11 is connected to PD0 for the 48-pin package.**
	SB5	ON	CN6 pin 14 is connected to PA4 for the 20-pin package.
		OFF	**CN6 pin 14 is connected to PD3 for the 48-pin package**
	SB8	ON	CN6 pin 5 is connected to PA14 for the 20-pin package.
		OFF	**CN6 pin 5 is connected to PC7 for the 48-pin package.**
	SB9	ON	CN6 pin 4 is connected to PA13 for the 20-pin package.
		OFF	**CN6 pin 4 is connected to PC6 for the 48-pin package.**
Power selection	SB1	ON	Disable slide switch for 3V3 voltage ON/OFF.
		OFF	**Enable slide switch for 3V3 voltage ON/OFF.**
	SB6	**ON**	**5V power is selected for the CN2 connector.**
		OFF	5V power is not selected for the CN2 connector.
	SB7	ON	3V3 power is selected for the CN2 connector.
		OFF	**3V3 power is not selected for the CN2 connector.**

1. *Default solder bridge state is in bold*

7 Board connectors

7.1 CN1 STMod+ connector

The STMod+ connector is available on the STM32C0316-DK Discovery kit to support flexibility in small form factor applications. The STMod+ connector extends UART and spare I/Os for different peripheral expansions. It is described in Table 9.

Table 9. CN1 STMod+ connector

Connector	Pin number	Pin name	Port
CN1	1	CTS	PA0
	2	TX	PA2
	3	RX	PA3
	4	RTS	PA1
	5	GND	-
	6	5V	-
	7	SCL	PB10/PA11
	8	GPIO	PA7
	9	GPIO	PD2
	10	SDA	PB11/PA12
	11	GPIO	PC14
	12	GPIO	PC15
	13	GPIO	PA4
	14	GPIO	PA5
	15	5V	-
	16	GND	-
	17	GPIO	PB0
	18	GPIO	PA6
	19	GPIO	PD1
	20	GPIO	PD0

7.2 CN2 Bluetooth® connector

The Bluetooth® connector is available on the STM32C0316-DK Discovery kit to support Bluetooth® HC-05/06 dongles. It is a 4-pin header with 5 V (or 3.3 V with solder bridge) supply rail and UART RX/TX link. It is described in Table 10. This serial interface is shared with STLink-VCP and goes to the same USART pins. SW1 slide switch is used to disconnect STLink VCP to Target MCU RX to avoid conflict. When using STLink-VCP remove HC-05

Table 10. CN2 Bluetooth® connector

Pin number	Pin name	Description
1	VDD	5V or 3V3 power selection by SB6 and SB7
2	GND	Power supply
3	BT-TX	UART transmit data
4	BT-RX	UART receive data

7.3 CN3 USB Micro-B power connector

The USB Micro-B power connector is used to connect 5 V rail power from PC for board power supply. The USB device function operates only with STM32G0B1 QFP48 device configuration.

Table 11. CN3 USB Micro-B connector

Terminal	Description	Terminal	Description
1	V_{BUS} (Power)	4	ID
2	DM	5	GND
3	DP	6 - 11	Shield

7.4 CN4 on-board pads to BTB card edge connector

Table 12. CN4 on-board pads to BTB card edge connector

Side	Pin number	Pin description	Type
TOP	1	5V(1)	S
	2	NC(2)	-
	3	SWDIO	I/O
	4	SWCLK	I
	5	NC(2)	-
BOTTOM	6	GND	S
	7	VCP_RX	I
	8	VCP_TX	O
	9	NRST	I
	10	3V3(3)	S

1. *Do not connect on target.*
2. *NC means not required for SWD connection.*
3. *Output power source for STLINK-V3MINIE.*

7.5 CN5 STDC14 connector

The CN5 STDC14 connector allows the connection to the STLINK-V3MINIE tiny probe through the SWD protocol, respecting (from pins 3 to 12) the ARM10 pinout (Arm® Cortex® debug connector). But it also advantageously provides two UART signals for the Virtual COM port. The related pinout for the STDC14 connector is listed in Table 13.

Figure 5. CN5 STDC14 connector

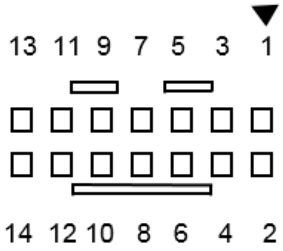


Table 13. CN5 STDC14 connector pinout

STDC14 pin number	ARM10 pin number	Description	Type
1	-	5V(1)	S
2	-	GND(1)	S
3	1	3V3(2)	O
4	2	SWDIO	I/O
5	3	GND	S
6	4	SWCLK	I
7	5	GND	S
8	6	NC(3)	-
9	7	NC(3)	-
10	8	NC(3)	-
11	9	NC(3)	-
12	10	NRST	I
13	-	VCP_RX	I
14	-	VCP_TX	O

1. *Do not connect on target.*
2. *Input for STLINK-V3MINIE.*
3. *NC means not required for SWD connection.*

7.6 CN6/CN7 DIP28 extension connectors

The extension connectors are available on the STM32C0316-DK Discovery kit to support flexibility in user applications. They form a DIP28 which tries to be as close as possible to ATMEGA328 footprint and includes UART, SPI, I^2C, ADCs, and spare I/Os for different peripheral expansion. It is described in Table 14. CN6/CN7 DIP28 extension connectors.

Table 14. CN6/CN7 DIP28 extension connectors

Connector	Pin number	Pin name	Port
CN6	1	NRST	-
	2	RX	PA3
	3	TX	PA2
	4	GPIO	PA13/PC6
	5	GPIO	PA14/PC7
	6	GPIO	PA0
	7	5V	-
	8	GND	-
	9	NC	-
	10	NC	-
	11	GPIO	PC14/PD0
	12	GPIO	PC15/PD1
	13	GPIO	PA5/PD2
	14	GPIO	PA4/PD3
CN7	1	ADC/SCL	PB10/PA11
	2	ADC/SDA	PB11/PA12
	3	GPIO	PA9
	4	GPIO	PA10
	5	ADC	PA5
	6	ADC	PA4
	7	GND	-
	8	NC	-
	9	5V	-
	10	SCK	PA1
	11	MISO	PA6
	12	MOSI	PA7
	13	NSS	PB0
	14	GPIO	PB8

8 Port mapping for different packages

Table 15. **CN6/CN7 DIP28 extension connectors**

-	STM32	STM32C031C6T6	STM32G051F8Y6	STM32C011F6U6
PCB trace name	Key AF	QFP48	WLCSP20	QFN20
PA0	CTS2	PA0	PA0	PA0
PA1	RTS2/SCK1	PA1	PA1	PA1
PA2	TX2	PA2	PA2	PA2
PA3	RX2	PA3	PA3	PA3
PA4	ADC_IN.x	PA4	PA4	PA4
PA5	ADC_IN.x	PA5	PA5	PA5
PA6	MISO1	PA6	PA6	PA6
PA7	MOSI1	PA7	PA7	PA7
PA8	GPIO	PA8	N/A	N/A
PA9	BL	PA9	N/A	N/A
PA10	BL	PA10	N/A	N/A
USBD_N	USB	PA11	N/A	N/A
USBD_P	USB	PA12	N/A	N/A
PA13	SWDIO	PA13	PA13	PA13
PA14	SWCLK/BOOT0	PA14/PA15	PA14	PA14
PB0	NSS1	PB0/PB1/PB2	PB0/PB1/PB2/PA8	PA8
STM32_TX1	TX1	PB3/PB4/PB5/PB6	PB3/PB4/PB5/PB6	PB6
STM32_RX1	RX1	PB7/PB8	PB7/PB8	PB7
SCL	SCL1	PB10(1)	PA11/PA9	PA11/PA9
SDA	SDA1	PB11(1)	PA12/PA10	PA12/PA10
PC6	GPIO	PC6	N/A	N/A
PC7	GPIO	PC7	N/A	N/A
PD0	GPIO	PD0	N/A	N/A
PD1	GPIO	PD1	N/A	N/A
PD2	GPIO	PD2	N/A	N/A
PD3	GPIO	PD3	N/A	N/A
NRST	PF2/NRST	PF2/NRST	PF2/NRST	PF2/NRST
PC14	OSC23_IN	PC14_OSC32IN/PB9	PC14_OSC32IN	PC14_OSC32IN
PC15	OSC32_OUT	PC15_OSC32OUT	PC15_OSC32OUT	PC15_OSC32OUT

1. *Uses simulated I^2C.*

9 STM32C0316-DK board information

9.1 Product marking

The stickers located on the top or bottom side of the PCB provide product information:

- Product order code and product identification for the first sticker
- Board reference with revision, and serial number for the second sticker

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

On the second sticker, the first line has the following format: “MBxxxx-Variant-yzz”, where “MBxxxx” is the board reference, “Variant” (optional) identifies the mounting variant when several exist, "y" is the PCB revision and "zz" is the assembly revision, for example B01. The second line shows the board serial number used for traceability.

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 designs or in production.

“E” or “ES” 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.

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.

9.2 STM32C0316-DK product history

9.2.1 Product identification DK32C0316$KT1

This product identification is based on the MB1716 revision A-03 and MB1762 revision B-01 boards.

It embeds the STM32C031C6T6 microcontroller with revision code "A". The limitations of this revision are detailed in the errata sheet *STM32C031 device errata* (ES0568).

Product limitations

No limitation identified for this product identification.

9.3 Board revision history

9.3.1 Board MB1716 revision A-03

The revision A-03 is the initial release of the MB1716 board.

Board limitation

No limitation identified for this board revision.

9.3.2 Board MB1762 revision B-01

The revision B-01 is the initial release of the MB1762 board.

Board limitation

No limitation identified for this board revision.

10 Federal Communications Commission (FCC) and Innovation, Science and Economic Development Canada (ISED) 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 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)

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STMicroelectronics, Inc.
750 Canyon Drive | Suite 300 | Coppell, Texas 75019
USA
Telephone: +1 972-466-7845

10.2 ISED Compliance Statement

This device complies with FCC and ISED Canada RF radiation exposure limits set forth for general population for mobile application (uncontrolled exposure). This device must not be collocated or operating in conjunction with any other antenna or transmitter.

Compliance Statement

Notice: This device complies with ISED Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

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

Déclaration de conformité

Avis: Le présent appareil est conforme aux CNR d'ISDE Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

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

Revision history

Table 16. **Document revision history**

Date	Revision	Changes
28-Jan-2022	1	Initial release.

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