# Discovery kit with STM32U083MC MCU

## Introduction

The STM32U083C-DK Discovery kit is a complete demonstration and development platform for the STM32U083MCT6 microcontroller. It is used as a reference design for the user application development before porting to the final product.

The full range of hardware features on the board helps the user to evaluate all the peripherals (USB FS device, segment LCD, touchkey, temperature sensor, and others) and to develop applications. The ARDUINO® Uno V3, mikroBUS™, and extension connectors provide easy connection to extension shields or daughterboards for specific applications.

The STM32U083C-DK Discovery kit does not require any separate probe as it integrates the STLINK-V2EC debugger/ programmer. It is operated by plugging it into a PC through a standard USB Type-A or USB Type-C® to USB Type-C® cable.

**Figure 1. STM32U083C-DK top view**

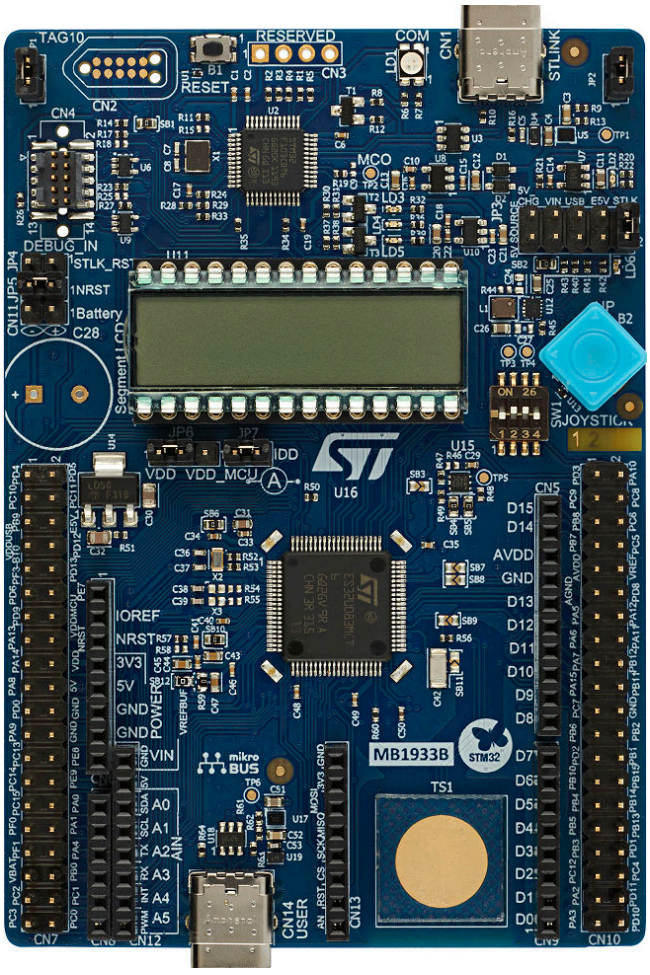
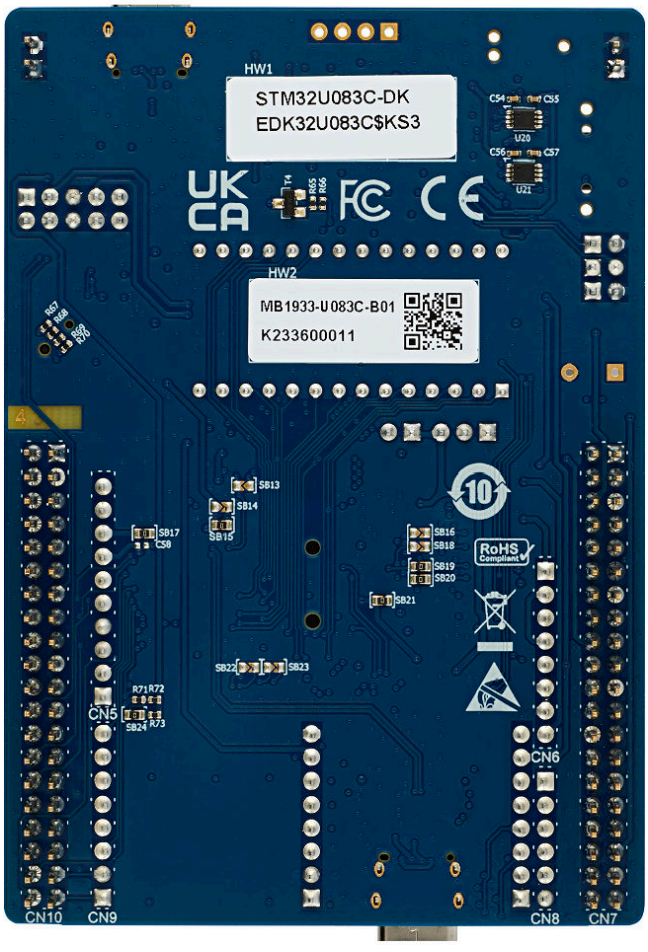



**Figure 2. STM32U083C-DK bottom view**




*Pictures are not contractual.*

# 1 Features

- Ultra-low-power STM32U083MC microcontroller based on the Arm® Cortex®-M0+ core, featuring 256 Kbytes of flash memory and 40 Kbytes of SRAM in an LQFP80 package
- 4×24-segment LCD
- Three user LEDs
- Reset push-button
- User joystick
- Touchkey
- Temperature sensor
- Board connectors:
  - ST-LINK USB Type-C® connector
  - User USB Device with USB Type-C® connector
  - mikroBUS™ connectors
  - MIPI® debug in connector (Arm® Cortex® 10-pin 1.27 mm-pitch debug connector over STDC14 footprint)
  - Extension connectors for full access to all STM32 I/Os
  - VBAT dedicated connector provides the capability to power the board on a battery
- Flexible power-supply options: ST-LINK USB $V_{BUS}$, USB connector, or external sources
- VDD power supply at 1.8 or 3.3 V by step-down converter
- On-board STLINK-V2EC 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

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

# 2 Ordering information

To order the STM32U083C-DK Discovery kit, refer to Table 1. Additional information is available from the datasheet and reference manual of the target STM32.

**Table 1. Ordering information**

| Order code | Board reference | Target STM32 |
|---|---|---|
| STM32U083C-DK | • MB1933(1) | STM32U083MCT6 |

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**

| STM32XXYYZ-DK | Description | Example: STM32U083C-DK |
|---|---|---|
| XX | MCU series in STM32 32-bit Arm Cortex MCUs | STM32U0 series |
| YY | MCU product line in the series | STM32U083 product line |
| Z | STM32 flash memory size:<br>• C for 256 Kbytes | 256 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 USB Type-C® cable

*Note: macOS® is a trademark of Apple Inc., registered in the U.S. and other countries and regions.*
*Linux® is a registered trademark of Linus Torvalds.*
*Windows is a trademark of the Microsoft group of companies.*

## 3.2 Development toolchains

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

1. *On Windows® only.*

## 3.3 Demonstration software

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

# 4 Conventions

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

**Table 3. ON/OFF convention**

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

# 5 Quick start

Before installing and using the product, accept the evaluation product license agreement from the *www.st.com/epla* webpage. For more information on the STM32U083C-DK Discovery kit and the demonstration software example, visit the STM32U083C-DK webpage.

## 5.1 Getting started

Follow the sequence below to configure the STM32U083C-DK Discovery kit and launch the demonstration application (refer to Section 6.1: STM32U083C-DK board layout for component locations):

1. Check jumper and switcher positions on board (refer to Table 4. Default jumper configuration),
2. For correct identification of all device interfaces from the host PC, install the STLINK-V2EC USB driver available on the *www.st.com/stm32nucleo* webpage, before connecting to the board,
3. To power the board, connect the STM32U083C-DK Discovery board to a PC with a USB Type-A or USB Type-C® to USB Type-C® cable through the USB connector (CN1). Once powered on, the PWR green LED (LD6) lights up and the COM LED (LD1) blinks,
4. Observe the LCD screen (U11) and push the joystick (B2) direction based on the display:
   - If the air quality sensor is connected to the board (if the user plugs it): The LCD informs of *air quality measurements* (CO2 and TVOC),
   - If the air quality sensor is not connected to the board (not plugged), a menu to select three different demonstrations is displayed on the LCD:
     a. *Temp Sensor demo* displays the temperature of the temperature sensor on the LCD,
     b. *Touch Wakeup demo* uses *TSC1* to wake up from the Stop mode (*Stop/Wakeup* displayed on the LCD),
     c. *LowPower Modes demo* selects one of the low-power modes to be used with a duty cycle from RTC to be in the Low-power or Running mode.
5. Download the demonstration software and several software examples that help to use the STM32U083C-DK Discovery kit features. These are available on the *www.st.com* website,
6. Develop your application using the available examples.

**Table 4. Default jumper configuration**

| Jumper | Definition | Default position | Comment |
|---|---|---|---|
| JP7 | IDD measurement | **ON** | STM32 VDD current measurement |
| JP3 | 5 V power selection | **[1-2]** | 5 V power supply from STLINK USB |
| JP4 | STLK reset | **OFF** | No STLK reset |
| JP5 | NRST connection | **ON** | Reset signal fromSTLINK-V2EC to target MCU |
| JP6 | Sensor power selection | **[1-2]** | VDD is the temperature sensor and mikroBUS™ connectors power supply |
| SW1 | VDD output voltage configuration | **[1-8] OFF;**<br>**[2-7], [3-6] ON** | Output voltage VDD is 3.3 V |
| | BOOT0 selection | **[4-5] OFF** | Main flash memory is selected as boot space |

# 6 Hardware layout and configuration

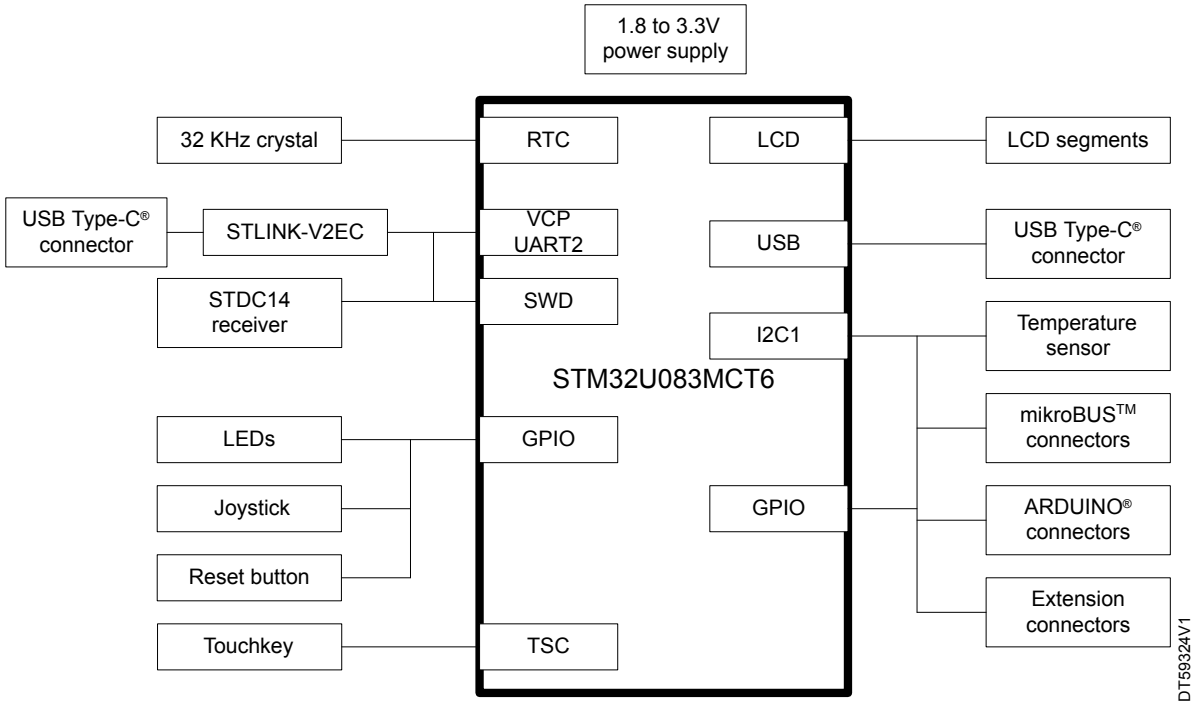
The STM32U083C-DK Discovery kit is designed around the STM32U083MC microcontroller, in an LQFP80 package.

Figure 3 illustrates the connection between the STM32 and its peripherals (STLINK-V2EC, push-button, joystick, touchkey, LEDs, temperature sensor, LCD segments, user USB, mikroBUS™ connectors, ARDUINO® connectors, and extension connectors).

Figure 4 shows the location of the STM32U083C-DKDiscovery kit features.

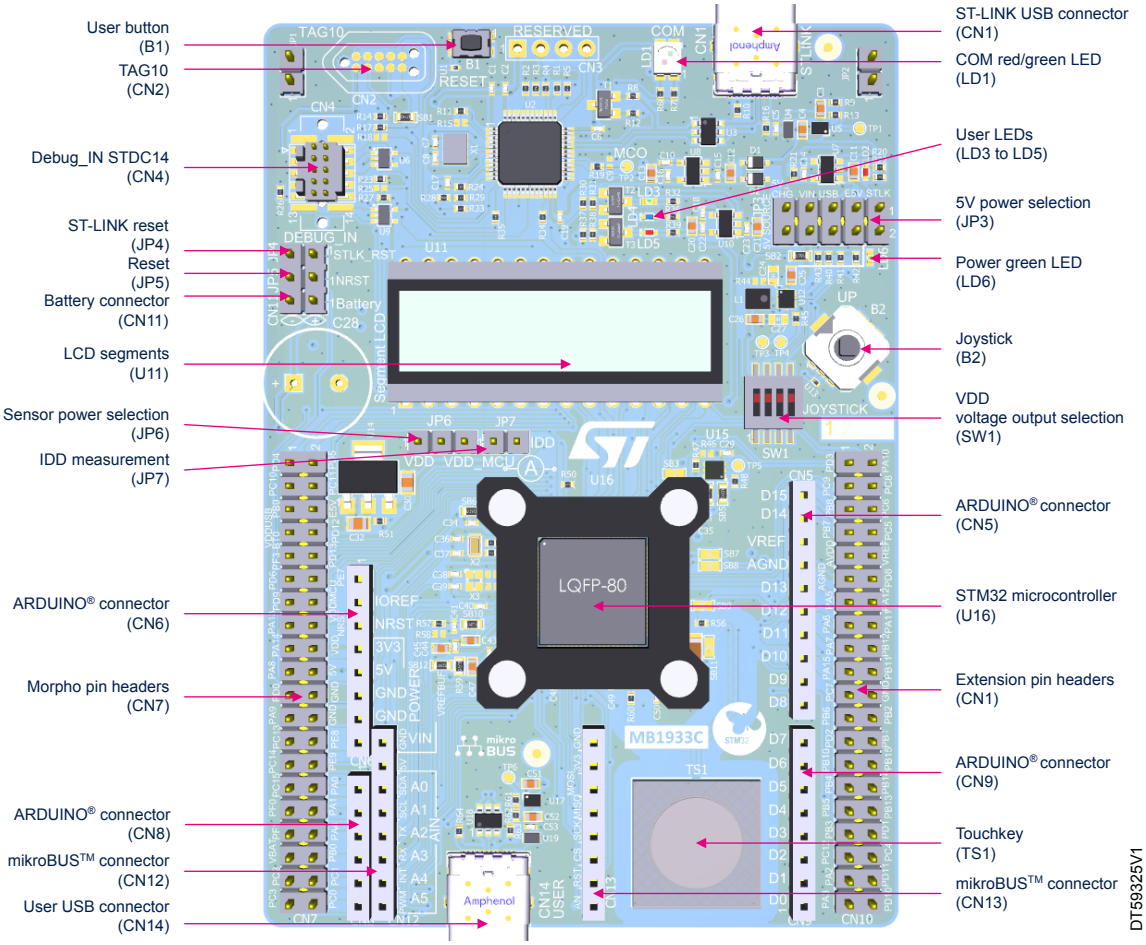
The mechanical dimensions of the board are shown in Figure 5.

**Figure 3. Hardware block diagram**



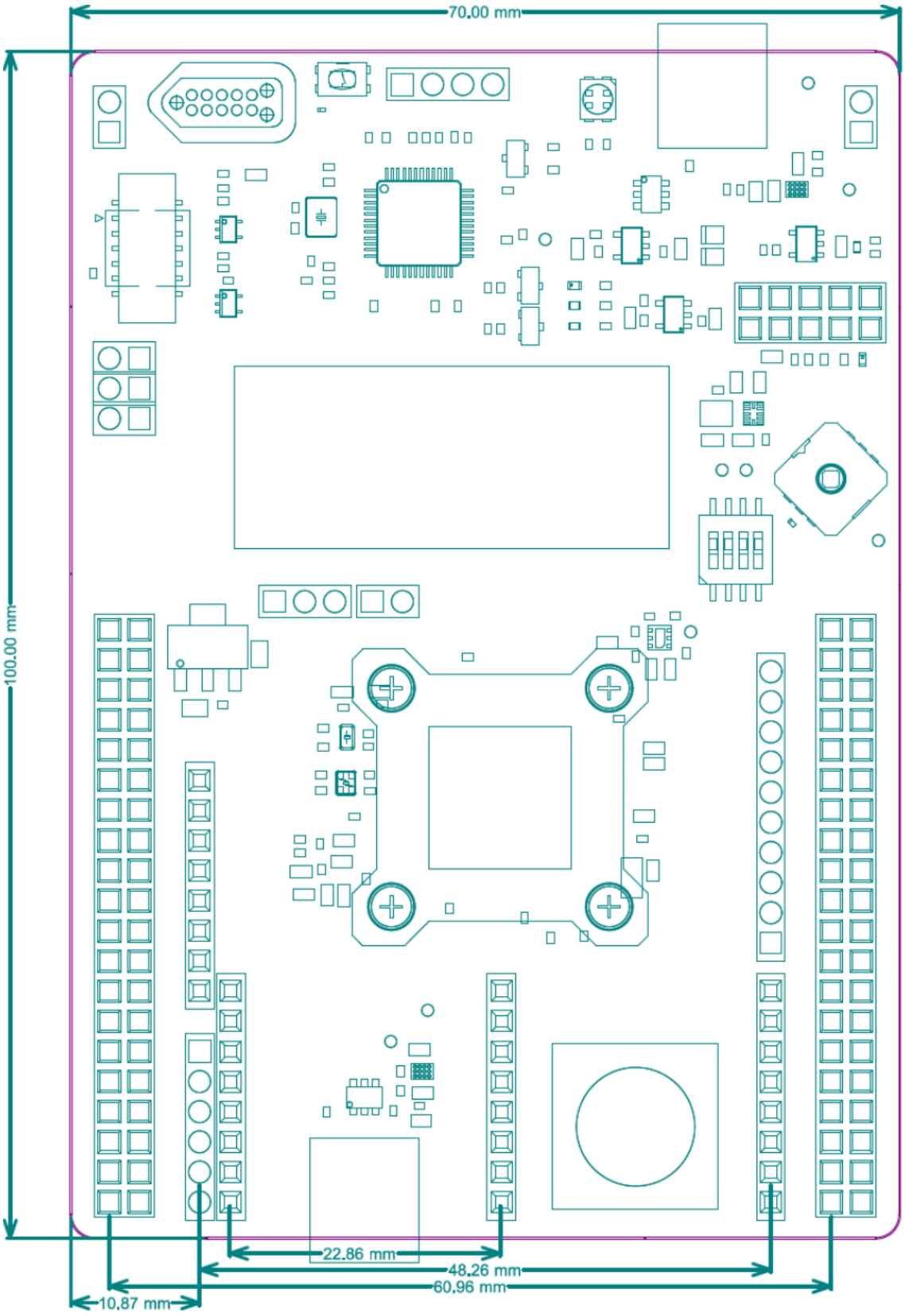
## 6.1 STM32U083C-DK board layout

**Figure 4. STM32U083C-DK layout top view**



## 6.2 Mechanical drawing

Figure 5. **STM32U083C-DK board mechanical drawing (in millimeters)**



## 6.3 Embedded STLINK-V2EC

The STLINK-V2EC programming and debugging tool is integrated with the STM32U083C-DK Discovery kit.

The embedded STLINK-V2EC supports only the SWD for STM32 devices.

For all general information concerning the debugging and programming features of STLINK-V2EC, refer to the user manual *ST-LINK/V2 in-circuit debugger/programmer for STM8 and STM32* (UM1075) and the technical note *Overview of ST-LINK derivatives* (TN1235).

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

- Using the embedded STLINK-V2EC
- Using an external debug tool connected to the STDC14/MIPI10 connector (CN4)

Refer to Table 10. Jumper configuration to switch between STLINK-V2EC and STDC14 configurations.

The STLINK-V2EC facility for debugging and flashing is integrated into the STM32 Discovery kit.

Features supported in STLINK-V2EC:

- USB software re-enumeration
- Mass storage interface on USB
- USB power management request for more than 100 mA power on the USB connector

Known limitations:

- Activating the readout protection on the STM32 target prevents the target application from running afterward. The target readout protection must be kept disabled on STLINK-V2EC boards.

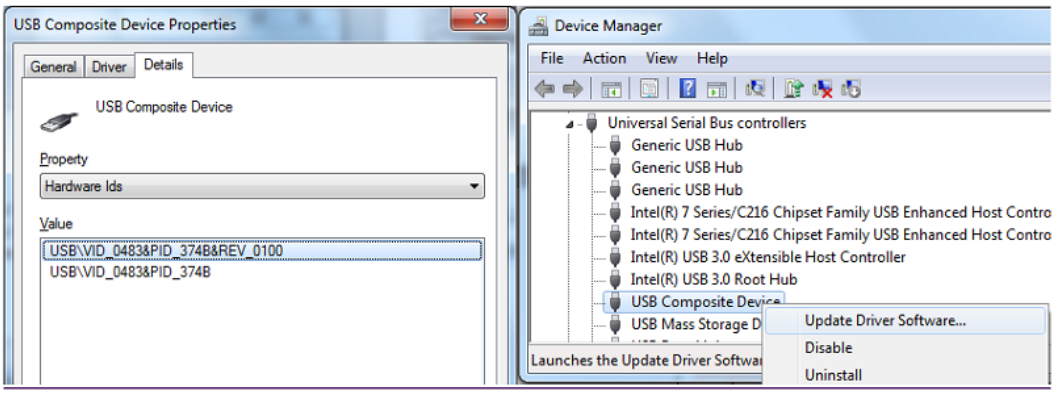
### 6.3.1 Drivers

Until Windows® 10, STLINK-V2EC requires a dedicated USB driver, which is available from *www.st.com*.

In case the STM32U083C-DK Discovery kit is connected to the PC before the driver is installed, some STM32 Discovery kit 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 6.

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

**Figure 6. USB composite device**




### 6.3.2 STLINK-V2EC firmware upgrade

STLINK-V2EC embeds a firmware mechanism for the in-place upgrade through the USB port. As the firmware might evolve during the lifetime of the STLINK-V2EC product (for example new functionalities, bug fixes, support for new microcontroller families), visiting the *www.st.com* website is recommended before starting to use the STM32U083C-DK Discovery kit, then periodically to stay up-to-date with the latest firmware version.

### 6.3.3 Programming and debugging the on-board MCU using the Debug_IN connector

To program the STM32 on board, plug in the Debug_IN connector (CN4) or TAG10 connector (CN2), as shown in Figure 4. The Debug_IN connector is an Arm® Cortex® 10-pin 1.27 mm-pitch debug connector over the STDC14/MIPI10 footprint according to Table 5. It supports the STDC14 or MIPI10 standard connectors. The TAG10 connector pinout is shown in Table 6.

**Table 5. STDC14/MIPI10 connector (CN4) (SWD only)**

| MIPI10 pin | STDC14 pin | CN4 | Designation |
|---|---|---|---|
| - | 1 | N/A | - |
| - | 2 | N/A | - |
| 1 | 3 | VDD | Target VDD from the application |
| 2 | 4 | SWDIO | SWD data input/output |
| 3 | 5 | GND | Ground |
| 4 | 6 | SWCLK | SWD clock |
| 5 | 7 | GND | Ground |
| 6 | 8 | SWO | Reserved |
| 7 | 9 | SWCLK | JRCLK |
| 8 | 10 | N/A | - |
| 9 | 11 | GNDDetect | - |
| 10 | 12 | NRST | RESET of the target MCU |
| - | 13 | VCP_RX | Target RX used for VCP (with UART supporting bootloader) |
| - | 14 | VCP_TX | Target TX used for VCP (with UART supporting bootloader) |

**Table 6. TAG10 connector (CN2) (SWD only)**

| TAG10 pin | CN2 | Designation |
|---|---|---|
| 1 | VDD | Target VDD from the application |
| 2 | SWDIO | SWD data input/output |
| 3 | GND | Ground |
| 4 | SWCLK | SWD clock |
| 5 | GND | Ground (via SB1) |
| 6 | SWO | Reserved |
| 7 | N/A | - |
| 8 | N/A | - |
| 9 | N/A | - |
| 10 | NRST | Reset of target MCU |

## 6.4 Power supply and power selection

### 6.4.1 External power supply input

Several DC power sources can power the STM32U083C-DK Discovery kit. It is possible to supply the STM32U083C-DK Discovery kit with any of the following sources:

- 5V_STLK: 5 V from the STLINK-V2EC USB Type-C® connector
- 5V_VIN: 7 to 12 V from the ARDUINO® or extension connectors, with 5 V adaptation from LDO
- E5V: External 5 V power from extension connectors
- VBUS_STLK: 5 V from the user USB Type-C® connector without enumeration
- 5V_USB: 5 V from the USB Type-C® connector

*Note: If the 5V_VIN or E5V DC power source is used to power a board, this power must comply with the EN-62368-1: 2014/A11:2017 standard and must be safety extralow voltage (SELV) with limited power capability.*

The power supply capabilities are shown in Table 7.

**Table 7. Power source capabilities**

| Input power | Connector pins | Voltage range | Maximum current | Limitation |
|---|---|---|---|---|
| 5V_STLK | CN1 JP3[1-2] | 4.75 to 5.5 V | 500 mA | The maximum current depends on the USB enumeration:<br>• 100 mA without enumeration<br>• 500 mA with good enumeration |
| VIN | CN6 pin 8<br>JP3[7-8] | 7 to 12 V | 800 mA | From 7 to 12 V only and the input current capability is linked to the input voltage:<br>• 800 mA input current when VIN = 7 V<br>• 450 mA input current when 7 V < VIN < 9 V<br>• 250 mA input current when 9 V < VIN < 12 V |
| E5V | CN7 pin 6<br>JP3[3-4] | 4.75 to 5.5 V | 1 A | The maximum current depends on the power source. 1 A maximum is recommended for this board. |
| VBUS_STLK | CN1<br>JP3[9-10] | 4.75 to 5.5 V | 500 mA | The maximum current depends on the USB Host used to power the board. No USB enumeration. |
| 5V_USB | CN14<br>JP3[5-6] | 4.75 to 5.5 V | 500 mA | The maximum current depends on the presence or absence of the USB enumeration. |

**5V_STLK** is a 5 V DC power with limitations from the STLINK-V2EC USB connector (CN1). In this case, the 5V jumper selection (JP3) must be on [1-2] to select the STLK power source on the JP3 connector. This is the default setting. If the USB enumeration succeeds, the STLK power is enabled, by asserting the T_PWR_EN signal coming from STLINK-V2EC. This pin is connected to a power switch, which powers the board. This power switch also features a current limitation to protect the PC in case of a short circuit on board, detected with a current higher than 750 mA.

The STM32U083C-DK Discovery kit and its shield can be powered from the STLINK-V2EC USB connector (CN1), but only the STLINK-V2EC circuit is powered before USB enumeration because the host PC only provides 100 mA to the board at that time. During the USB enumeration, the STM32U083C-DK Discovery kit and its shield request no more than 500 mA current.

- If the host can provide the required power, the enumeration ends with a *SetConfiguration* command. Then, the power transistor is switched ON and the green LED (LD3) is turned ON. Thus, the STM32U083C-DK Discovery kit and its shield request no more than 500 mA current.
- If the host is not able to provide the required current, the enumeration fails. Therefore, the power switch stays OFF and the MCU part including the expansion board is not powered. As a consequence, the green LED (LD3) stays turned OFF. In this case, it is mandatory to use an external power supply.

**VIN** is the 7 to 12 V DC power from the ARDUINO® connector (CN6 pin 8). The 5V jumper selection (JP3) must be on [7-8] to select the VIN power source. In that case, the DC power can come from the ARDUINO® Uno V3 battery shield and is compatible with Adafruit® PowerBoost 500 shield.

An LDO (U14) is used to provide a fixed 5 V from VIN (7-12 V).

**E5V** is the DC power coming from an external 5 V DC power source from the extension connector (CN7 pin 6.) The 5V jumper selection (JP3) must be on [3-4] to select the E5V power source.

**VBUS_STLK** is when a DC power charger is connected to the STLINK-V2EC USB connector (CN1). To select the CHG power source, the 5V jumper selection (JP3) must be on [9-10]. If an external USB charger powers the STM32U083C-DK Discovery kit, then the debugging feature through CN1 is not available. If a host computer is connected instead of the charger, it is recommended to select the STLK power source.

**5V_USB** is a 5 V DC power with limitations from the USB Type-C® connector (CN14). In this case, the 5V jumper selection (JP3) must be on [5-6] to select the USB power source on the JP3 connector.

### 6.4.2 Programing/debugging when the power supply is not from STLINK-V2EC (STLK)

In case the current consumption of the Discovery kit and the expansion boards exceeds the allowed current on the ST-LINK USB connector, the external power VIN, E5V, or user USB can be used. In such a case, it is still possible to use the embedded ST-LINK for VCP programming and debugging. In this case, the following power sequence procedure must be respected:

1. Set the JP3 jumper according to the 5 V selected external power source.
2. Connect the external power source according to Table 7.
3. Power on the external power supply.
4. Check that the 5 V green LED (LD6) is turned ON.
5. Connect the PC to the USB connector (CN1) for programming/debugging.

If this sequence is not followed, the STLINK-V2EC $V_{BUS}$ might first supply power to the board, and the following risks might be encountered:

- If the board needs more than 500 mA current, the PC might be damaged or the current limited by the PC. Therefore, the board is not powered correctly.
- 500 mA is requested at the enumeration: This request is rejectable and the enumeration does not succeed if the PC does not provide such a current. Consequently, the board is not power supplied (LED LD6 remains OFF).

### 6.4.3 VDD IDD measurement

The IDD-labeled jumper (JP7) is used to measure the consumption of the STM32 microcontroller by removing the jumper and connecting an ammeter or any other current measurement tool:

- Jumper ON: The STM32 microcontroller is powered (default configuration).
- Jumper OFF: To power and measure the consumption of the STM32 microcontroller, an ammeter, or an external 3.3 V power supply must be connected.

The IDD jumper can be used to perform the current consumption for both 3.3 and 1.8 V MCU voltages.

## 6.5 OSC clock sources

Two clock sources are available on the Discovery kit:

- LSE is the 32.768 kHz crystal for the STM32 embedded RTC
- HSE is the 24 MHz oscillator for the STM32 microcontroller. Not fitted by default.

To help select the crystals and their associated capacitors, refer to the application note *Oscillator design guide for STM8AF/AL/S, STM32 MCUs and MPUs* (AN2867).

### 6.5.1 LSE: OSC 32 KHz clock supply

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

**LSE on-board oscillator X2 crystal (default configuration)**

For example, the X2 crystal embedded in the Discovery kit has the following characteristics: 32.768 kHz, 6 pF, and 20 ppm.

The use of the embedded X2 crystal requests the following SB configuration:

- SB16 and SB18 OFF
- R52 and R53 ON

**External oscillator connected to PC14 input**

The use of the external oscillator through pin 27 of the extension connector (CN7) requests the following configuration:

- SB16 ON
- R52 and R53 OFF

**LSE not used**

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

- SB16 and SB18 ON
- R52 and R53 OFF

### 6.5.2 HSE: OSC clock supply

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

**HSE on-board oscillator from X3 crystal**

For example, the X3 crystal embedded in the Discovery kit has the following characteristics: 24 MHz, 8 pF, 20 ppm. The use of the embedded X3 crystal requests the following solder bridge configuration:

- SB19 and SB20 OFF
- R54 and R55 ON

**External oscillator to PF0 input**

The input clock comes from an external oscillator through PF0 (CN17 pin 31). The following configuration is needed:

- SB19 ON
- R54 and R55 OFF

**HSE not used (default configuration)**

PF0 and PF1 are used as GPIOs instead of clocks. The following configuration is needed:

- SB19 and SB20 ON
- R54 and R55 OFF

## 6.6 Reset sources

The Discovery kit reset signal is active LOW and the reset sources include:

- The reset push-button (B1)
- The embedded STLINK-V2EC
- The ARDUINO® connector (CN6 pin 3)
- The extension connector (CN7 pin 16)

## 6.7 Virtual COM port (VCP)

An STM32 serial interface is connected to the STLINK-V2EC debug interface. The user can choose the USART2 interface. Refer to Table 8 below to set the USART2 connection to the VCP interface.

**Table 8. VCP communication**

| Pin name | Function | Virtual COM port (default configuration | Expansion connectors connection |
|---|---|---|---|
| PA2 | USART2 TX | U21 ON | U21 and R25 OFF |
| PA3 | USART2 RX | R33 ON | R33 OFF |

## 6.8 LEDs

Six LEDs are available on the STM32U083C-DK Discovery kit. The six LEDs are located on the top side of the board:

**STLINK-V2EC tricolor LED (LD1)**

The tricolor (green, orange, and red) LED provides information about STLINK-V2EC communication status (LD1). For detailed information about the LED, refer to the technical note *Overview of ST-LINK derivatives* (TN1235).

**VBUS_STLK over current LED (LD2)**

The red LED is ON when overcurrent is detected on USB $V_{BUS}$. The LED gives the information that more than 500 mA is requested on $V_{BUS}$. In this case, it is recommended to supply the board with E5V, VIN, or in the USB charger mode.

**5V PWR LED (LD6)**

The green LED (LD6) indicates that the Discovery kit is powered by a 5 V source, and this source is available on CN6 pin 5 and CN7 pin 20.

**User green LED (LD3), blue LED (LD4), and red LED (LD5)**

The user green LED (LD3) is connected to the STM32 I/O PC13.

The user blue LED (LD4) is connected to the STM32 I/O PA5 (R66 ON, default configuration), also used for ARDUINO® D13 function.

The user red LED (LD5) is connected to the STM32 I/O PB2.

A transistor is used to drive the LED whatever the MCU 1V8 or 3V3 voltage range.

## 6.9 Push-buttons

Two buttons are available on the Discovery kit.

### RESET button (B1)

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.

### Joystick (B2)

This joystick is a 5-way rock switch using a single ADC input pin PC2. Push-in *Select* can be used as a digital user button and EXTI wake-up interrupt.

The joystick position for the ADC value refers to Table 9.

**Table 9. Joystick position for the ADC value**

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

VREF is connected to the joystick resistor network as the power supply. So, the joystick can work whenever 3.3 or 1.8 V for the ADC measurement ratio.

## 6.10 Jumper configuration

The default jumper positions are shown in Table 4. Table 10 describes the other available jumper settings

**Table 10. Jumper configuration**

| Jumper/CN | Function | State[1] | Comment |
|---|---|---|---|
| JP1, JP2 | GND | **ON** | GND probe |
| JP3 | 5 V power selection | **[1-2]** | 5 V from ST-LINK |
| | | [3-4] | 5 V from E5V |
| | | [5-6] | 5 V from user USB |
| | | [7-8] | 5 V from VIN 7 V to 12 V |
| | | [9-10] | 5 V from VBUS_STLK |
| | | OFF | No 5 V power |
| JP4 | STLK reset | **OFF** | No STLK reset |
| | | ON | STLK reset |
| JP5 | NRST connection | **ON** | Reset signal from STLINK-V2EC to target MCU |
| | | OFF | STLINK-V2EC cannot reset target MCU |
| JP6 | Sensor power selection | **[1-2]** | VDD is the temperature sensor and mikroBUS™ connectors power supply |
| | | [2-3] | VDD_MCU is the temperature sensor and mikroBUS™ connectors power supply |
| JP7 | IDD measurement | **ON** | VDD_MCU = VDD |
| | | OFF | To connect the external source (ULPBench probe as an example) |

1. *The default jumper state is shown in bold.*

## 6.11 Segment LCD

A 4×24-segment LCD, four commons, multiplexed 1/4 duty, 1/3 bias is mounted on the DIP28 connector (U11). Table 11 shows the remapped LCD pins to the STM32U083MC GPIO and segment LCD functions.

**Table 11. LCD pinout**

| LCD pin | LCD name | MCU GPIO | LCD function |
|---|---|---|---|
| 1 | SEG0 | PC4 | LCD_SEG22 |
| 2 | SEG1 | PC5 | LCD_SEG23 |
| 3 | SEG2 | PB1 | LCD_SEG6 |
| 4 | SEG3 | PE7 | LCD_SEG45 |
| 5 | SEG4 | PE8 | LCD_SEG46 |
| 6 | SEG5 | PE9 | LCD_SEG47 |
| 7 | SEG6 | PB11 | LCD_SEG11 |
| 8 | SEG7 | PB14 | LCD_SEG14 |
| 9 | SEG8 | PB15 | LCD_SEG15 |
| 10 | SEG9 | PD8 | LCD_SEG28 |
| 11 | SEG10 | PD9 | LCD_SEG29 |
| 12 | SEG11 | PD12 | LCD_SEG32 |
| 13 | COM3 | PB9 | LCD_COM3 |
| 14 | COM2 | PA10 | LCD_COM2 |
| 15 | COM1 | PA9 | LCD_COM1 |
| 16 | COM0 | PA8 | LCD_COM0 |
| 17 | SEG12 | PD13 | LCD_SEG33 |
| 18 | SEG13 | PC6 | LCD_SEG24 |
| 19 | SEG14 | PC8 | LCD_SEG26 |
| 20 | SEG15 | PC9 | LCD_SEG27 |
| 21 | SEG16 | PC10 | LCD_SEG48 |
| 22 | SEG17 | PD0 | LCD_SEG34 |
| 23 | SEG18 | PD1 | LCD_SEG35 |
| 24 | SEG19 | PD3 | LCD_SEG36 |
| 25 | SEG20 | PD4 | LCD_SEG37 |
| 26 | SEG21 | PD5 | LCD_SEG38 |
| 27 | SEG22 | PD6 | LCD_SEG39 |
| 28 | SEG23 | PC11 | LCD_SEG49 |

## 6.12 USB Type-C® FS port

The STM32U083C-DK Discovery kit supports USB full-speed (FS) communication. The USB connector (CN14) is a USB Type-C® connector. The USB connector (CN14) can power the Discovery board at a 5 V DC voltage with a 500 mA current limitation. The VBUS2 voltage is connected to U17 for $V_{BUS}$ overvoltage protection.

The STM32U083C-DK Discovery kit supports USB Type-C® sink only. When a USB Host connection to the USB Type-C® connector (CN14) of the STM32U083C-DK Discovery kit is detected, it starts behaving as a USB Device. Depending on the powering capability of the USB Host, the board can take power from the $V_{BUS}$ terminal of CN14. In the board schematic diagrams, the corresponding power voltage line is called 5V_USB.

Section 6.4.1 provides information on how to use the powering option.

The PB6 pin is used as $V_{BUS}$ sensing detection when the USB Device is bus-powered or self-powered. When VDD is 3.3 V, SB24 is ON. When VDD is 1.8 V, SB24 is OFF as the resistor divider value for $V_{BUS}$ detection.

The hardware configuration for the USB FS interface is shown in Table 12.

**Table 12. USB Type-C® FS GPIO configuration**

| GPIO | Hardware | Setting(1) | Configuration |
|---|---|---|---|
| PA11 | SB8 | **OFF** | PA11 is used as the USB_FS_N diff pair interface. |
| | | ON | PA11 is connected in parallel to the extension connector (CN10).<br>The USB interface can be disturbed. |
| PA12 | SB7 | **OFF** | PA12 is used as the USB_FS_P diff pair interface. |
| | | ON | PA12 is connected in parallel to the extension connector (CN10).<br>The USB interface can be disturbed. |

1. *The default configuration is shown in bold.*

## 6.13 Touchkey button

The STM32U083C-DK Discovery kit supports a touchkey button based on either RC charging or charge-transfer technique. This one is enabled by default.

The touchkey button is connected to one of the TSC ports of STM32U083MC with the related charge capacitor. An active shield is designed in layer 2 of the main PCB, under the button footprint. It allows the reduction of disturbances from other circuits to prevent false touch detections.

The active shield is connected to another TSC interface of STM32U083MC through the R56 serial resistor. The related charge capacitor is connected to the same TSC interface.

The solder bridge and jumper configuration related to the touchkey function enables or disables its operation. However, most of them serve to optimize the touchkey performance, by isolating copper tracks to avoid disturbances due to their antenna effect.

For more information about the TSC interface and the tuning explanation for this interface, refer to the application note *Getting started with touch sensing control on STM32 microcontrollers* (AN5105) and the STM32U0xx product datasheets.

Table 13 describes the hardware configuration for the touchkey button interface.

**Table 13. Hardware I/O configuration for the touchkey button interface**

| GPIO | Hardware | Setting(1) | Configuration |
|---|---|---|---|
| PD10 | SB11 | **OFF** | PD10 is directly connected to TKEY_CS. |
| | | ON | PD10 can be used for extension I/O connectors. In this case, the touch key layout is not optimized and the touchkey button may not be functional. |
| PD11 | SB9 | **OFF** | PD11 is directly connected to the touchkey button. |
| | | ON | PD11 can be used for extension I/O connectors. In this case, the touch key layout is not optimized and the touchkey button may not be functional. |
| PB12 | SB23 | **OFF** | PB12 is directly connected to the SHIELD touchkey button. |
| | | ON | PB12 can be used for extension I/O connectors. In this case, the touch key layout is not optimized and the touchkey button may not be functional. |
| PB13 | SB22 | **OFF** | PB13 is directly connected to SHIELD_CS. |
| | | ON | PB13 can be used for extension I/O connectors. In this case, the touch key layout is not optimized and the touchkey button may not be functional. |

1. *The default configuration is shown in bold.*

## 6.14 Temperature sensor

The STM32U083C-DK Discovery kit embeds an ultra-low-power temperature sensor with 0.5°C accuracy and ALERT support. This sensor is managed with an I$^2$C shared with the ARDUINO® and mikroBUS™ connectors. The I$^2$C read/write address is `0x7F/0x7E`.

The temperature sensor is powered by VDD or VDD_MCU by jumper JP6. Refer to Section 6.10 for jumper configuration.

# 7 Connectors

## 7.1 ARDUINO® Uno V3

The CN5, CN6, CN8, and CN9 connectors are female connectors supporting the ARDUINO® Uno V3 standard. Most shields designed for ARDUINO® can fit the Discovery board.

**Caution:** Most of the STM32 microcontroller I/Os are 5V-tolerant, but a few of them are only 3.6V-compatible, while ARDUINO® Uno V3 is 5V-compatible. Refer to the STM32 series databrief and STM32xxxx product datasheets for their I/O structure.

The related pinout for the ARDUINO® connector is listed in Table 14.

Table 14. **ARDUINO® connectors on STM32U083C-DK**

| Left connectors | | | | |
|---|---|---|---|---|
| **Connector** | **Pin number** | **Pin name** | **MCU pin** | **Function** |
| CN6 | 1 | NC | - | Reserved for test |
| | 2 | IOREF | - | I/O reference |
| | 3 | NRST | NRST | RESET |
| | 4 | 3V3 | - | 3.3 V input/ output |
| | 5 | 5V | - | 5 V output |
| | 6 | GND | - | GND |
| | 7 | GND | - | GND |
| | 8 | VIN | - | 7 to 12 V power input |
| CN8 | 1 | A0 | PA0(2) | ADC1_IN4 |
| | 2 | A1 | PA1(2) | ADC1_IN5 |
| | 3 | A2 | PA4(2) | ADC1_IN8 |
| | 4 | A3 | PB0(2) | ADC1_IN17 |
| | 5 | A4 | PC1(2) | ADC1_IN1 or I2C1_SDA |
| | 6 | A5 | PC0(2) | ADC1_IN0 or I2C1_SCL |

| Right connectors | | | | |
|---|---|---|---|---|
| **Function** | **MCU pin** | **Pin name** | **Pin number** | **Connector** |
| I2C1_SCL | PB8 | SCL/D15 | 10 | CN5 |
| I2C1_SDA | PB9 | SDA/D14 | 9 | |
| VREF+(1) | - | VREF | 8 | |
| GND | - | GND | 7 | |
| SPI1_SCK | PA5 | SCK/D13 | 6 | |
| SPI1_MISO | PA6 | MISO/D12 | 5 | |
| SPI1_MOSI or TIM1_CH1N | PA7 | PWM/MOSI/D11 | 4 | |
| SPI_CS or TIM16_CH1N | PB6 | PWM/CS/D10 | 3 | |
| TIM3_CH2 | PC7 | PWM/D9 | 2 | |
| IO | PA9 | D8 | 1 | |
| IO | PA8 | D7 | 8 | CN9 |
| TIM2_CH3 | PB10 | PWM/D6 | 7 | |
| TIM3_CH1 | PB4 | PWM/D5 | 6 | |
| IO | PB5 | D4 | 5 | |
| TIM2_CH2 | PB3 | PWM/D3 | 4 | |
| IO | PC12 | D2 | 3 | |
| USART2_TX | PA2 | TX/D1 | 2 | |
| USART2_RX | PA3 | RX/D0 | 1 | |

1. *VREF is selected from the internal as default. VREF can be selected from external CN5 pin8 or CN10 pin 10 (SB17 ON and SB12 OFF).*
2. *The ADC input range is 0 <= VIN <= VREF.*

## 7.2 Extension connectors (CN7 and CN10)

The extension connectors are two 2x20 2.54-pitch male pin headers (CN7 and CN10). They can be used to connect the STM32U083C-DK Discovery kit to an expansion or prototype/wrapping board placed on top of it. All signals and power pins of the STM32 are available on the extension connectors. An oscilloscope, a logic analyzer, or a voltmeter can also probe this connector.

Table 15 describes the CN7 and CN10 connector pinout.

**Table 15. Pin assignment for the STM32 on the extension connectors**

| CN7 | | | |
|---|---|---|---|
| Pin name | Pin number | Pin number | Pin name |
| PD4 | 1 | 2 | PD5 |
| PC10 | 3 | 4 | PC11 |
| PB9 | 5 | 6 | E5V |
| VDDUSB | 7 | 8 | PD12 |
| PF3-BOOT0 | 9 | 10 | PD13 |
| PD6 | 11 | 12 | PE7 |
| PD9 | 13 | 14 | VDD_MCU |
| PA13(1) | 15 | 16 | NRST |
| PA14(1) | 17 | 18 | VDD |
| PA8 | 19 | 20 | 5V |
| PD0 | 21 | 22 | GND |
| PA9 | 23 | 24 | GND |
| PC13 | 25 | 26 | PE8 |
| PC14(2) | 27 | 28 | PE9 |
| PC15(2) | 29 | 30 | PA0 |
| PF0(2) | 31 | 32 | PA1 |
| PF1(2) | 33 | 34 | PA4 |
| VBAT | 35 | 36 | PB0 |
| PC2 | 37 | 38 | PC1 |
| PC3 | 39 | 40 | PC0 |

| CN10 | | | |
|---|---|---|---|
| Pin name | Pin number | Pin number | Pin name |
| PD3 | 1 | 2 | PA10 |
| PC9 | 3 | 4 | PC8 |
| PB8 | 5 | 6 | PC6 |
| PB7 | 7 | 8 | PC5 |
| AVDD | 9 | 10 | VREF(5) |
| AGND | 11 | 12 | PD8 |
| PA5 | 13 | 14 | PA12(3) |
| PA6 | 15 | 16 | PA11(3) |
| PA7 | 17 | 18 | PB12(4) |
| PA15 | 19 | 20 | PB11 |
| PC7 | 21 | 22 | GND |
| PB6 | 23 | 24 | PB2 |
| PD2 | 25 | 26 | PB1 |
| PB10 | 27 | 28 | PB15 |
| PB4 | 29 | 30 | PB14 |
| PB5 | 31 | 32 | PB13(4) |
| PB3 | 33 | 34 | PD1 |
| PC12 | 35 | 36 | PC4 |
| PA2 | 37 | 38 | PD11(4) |
| PA3 | 39 | 40 | PD10(4) |

1. *PA13 and PA14 are shared with SWD signals connected to STLINK-V2EC. It is not recommended to use them as I/O pins.*
2. *Refer to Section 6.5 for details.*
3. *Refer to Table 12 for details.*
4. *Refer to Table 13 for details.*
5. *The ADC input range is 0 <= VIN <= VREF.*

## 7.3 mikroBUS™ compatible connectors (CN12 and CN13)

The mikroBUS™ compatible connectors CN12 and CN13 are a pair of 1×8-pin female connectors with a 2.54 mm pitch. The mikroBUS™ pinout assignment is available at the mikroe.com website.

Table 16 shows the definition of the pins.

**Table 16. Description of the mikroBUS™ connector pins**

| Pin name | mikroBUS™ function | Pin number |
|---|---|---|
| PA0 | AN | 1 |
| PB10 | RST | 2 |
| PA15 | CS | 3 |
| PA5 | SCK | 4 |
| PA6 | MISO | 5 |
| PA7 | MOSI | 6 |
| - | +3.3 V | 7 |
| - | GND | 8 |

| Pin number | mikroBUS™ function | Pin name |
|---|---|---|
| 1 | PWM | PB3 |
| 2 | INT | PB4 |
| 3 | RX | PA3 |
| 4 | TX | PA2 |
| 5 | SCL | PB8 |
| 6 | SDA | PB7 |
| 7 | +5 V | - |
| 8 | GND | - |

# 8 STM32U083C-DK product information

## 8.1 Product marking

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

- First sticker: product order code and product identification, generally placed on the main board featuring the target device.
  Example:

  Product order code
  Product identification

- Second sticker: board reference with revision and serial number, available on each PCB.
  Example:

  MBxxxx-Variant-yzz
  syywwxxxxx

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

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

Parts marked as *"ES"* or *"E"* are not yet qualified and therefore not approved for use in production. ST is not responsible for any consequences resulting from such use. In no event will ST be liable for the customer using any of these engineering samples in production. ST's Quality department must be contacted prior to any decision to use these engineering samples to run a qualification activity.

*"ES"* or *"E"* marking examples of location:

- On the targeted STM32 that is soldered on the board (for an illustration of STM32 marking, refer to the STM32 datasheet *Package information* paragraph at the *www.st.com* website).
- Next to the evaluation tool ordering part number that is stuck, or silk-screen printed on the board.

Some boards feature a specific STM32 device version, which allows the operation of any bundled commercial stack/library available. This STM32 device shows a *"U"* marking option at the end of the standard part number and is not available for sales.

To use the same commercial stack in their applications, the developers might need to purchase a part number specific to this stack/library. The price of those part numbers includes the stack/library royalties.

## 8.2 STM32U083C-DK product history

**Table 17. Product history**

| Order code | Product identification | Product details | Product change description | Product limitations |
|---|---|---|---|---|
| STM32U083C-DK | DK32U083C$KS1 | MCU:<br>• STM32U083MCT6 silicon revision "A" | Initial revision | No limitation |
| | | MCU errata sheet:<br>• *STM32U073xx and STM32U083xx device errata* (ES0602) | | |
| | | Board:<br>• MB1933-U083C-C02 (main board) | | |

## 8.3 Board revision history

**Table 18. Board revision history**

| Board reference | Board variant and revision | Board change description | Board limitations |
|---|---|---|---|
| MB1933 (main board) | MB1933-U083C-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 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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## 9.2 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 19. **Document revision history**

| Date | Revision | Changes |
|---|---|---|
| 08-Feb-2024 | 1 | Initial release. |

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