

## Getting started with the X-NUCLEO-SNK1M1 USB Type-C™ Power Delivery Sink expansion board based on TCPP01-M12 for STM32 Nucleo

### Introduction

The X-NUCLEO-SNK1M1 expansion board allows evaluating the features of TCPP01-M12 and the USB Type-C overvoltage protection for  $V_{BUS}$  and CC lines suitable for Sink applications.

The expansion board is designed to be stacked on top of any STM32 Nucleo-64 development board exploiting the characteristics of the USB Type-C and Power Delivery (UCPD) peripheral embedded in their microcontrollers.

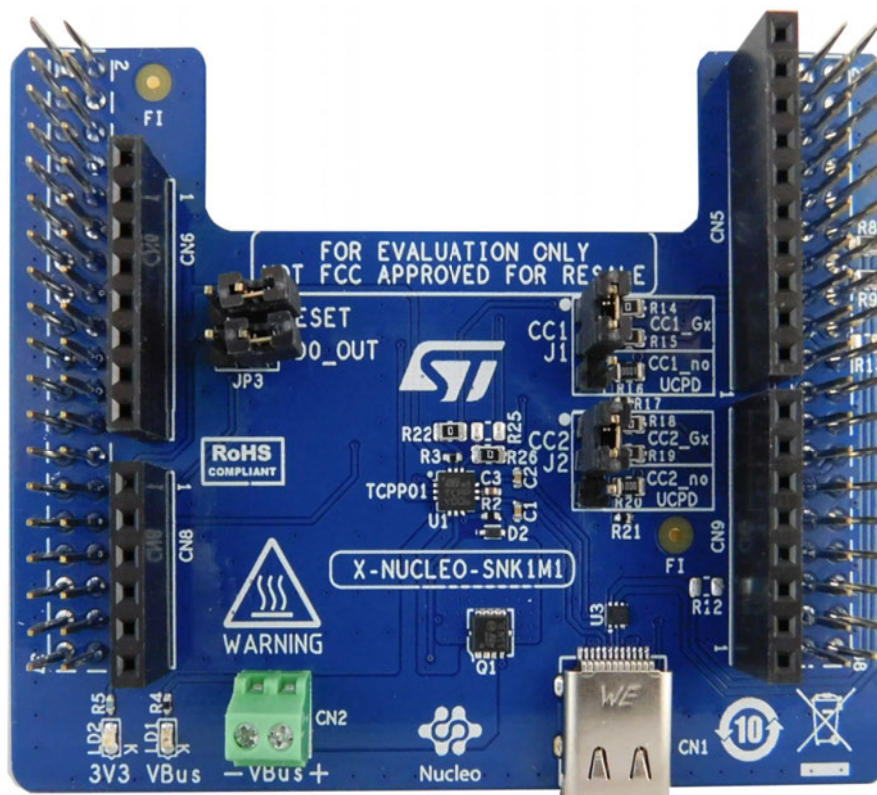
It can also be stacked on other STM32 Nucleo development boards not supporting the UCPD peripheral to demonstrate the Type-C basic operations (attach, detach and power supply current capability recognition).

The X-NUCLEO-SNK1M1 provides an effective demonstration of the dead battery operation, thanks to the integrated ST715PU33R LDO linear regulator that supplies the connected STM32 Nucleo development board when a Source is attached via a USB Type-C connector.

The X-NUCLEO-SNK1M1 is compliant with the latest USB Type-C and Power Delivery specifications and is also USB-IF certified as a 100 W solution supporting Programmable Power Supply (PPS) function.

The companion software package (X-CUBE-TCPP) contains the application examples for development boards embedding UCPD-based microcontrollers (NUCLEO-G071RB, NUCLEO-G474RE and NUCLEO-G0B1RE) and for non-UCPD ones (NUCLEO-L412RB-P).

Figure 1. X-NUCLEO-SNK1M1 expansion board



**Note:** Before running any demo, set CC1 J1, CC2 J2, JP3 and JP4 jumpers according to the configuration described in Section 1.3 Demo application setup.

# 1 Getting started

## 1.1 Overview

The **X-NUCLEO-SNK1M1** expansion board features:

- On-board **TCPP01-M12** protection for USB Type-C and PD Sink applications
- Compliant with the latest USB Type-C and Power delivery specification, including the Programmable Power Supply (PPS) feature
- USB-IF certified (Test ID certification: 5205)
- 100 W-rated solution
- 6 V overvoltage protection (OVP) on CC lines against short-to- $V_{BUS}$  when the connector is unplugged
- Up to 22 V adjustable overvoltage protection (OVP) on  $V_{BUS}$  line against charger failure
- Surge protection (8/20  $\mu$ s) and system-level ESD protection on  $V_{BUS}$
- Common mode filter and ESD protection on USB 2.0 High Speed data lines
- System level ESD protection on CC lines as per IEC61000-4-2 level 4 ( $\pm 8$  kV contact discharge)
- Low power mode for battery operation allowing zero current consumption when no cable is attached
- Integrated dead battery management when the device battery is fully depleted
- Overtemperature protection (OTP)
- RoHS compliant

## 1.2 Hardware architecture

The **X-NUCLEO-SNK1M1** expansion board is designed to be used with any **STM32 Nucleo-64** development board embedding the UCPD peripheral (mainly **NUCLEO-G071RB**, **NUCLEO-G474RE** and **NUCLEO-G0B1RE**) and also with the ones not supporting the UCPD peripheral.

*Note:* *The compliance with the USB Type-C and Power Delivery specification is guaranteed only for the STM32 Nucleo development boards embedding the microcontrollers (STM32G071RB and STM32G474RE) with a UCPD peripheral.*

When stacked with a non-UCPD STM32 Nucleo development board, the **X-NUCLEO-SNK1M1** can still demonstrate some Type-C basic operations like ATTACH/DETACH recognition and identification of source current capability.

Moreover, two couples of resistances, used as solder bridge selectors, allow exploiting the USB2.0 peripheral.

The expansion board must be plugged on the matching pins of the development board CN7 and CN10 ST morpho connectors.

When plugged onto an **STM32 Nucleo** development board, the expansion board can be supplied in two different ways:

- by the **STM32 Nucleo** ST-LINK supply using the development board internal LDO
- by the  $V_{BUS}$  provided when a Source is plugged into the CN1 USB Type-C connector and thanks to the integrated **ST715PU33R** LDO linear regulator (U2) that supplies the entire system, which supports Dead Battery operation mode.

Figure 2. X-NUCLEO-SNK1M1 main functional blocks (top view)

1. Morpho connector (CN7)
2. Arduino connector (CN6, CN8)
3. Reset jumper (JP4)
4. LDO OUT jumper (JP5)
5. 3V3 LED (LD2)
6. V<sub>BUS</sub> LED (LD1)
7. Power connector (CN2)
8. TCPP01-M12 USB-C overvoltage protection for VBUS and CC lines (U1)
9. BAT54K Schottky diode (D2)
10. CC1 line configuration jumper (J1)
11. CC2 line configuration jumper (J2)
12. USB data setting resistor (R12)
13. ECMF02-2AMX6 common-mode filter and ESD protection for USB 2.0 and MIPI/MDDI interfaces (U3)
14. Type-C connector (CN1)
15. STL11N3LLH6 N-channel 30 V, 6 mOhm typ., 11 A STripFET H6 Power MOSFET (Q1)
16. Arduino connector (CN5, CN9)
17. Morpho connector (CN10)
18. USB data setting resistor (R8, R9)
19. USB data setting resistor (R13)

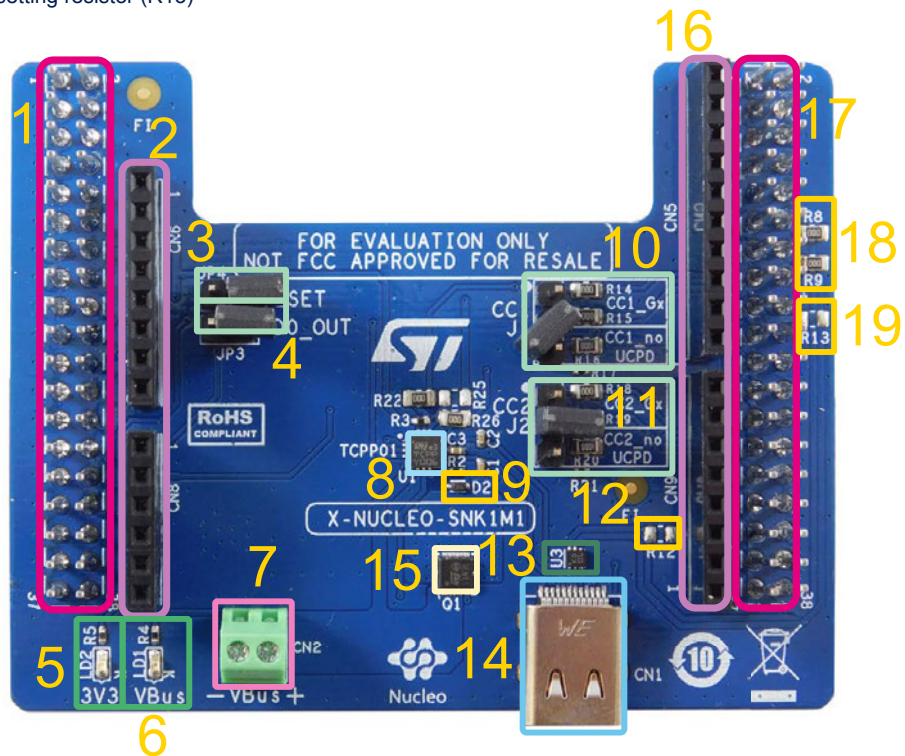
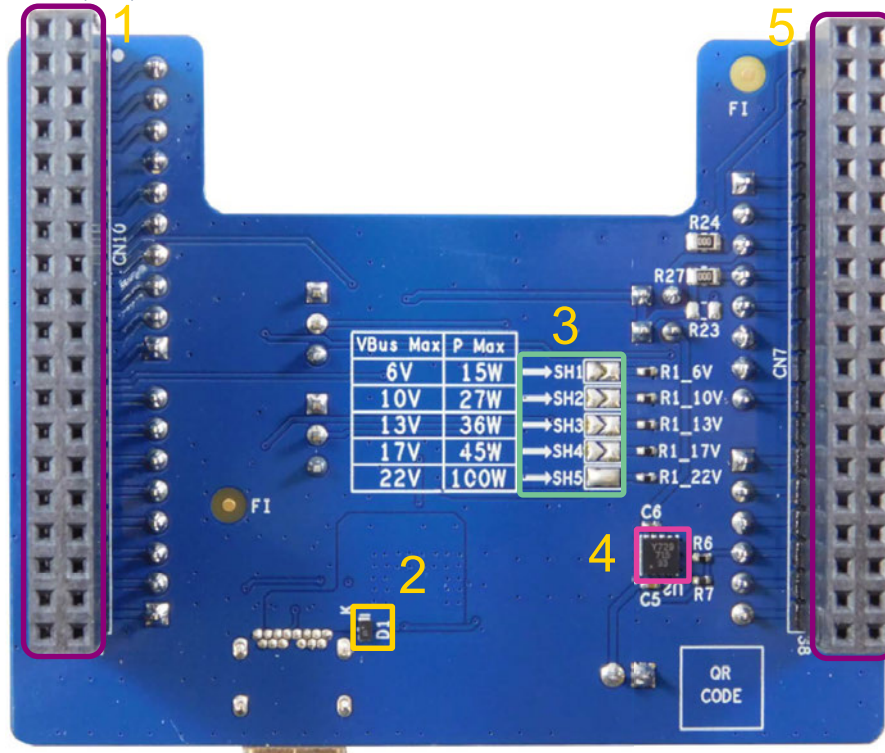


Figure 3. X-NUCLEO-SNK1M1 main functional blocks (bottom view)

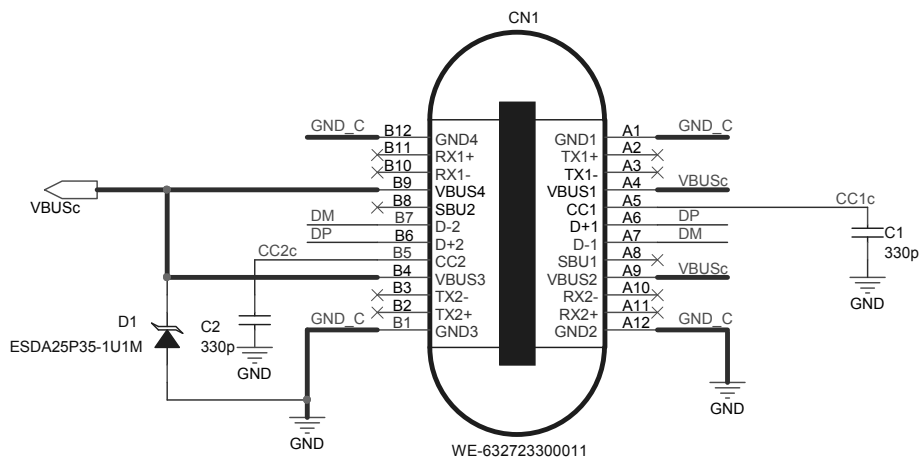
1. Morpho connector (CN10)
2. ESDA25P35-1U1M TVS diode (D1)
3. OVP threshold solder bridges (SH1, SH2, SH3, SH4, SH5)
4. ST715PU33R high input voltage LDO linear regulator (U2)
5. Morpho connector (CN7)



### 1.2.1 Type-C connector

The USB Type-C receptacle (CN1) gathers the  $V_{BUS}$  path and the main connections, such as CC lines and USB2.0 data lines (DP, DM), before dispatching data to the major functional blocks.

Figure 4. Type-C receptacle (CN1) and ESDA25P35-1U1M TVS diode (D1)



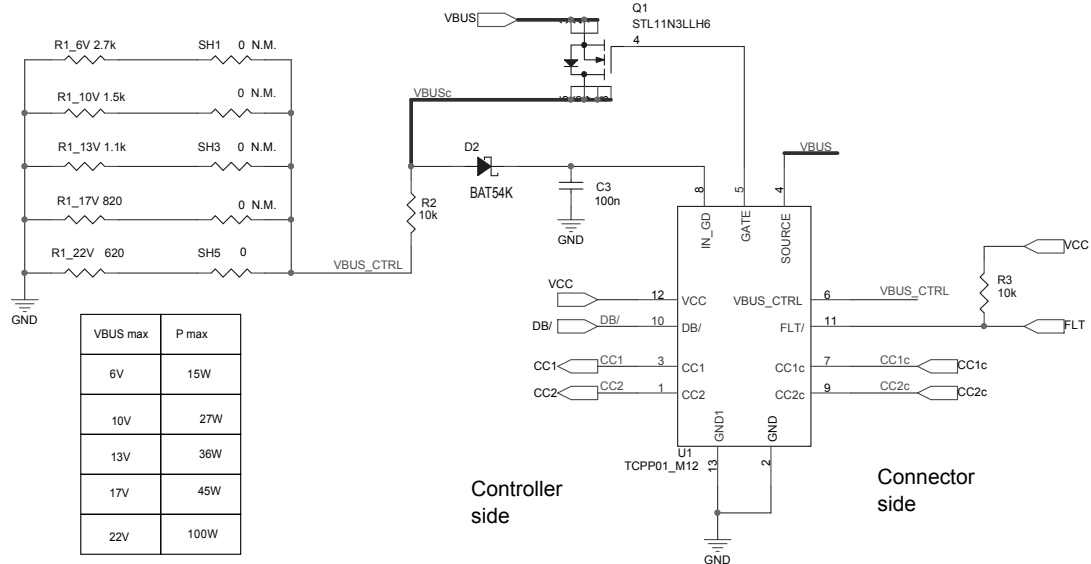
**Note:**  $V_{BUS}$  path capacitive value should be included between  $1\ \mu\text{F}$  and  $10\ \mu\text{F}$  for a USBPD SINK port design. An ESDA25P35-1U1M TVS diode has been integrated to protect the  $V_{BUS}$  power line and, consequently, the entire system against EOS and ESD transients when a Source is connected through the USB-C cable.

### 1.2.2 TCPP01-M12 USB-C protection and $V_{BUS}$ overvoltage protection setup

TCPP01-M12 (U1) protects CC1 and CC2 pins of the USB-C and PD controller Sink against overvoltage in case a short-circuit event with the  $V_{BUS}$  occurs during the ATTACH or DETACH operation with a defective tool.

The protection is implemented by removing the USB Type-C cable from its receptacle.

Figure 5. TCPP01-M12 protection (U1) driving the STL11N3LLH6 MOS (Q1)



TCPP01-M12 overvoltage protection (OVP) threshold setup mechanism is based on a resistive network composed of five resistors (R1\_6V, R1\_10V, R1\_13V, R1\_17V and R1\_22V) and five solder bridges (SH1, SH2, SH3, SH4 and the SH5). Connected to the device through the BAT54K signal Schottky diode (D2), this section is shown in the figure above (left side) and is placed at the board bottom.

On the X-NUCLEO-SNK1M1 expansion board, the 22 V OVP threshold is set by default via SH5. To change the threshold to another value (6, 10, 13 or 17 V), remove SH5 and add a different solder bridge on the selected OVP voltage.

When a defective power source plugged onto the Type-C connector produces a voltage higher than the selected OVP threshold, the TCPP01-M12 OVP mechanism controls the external MOSFET Q1 and interrupts the  $V_{BUS}$  line.

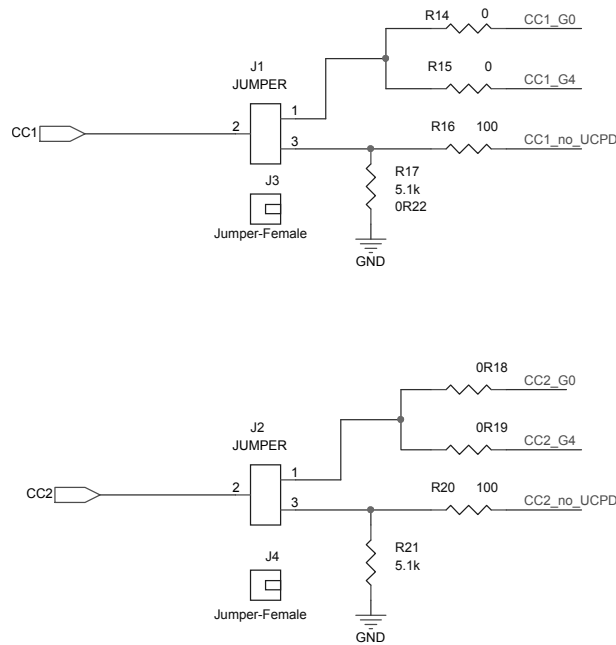
### 1.2.3 CC lines and configuration jumpers

Two headers for jumpers (J1 and J2) have been integrated to change the CC lines paths from the TCPP01-M12 protection to the ST morpho connectors (CN7 and CN10) on the STM32 Nucleo development board, setting them differently according to the peripheral mapping of the STM32 microcontroller.

This integration guarantees the solution flexibility support for the demo across the STM32 Nucleo-64 development board range.



Figure 6. CC line configuration jumpers



The table below shows the jumper settings to configure the X-NUCLEO-SNK1M1 to work with the STM32 Nucleo development boards embedding the UCPD peripherals (NUCLEO-G071RB, NUCLEO-G474RE and NUCLEO-G0B1RE) as well as with other STM32 Nucleo-64 boards (NUCLEO-L412RB-P) implementing the Type-C attach-detach recognition mechanism.

Table 1. J1 and J2 CC lines configuration setting jumpers

Compatible STM32 Nucleo boards	Jumpers	
	CC1 - J1	CC2 - J2
Any STM32 Nucleo-64 development board with UCPD (NUCLEO-G071RB, NUCLEO-G474RE and NUCLEO-G0B1RE)		
Any STM32 Nucleo-64 development board without UCPD (NUCLEO-L412RB-P)		

When both configuration jumpers (J1 and J2) are set to positions 1-2, the board is compatible with NUCLEO-G071RB, NUCLEO-G474RE and NUCLEO-G0B1RE offering the UCPD peripheral.

This association permits to fully demonstrate the main characteristics of the USB Type-C and Power Delivery standards implemented by the demo application example.

When J1 and J2 are both set to positions 2-3, the X-NUCLEO-SNK1M1 can match any STM32 Nucleo-64 development board, demonstrating the basic mechanism of the Type-C specification, thanks to two pull-down resistors (R17 and R21) connected to the pins working as CC lines, allowing the Sink Type-C operations to run with any attached Source.

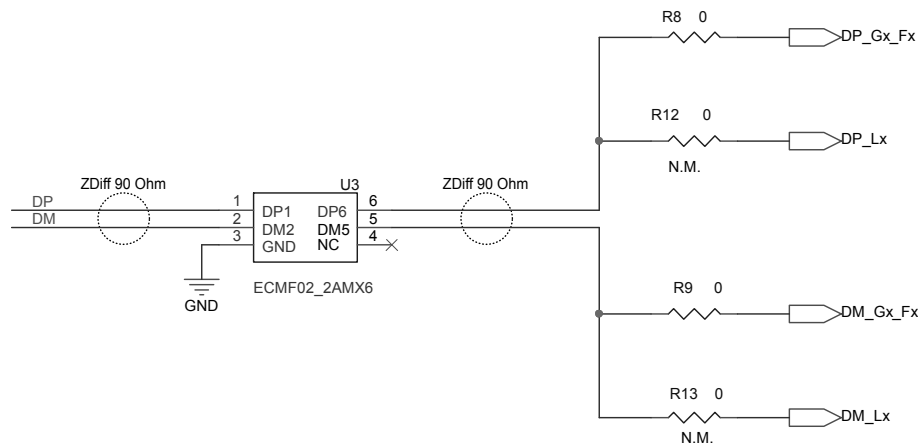
### 1.2.4 USB 2.0 data path and configuration setting

The X-NUCLEO-SNK1M1 expansion board allows STM32 Nucleo development boards that feature a USB2.0 peripheral to expose the D+/D- lines on the Type-C receptacle (CN1).

Most STM32 Nucleo-64 development boards feature this functionality on the ST morpho connector CN10-12 and CN10-14 pins, whereas NUCLEO-L412RB-P, NUCLEO-L433RC-P, NUCLEO-L452RE-P and NUCLEO-L476RG boards map USB2.0 data pins on CN10-33 and CN10-17 pins.

Two couples of resistances has been implemented and connected to the ECMF02-2AMX6 (U3) USB2.0 data lines protection to extend the use of this peripheral to all the STM32 Nucleo-64 development boards.

Figure 7. USB2.0 data lines protection ECMF02-2AMX6 (U3) and resistor setup

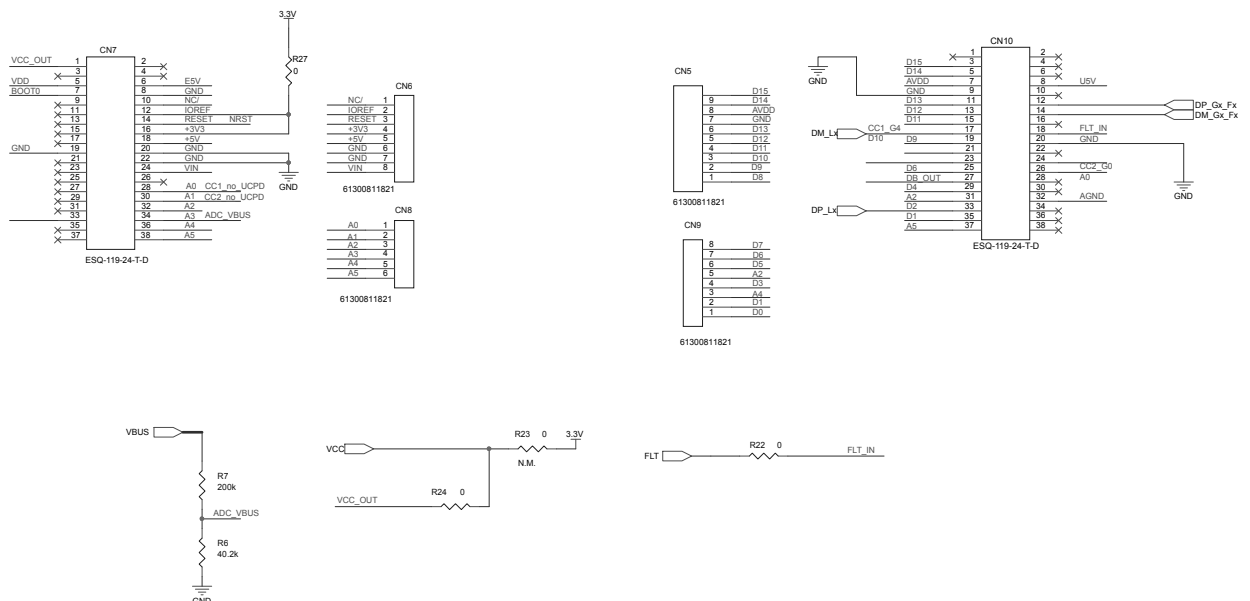


By default, the X-NUCLEO-SNK1M1 board mounts R8 and R9 resistors fitted to guarantee USB2.0 compatibility to all the main microcontroller families, but, for the L4 family (NUCLEO-L412RB-P, NUCLEO-L433RC-P, NUCLEO-L452RE-P and NUCLEO-L476RG) only, they have to be removed and replaced by R12 and R13 solder bridges.

### 1.2.5 ST morpho and Arduino UNO V3 connectors

The figure below shows the X-NUCLEO-SNK1M1 expansion board ST morpho and Arduino UNO V3 connectors, detailing the main connections, functions and configuration settings.

Figure 8. ST morpho and Arduino UNO V3 connectors



In addition to the main functions related to the USB Type-C and Power Delivery specification:

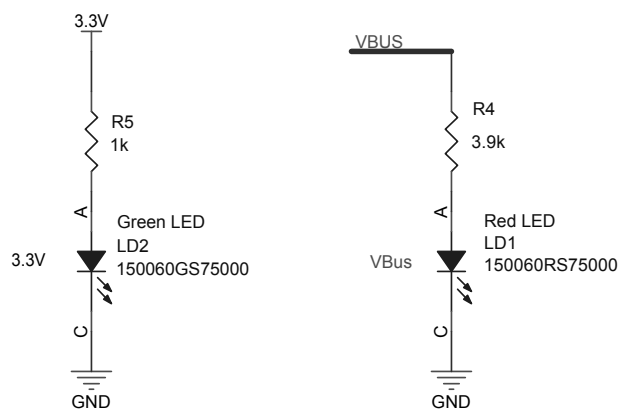
- an ADC channel can be used to monitor the  $V_{BUS}$  voltage (ADC\_VBUS)
- a supply option path allows supplying the **TCPP01-M12** either via the 3.3 V provided by the **STM32 Nucleo** development board or via a GPIO on the ST morpho connector (CN7-1). You can select the path through R23 and R24 resistances. This option, combined with the **TCPP01-M12** low consumption, is useful for battery-powered devices as the **TCPP01-M12** can be powered only when an attachment is detected (low-power mode)
- the **TCPP01-M12** fault report pin (open drain) is connected to the ST morpho connector pin (CN10 – 18) to be monitored by the STM32 microcontroller (FLT – FLT\_IN path)

### 1.2.6 Indication LEDs

Two LEDs mounted on the **X-NUCLEO-SNK1M1** top side indicate the supply status of the expansion board and the stacked **STM32 Nucleo** development board:

- the red LED (LD1) turns ON when a source application board is plugged to the **X-NUCLEO-SNK1M1** CN1 connector and the USB Type-C  $V_{BUS}$  voltage is present;
- the green LED (LD2) indicates that the 3.3 V is present and is supplying the **STM32 Nucleo** microcontroller development board.

**Figure 9. Indication LEDs**



### 1.2.7 Dead battery mode configuration jumpers and internal LDO

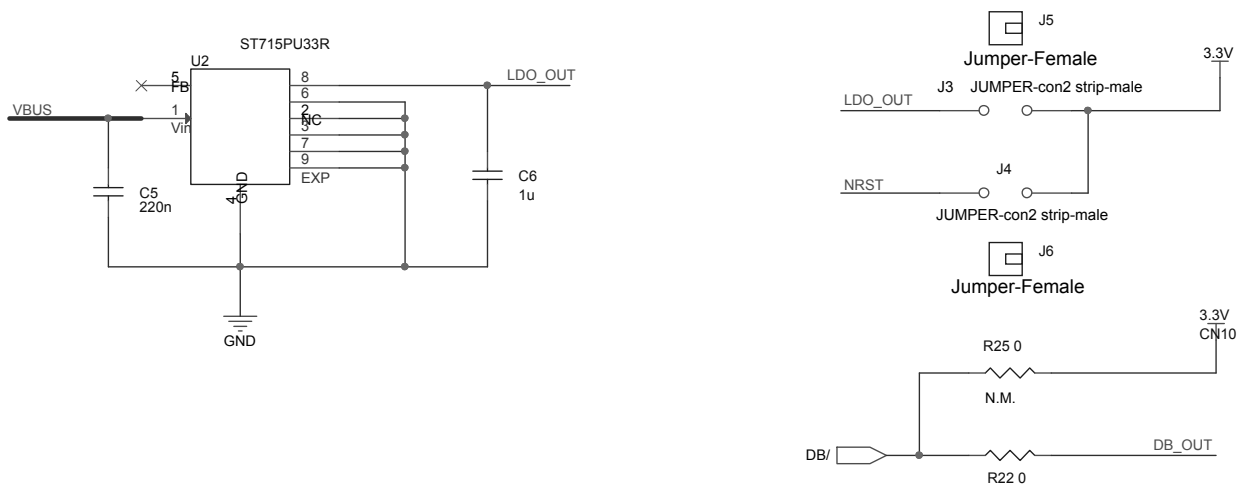
Thanks to the dead battery feature, described by the USB Power Delivery specification and implemented by the **X-NUCLEO-SNK1M1**, it is possible to directly power the system through the  $V_{BUS}$  provided by a Source, as an alternative mode to the standard supply through the **STM32 Nucleo ST-LINK**.

**Note:** Before configuring the **X-NUCLEO-SNK1M1** to operate in dead battery mode, check whether the supply selection jumpers on the **STM32 Nucleo** board have been removed:

- on the **NUCLEO-G071RB** and the **NUCLEO-G0B1RE**, remove the jumper from JP2 header
- on the **NUCLEO-G474RE**, remove the jumper from JP5 header 5V\_SEL
- on the **NUCLEO-L412RB-P**, remove the jumper from JP5 header







Figure 10. Dead battery mode circuitry



To select the dead battery operation mode on the X-NUCLEO-SNK1M1, JP3 and JP4 jumpers must be fit.

Table 2. J3 and J4 power mode selection jumpers

Power mode	Jumpers	
	J3 (LDO_OUT)	J4 (RESET)
ST-LINK powered mode	 (open)	 (open)
Dead battery mode	 (fit)	 (fit)

JP3 jumper connects the  $V_{BUS}$  path from the Type-C connector to the LDO (U2) which is connected to the STM32 Nucleo development board 3.3 V path and can power the entire solution.

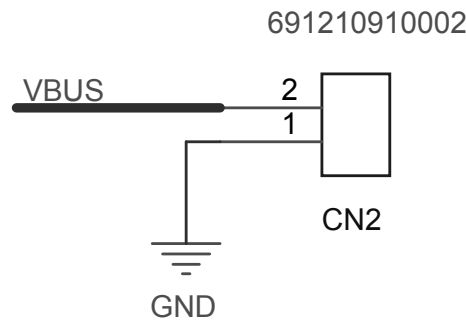
When fitted, JP5 jumper forces the STM32 I/O negative reset to level 1. It must be connected when the STM32 is powered by the X-NUCLEO-SNK1M1.

By default, the TCPP01-M12 dead battery option has been set to be driven by an STM32 microcontroller pin through R26 solder bridge, thus removing the TCPP01-M12 dead battery clamp when GPIO is connected on ST morpho connector (CN10-24). The alternative operating mode is to fit the TCPP01-M12 dead battery option to 3V3 through the R25 mounting solder bridge (consequently, R26 must be not fitted).

In the application firmware package, this option has been included in the firmware examples where a GPIO (ST morpho CN10-24) properly drives the dead battery option.

### 1.2.8 Power connector

CN2 power connector can be used to connect a load and monitor the  $V_{BUS}$  voltage level negotiated by the system with a Source attached to CN1 Type-C connector.

**Figure 11. CN2 power connector**


*Note:* To monitor the output voltage, an appropriate resistance has to be connected to the X-NUCLEO-SNK1M1 CN2.

### 1.3 Demo application setup

The X-NUCLEO-SNK1M1 expansion board flexibility permits to demonstrate the TCPP01-M12 protection features and capabilities with a wide range of STM32 Nucleo development boards.

The X-CUBE-TCPP companion software package contains specific application examples for the STM32 Nucleo embedding the USB Type-C and Power Delivery management (NUCLEO-G071RB, NUCLEO-G474RE and NUCLEO-G0B1RE) and, for the ones without the UCPD peripheral, the package demonstrates how to comply with basic Type-C operations (NUCLEO-L412RB-P).

#### 1.3.1 Programming and debugging

Once the X-NUCLEO-SNK1M1 expansion board has been connected to a NUCLEO-G071RB, NUCLEO-G474RE, NUCLEO-G0B1RE or NUCLEO-L412RB-P, to program and debug, the STM32 Nucleo development board has to be connected to a laptop by the embedded USB ST-LINK connector (CN2) to supply the solution and program the firmware example in the application microcontroller.

*Note:* Set the jumpers as follows:

- On the STM32 Nucleo development board, ensure the 5 V selection jumper fits with the 5 V ST-LINK header (JP5 on NUCLEO-G474RE and NUCLEO-L412RB-P, JP2 on NUCLEO-G071RB and NUCLEO-G0B1RE)
- On the X-NUCLEO-SNK1M1 expansion board:
  - remove LDO OUT jumper (JP3)
  - remove NRST jumper (JP4)

*Note:* The X-CUBE-TCPP MCU firmware applications are designed to select the highest and closest power profile exposed by the Source, after the explicit contract negotiation.

##### 1.3.1.1 Running the demo application with NUCLEO-G071RB or NUCLEO-G0B1RE development board

The NUCLEO-G071RB development board embeds the STM32G071RB microcontroller with the UCPD peripheral. To run the application demo with the NUCLEO-G071RB, powering the system via ST-LINK micro-USB connector, follow the procedure below.

- Step 1.** Check the jumper is closed on the development board JP2 header, STLK 1-2 pins.
- Step 2.** On the X-NUCLEO-SNK1M1 expansion board, fit CC1 JP1 and CC2 JP2 jumpers on position 1-2.
- Step 3.** Plug the expansion board on top of the STM32 Nucleo and leave J3 and J4 headers open.
- Step 4.** Connect the NUCLEO-G071RB or NUCLEO-G0B1RE micro-USB connector (CN1) to the PC/laptop. The board appears as a virtual disk (NODE\_G071RB).
- Step 5.** Program the STM32G071RB by dragging and dropping the binary file corresponding to the board (GO\_SNK1M1\_Consumer.bin) to the virtual disk.  
STM32 Nucleo LD1 LED blinks red and green for few seconds. When the LED stops blinking, the programming operation is complete and the demo is ready.

- Step 6.** Plug a Source application board on the **X-NUCLEO-SNK1M1** expansion board CN1 connector through a Type-C cable and refer to the following LED operation description to identify the application results:
- **NUCLEO-G071RB/NUCLEO-G0B1RE** LD3 LED is ON when the board is supplied by the **ST-LINK** micro-USB connector (CN1)
  - **X-NUCLEO-SNK1M1** LD2 LED is ON when the 3V3 voltage is provided to the expansion board by the **STM32 Nucleo**
  - **X-NUCLEO-SNK1M1** LD1 LED is ON when a Source is connected to the USB Type-C CN1 connector and the  $V_{BUS}$  is provided
  - **NUCLEO-G071RB/NUCLEO-G0B1RE** LD4 LED:
    - blinks once every 2 seconds when USB default (up to 500 mA) is identified
    - blinks twice every 2 seconds when a Source USB Type-C 1.5 A current capability is identified;
    - blinks 3 times every 2 seconds when a Source USB Type-C 3 A current capability is identified;
    - is ON when the explicit negotiation between the two contractors is reached.

#### 1.3.1.1.1 **Dead battery operation mode**

- Step 1.** Repeat steps 1- 4 described in [Section 1.3.1.1](#)
- Step 2.** Disconnect the micro-USB cable from **NUCLEO-G071RB/NUCLEO-G0B1RE** CN1.
- Step 3.** Remove the power selection jumper from the JP2 header on **NUCLEO-G071RB/NUCLEO-G0B1RE** development board (previously set on STLK 1-2 pins) and leave it fully open.
- Step 4.** On the **X-NUCLEO-SNK1M1**, set LDO OUT jumper (JP3) and NRST jumper (JP4).
- Step 5.** Plug a Source board to **X-NUCLEO-SNK1M1** CN1 connector through a Type-C cable.  
The provided  $V_{BUS}$  supplies the Sink solution while the LEDs define the status as previously described.

#### 1.3.1.2 **Running the demo application with NUCLEO-G474RE development board**

The **NUCLEO-G474RE** development board embeds the **STM32G474RE** microcontroller with the UCPD and USB2.0 data peripherals. To run the application demo with the **NUCLEO-G474RE**, powering the system via **ST-LINK** micro-USB connector, follow the procedure below.

- Step 1.** Check the jumper is closed on the development board JP5 header, 5V\_STLK 1-2 pins.
- Step 2.** On the **X-NUCLEO-SNK1M1** expansion board, fit CC1 JP1 and CC2 JP2 jumpers on position 1-2.
- Step 3.** Plug the expansion board on top of the **STM32 Nucleo** and leave J3 and J4 headers open.
- Step 4.** Connect the **NUCLEO-G474RE** micro-USB connector (CN1) to the PC/laptop.  
The board appears as a virtual disk (NODE\_G474RE).
- Step 5.** Program the **STM32G474RE** by dragging and dropping the binary file corresponding to the board (G4\_SNK1M1\_Consumer.bin) to the virtual disk.  
**STM32 Nucleo** LD1 LED blinks red and green for few seconds. When the LED stops blinking, the programming operation is complete and the demo is ready.

- Step 6.** Plug a Source application board on the X-NUCLEO-SNK1M1 expansion board CN1 connector through a Type-C cable and refer to the following LED operation description to identify the application results:
- NUCLEO-G474RE LD3 LED is ON when the board is supplied by the ST-LINK micro-USB connector (CN1)
  - X-NUCLEO-SNK1M1 LD2 LED is ON when the 3V3 voltage is provided to the expansion board by the STM32 Nucleo
  - X-NUCLEO-SNK1M1 LD1 LED is ON when a Source is connected to the USB Type-C CN1 connector and the VBUS is provided
  - NUCLEO-G474RE LD2 LED:
    - blinks once every 2 seconds when USB default (up to 500 mA) is identified
    - blinks twice every 2 seconds when a Source USB Type-C 1.5 A current capability is identified;
    - blinks 3 times every 2 seconds when a Source USB Type-C 3 A current capability is identified;
    - blinks 4 times every 2 seconds when the explicit negotiation between the two contractors is reached;
    - turns ON when the explicit negotiation between the two contractors is reached and the USB2.0 data connection is established.

#### 1.3.1.2.1 Dead battery operation mode

- Step 1.** Repeat steps 1- 4 described in Section 1.3.1.2
- Step 2.** Disconnect the micro-USB cable from NUCLEO-G474RE CN1.
- Step 3.** Remove the power selection jumper from the JP2 header on NUCLEO-G474RE development board (previously set on STLK 1-2 pins) and leave it fully open.
- Step 4.** Set JP8 jumper on 2-3 pins.
- Step 5.** On the X-NUCLEO-SNK1M1, set LDO OUT jumper (JP3) and NRST jumper (JP4).
- Step 6.** Plug a Source board to X-NUCLEO-SNK1M1 CN1 connector through a Type-C cable. The provided  $V_{BUS}$  supplies the Sink solution while the LEDs define the status as previously described.

#### 1.3.1.3 Running the demo application with NUCLEO-L412RB-P development board

The NUCLEO-L412RB-P development board embeds the STM32L412RB microcontroller which includes the USB2.0 data peripheral only. The application example demonstrates that the TCPP01-M12 protection can be matched with microcontrollers which does not include the UCPD peripheral to implement a Type-C Sink port only, thus exploiting the microcontroller ADC peripherals to monitor the current capabilities of the Source. To run the application demo with the NUCLEO-L412RB-P, powering the system via ST-LINK micro-USB connector, follow the procedure below.

- Step 1.** Check the jumper is closed on the development board JP5 header, 5V\_STLK 1-2 pins.
- Step 2.** On the X-NUCLEO-SNK1M1 expansion board, fit CC1 JP1 and CC2 JP2 jumpers on position 1-2.
- Step 3.** Plug the expansion board on top of the STM32 Nucleo and leave J3 and J4 headers open.
- Step 4.** Connect the NUCLEO-L412RB-P micro-USB connector (CN1) to the PC/laptop. The board appears as a virtual disk (NODE\_L412RB).
- Step 5.** Program the STM32L412RB by dragging and dropping the binary file corresponding to the board (SNK1M1\_Consumer\_TypeC\_Only.bin) to the virtual disk. STM32 Nucleo LD1 LED blinks red and green for few seconds. When the LED stops blinking, the programming operation is complete and the demo is ready.

- Step 6.** Plug a Source application board on the X-NUCLEO-SNK1M1 expansion board CN1 connector through a Type-C cable and refer to the following LED operation description to identify the application results:
- NUCLEO-L412RB-P LD3 LED is ON when the board is supplied by the ST-LINK micro-USB connector (CN1)
  - X-NUCLEO-SNK1M1 LD2 LED is ON when the 3V3 voltage is provided to the expansion board by the STM32 Nucleo
  - X-NUCLEO-SNK1M1 LD1 LED is ON when a Source is connected to the USB Type-C CN1 connector and the  $V_{BUS}$  is provided
  - NUCLEO-L412RB-P LD2 LED:
    - blinks once every 2 seconds when USB default is identified
    - blinks twice every 2 seconds when a Source USB Type-C 1.5 A current capability is identified;
    - blinks 3 times every 2 seconds when a Source USB Type-C 3 A current capability is identified.

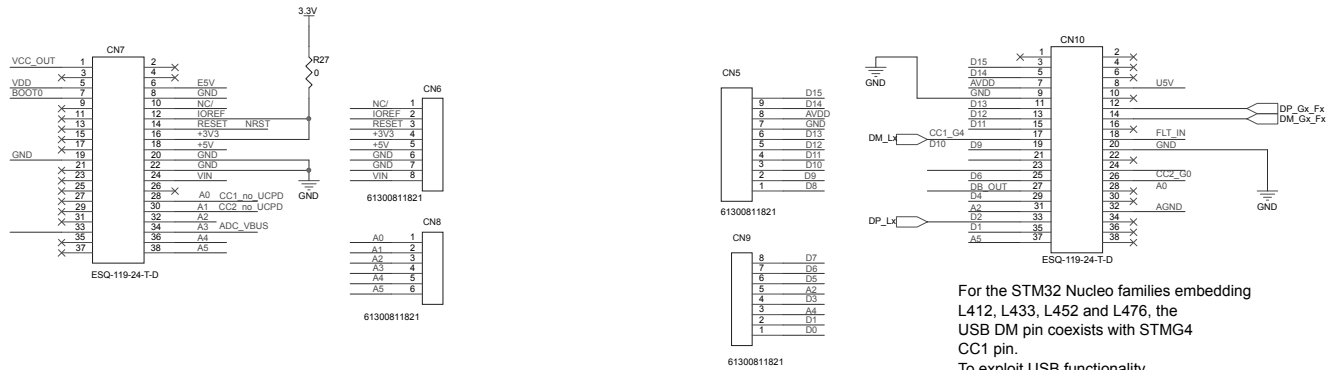
#### 1.3.1.3.1 Dead battery operation mode

- Step 1.** Repeat steps 1- 4 described in Section 1.3.1.3
- Step 2.** Disconnect the micro-USB cable from NUCLEO-L412RB-P CN1.
- Step 3.** Remove the power selection jumper from the JP2 header on NUCLEO-L412RB-P development board (previously set on STLK 1-2 pins) and leave it fully open.
- Step 4.** On the X-NUCLEO-SNK1M1, set LDO OUT jumper (JP3) and NRST jumper (JP4).
- Step 5.** Plug a Source board to X-NUCLEO-SNK1M1 CN1 connector through a Type-C cable.  
The provided  $V_{BUS}$  supplies the Sink solution while the LEDs define the status as previously described.

*Note:* The firmware application example designed for the NUCLEO-L412RB-P embeds the USB2.0 driver which can start the USB enumeration when the board is connected to a laptop or a PC. To test this functionality, R8 and R9 solder bridges have to be mounted while R12 and R13 have to be mounted.

## 2 Schematic diagrams

Figure 12. X-NUCLEO-SNK1M1 circuit schematic (1 of 2)



For the STM32 Nucleo families embedding L412, L433, L452 and L476, the USB DM pin coexists with STMG4 CC1 pin.  
To exploit USB functionality with these L4 families, solder bridges R12, R13 must be fit and R8 and R9 removed

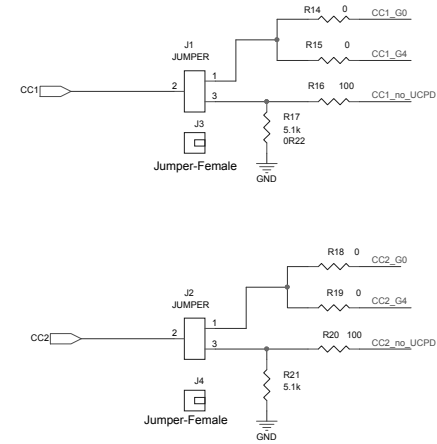
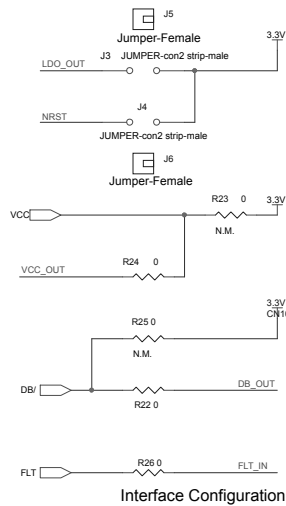
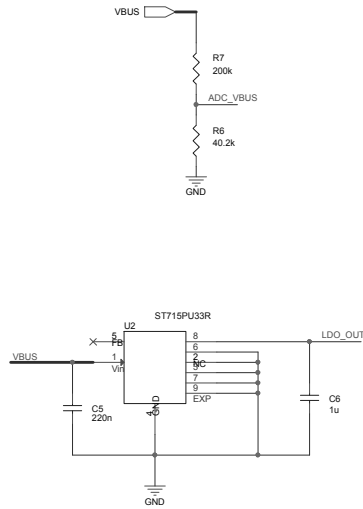
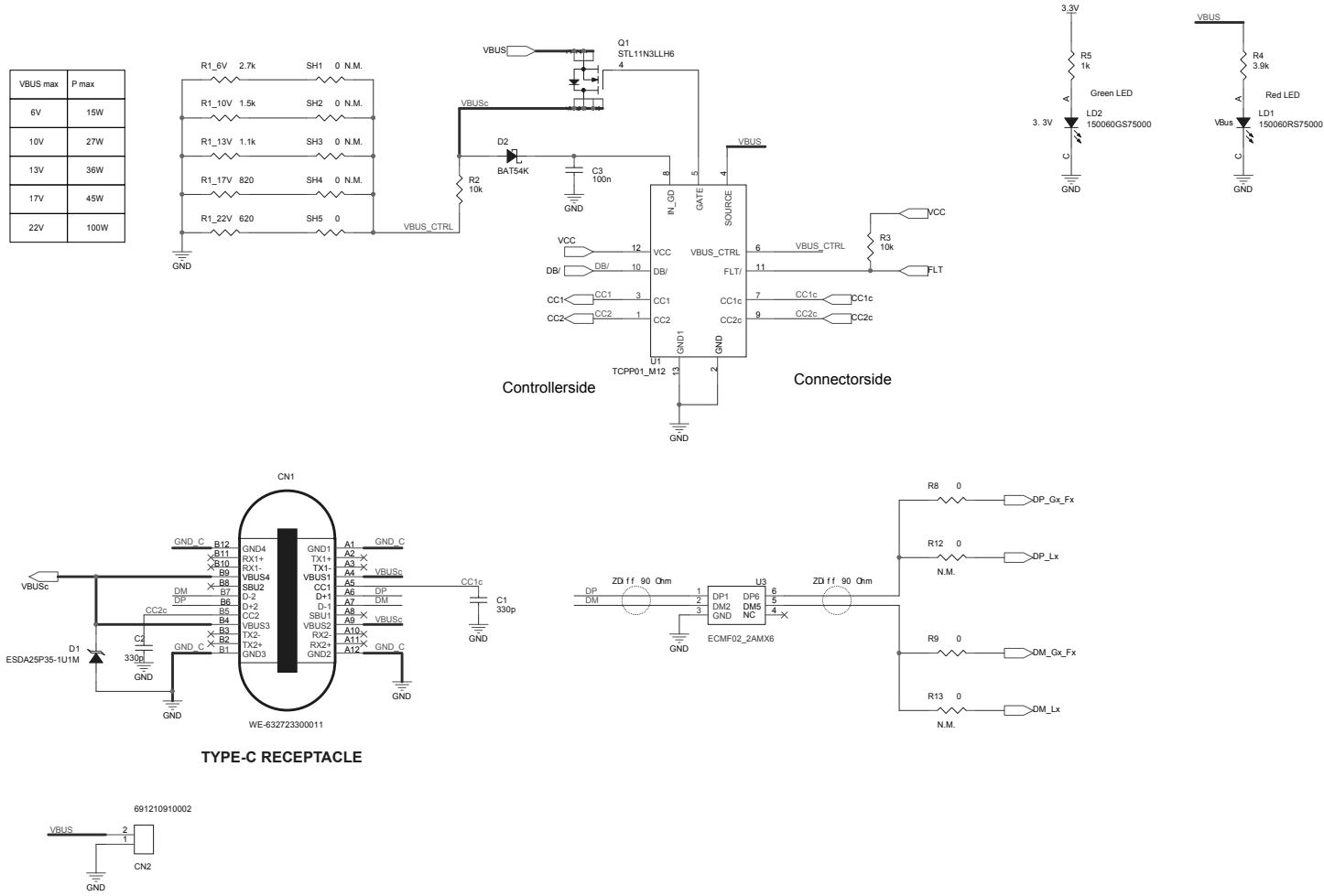




Figure 13. X-NUCLEO-SNK1M1 circuit schematic (2 of 2)



### 3 Bill of materials

**Table 3. X-NUCLEO-SNK1M1 bill of materials**

Item	Q.ty	Ref.	Part/value	Description	Manufacturer	Order code
1	2	C1, C2	330 p, 0402 (1005 Metric), 50 Vdc V, ±10 %, SMD 0402 X7R	Ceramic capacitors	Würth Electronics Inc.	885012205058
2	1	C3	100 n, 0402 (1005 Metric), 50Vdc V, ±10 %, SMD 0402 X7R	Ceramic capacitor	TDK	C1005X7R1H104K050B B
3	1	C5	220n, 0402 (1005 Metric), 35Vdc V, ±10 %, SMD 0402 X7R	Ceramic capacitor	Murata Electronics	GRM155C8YA224ME01 D
4	1	C6	1 µF, 0402 (1005 Metric), 6Vdc V, ±10 %, SMD 0402 X5R	Ceramic capacitor	Kemet	C0402C105K8PAC7411
5	1	CN1	WE-63272330001 1, THT/SM	USB 3.1 Type-C receptacle	Würth Electronics Inc.	632723300011
6	1	CN2	691210910002, 2.54 mm	Terminal block	Würth Electronics Inc.	691210910002
7	1	CN5	61301011821, 10 pos., 0.1, gold PCB	Connector receptacle	Würth Electronics Inc.	61301011821
8	2	CN6, CN9	61300811821, 8 pos., 0.1, gold PCB	Connector receptacles	Würth Electronics Inc.	61300811821
9	2	CN7, CN10	ESQ-119-24-T-D, 38 pos., 0.1, gold PCB	Connector receptacles	Samtec Inc.	ESQ-119-24-T-D
10	1	CN8	61300611821, 6 pos., 0.1, gold PCB	Connector receptacle	Würth Electronics Inc.	61300611821
11	1	D1	ESDA25P35-1U1 M, 2-UDFN, 1400 W (1.4 kW)	High power transient voltage suppressor	ST	<a href="#">ESDA25P35-1U1M</a>
12	1	D2	BAT54K, SC-79, SOD-523, 900 mV @ 100 mA V, 300mA (DC) A	General purpose Schottky diode	ST	<a href="#">BAT54KFILM</a>
13	2	J1, J2	Jumper, 3 pos.	Connector header	AMTEK	PH1S25-1x03GB6/3-L
14	1	J3 FIT ON PIN 1-2 OF J1	Jumper,female	Connector jumper	AMTEK	MJ1B-AGB-L
15	1	J4, FIT ON PIN 1-2 OF J2	Jumper,female	Connector jumper	AMTEK	MJ1B-AGB-L

Item	Q.ty	Ref.	Part/value	Description	Manufacturer	Order code
16	2	J5, J6 PROVIDE BUT NOT ASSEMBLY	Jumper,female	Connector jumpers	AMTEK	MJ1B-AGB-L
17	2	JP3, JP4	Jumpers, con2- strip-male	Connector jumpers	AMTEK	PH1S25-1x02GB6/3-L
18	1	LD1	150060RS75000, 0603 (1608 Metric), 20 m A	Red LED	Würth Electronics Inc.	150060RS75000
19	1	LD2	150060GS75000, 0603 (1608 Metric), 20 m A	Green LED	Würth Electronics Inc.	150060GS75000
20	1	Q1	STL11N3LLH6, 8- PowerVDFN	STripFET H6 Power MOSFET in a PowerFLAT 3.3 x 3.3 package	ST	<a href="#">STL11N3LLH6</a>
21	2	R2, R3	10 k, 0402 (1005 Metric), 0.063W, 1/16 W, ±1 %	Chip resistors	Yageo	RC0402FR-0710KL
22	1	R4	3.9 k, 0402 (1005 Metric), 0.063W, 1/16 W, ± 0.1 %	Chip resistor	Vishay	CRCW04023K90FKED
23	1	R5	1k, 0402 (1005 Metric), 0.063W, 1/16 W, ±1 %	Chip resistor	Vishay	CRCW04021K00FKED
24	1	R6	40.2 k, 0402 (1005 Metric), 0.063 W, 1/16 W, ±1 %	Chip resistor	Vishay	CRCW040240K2FKED
25	1	R7	200 k, 0402 (1005 Metric), 0.063W, 1/16 W, ±1 %	Resistor	Vishay	CRCW0402200KFKEDC
27	10	R8, R9, R14, R15, R18, R19, R22, R24, R26, R27	0, 0805 (2012 Metric), 1/8 W	Resistors	Yageo	RC0805JR-070RL
28	4	R12,R13, R23, R25	0805 (2012 Metric), 0.125 W, 1/8 W	Resistors (not mounted)	Yageo	RC0805JR-070RL
29	2	R17, R21	5.1 k, 0402 (1005 Metric), 1/16 W, ±1 %	Chip resistors	Vishay	CRCW04025K10FKED
30	1	R1_10V	1.5 k, 0402 (1005 Metric), 1/4 W, ±1 %	Chip resistor	Yageo	RC0402FR-071K5L
31	1	R1_13V	1.1 k, 0402 (1005 Metric), 1/4 W, ±1 %	Chip resistor	Multicomp	MCWR04X1101FTL
32	1	R1_17V	820, 0402 (1005 Metric), 1/4 W, ±1 %	Chip resistor	Vishay	CRCW0402820RFKED

Item	Q.ty	Ref.	Part/value	Description	Manufacturer	Order code
33	1	R1_22V	620, 0402 (1005 Metric), 1/16 W, ±1 %	Chip resistor	Yageo	RC0402FR-07620RL
34	1	R1_6V	2.7 k, 0402 (1005 Metric), 1/4 W, ±1 %	Chip resistor	Yageo	RC0402FR-072K7L
35	4	SH1, SH2, SH3, SH4	0, 0805-Solder Bridge	Jumpers (not mounted)	Any	Any
36	1	SH5	0, 0805-Solder Bridge	Jumper	Any	Any
37	1	U1	TCPPO1-M12, 3X3X1 mm,	Overvoltage protection for USB-C or Power Delivery	ST	<a href="#">TCPPO1-M12</a>
38	1	U2	ST715PU33R, 8-VDFN Exposed Pad	High input voltage - 85 mA LDO linear regulator	ST	<a href="#">ST715PU33R</a>
39	1	U3	ECMF02_2AMX6, 6-UFQFN, 200 mA	Common-mode filter and ESD protection for USB 2.0 and MIPI/MDDI interfaces	ST	<a href="#">ECMF02-2AMX6</a>
40	1		PCB, 72.6x58.6 mm	FR4 Standard 72.6x58.6x1.5 5 mm	Massive PCB Technologies LTD	PROT-X-NUCLEO-SNK1M1-ver.2 (0EC0C1)

## Revision history

**Table 4. Document revision history**

Date	Version	Changes
15-Mar-2021	1	Initial release.
15-Apr-2021	2	Added NUCLEO-G0B1RE development board compatibility information.
10-May-2021	3	Updated <a href="#">Section 1.2.1 Type-C connector</a> and <a href="#">Section 1.3.1.2.1 Dead battery operation mode</a> .

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