Discovery kit for LoRaWAN™ and LPWAN protocols with STM32L0

Introduction

The B-L072Z-LRWAN1 Discovery kit embeds the CMWX1ZZABZ-091 LoRa® module (Murata). This Discovery kit allows users to develop easily applications with the STM32L072CZ and the LoRa® RF connectivity in one single module.

The B-L072Z-LRWAN1 Discovery kit has the full set of features available in the STM32L0 Series and offers ultra-low-power and LoRa® RF features. The B-L072Z-LRWAN1 Discovery kit is a low-cost and easy-to-use development kit to quickly evaluate and start a development with an STM32L072CZ microcontroller.

The B-L072Z-LRWAN1 Discovery kit includes LoRa® RF interface, LEDs, push-buttons, antenna, Arduino™ Uno V3 connectors, USB 2.0 FS connector in Micro-B format. The integrated ST-LINK/V2-1 provides an embedded in-circuit debugger and programmer for the STM32L0 MCUs.

The LoRaWAN™ stack is certified class A and C compliant. It is available inside the I-CUBE-LRWAN firmware package.

The B-L072Z-LRWAN1 Discovery kit comes with direct access to ARM® mbed™ online resources at http://mbed.org as well as several examples, to help users setting up a complete LoRaWAN™ node.

Figure 1. B-L072Z-LRWAN1 LoRa® Discovery kit
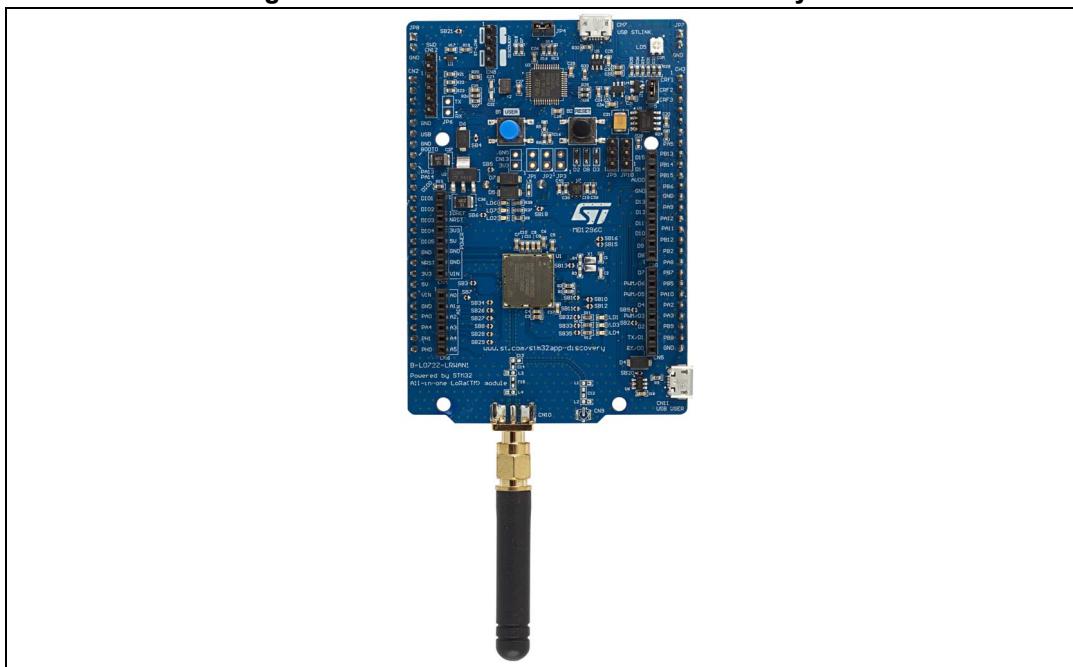
1. Picture is not contractual.

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1 Features

The B-L072Z-LRWAN1 Discovery kit offers the following features:

- CMWX1ZZABZ-091 LoRa® module (Murata)
  - Embedded ultra-low-power STM32L072CZ Series MCUs, based on ARM®Cortex® -M0+ core, with 192 Kbytes of Flash memory, 20 Kbytes of RAM, 20 Kbytes of EEPROM
  - USB 2.0 FS
  - 4-channel,12-bit ADC, 2xDAC
  - 6-bit timers, LP-UART, I²C and SPI
  - Embedded SX1276 transceiver
  - LoRa®, FSK, GFSK, MSK, GMSK and OOK modulations
  - +14 dBm or +20 dBm selectable output power
  - 157 dB maximum link budget
  - Programmable bit rate up to 300 Kbit/s
  - High sensitivity: down to -137 dBm
  - Bullet-proof front end: IIP3 = -12.5 dBm
  - 89 dB blocking immunity
  - Low RX current of 10 mA, 200 nA register retention
  - Fully integrated synthesizer with a resolution of 61 Hz
  - Built-in bit synchronizer for clock recovery
  - Sync word recognition
  - Preamble detection
  - 127 dB+ dynamic range RSSI
- SMA and U.FL RF interface connectors
- Including 50 Ohm SMA RF antenna
- On-board ST-LINK/V2-1 debugger/programmer with USB re-enumeration capability: mass storage, virtual COM port and debug port
- Board power supply:
  - USB ST LINK/V2-1
  - USB FS connector
  - External VIN from Arduino Uno V3 connector
  - External 3.3 V connector CN13
  - USB charger
  - Batteries
- 3xAAA-type-battery holder for standalone operation
- 7 LEDs:
  - 4 general-purpose LEDs
  - 5 V-power LED
  - ST-LINK-communication LED
  - Fault-power LED
- 2 push-buttons (user and reset)
- Arduino™ Uno V3 connectors
- ARM® mbed-enable™ (see http://mbed.org)

2 Product marking

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

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

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

3 Conventions

Table 1 provides the definition of some conventions used in the present document.

Table 1. ON/OFF conventions

Convention	Definition
Jumper JPx ON	Jumper fitted
Jumper JPx OFF	Jumper not fitted
Solder bridge SBx ON	SBx connections closed by solder
Solder bridge SBx OFF	SBx connections left open

4 System requirements

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

5 Development toolchains

- Keil® MDK-ARM[a]
- IAR™ EWARM[a]
- GCC-based IDEs including free SW4STM32 from AC6
- ARM® mbed™ online

6 Demonstration software

The demonstration software is preloaded in the STM32 Flash memory. The latest versions of the demonstration source code and associated documentation can be downloaded from the www.st.com/i-cube-lrwan webpage.

7 Ordering and product information

Before installing and using the product, accept the Evaluation Product License Agreement at the www.st.com/stm32app-discovery webpage.

For more information on the STM32L072 Discovery kit visit the www.st.com/stm32app-discovery webpage.

To order the B-L072Z-LRWAN1 Discovery kit refer to *Table 2*.

Table 2. Ordering information

RPN	Target STM32
B-L072Z-LRWAN1	STM32L072CZ

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a. On Windows[®] only.

8 Hardware layout and configuration

The B-L072Z-LRWAN1 Discovery kit has been designed around the Murata LoRa® module including the STM32L072CZ microcontroller in a 49-pin WLCSP package.

Figure 2 illustrates the connection between the Murata LoRa® module and the peripherals (ST-LINK/V2, RF Antenna, LEDs, push-buttons, USB 2.0 FS Micro-B connector, 3xAAA battery holder).

Figure 3 and *Figure 4* help users to locate these features on the STM32L072 Discovery kit.

Figure 2. Hardware block diagram
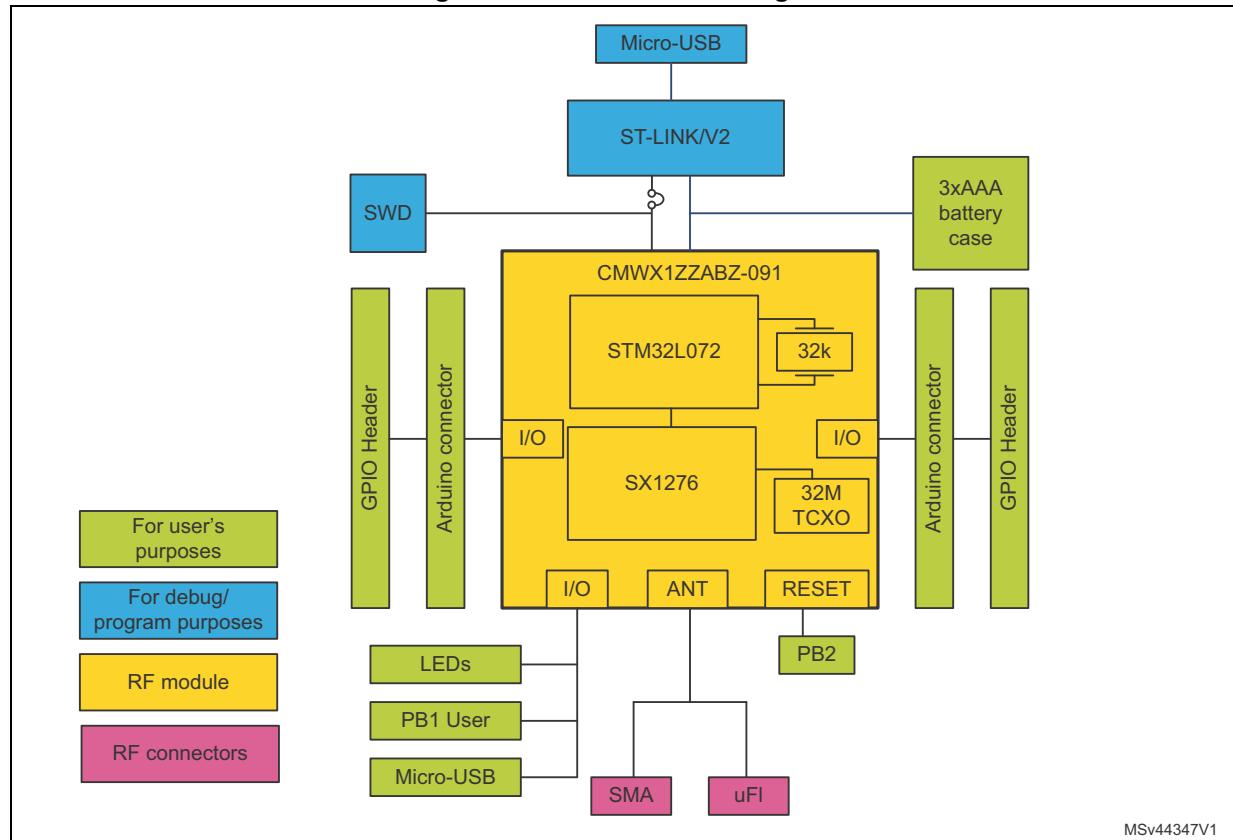
**Figure 3. B-L072Z-LRWAN1 top layout**
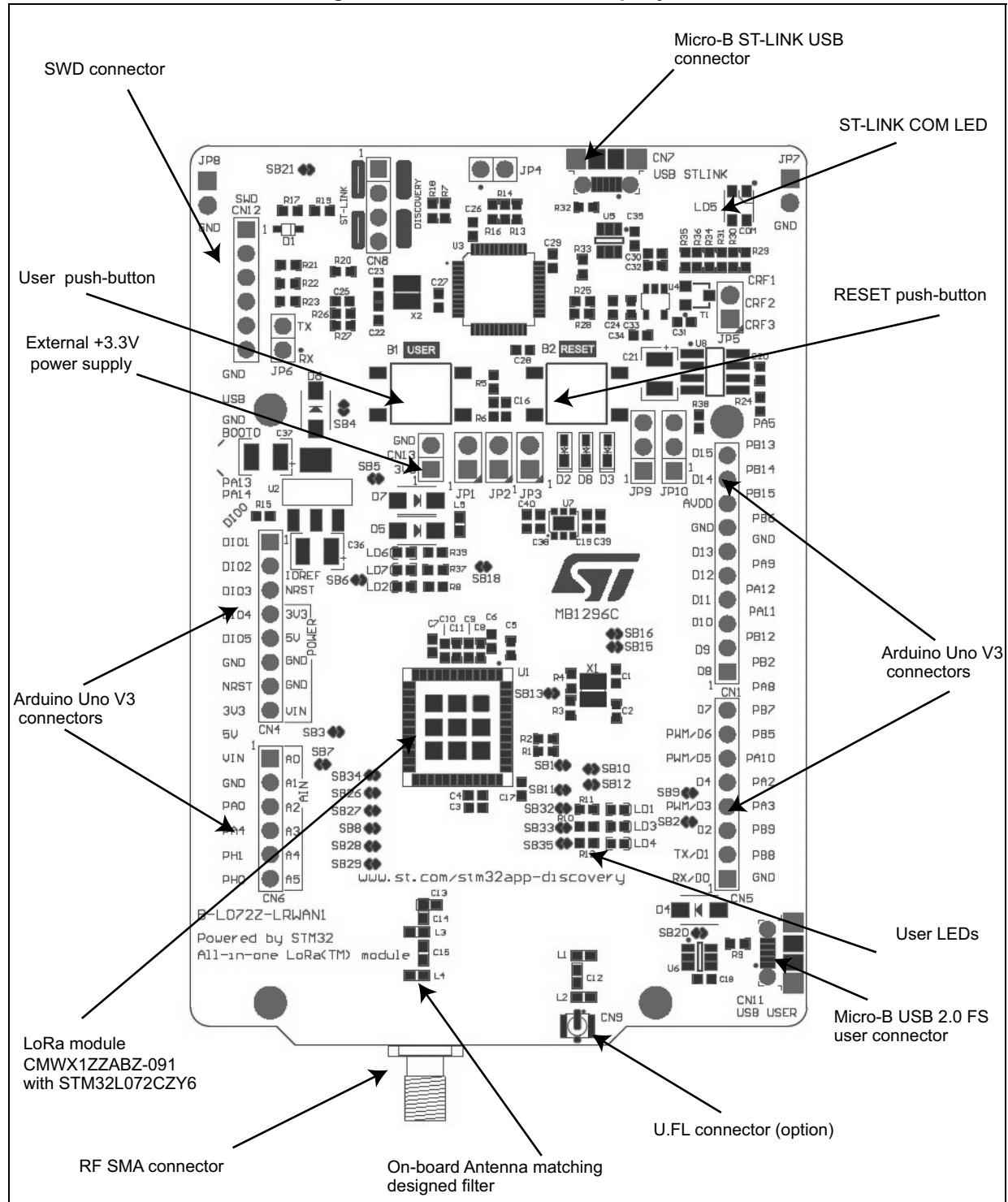
Figure 4. B-L072Z-LRWAN1 bottom layout
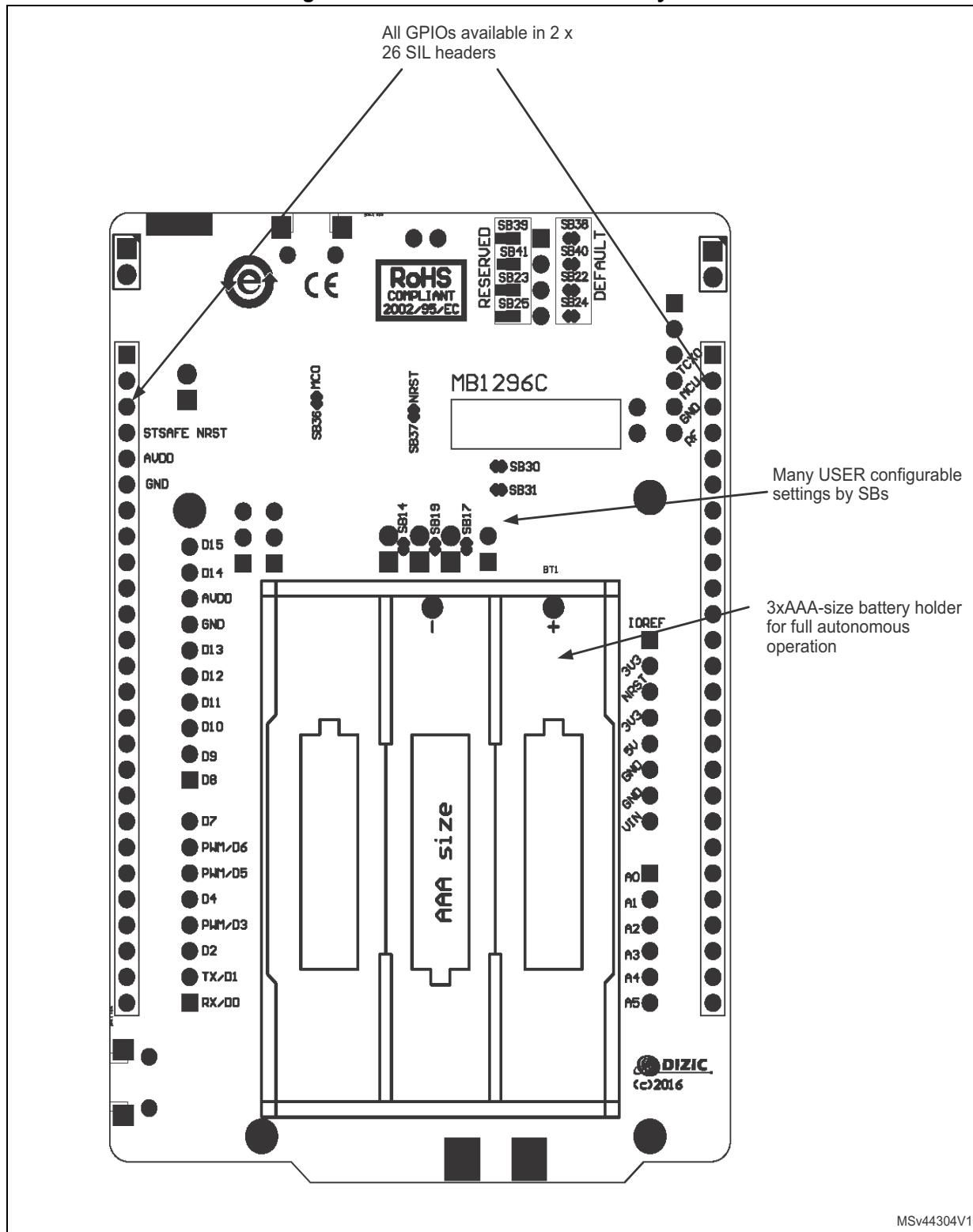
8.1 B-L072Z-LRWAN1 Discovery kit mechanical drawing

Figure 5. B-L072Z-LRWAN1 mechanical drawing
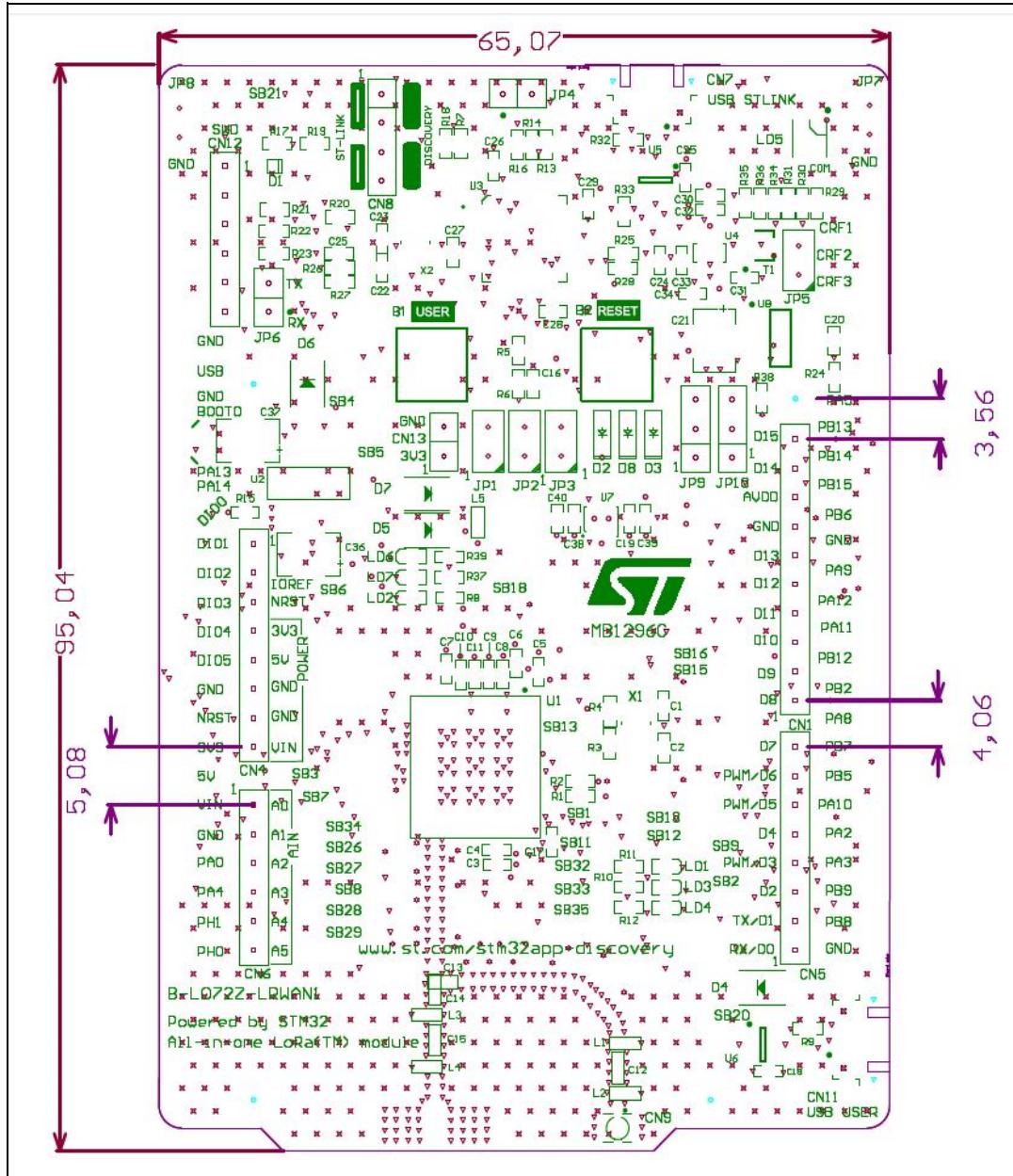
8.2 Embedded ST-LINK/V2-1

The ST-LINK/V2-1 programming and debugging tool is integrated on the B-L072Z-LRWAN1 Discovery kit. Compared to ST-LINK/V2 the changes are listed below.

The new features supported on ST-LINK/V2-1 are:

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

These features are no more supported on ST-LINK/V2-1:

- SWIM interface
- Application voltage lower than 3 V

For general information concerning the debugging and programming features that are common to both versions V2 and V2-1, refer to *ST-LINK/V2 in-circuit debugger/programmer for STM8 and STM32* User manual (UM1075).

8.2.1 Drivers

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

In case the B-L072Z-LRWAN1 Discovery kit is connected to the PC before the driver is installed, some B-L072Z-LRWAN1 interfaces may be declared as "unknown" in the PC device manager. In this case the user must install the driver files and update the driver of the connected device from the device manager.

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

Figure 6. USB composite device
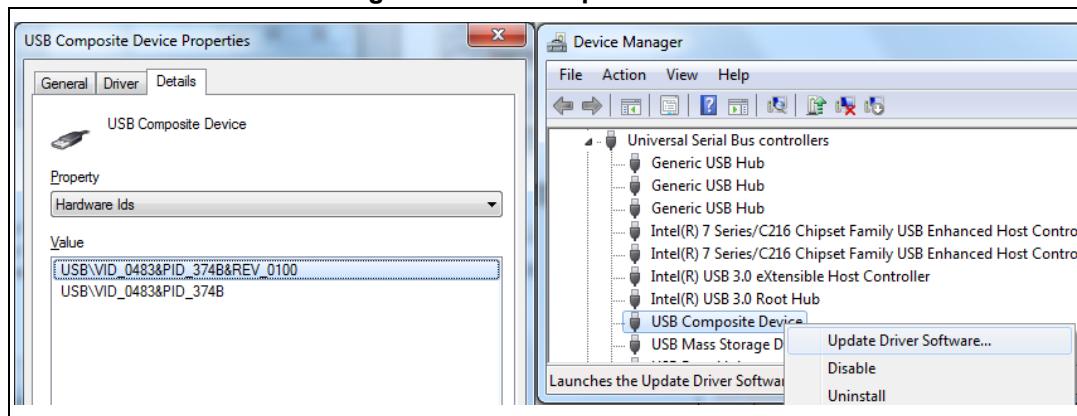
8.2.2 ST-LINK/V2-1 firmware upgrade

The ST-LINK/V2-1 embeds a firmware upgrade mechanism for in-situ upgrade through the USB port. As the firmware may evolve during the life time of the ST-LINK/V2-1 product (for example new functionalities, bug fixes, support for new microcontroller families), it is recommended to visit the *www.st.com* website before starting to use the B-L072Z-LRWAN1 Discovery kit and periodically, to stay up-to-date with the latest firmware version.

8.3 Power supply

The B-L072Z-LRWAN1 Discovery kit is designed to be powered in various ways. It can be simply plugged on a USB PC port with a Micro-B USB cable. In this mode, the board is programmed and debugged via the ST-LINK/V2-1 USB port on CN7. It is possible to use one of the different following sources:

- External +3.3 V connected to CN13 (+3.3 V and GND pins of CN13 must be connected).

- 7-12 V DC power supply plugged on Arduino™ Uno V3 connectors: VIN on pin 8 and GND on pin 7 of CN4 (VIN and GND pins must be both connected)

- USB 2.0 FS Micro-B on CN11 connector (Device mode). The power supply is provided by the USB port connected to CN11.

- On-board 3xAAA-sized battery holder BT1 located on the bottom side of the Discovery kit (batteries are not delivered inside the Discovery kit package). Respect the battery polarities mentioned in the battery case.

- 5V_ST_LINK DC power with limitation from ST-LINK USB connector. The USB type Micro-B connector CN7 of ST-LINK/V2-1. If the USB enumeration succeeds (as explained below), the ST-LINK 5 V link power is enabled, by asserting the PWR_ENn signal. This pin is connected to a power switch ST890, which powers the board. This power switch features also a current limitation to protect the PC in case of a short-circuit on board (more than 625mA). The Discovery kit can be powered from the ST-LINK USB connector, but only the ST-LINK circuit has the power before USB enumeration, because the host PC only provides 100 mA to the board at that time. During the USB enumeration, the Discovery kit requires 300 mA power from the host PC. If the host is able to provide the required power, the enumeration finishes by a "SetConfiguration" command and then, the power transistor ST890 is switched ON, the red LED LD7 is turned ON, thus the Discovery kit can consume maximum 300 mA current, but no more. If the host is not able to provide the requested current, the enumeration fails. Therefore the ST890 remains OFF and the STM32 part including the extension board is not powered. As a consequence the red LED LD7 remains turned OFF. In this case it is mandatory to use an external power supply.

To further decrease the current consumption of the board, the LED7 must be disconnected by opening SB18.

Users do not have to manage the different configurations with jumpers or switches. The power supplies are internally managed by a set of diodes on the respective power supply branches.

If the board is supplied by CN13, by battery or by CN11, SB37 must be removed to release the RESET pin managed by ST-LINK. In that case the ST-LINK is no more powered.

The red LED LD7 (+5 V power supply) is turned on (with SB18 ON) as soon as one of the power sources listed above is present.

Note: *The Discovery kit must be powered by a power supply unit or by an auxiliary equipment complying with the standard EN-60950-1: 2006+A11/2009, and must be Safety Extra Low Voltage (SELV) with limited power capability.*

8.4 IDD measurements

The B-L072Z-LRWAN1 Discovery kit power consumption is measured by mean of three connectors (not fitted initially) JP1, JP2 and JP3. These three connectors are respectively connected to the power-supply inputs VDD_RF_LRA, VDD_USB_LRA and VDD_MCU_LRA of the LoRa® module. The purpose is to monitor separately the different power consumptions by branches which are divided in three sections: RF, USB and MCU. To be able to insert a multimeter in each branch where the measurements must take place, users have to remove the associated solder bridge that initially shortcut the JPx connectors in the default configuration.

The *Table 3* below summarizes the possible configurations:

Table 3. IDD measurements and solder-bridge settings

Jumper name	Status	IDD Measurement
JP1 VDD_RF_LRA	SB17 ON (default)	N/A
	SB17 OFF	IDD VDD_RF_LRA
JP2 VDD_USB_LRA	SB19 ON (default)	N/A
	SB19 OFF	IDD VDD_USB_LRA
JP3 VDD_MCU_LRA	SB14 ON (default)	N/A
	SB14 OFF	IDD VDD_MCU_LRA

8.5 Clock sources

The Murata LoRa® module embeds its own TCXO running at 32 MHz when enabled.

The TCXO is either controlled by the STM32 pin PA12 (when pin 1 of JP9 is connected to pin 2 of JP9) or always enabled (when pin 2 of JP9 is connected to pin 3 of JP9). For the description of the jumpers refer to *Table 10*.

When an accurate external-high-speed clock is needed by the STM32, the TCXO_OUT clock pin is supplied by the module pin PH0_OSC_IN by closing SB13.

The B-L072Z-LRWAN1 Discovery kit can be equipped, if needed, with an external crystal oscillator. An 8 MHz oscillator with 20 pF capacitors can be added on the board (X1, C1 and C2 are not fitted by default) for user needs.

8.6 Reset sources

The reset signal of the B-L072Z-LRWAN1 Discovery kit is active low and the reset sources is one of the following:

- Reset button B2
- Arduino Uno V3 shield board from CN4
- LoRa® module internal reset coming either from STSAFE security IC or STM32L072CZ (selectable by jumper JP10)
- Embedded ST-LINK/V2-1

8.7 Antenna and RF connection

The B-L072Z-LRWAN1 Discovery kit includes a stubby straight 900 MHz 50 ohm antenna that must be connected to the SMA connector CN10 for any RF communication purpose. There are two paths designed for RF signal (the blue arrow in the *Figure 7*), the default path is connected to the SMA connector output (the red arrow in the *Figure 7*) and the second one is U.FL CN9 connector (the green arrow in the *Figure 7*). Each RF signal path includes an antenna matching circuitry that can be mounted and adjusted by advanced users. Initially, the default path connects the LoRa® module RF signal to the SMA connector through 0 Ohm resistors that are fitted at the location of C14 and C15. Notice that C13 and C14, as shown below in *Figure 7,* have a common pad on layout from antenna circuitry. If the users want to connect the U.FL connector instead of the SMA, they need to redirect the RF signal through C13 and then rotate the component on the expected footprint.

Figure 7. RF signal path and connectors
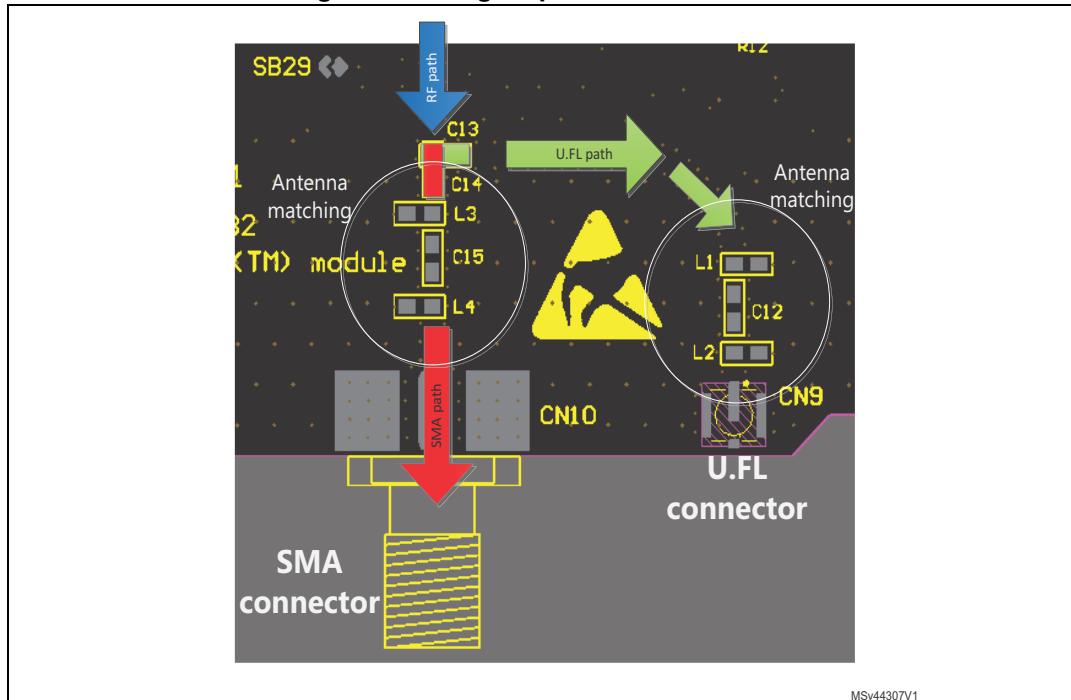
8.8 Virtual COM port

The serial interface USART2 is directly available as a virtual COM port of the PC, connected to the ST-LINK/V2-1 USB connector CN7. For configuration details refer to "*STM32 LoRa® software expansion for STM32Cube*" User manual (UM2073).

8.9 Buttons and LEDs

The black button B2 located at the top side of the Discovery kit, is the reset of the microcontroller STM32L072CZ.

The blue button B1 located at the top side is available to be used as a digital input or as a wakeup-alternate function. When the button is depressed the logic state is 1, otherwise the logic state is 0.

By default the user button is connected to PB2, it can also be connected to PA0 as wakeup source. In this case, SB31 must be removed and SB30 must be fitted.

Seven LEDs located at the top side are available, four of which are general purpose LEDs for user needs. To light a LED a high-logic state 1 should be written in the corresponding GPIO register. *Table 4* shows the assignment of the control ports to the LED indicators.

Table 4. Assignment of the control ports

Reference	Color	Name	Comment/function
B1	Blue	USER	Alternate function wakeup
B2	Black	RESET	Microcontroller reset
LD1	Green	GP	User defined
LD2	Green	GP	User defined
LD3	Blue	GP	User defined
LD4	Red	GP	User defined
LD5	Red/Green	ST-LINK COM	Green when communication
LD6	Red	Fault power	Current upper than 625mA
LD7	Red	5 V Power	5 V present

8.10 USB FS

The B-L072Z-LRWAN1 board supports USB FS 2.0 communication via a USB Micro-B connector. V_{BUS} is powered by another USB host when B-L072Z-LRWAN1 board works as a USB device.

Note: *When the B-L072Z-LRWAN1 board is powered by an external power supply through USB FS connector (CN11), in device mode, do not use a PC as power source if the current consumption is greater than 100 mA, otherwise the PC can be damaged.*

9 Connectors

9.1 Arduino Uno V3 connectors

Table 5. Arduino Uno V3 connectors

Connector	Pin	Pin name	STM32 Pin	Function
CN1	10	D15	PB8	I2C1_SCL
	9	D14	PB9	I2C1_SDA
	8	AVDD	VREF+	VREF+
	7	GND	GND	Ground
	6	D13	PA5 or PB13	SPI1_SCK or SPI2_SCK
	5	D12	PB14	SPI2_MISO
	4	D11	PB15	SPI2_MOSI
	3	D10	PB6	LPTIM1_ETR
	2	D9	PB12	SPI2_NSS
	1	D8	PA9	USART1_TX
CN4	1	NC	-	-
	2	IOREF	-	+3.3 V Ref
	3	RESET	NRST	MCU_nRST
	4	+3.3 V	-	+3.3 V input/output
	5	+5 V	-	5 V output
	6	GND	-	Ground
	7	GND	-	Ground
	8	VIN	-	Power input
CN5	8	D7	PA8	MCO
	7	D6	PB2	LPTIM1_OUT
	6	D5	PB7	LPTIM1_IN2
	5	D4	PB5	LPTIM1_IN1
	4	D3	PB13 or NC	TIM21_CH1 or NC
	3	D2	PA10	USART1_RX
	2	D1	PA2	USART2_TX
	1	D0	PA3	USART2_RX

Table 5. Arduino Uno V3 connectors (continued)

Connector	Pin	Pin name	STM32 Pin	Function
CN6	1	A0	PA0	ADC_IN0
	2	A1	NC or PA0	NC or ADC_IN0
	3	A2	PA4	ADC_IN4
	4	A3	NC or PA4	NC or ADC_IN4
	5	A4	PH1 or PB9	OSC_IN or I2C1_SDA
	6	A5	PH0 or PB8	OSC_OUT or I2C1_SCL

9.2 B-L072Z-LRWAN1 Discovery kit CN2 and CN3 connectors

Table 6. Connector CN2

Connector	Pin	Pin name	STM32 Pin	Function
CN2	1	TCXO_VCC	-	LoRa® module TCXO power
	2	VDD_MCU_LRA	-	MCU section power supply
	3	GND	-	Ground
	4	VDD_RF_LRA	-	MCU section power supply
	5	GND	-	Ground
	6	VDD_USB_LRA	-	MCU section power supply
	7	GND	-	Ground
	8	BOOT0	BOOT0	BOOT0
	9	PA13	PA13	SWDIO
	10	PA14	PA14	SWCLK
	11	SX1276_DIO0	-	LoRa® module debug pin
	12	SX1276_DIO1	-	LoRa® module debug pin
	13	SX1276_DIO2	-	LoRa® module debug pin
	14	SX1276_DIO3	-	LoRa® module debug pin
	15	SX1276_DIO4	-	LoRa® module debug pin
	16	SX1276_DIO5	-	LoRa® module debug pin
	17	GND	-	Ground
	18	MCU_nRST	NRST	RESET
	19	+3.3 V	-	+3.3 V power supply input/output
	20	+5 V	-	+5 V power supply input
	21	VIN	-	VIN power supply input (7-12Vdc)
	22	GND	-	Ground
	23	PA0	PA0	ADC_IN0
	24	PA4	PA4	ADC_IN4
	25	PH1	PH1	OSC_OUT
	26	PH0	PH0	OSC_IN

Table 7. Connector CN3

Connector	Pin	Pin name	STM32 Pin	Function
CN3	1	CRF1	PA1	LoRa® module dedicated pin
	2	CRF2	PC2	LoRa® module dedicated pin
	3	CRF3	PC1	LoRa® module dedicated pin
	4	STSAFE_nRST	-	STSAFE security IC reset pin
	5	AVDD	VREF+	VREF+
	6	GND	-	Ground
	7	PA5	PA5	ADC_IN5
	8	PB13	PB13	SPI2_SCK
	9	PB14	PB14	SPI2_MISO
	10	PB15	PB15	SPI2_MOSI
	11	PB6	PB6	LPTIM1_ETR
	12	GND	-	Ground
	13	PA9	PA9	USART1_TX
	14	PA12	PA12	USB_DP
	15	PA11	PA11	USB_DM
	16	PB12	PB12	SPI2_NSS
	17	PB2	PB2	LPTIM1_OUT
	18	PA8	PA8	MCO
	19	PB7	PB7	LPTIM1_IN2
	20	PB5	PB5	LPTIM1_IN1
	21	PA10	PA10	USART1_RX
	22	PA2	PA2	ADC_IN2
	23	PA3	PA3	ADC_IN3
	24	PB9	PB9	I2C1_SDA
	25	PB8	PB8	I2C1_SCL
	26	GND	-	Ground

9.3 Other connectors

9.3.1 Debug connector SWD

Table 8. Debug connector SWD (CN12)

Connector	Pin	Pin name	Function
CN12	1	VDD_TARGET	VDD from application
	2	SWCLK	SWD clock
	3	GND	Ground
	4	SWDIO	SWD data input/output
	5	NRST	RESET of target MCU
	6	SWO	Reserved

9.3.2 SWD Interface

It is very easy to use ST-LINK/V2-1 to program an STM32 microcontroller on an external application. Simply remove the two jumpers from CN8 and connect the application to the CN12 debug connector according to *Table 8*.

9.3.3 External +3.3 V

Table 9. External +3.3 V (CN13)

Connector	Pin	Pin name	Function
CN13	1	+3.3 V external	External +3.3 V power supply input
	2	GND	Ground

Caution: When using the external +3.3 V power supply input, SB6 must be OFF.

9.4 Description of the jumpers

Table 10. Description of the jumpers

Jumper	Pin number	Designation	Default state	Function
JP1	2	VDD_RF_LRA	OFF	Allows IDD VDD_RF_LRA measurement
JP2	2	VDD_USB_LRA	OFF	Allows IDD VDD_USB_LRA measurement
JP3	2	VDD_MCU_LRA	OFF	Allows IDD VDD_MCU_LRA measurement
JP5	2	USB charger	OFF	USB charger
JP7, JP8	2	GND	ON	Ground
JP6	2	ST-LINK TX/RX	OFF	ST-LINK TX/RX signals

Table 10. Description of the jumpers (continued)

Jumper	Pin number	Designation	Default state	Function
JP9	3	TCXO selection	2-3	Selection TCXO to VDD or external TCXO power
JP10	3	Reset source selection	1-2	Reset source selection between STSAFE or PA11

9.5 Configuration of the solder bridges

Refer to *Figure 8* and *Figure 9* to locate the solder bridges.

Table 11. Configuration of the solder bridges

Solder bridges	Designation	Default state	Function
SB19	Short VDD_USB_LRA	ON	Short VDD_USB_LRA connection
SB14	Short VDD_MCU_LRA	ON	Short VDD_MCU_LRA connection
SB17	Short VDD_RF_LRA	ON	Short VDD_RF_LRA connection
SB20	Short D4	OFF	D4 bypass
SB4	Short D6	OFF	D6 bypass
SB5	Short D7	OFF	D7 bypass
SB18	+5 V LED	ON	+5 V power supply ON
SB6	+3.3 V regulator output	ON	Used to disconnect internal +3.3 V regulator when external source applied on External 3.3 V pin
SB38,SB40, SB22, SB24	ST-LINK default	ON	Reserved
SB39, SB41, SB23, SB25	ST-LINK reserved	OFF	Reserved
SB37	ST-LINK RESET	ON	Connection between ST-LINK reset signal and LoRa® module reset
SB36	ST-LINK MCO	OFF	Optional ST-LINK MCO redirected to LoRa® module input clock OSC_IN
SB6	ST-LINK +5 V power	ON	Optional ST-LINK regulator disconnected from +5 V
SB21	ST-LINK force RESET	OFF	Reserved
SB26	PA5 to DIO4	OFF	Reserved to LoRa® module debug
SB27	PA4 to DIO5	OFF	Reserved to LoRa® module debug
SB28	ST-LINK TX	ON	Virtual COM port TX
SB29	ST-LINK RX	ON	Virtual COM port RX
SB15	LRA_USB_DP	OFF	Optional USB_DP connection
SB16	LRA_USB_DM	OFF	Optional USB_DM connection

Table 11. Configuration of the solder bridges (continued)

Solder bridges	Designation	Default state	Function
SB13	TCXO_OUT to OSC_IN	OFF	Allows connection of TXCO output to STM32L072CZY6 OSC_IN input
SB31	USER button PB2	ON	User push-button connected to PB2
SB30	USER button PA0	OFF	User push-button connected to PA0
SB32	LED LD1	ON	LD1 ON
SB33	LED LD3	ON	LD3 ON
SB35	LED LD4	ON	LD4 ON
SB34	LED LD2	ON	LD2 ON
SB10	PH1 Arduino	OFF	Connection A5(CN6) Arduino to PH1
SB3	PA5 Arduino	ON	Connection D13(CN1) Arduino to PA5
SB9	PB13 Arduino	ON	Connection D3(CN5) Arduino to PB13
SB2	PB13 Arduino	OFF	Connection D13(CN5) Arduino to PB13
SB7	PA0 alias Arduino	OFF	Connection A1(CN6) Arduino to PA0
SB8	PA4 alias Arduino	OFF	Connection A3(CN6) Arduino to PA4
SB11	PB9 Arduino	OFF	Connection A4(CN6) Arduino to PB9
SB12	PB8 Arduino	OFF	Connection A54(CN6) Arduino to PB8
SB1	PH0 Arduino	OFF	Connection A4(CN6) Arduino to PH0

Figure 8. B-L072Z-LRWAN1: location of the solder bridges (top view)
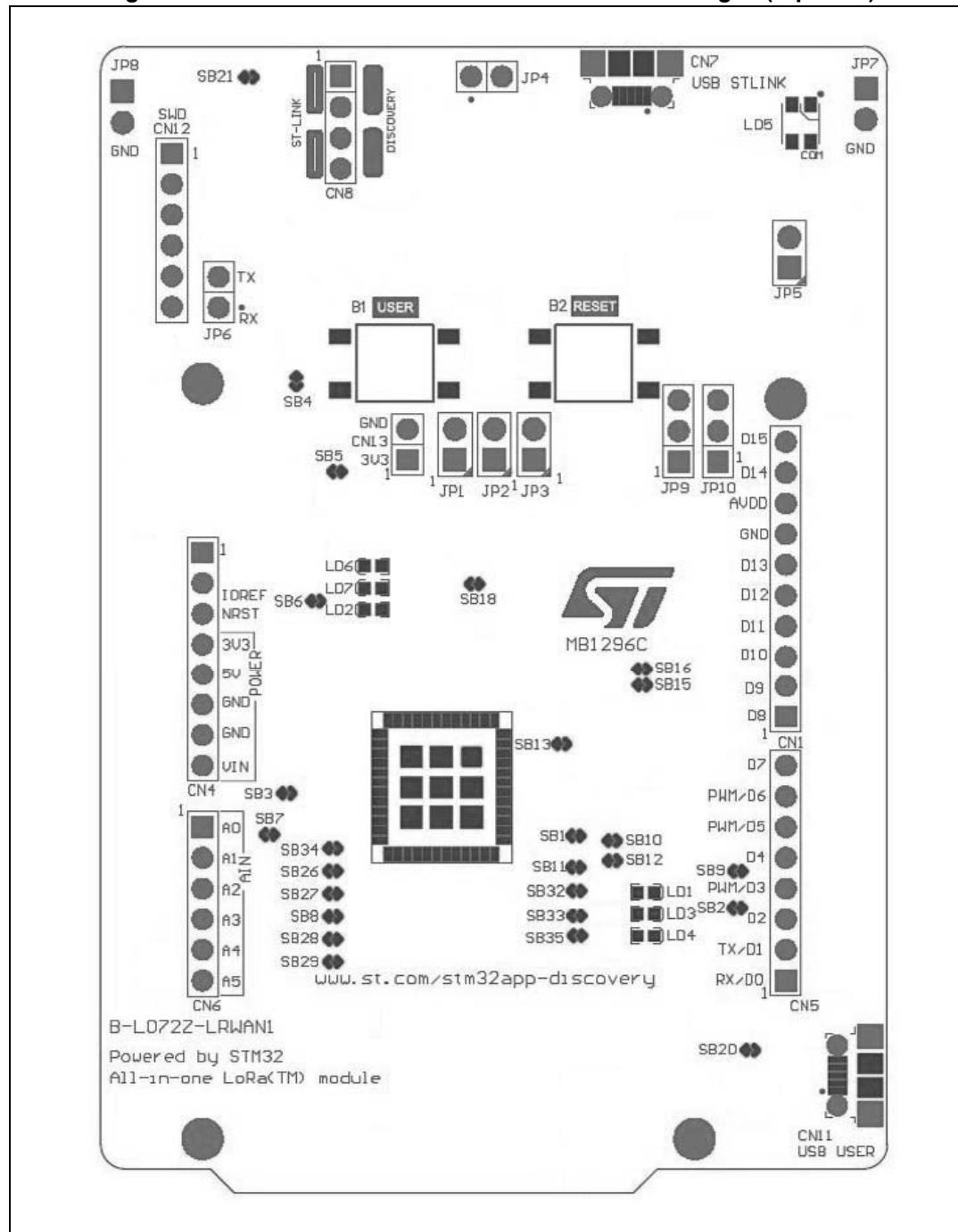
Figure 9. B-L072Z-LRWAN1: location of the solder bridges (bottom view)
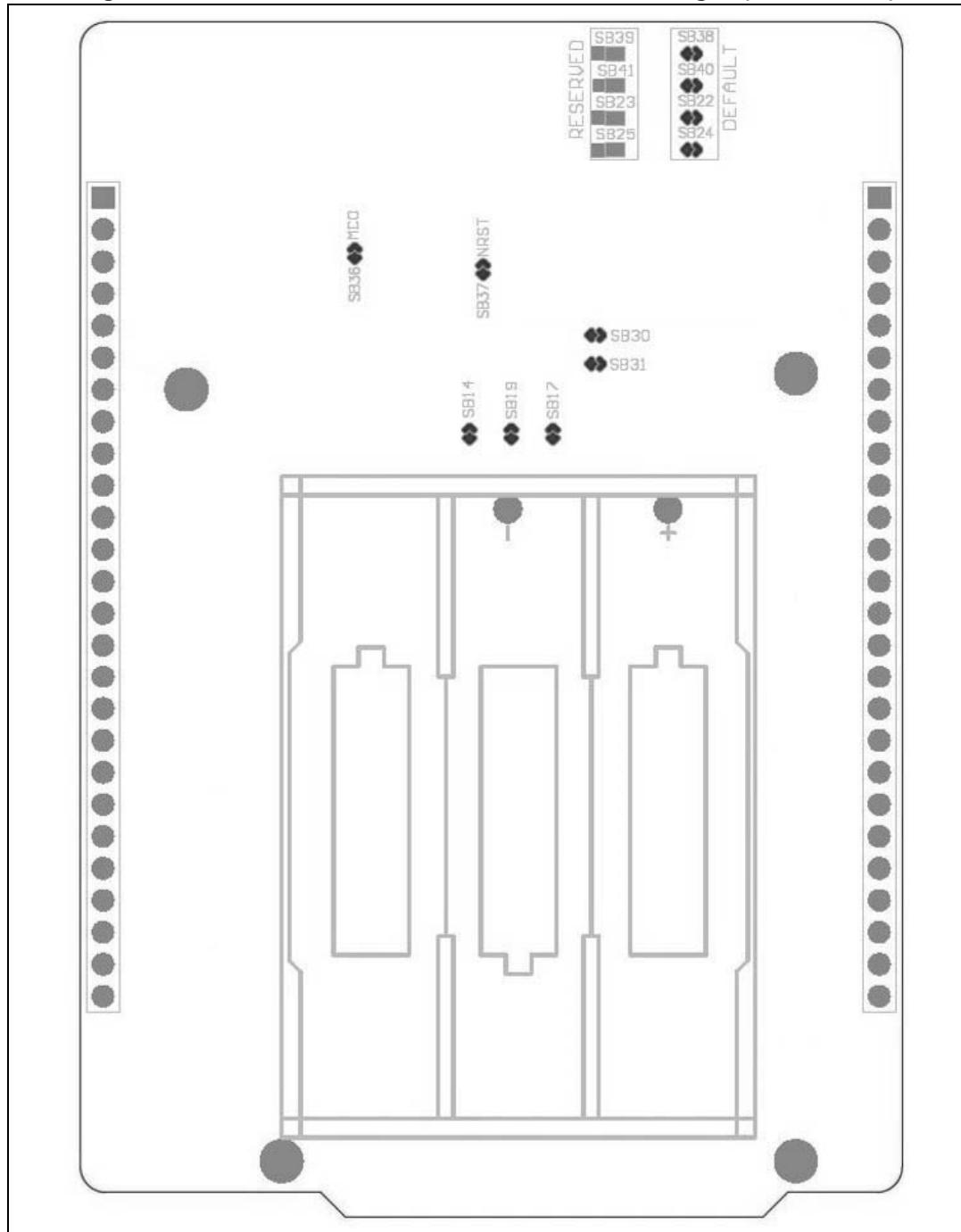
10   B-L072Z-LRWAN1 Discovery kit information

10.1   Identification

The sticker located on the bottom side of the PCB board shows the information about the B-L072Z-LRWAN1 Discovery kit identification such as board reference, revision and serial number. The format of the identification is the following:

- MBxxxx p-bb:
  the board reference is MB1296, "p" corresponds to the PCB revision and "bb" to the BOM revision: for example A-01.

- yywwnnnnn:
  "yy" are the two last digits of the manufacturing year, "ww" identifies the manufacturing week and "nnnnn" is the board serial number.

10.2   Revision history

10.2.1   Revision C-01

The revision C-01 of the B-L072Z-LRWAN1 Discovery kit is the initial released version.

10.3   Known limitations

10.3.1   Revision C-01

The power current consumption on VDD_MCU_LRA and on VDD_USB_LRA cannot be measured as independent branches.To measure the total power consumption including the MCU LRA and the USB LRA currents, both SB14 and SB19 must be removed. A multimeter can be placed indifferently where JP2 or JP3 connectors are located. No workaround is available.

Appendix A   Schematic diagrams

This section provides design schematics for the B-L072Z-LRWAN1 Discovery kit features:

- Top view of the Discovery kit, see *Figure 10*
- Internal/External Power Supply section, see *Figure 11*
- Embedded ST-LINK/V2-1, see *Figure 12*
- LoRa module connections, see *Figure 13*
- USB 2.0 FS antenna and miscellaneous features, see *Figure 14*
- Arduino Uno V3 extension connectors and headers, see *Figure 15*

Figure 10. B-L072Z-LRWAN1 Discovery kit, Top view

MB1296-Connectors
MB1296-Connectors.SchDoc

PA[0..15]
PB[0..15]
PC[0..15]
PH[0..1]
SX1276_DIO[0..5]
CRF[1..3]
STSAFE_nRST
MCU_nRST
TCXO_VCC
BOOT0
VREF+

MB1296-LRA_Module
MB1296-LRA_Module.SchDoc

PA[0..15]
PB[0..15]
PC[0..15]
PH[0..1]
SX1276_DIO[0..5]
CRF[1..3]
STSAFE_nRST
MCU_nRST
TCXO_VCC
BOOT0
VREF+

MB1296-USB_Antenna
MB1296-USB_Antenna.SchDoc

ANT
MCU_nRST
LRA_USB_P
LRA_USB_N

PA[0..15]
PB[0..15]

ANT
LRA_USB_P
LRA_USB_N

MB1296-Power
MB1296-Power.SchDoc

PWR_ENn

MB1296-STLINK
MB1296-STLINK.SchDoc

PWR_ENn

STLINK_TX
STLINK_RX
MCO
MCU_nRST
SWDIO
SWCLK

STLINK_TX
STLINK_RX
MCO

SWDIO
SWCLK

Title: **Top**
Project: **STM32 LoRa Discovery**
Size: A4   Reference: MB1296   Revision: C-01
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Figure 11. Power
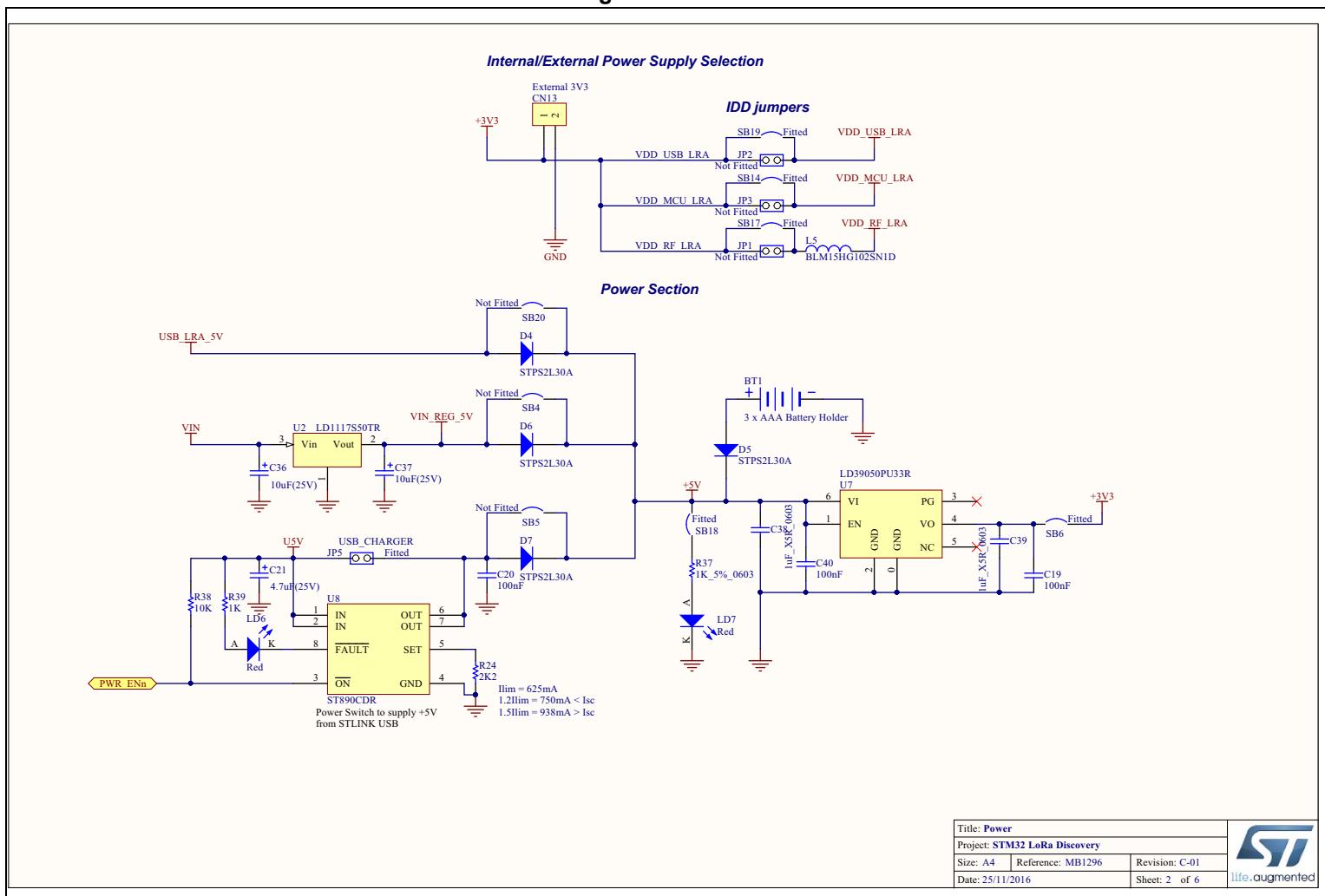
Figure 12. ST-LINK/V2-1
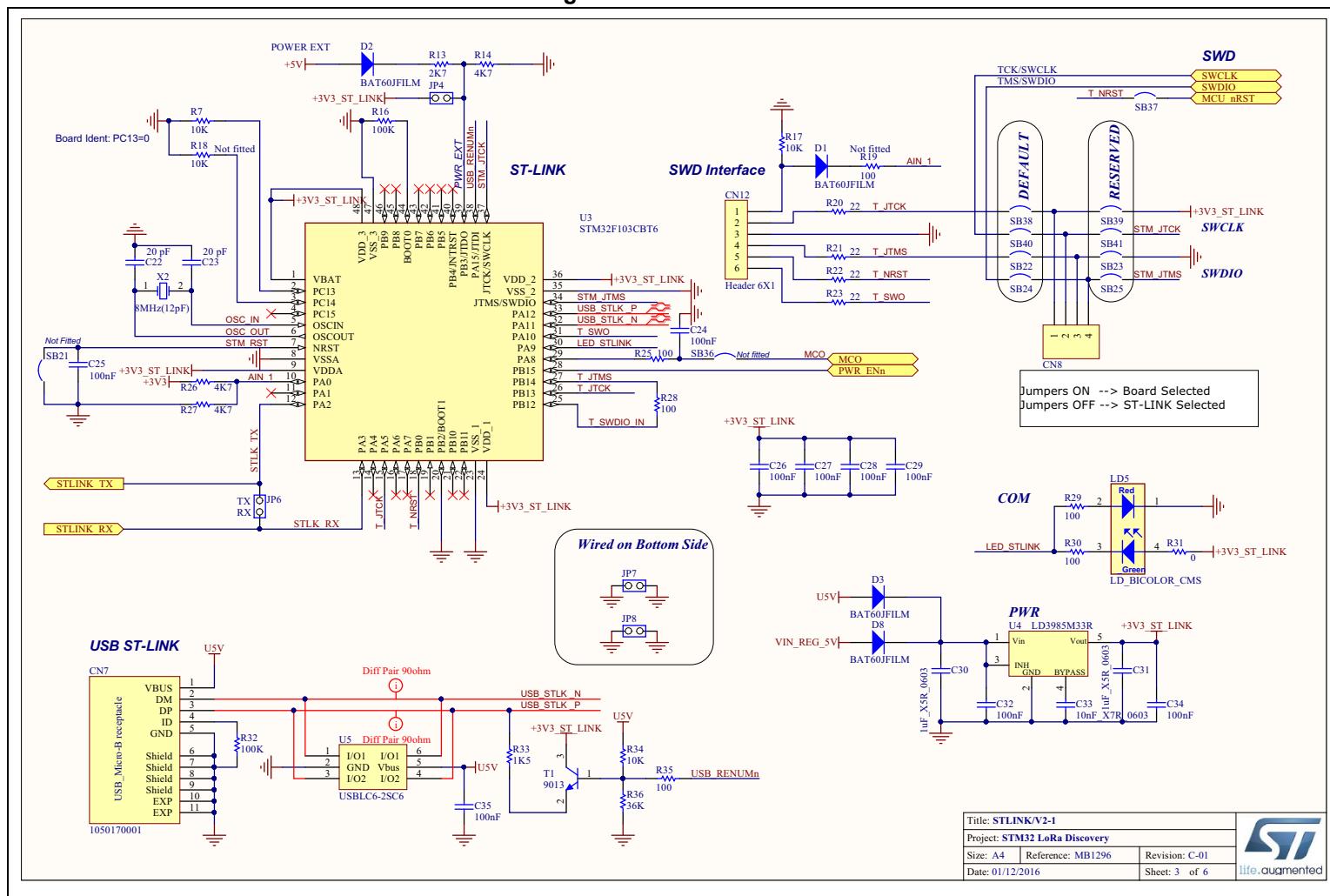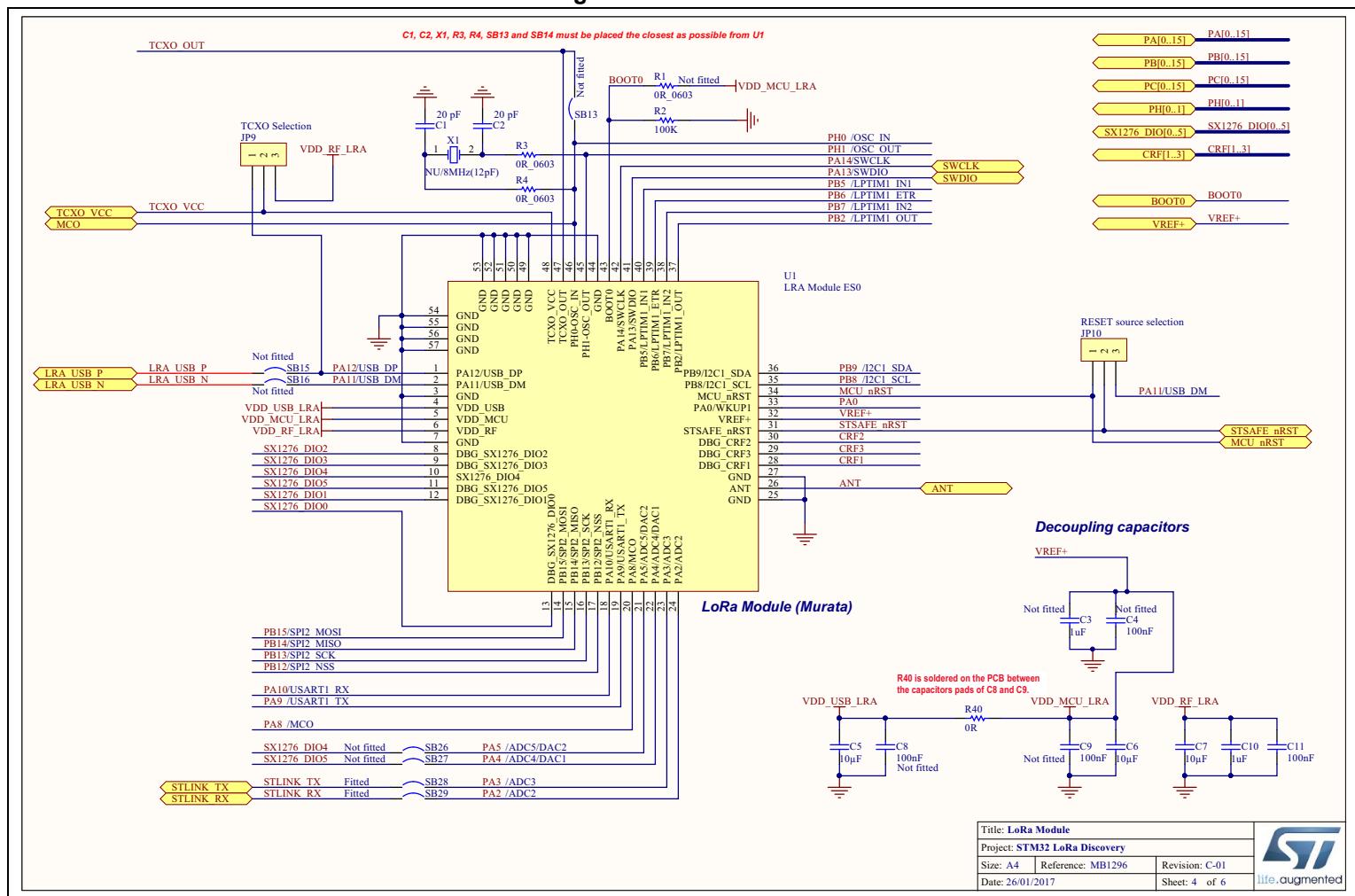
Figure 13. LoRa module

Figure 14. USB 2.0 FS and antenna

Antenna section with connectors

C39 and C40 have a common pad on Antenna side signal

C14 and C15 are temporarily replaced by 0Ohm resistor

General purpose User Button (or LoRa Wake Up)

RESET button

USB Interface LoRa module

To be placed on the opposite side of USB STLINK connector

General purpose LEDs

Title:	**LoRa USB - Antenna**	
Project:	**STM32 LoRa Discovery**	
Size: A4	Reference: MB1296	Revision: C-01
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Figure 15. Connectors

Extension connectors

PA[0..15]	PA[0..15]
PB[0..15]	PB[0..15]
PC[0..15]	PC[0..15]
PH[0..1]	PH[0..1]
SX1276_DIO[0..5]	SX1276_DIO[0..5]
CRF[1..3]	CRF[1..3]
STSAFE_nRST	STSAFE_nRST
MCU_nRST	MCU_nRST
BOOT0	BOOT0
TCXO_VCC	TCXO_VCC
VREF+	VREF+

Title: **Connectors**
Project: **STM32 LoRa Discovery**
Size: A4   Reference: MB1296   Revision: C-01
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Revision history

Table 12. Document revision history

Date	Revision	Changes
14-Feb-2017	1	Initial version

IMPORTANT NOTICE – PLEASE READ CAREFULLY

DocID029802 Rev 1