Discovery kit for IoT node, multi-channel communication with STM32L4+ Series

Introduction

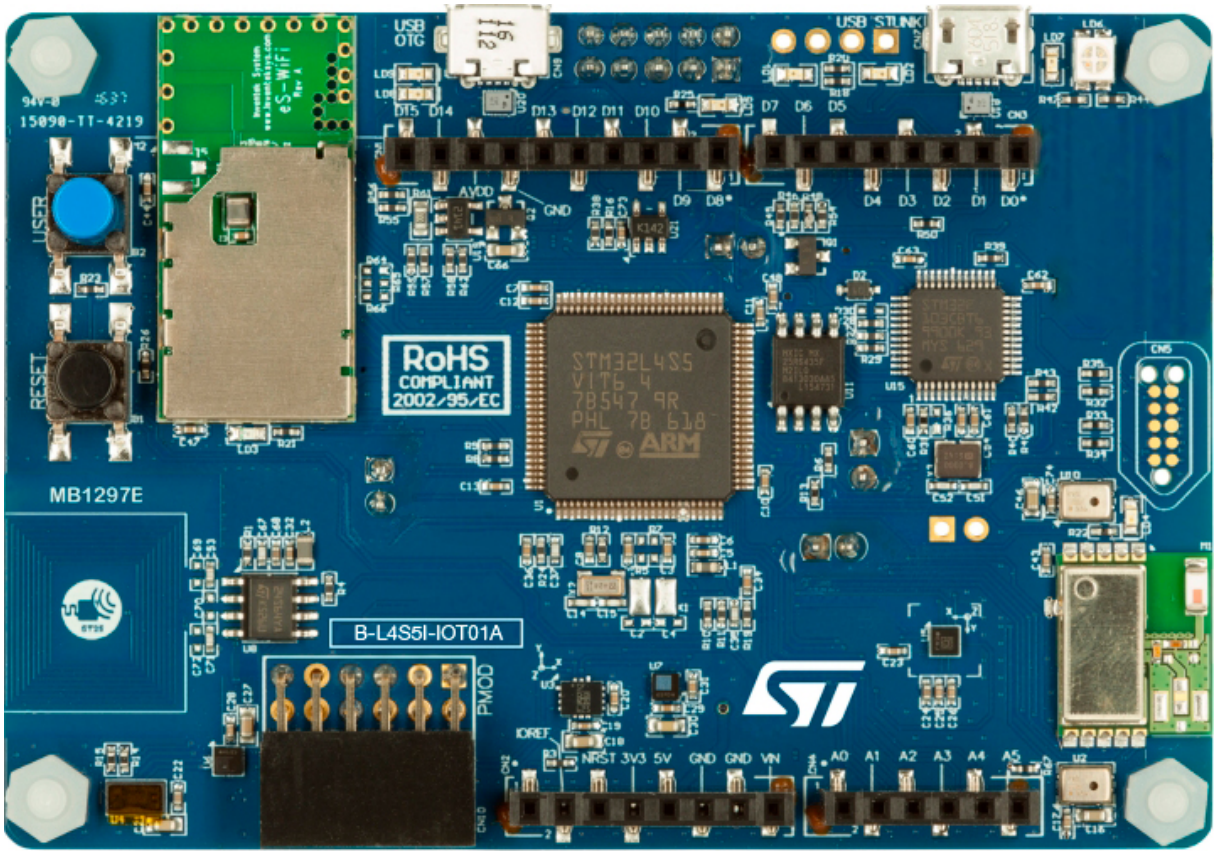
The B-L4S5I-IOT01A Discovery kit for the IoT node allows the user to develop applications with a direct connection to the cloud servers.

The B-L4S5I-IOT01A Discovery kit for the IoT node enables a wide diversity of applications by exploiting low-power multilink communication (Bluetooth® Low Energy, Wi-Fi®, NFC), multiway sensing (detection, environmental awareness) and Arm® Cortex®-M4 core-based STM32L4+ Series features.

ARDUINO® Uno V3 and Pmod™ connectivity provide unlimited expansion capabilities with a large choice of specialized add-on boards.

The B-L4S5I-IOT01A Discovery kit for the IoT node includes an ST-LINK debugger/programmer and comes with the comprehensive STM32CubeL4 MCU Package, which provides an STM32 comprehensive software HAL library as well as various software examples to seamlessly connect to cloud servers.

Figure 1. B-L4S5I-IOT01A Discovery kit for the IoT node



Picture is not contractual.

1 Features

- Ultra-low-power STM32L4+ Series STM32L4S5VIT6 microcontroller based on the Arm® Cortex®-M4 core with 2 Mbytes of Flash memory and 640 Kbytes of RAM in LQFP100 package
- 64-Mbit Quad-SPI Flash memory from Macronix™
- Bluetooth® 4.1 module (SPBTLE-RF) from STMicroelectronics
- 802.11 b/g/n compliant Wi-Fi® module (ISM43362-M3G-L44) from Inventek Systems
- Dynamic NFC tag based on ST25DV04K with its printed NFC antenna
- 2 digital omnidirectional microphones (MP34DT01) from STMicroelectronics
- Capacitive digital sensor for relative humidity and temperature (HTS221) from STMicroelectronics
- High-performance 3-axis magnetometer (LIS3MDL) from STMicroelectronics
- 3D accelerometer and 3D gyroscope (LSM6DSL) from STMicroelectronics
- 260-1260 hPa absolute digital output barometer (LPS22HB) from STMicroelectronics
- Time-of-flight and gesture-detection sensor (VL53L0X) from STMicroelectronics
- Highly-secure solution (STSAFE-A110) from STMicroelectronics
- 2 push-buttons (user and reset)
- USB OTG FS with Micro-AB connector
- ARDUINO® Uno V3 expansion connector
- Pmod™ expansion connector
- Flexible power-supply options: ST-LINK, USB V_{BUS} or external sources
- On-board ST-LINK/V2-1 debugger/programmer with USB re-enumeration capability: mass storage, Virtual COM port, and debug port
- Comprehensive free software libraries and examples available with the STM32Cube MCU Package
- Support of a wide choice of Integrated Development Environments (IDEs) including IAR™, Keil®, 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 B-L4S5I-IOT01A Discovery kit for the IoT node, 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
B-L4S5I-IOT01A	MB1297	STM32L4S5VIT6U

2.1 Product marking

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

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

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

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

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

2.2 Codification

The meaning of the codification is explained in Table 2.

Table 2. Codification explanation

B-L4S5I-IOT01A	Description	B-L4S5I-IOT01A
B	Discovery kit with a variety of sensors	Sensor node
L4S5	MCU product line in STM32 32-bit Arm Cortex MCUs	STM32L4R5/S5 in the STM32L4+ Series
I	STM32 Flash memory size: • I for 2 Mbytes	2 Mbytes
IOT	Dedicated to IoT applications	Discovery kit for IoT applications

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

3 Development environment

The B-L4S5I-IOT01A Discovery kit for the IoT node runs with the STM32L4S5VI 32-bit microcontroller based on the Arm® Cortex®-M4 core.

3.1 System requirements

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

Note: macOS® is a trademark of Apple Inc. registered in the U.S. and other countries.
All other trademarks are the property of their respective owners.

3.2 Development toolchains

- IAR™ - EWARM (see note)
- Keil® - MDK-ARM (see note)
- STMicroelectronics - STM32CubeIDE

Note: On Windows® only.

3.3 Demonstration software

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

4 Conventions

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

Table 3. ON/OFF convention

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

5 Delivery recommendations

Before the first use, make sure that no damage occurred to the board during shipment and no socketed components are not firmly fixed in their sockets or loose in the plastic bag.

6 Hardware layout and configuration

The B-L4S5I-IOT01A Discovery kit for the IoT node is designed around the STM32L4S5VIT6U target microcontroller in a 100-pin LQFP package. The hardware block diagram (Refer to Figure 2) illustrates the connection between the STM32 and peripherals: embedded ST-LINK, ARDUINO® Uno V3 shields, Pmod™ connector, Quad-SPI Flash memory, USB OTG connectors, digital microphones, various ST-MEMS sensors, and the three RF modules (Wi-Fi®, Bluetooth®, and NFC). Figure 3 and Figure 4 help users to locate these features on the B-L4S5I-IOT01A Discovery kit for the IoT node. Figure 5 gives the mechanical dimensions of the B-L4S5I-IOT01A Discovery kit for the IoT node.

Figure 2. Hardware block diagram

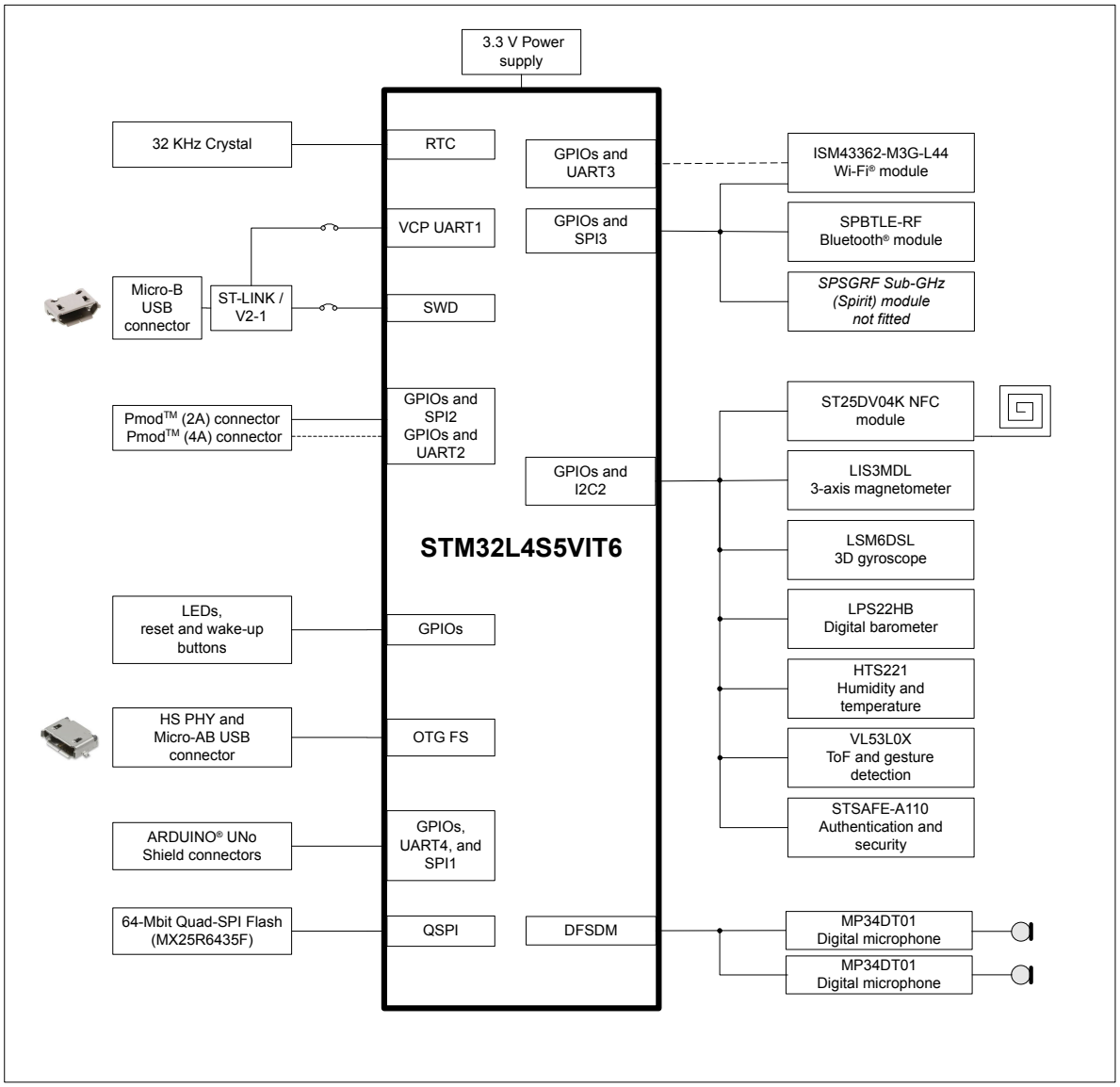


Figure 3. B-L4S5I-IOT01A Discovery kit for the IoT node layout (top view)

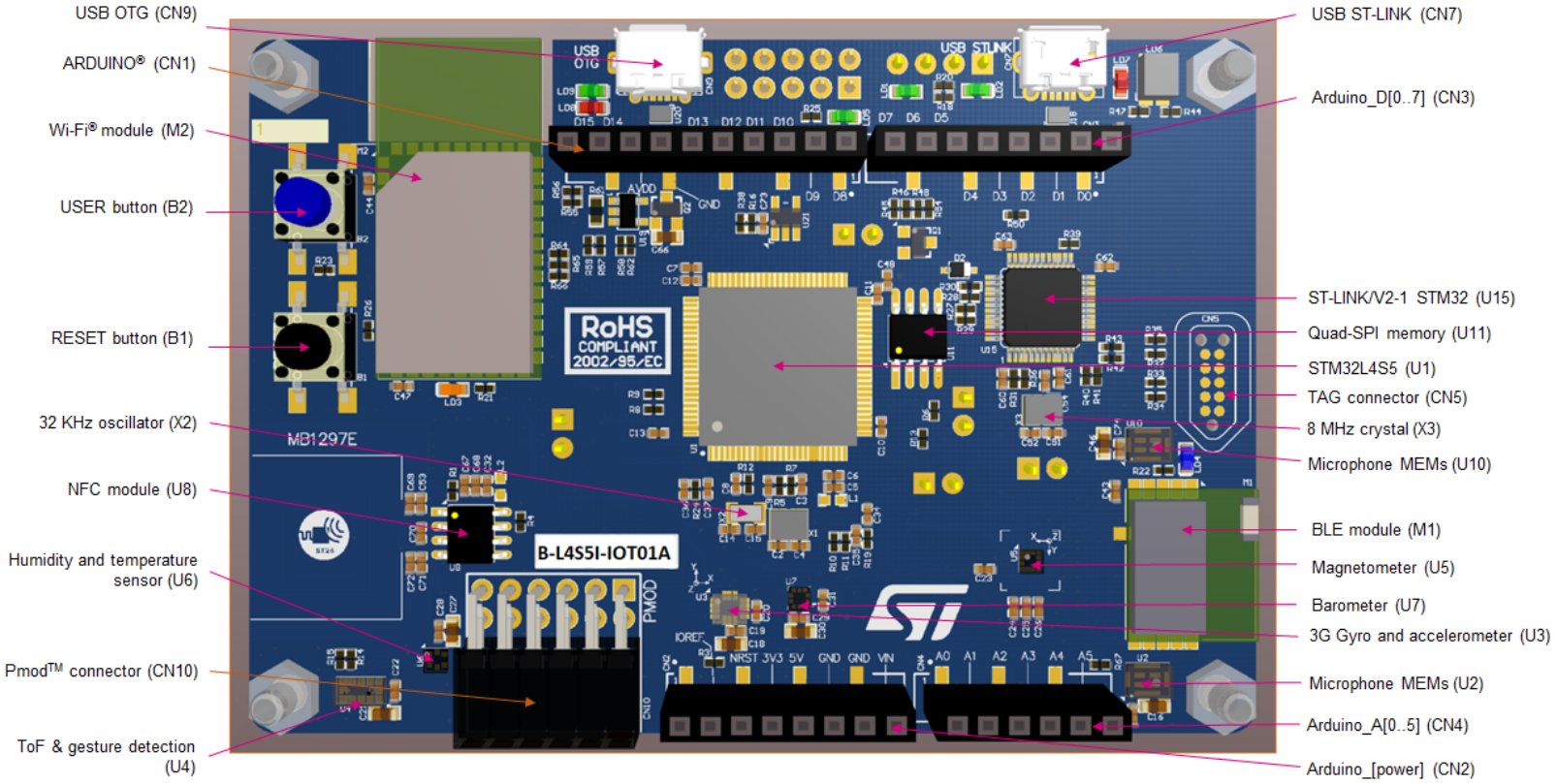


Figure 4. B-L4S5I-IOT01A Discovery kit for the IoT node layout (bottom view)

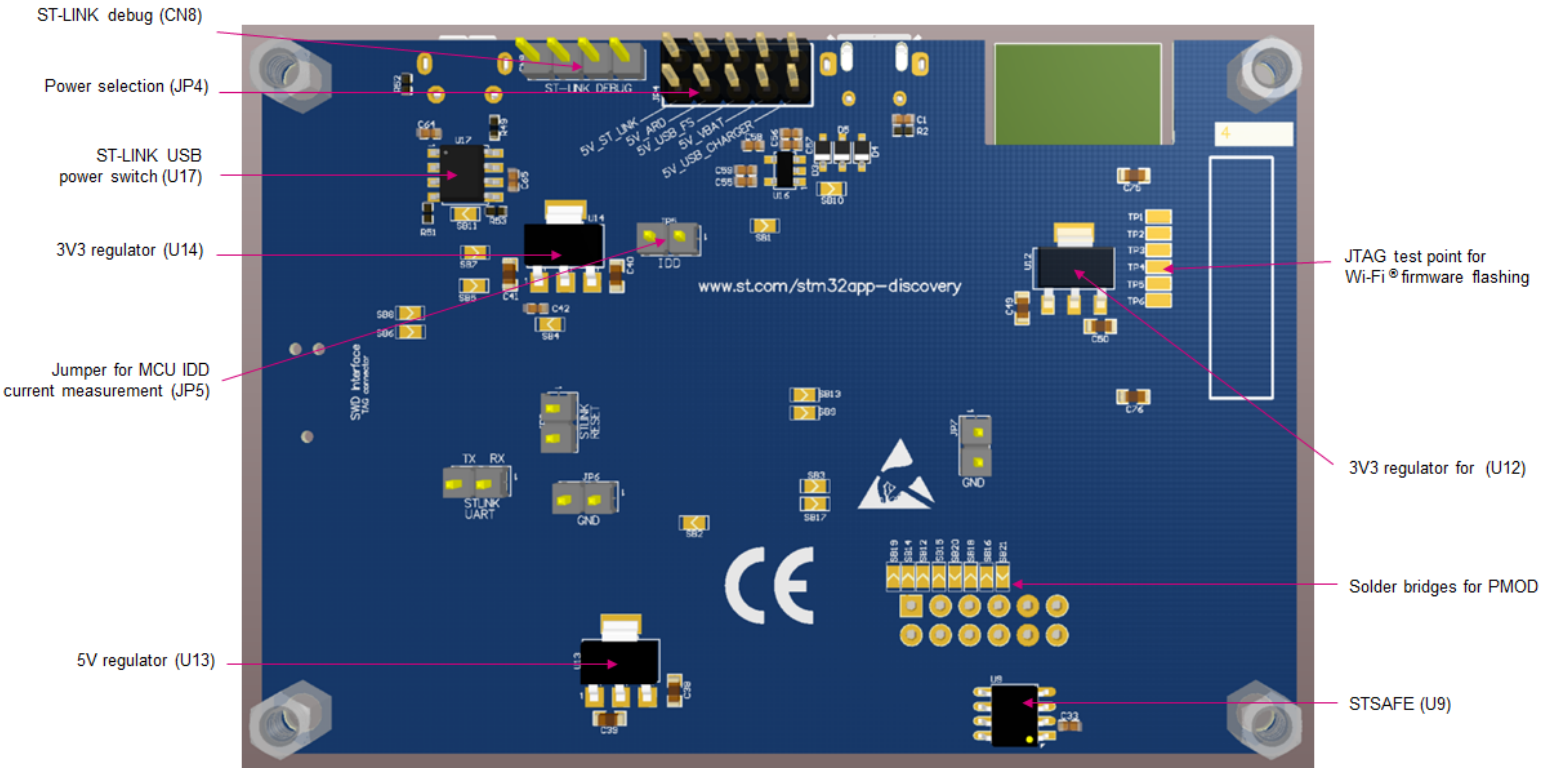
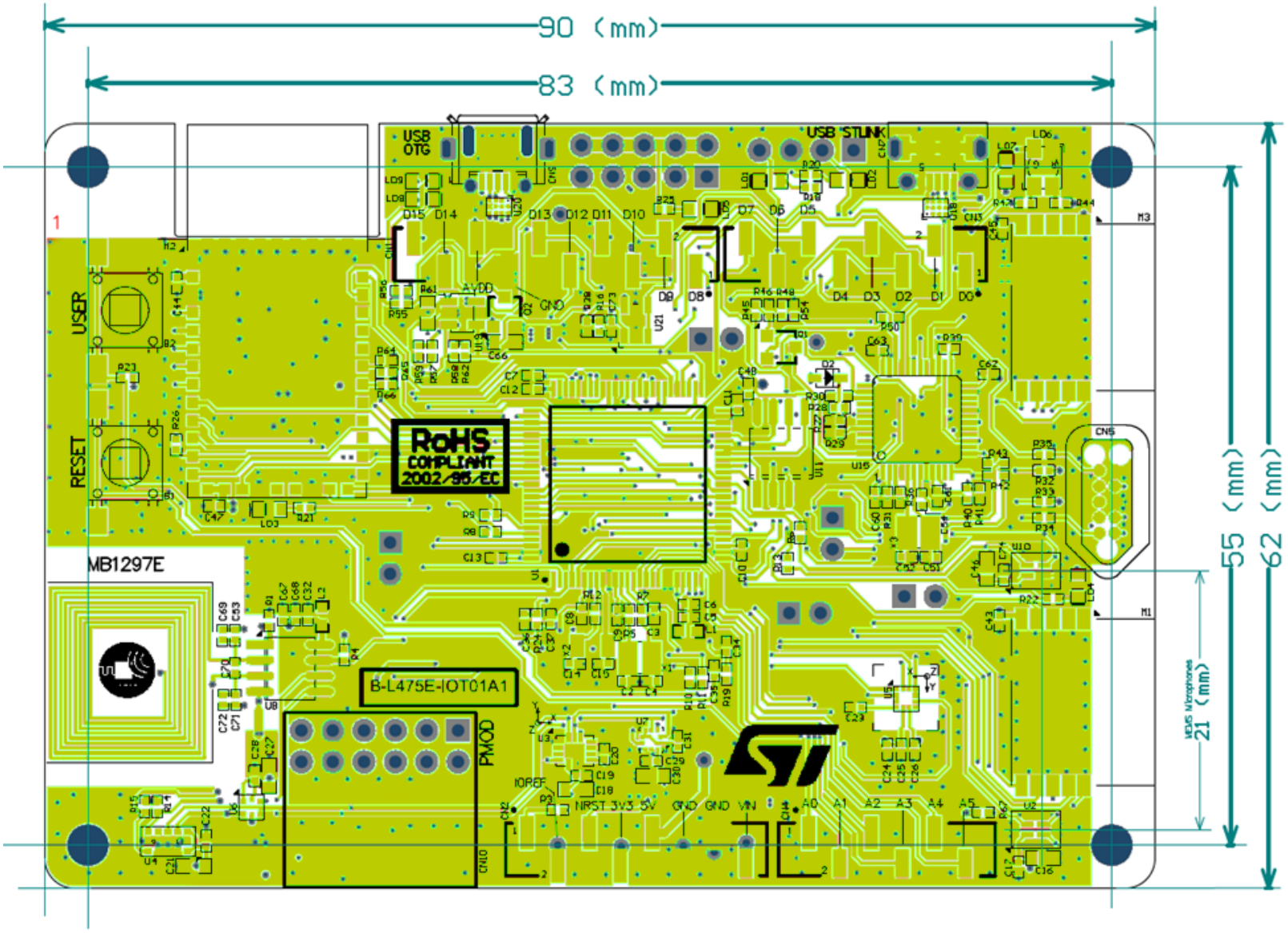


Figure 5. **B-L4S5I-IOT01A Discovery kit for the IoT node mechanical drawing in millimeters**



6.1 Embedded STLINK/V2-1

The ST-LINK/V2-1 programming and debugging tool is integrated on the B-L4S5I-IOT01A Discovery kit for the IoT node. Compared to the ST-LINK/V2 the changes are listed below.

The new features supported on the 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 100 mA power on USB

The following features are no more supported on the ST-LINK/V2-1:

- SWIM interface
- Application voltage lower than 3 V

For all general information concerning debugging and programming features common between V2 and V2-1 versions, refer to user manual *ST-LINK/V2 in-circuit debugger/programmer for STM8 and STM32* (UM1075) at the *www.st.com* website.

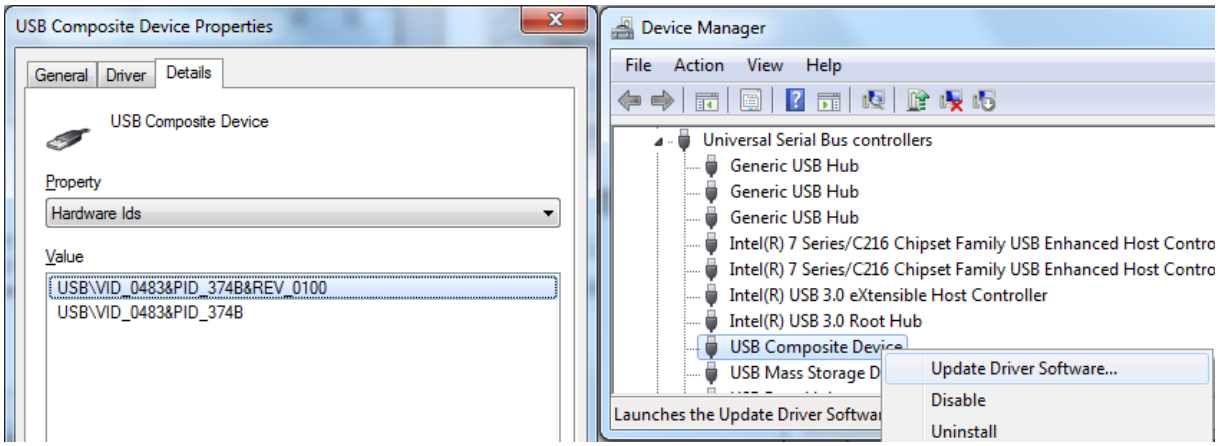
6.1.1 Drivers

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

In case the B-L4S5I-IOT01A Discovery kit for the IoT node is connected to the PC before the driver is installed, some Discovery board interfaces may be declared as “Unknown” in the PC device manager. In this case, the user must install the dedicated driver files, and update the driver of the connected device from the device manager as shown in Figure 6.

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

Figure 6. USB composite device



6.1.2 ST-LINK/V2-1 firmware upgrade

The ST-LINK/V2-1 embeds a firmware upgrade mechanism for the in-situ upgrade through the USB port. As the firmware may evolve during the lifetime of the ST-LINK/V2-1 product (for example new functionalities, bug fixes, support for new microcontroller families), it is recommended to visit the *www.st.com* website before starting to use the B-L4S5I-IOT01A Discovery kit for the IoT node and periodically, to stay up-to-date with the latest firmware version.

6.2 Power supply

The B-L4S5I-IOT01A Discovery kit for the IoT node is designed to be powered by a 5 V DC power supply. It is possible to configure the B-L4S5I-IOT01A Discovery kit for the IoT node to use any of the following five sources for the power supply: 5V_ST_LINK, 5V_ARD, 5V_USB_FS, 5V_VBAT, and 5V_USB_CHARGER.

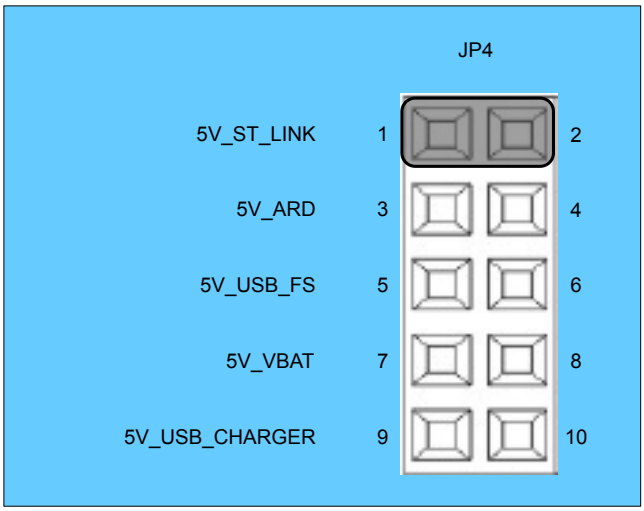
In case of external 5 V DC power adapter, the B-L4S5I-IOT01A Discovery kit for the IoT node must be powered by a power supply unit or by a piece of auxiliary equipment complying with the standard EN-60950-1: 2006+A11/2009, and must be Safety Extra Low Voltage (SELV) with limited power capability.

5V_ST_LINK

(Refer to Figure 7)

This is a 5V DC power with limitation from CN7, the USB type Micro-B connector of ST-LINK/V2-1. In this case, the JP4 jumper must be fitted between pin 1 and pin 2 to select the 5V_ST_LINK power source on the JP4 silkscreen. This is the default setting. If the USB enumeration succeeds, the 5V_ST_LINK power is enabled, by asserting the PWR_ENn signal (from STM32F103CBT6). 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 an onboard short-circuit (Current higher than 750 mA). The B-L4S5I-IOT01A Discovery kit for the IoT node can be powered from the ST-LINK USB connector CN7, 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 B-L4S5I-IOT01A Discovery kit for the IoT node asks for the 500 mA power to 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 B-L4S5I-IOT01A Discovery kit for the IoT node consumes up to 500 mA current, but no more. If the host cannot provide the requested current, the enumeration fails. Therefore the ST890 remains OFF and the MCU 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.

Figure 7. JP4: 5V_ST_LINK selection

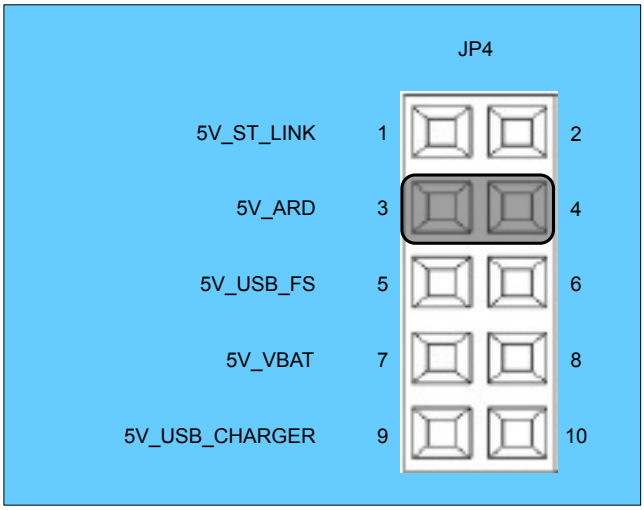


5V_ARD

(Refer to Figure 8)

This is the 7 to 12 V DC power from ARDUINO® CN2 pin 8 (named VIN on ARDUINO® connector silkscreen). In this case, the JP4 jumper must be fitted between pin 3 and pin 4 to select the 5V_ARD power source on the JP4 silkscreen and the DC power comes from the power supply through the ARDUINO® Uno V3 battery shield (compatible with Adafruit PowerBoost 500 shield).

Figure 8. **JP4: 5V_ARD selection from CN6 (VIN)**

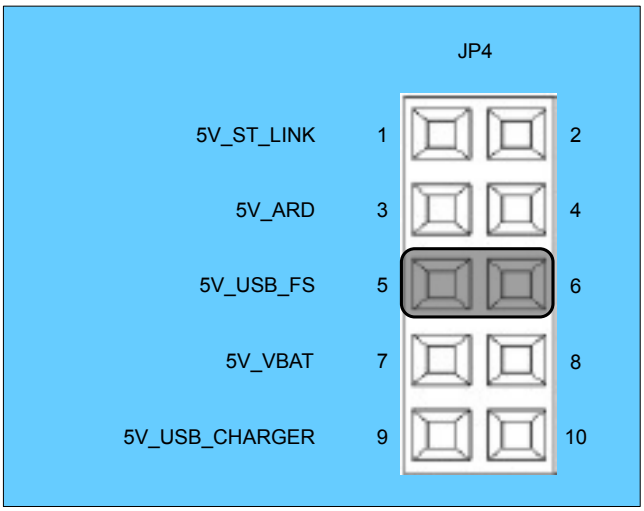


5V_USB_FS

(Refer to Figure 9)

This is the DC power with 500 mA limitation from CN9, the USB OTG FS Micro-AB connector. In this case, the JP4 jumper must be fitted between pin 5 and pin 6 to select the 5V_USB_FS power source on the JP4 silkscreen.

Figure 9. **JP4: 5V_USB_FS**

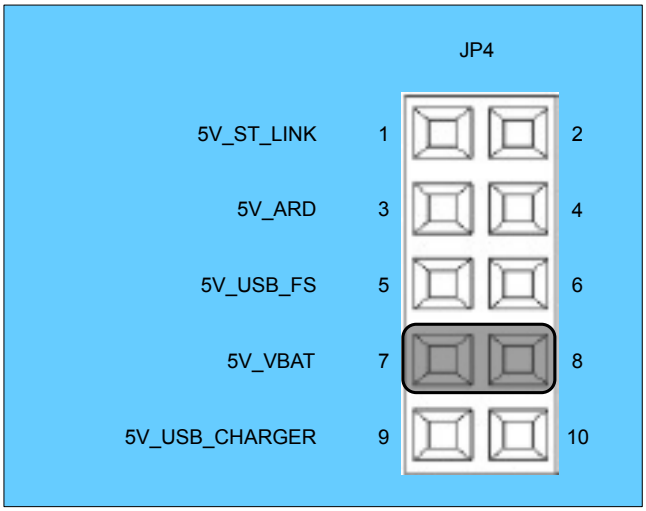


5V_VBAT

(Refer to Figure 10)

This is the DC power coming from an external source. In this case, the JP4 jumper must be fitted between pin 7 and pin 8 to select the 5V_VBAT power source on JP4 silkscreen.

Figure 10. **JP4: 5V_VBAT**

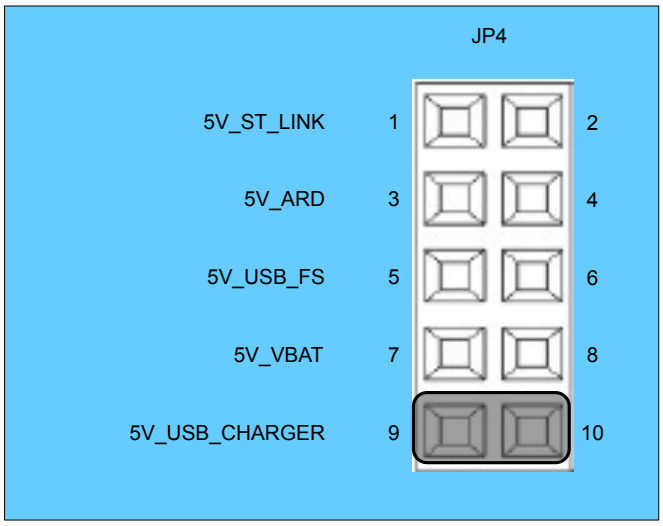


5V_USB_CHARGER

(Refer to Figure 11)

This is the DC power charger connected to the USB ST-LINK (CN7). To select the 5V_USB_CHARGER power source on JP4 silkscreen, the JP4 jumper must be fitted between pin 9 and pin 10. In this case, if the B-L4S5I-IOT01A Discovery kit for the IoT node is powered by an external USB charger, then the debug is not available. If the PC is connected instead of the charger, the limitation is no longer effective and the PC may be damaged.

Figure 11. **JP4: 5V_USB_CHARGER selection**

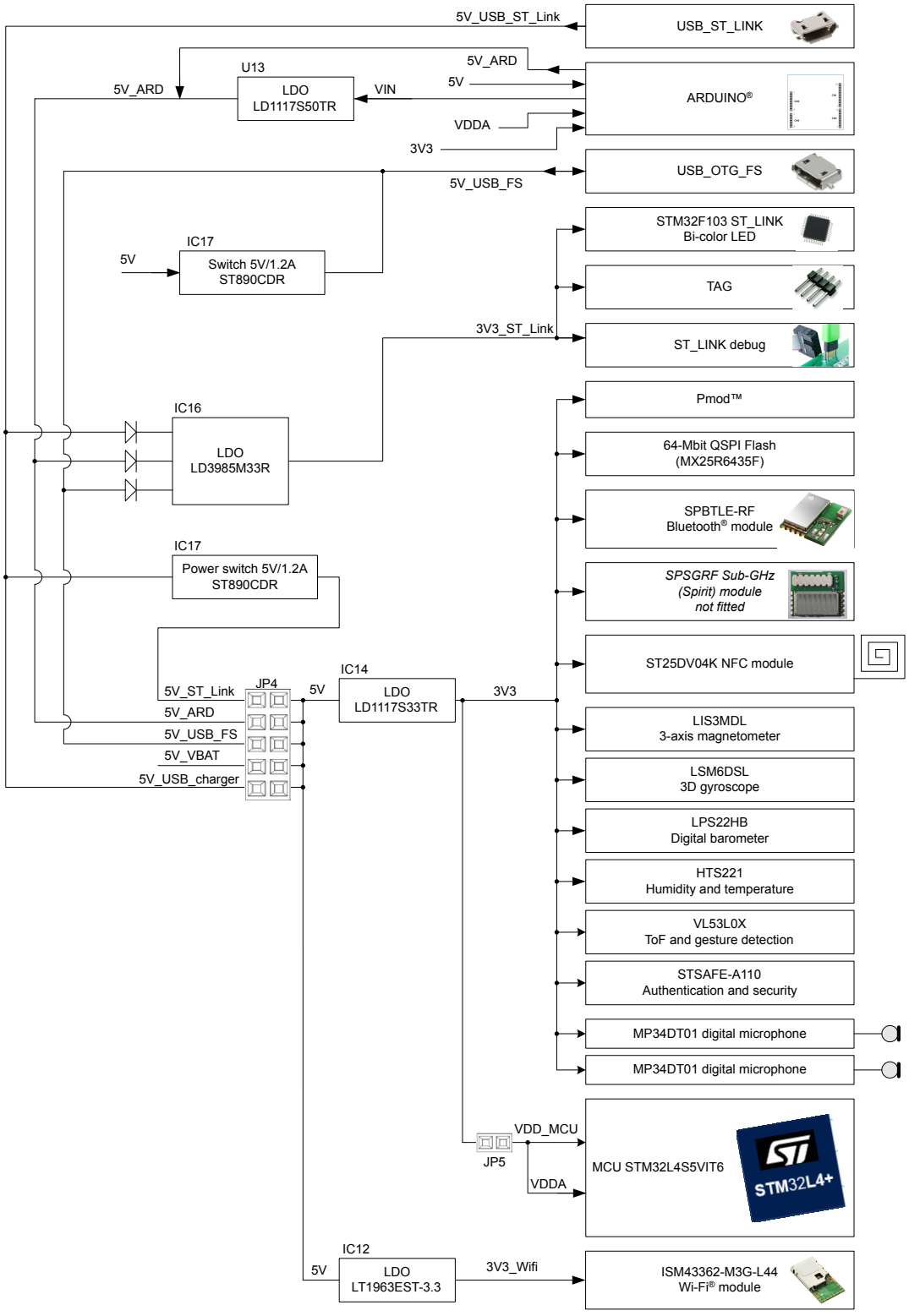


Note: If the board is powered by a USB charger, there is no USB enumeration, so the LD7 LED remains OFF permanently and the board is not powered. In this specific case only, the resistor R30 must be soldered, to allow the board to be powered anyway.

Caution: Do not connect the PC to the ST-LINK (CN7) when R30 is soldered. The PC may be damaged or the board may not be powered correctly.

The green LED LD5 is lit when the B-L4S5I-IOT01A Discovery kit for the IoT node is powered by the 5 V correctly. The power tree is shown in Figure 12. Power tree.

Figure 12. Power tree



6.3 Programming and debugging when the power supply is not from ST-LINK (5V_ST_LINK)

It is mandatory to power the board first using CN2 (VIN) or CN9 (USB_FS_OTG), then to connect the USB cable to the PC. Proceeding this way ensures that the enumeration succeeds, thanks to the external power source. The following power sequence procedure must be respected:

1. Connect the jumper JP4 on (5V_ARD) or (5V_USB_FS).
2. Connect the external power source to CN2 in case of an ARDUINO® shield or to CN9 in case of USB FS host interface.
3. Check that the red LED LD5 is turned ON.
4. Connect the PC to the USB connector CN7.

If this sequence is not respected, the board may be powered by V_{BUS} first from ST-LINK, and the following risks may be encountered:

1. If more than 500 mA current is needed by the board, the PC may be damaged or the current can be limited by the PC. As a consequence, the board is not powered correctly.
2. 500 mA is requested at the enumeration, so there is a risk that the request is rejected and enumeration does not succeed if the PC cannot provide such current.

6.4 Clock source

Three clock sources are described below:

- X1 8 MHz oscillator for the STM32L4S5VI microcontroller. This clock is not implemented in a basic configuration.
- X2 32.768 kHz crystal for the STM32L4S5VI embedded RTC
- X3 8 MHz clock from the ST-LINK MCU for the STM32L4S5VIT6Umicroncontroller.

6.5 Reset sources

The reset signal of the B-L4S5I-IOT01A Discovery kit for the IoT node is active LOW and the reset sources include:

- A reset button B1
- An ARDUINO® Uno V3 shield board from CN2
- An embedded ST-LINK/V2-1

6.6 USB OTG FS

The B-L4S5I-IOT01A Discovery kit for the IoT node supports USB OTG full-speed communications via the CN9 USB Micro-AB connector.

To do this, the following components must be added by the user:

- 8 MHz crystal (at X1 position). Reference is NX3225GD-8.00M
- 8.2 pF capacitor (0402 size) at the C2 position
- 8.2 pF capacitor (0402 size) at the C4 position
- 0-ohm resistor (0402 size) at the R5 position
- 0-ohm resistor (0402 size) at the R7 position

The B-L4S5I-IOT01A Discovery kit for the IoT node can be powered by the USB connectors at 5 V DC with 500 mA current limitation. A USB power switch (IC19) is also connected to V_{BUS} and provides power to CN9. The green LED LD9 is lit when either:

- The power switch is ON and the B-L4S5I-IOT01A Discovery kit for the IoT node works as a USB host,
- Or V_{BUS} is powered by another USB host when the B-L4S5I-IOT01A Discovery kit for the IoT node works as a USB device,

The red LED LD8 is lit when an over-current occurs.

6.7 Quad-SPI NOR Flash memory

64-Mbit Quad-SPI NOR Flash memory is connected to the Quad-SPI interface of the STM32L4S5VI microcontroller.

6.8 Virtual COM port

The serial interface USART1 is directly available as a Virtual COM port of the PC connected to the ST-LINK/V2-1 USB connector CN7. The Virtual COM port settings are configured with 115200 bps, 8-bit data, no parity, one-stop bit, and no flow control.

6.9 RF modules

Three RF interfaces are available on the B-L4S5I-IOT01A board:

1. Bluetooth® (V4.1 compliant) SPBTLE-RF module,
2. 802.11 b/g/n compliant Wi-Fi® module ISM43362-M3G-L44 from Inventek Systems,
3. Dynamic NFC Tag based on ST25DV04K with its printed NFC antenna (Double layer inductive antenna etched on the PCB).

6.9.1 Bluetooth® (V4.1 compliant) SPBTLE-RF module

The ST SPBTLE-RF module (M1) is implemented on the top side of the B-L4S5I-IOT01A Discovery kit for the IoT node.

The SPBTLE-RF is an easy to use Bluetooth® smart master-slave network processor module, compliant with Bluetooth® V4.1. The SPBTLE-RF B-Smart module supports multiple roles simultaneously, and it can act at the same time as Bluetooth® Smart sensor and hub device.

The entire Bluetooth® Smart stack and protocol are embedded into the SPBTLE-RF B-Smart module. The external host application processor, where the application resides, is connected to the SPBTLE-RF B-Smart module through a standard SPI interface (SPI3 of STM32L4S5VI).

The SPBTLE-RF B-SmarT module provides a complete RF platform in a tiny form factor (Footprint of this module is 13.5 mm x 11.5 mm). Radio, antenna, high frequency, and LPO oscillators are integrated to offer a certified solution to optimize the time to market of the final applications.

Figure 13. SPBTLE-RF module

The main features of the ST SPBTLE-RF module are listed below:

- Bluetooth® V4.1 compliant (Support of master and slave modes, multiple roles supported simultaneously)
- Embedded Bluetooth® low-energy protocol stack (GAP, GATT, SM, L2CAP, LL, RFPHY)
- Bluetooth® Low Energy profiles provided separately
- Bluetooth® radio performance
- Embedded ST BlueNRG-MS
- Tx power: + 4 dBm
- Host interface: SPI, IRQ, and RESET. On-field stack upgrading available via SPI.
- Certification: CE qualified, FCC, IC modular approval certified, BQE qualified
- On-board chip antenna

6.9.2 Inventek Systems ISM43362-M3G-L44 (802.11 b/g/n compliant Wi-Fi® module)

The Inventek Systems ISM43362-M3G-L44 module (M2) is implemented on the top side of the B-L4S5I-IOT01A Discovery kit for the IoT node This module is an embedded (eS-WiFi) wireless Internet Connectivity device. The Wi-Fi® hardware module consists of an Arm® Cortex®-M3 STM32 host processor, an integrated antenna (or optional external antenna) and a Broadcom Wi-Fi device. The module uses either a UART or an SPI interface (UART3 or SPI3 of STM32L4S5VI). By default, an SPI interface is used, as the corresponding firmware (for SPI capability) is downloaded on the Wi-Fi® ISM43362-M3G-L44 module. The Wi-Fi® module requires no operating system and has a completely integrated TCP/IP stack that only requires AT commands to establish connectivity for a wireless product. The footprint of this module is 14.5 mm x 30 mm.

Figure 14. ISM43362-M3G-L44 module

The main features of the Inventek system ISM43362-M3G-L44 module are:

- Based on the Broadcom BCM43362 MAC/Baseband/Radio device
- Supports Broadcom WICED SDK
- CPU Arm® Cortex®-M3 32-bit RISC core from STMicroelectronics
- IEEE 802.11n D7.0, OFDM-72.2 Mbps, single-stream width of 20 MHz, and short GI
- IEEE 802.11g, OFDM 54 Mbps
- IEEE 802.11b, DSSS 11 Mbps
- IEEE 802.11i, Security
  - WPA (Wi-Fi® Protected Access) –PSK/TKIP
  - WPA2 (Wi-Fi® Protected Access 2) –AES/CCMP/802.1x authentication
- GPIO, 5 ADC (SPI interface utilizes ADC pins)
- Power-saving mode allows the design of low-power applications
- Lead-free design which is compliant with ROHS requirements
- EMI/EMC Metal Shield for best RF performance in noisy environments and to accommodate for lower RF emissions/signature for easier FCC compliance
- FCC/CE compliance certification

On MB1297 revision E, the firmware revision inside the Wi-Fi® module must be C3.5.2.5.STM. The Wi-Fi® module maximum output power is limited to 9 dBm to fulfill FCC/IC/CE requirements. A Wi-Fi® output power higher than 9 dBm at the Wi-Fi® antenna is prohibited.

Note: Since Wi-Fi® and Bluetooth® Low Energy modules are using the same frequency ISM band (2.4 GHz to 2.485 GHz), the simultaneous activity of both modules may affect the RF performances of Wi-Fi® or Bluetooth® Low Energy (in terms of range or throughput).

6.9.3 Dynamic NFC Tag based on ST25DV04K with its printed NFC antenna

The ST25DV04K device is an NFC RFID Tag offering 4 Kbit of electrically erasable programmable memory (EEPROM). ST25DV04K offers two interfaces. The first one is an I²C serial link and can be operated from a DC power supply. The second one is an RF-link activated when ST25DV04K acts as a contactless memory powered by the received carrier electromagnetic wave.

In I²C mode, the ST25DV04K user memory contains up to 512 bytes which could be split into four flexible and protectable areas. In RF mode, following ISO/IEC 15693 or NFC forum type 5 recommendations, ST25DV04K user memory contains up to 128 blocks of 4 bytes which can be split into four flexible and protectable areas.

ST25DV04K offers a fast transfer mode between the RF and contact worlds, thanks to a 256-byte volatile buffer (also called Mailbox). In addition, the GPO pin of the ST25DV04K provide data informing the contact world about incoming events, like RF field detection, RF activity in progress or mailbox message availability. An energy harvesting feature is also proposed when external conditions make it possible.

The main features of the ST25DV04K are:

I²C interface

- Two-wire I²C serial interface supporting 1MHz protocol
- Single supply voltage from 1.8 V to 5.5 V
- Multiple bytes write programming, up to 256 bytes

Contactless interface

- Based on ISO/IEC 15693
- NFC Forum Type 5 tag certified by the NFC Forum
- Support of all ISO/IEC 15693 modulations, coding, sub-carrier modes, and data rates
- Custom fast read access up to 53 Kbps
- Single and multiple blocks read (same for extended commands)
- Single and multiple blocks write (up to 4) (same for extended commands)
- Internal tuning capacitance: 28.5 pF

Memory

- Up to 64 kbits of EEPROM (depending on the version)
- I^2C interface access bytes
- RF interface access blocks of 4 bytes
- Write time:
  - From I^2C: typical 5 ms for 1 byte
  - From RF: typical 5 ms for 1 block
- Data retention: 40 years
- Write cycles endurance:
  - 1 million write cycles at 25 °C
  - 600k write cycles at 85 °C
  - 500k write cycles at 105 °C
  - 400k write cycles at 125 °C

Fast transfer mode

- Fast data transfer between I^2C and RF interfaces
- Half-duplex 256-byte dedicated buffer

Energy harvesting

- Analog output pin to power external components

Data protection

- User memory: One to four configurable areas, protectable in reading and/or write by three 64-bit passwords in RF and one 64-bit password in I^2C
- System configuration: protected in write by a 64-bit password in RF and a 64-bit password in I^2C

Note: The hardware layout is ready to support a Sub-GHz low-power-programmable RF module (SPSGRF-868 or SPSGRF-915). The footprint is implemented (M3 designation), but no module is soldered.

6.10 STMicroelectronics sensors

Several STMicroelectronics sensors are available on the B-L4S5I-IOT01A Discovery kit for the IoT node and are listed below:

- Two on-board ST-MEMS audio sensor omnidirectional digital microphones (MP34DT01)
- Capacitive digital sensor for relative humidity and temperature (HTS221)
- High-performance 3-axis magnetometer (LIS3MDL)
- 3D accelerometer and 3D gyroscope (LSM6DSL)
- 260 hPa to 1260 hPa absolute digital output barometer (LPS22HB)
- Time-of-Flight and gesture detection sensor (VL53L0X)

6.10.1 Two on-board ST-MEMS microphones (MP34DT01)

The MP34DT01 is an ultra-compact, low-power, omnidirectional, digital ST-MEMS microphone built with a capacitive sensing element and an IC interface.

The sensing element, capable of detecting acoustic waves, is manufactured using a specialized silicon micromachining process dedicated to producing audio sensors.

The IC interface is manufactured using a CMOS process that allows designing a dedicated circuit able to provide a digital signal externally in PDM format.

The MP34DT01 has an acoustic overload point of 120 dBSPL with a 63 dB signal-to-noise ratio and –26 dBFS sensitivity.

On the B-L4S5I-IOT01A Discovery kit for the IoT node, there are two MP34DT01 microphones: one with LR pulled to VDD and the second with LR pulled low. DFSDM1_CKOUT and DFSDM1_DATIN2 are connected to both. In addition, both microphones are spaced at 21 mm apart for the beamforming algorithm to work. Indeed, several algorithm configurations are available for the user to find the best trade-off between audio output quality and resource consumption. For more details, refer to the user manual *STEVAL-IHM038V1: 3-phase BLDC/PMSM motor drive up to 50 W, suitable for fan controllers* (UM1697) on the *www.st.com* website.

The MP34DT01 is available in an HCLGA (3 mm x 4 mm x 1 mm) 4LD package, in a top-port design, SMD-compliant, EMI-shielded package and it is guaranteed to operate over an extended temperature range from -40 °C to +85 °C.

6.10.2 Capacitive digital sensor for relative humidity and temperature (HTS221)

HTS221 is an ultra-compact sensor for relative humidity and temperature. It includes a sensing element and a mixed-signal ASIC to provide the measurement information through digital serial interfaces.

The sensing element consists of a polymer dielectric planar capacitor structure capable of detecting relative humidity variations and it is manufactured using a dedicated ST process.

The HTS221 is available in a small top-holed cap land grid array (HLGA-6L 2 mm x 2 mm x 0.9 mm) package guaranteed to operate over a temperature range from -40 °C to +120 °C.

The main features of the HTS221 are:

- 0 to 100% relative humidity range,
- Low-power consumption: 2 µA @ 1 Hz ODR,
- Selectable ODR from 1 Hz to 12.5 Hz
- High relative humidity (rH) sensitivity: 0.004% rH/LSB
- Humidity accuracy: ± 3.5% rH, from +20% to +80% rH
- Temperature accuracy: ± 0.5 °C, from +15 °C to +40 °C
- Embedded 16-bit ADC
- 16-bit humidity and temperature output data
- SPI and I2C interfaces. On the B-L4S5I-IOT01A Discovery kit for the IoT node, the I2C2 bus from STM32L4S5VIT6U is used.
- Factory calibrated
- Tiny 2 mm x 2 mm x 0.9 mm package
- ECOPACK® compliant

6.10.3 High-performance 3-axis magnetometer (LIS3MDL)

LIS3MDL is an ultra-low-power high-performance three-axis magnetic sensor.

LIS3MDL has user-selectable full scales of ±4 / ±8 / ±12 / ±16 gauss.

The self-test capability allows the user to check the functionality of the sensor in the final application.

The device may be configured to generate interrupt signals for magnetic field detection.

LIS3MDL includes an I^2C serial bus interface, that supports standard and fast mode (100 and 400 kHz), and an SPI serial standard interface. On the B-L4S5I-IOT01A Discovery kit for the IoT node, the I2C2 bus from STM32L4S5VIT6U is used. LIS3MDL is available in a small thin plastic land grid array LGA-12 package (2.0 mm x 2.0 mm x 1.0 mm) and is guaranteed to operate over an extended temperature range of -40 to +85 °C.

LIS3MDL is also ECOPACK®, RoHS and “Green” compliant.

6.10.4 3D accelerometer and 3D gyroscope (LSM6DSL)

LSM6DSL is a system-in-package featuring a 3D digital accelerometer and a 3D digital gyroscope performing at 0.65 mA in high-performance mode and enabling always-on low-power features for an optimal motion experience for the consumer.

The event-detection interrupts enable efficient and reliable motion tracking and contextual awareness, implementing hardware recognition of free-fall events, 6D orientation, click and double-click sensing, activity or inactivity, and wake-up events.

LSM6DSL supports main OS requirements, offering real, virtual and batch sensors with 4 Kbytes for dynamic data batching.

LSM6DSL is designed to implement features such as significant motion, tilt, pedometer functions, step detector and step counter, time stamping and to support the data acquisition of an external magnetometer with ironing correction (hard, soft).

LSM6DSL has a full-scale acceleration range of ±2/±4/±8/±16 g and an angular rate range of ±125 / ±245 / ±500 / ±1000 / ±2000 dps.

The registers embedded inside the LSM6DSL may be accessed through both the I^2C and SPI serial interfaces. On the B-L4S5I-IOT01A Discovery kit for the IoT node, the I2C2 bus from STM32L4S5VIT6U is used.

LSM6DSL is available in a plastic land grid array LGA-14L (2.5x3x0.83mm) package, ECOPACK®, RoHS, and “Green” compliant.

6.10.5 260 hPa to 1260 hPa absolute digital output barometer (LPS22HB)

The absolute pressure-sensing device LPS22HB is an ultra-compact piezoresistive sensor which functions as a digital output barometer.

The device comprises a sensing element and an IC interface which communicates from the sensing element to the application through I2C or SPI. On the B-L4S5I-IOT01A Discovery kit for the IoT node, the I2C2 bus from STM32L4S5VIT6U is used.

The sensing element, which detects absolute pressure, consists of a suspended membrane manufactured using a dedicated process developed by ST.

LPS22HB is available in a full-mold, holed LGA package (HLGA). It is guaranteed to operate over a temperature range extending from -40 °C to +85 °C. The package is holed to allow external pressure to reach the sensing element.

The main features of LPS22HB are:

- From 260 hPa to 1260 hPa absolute pressure range
- Current consumption down to 3 µA
- High overpressure capability: 20x full-scale
- Embedded temperature compensation
- 24-bit pressure data output
- 16-bit temperature data output
- ODR from 1 Hz to 75 Hz
- SPI and I²C interfaces
- Embedded FIFO
- Interrupt functions: Data Ready, FIFO flags, pressure thresholds
- Supply voltage from 1.7 V to 3.6 V
- High shock survivability: 22,000 g
- Small and thin package
- ECOPACK® lead-free compliant

6.10.6 Time-of-Flight and gesture detection sensor (VL53L0X)

VL53L0X is a new generation Time-of-Flight (ToF) laser-ranging module housed in a small package, providing accurate distance measurement whatever the target reflectance, unlike conventional technologies. It can measure absolute distances up to two meters, setting a new benchmark in ranging performance levels, opening the door to various new applications.

VL53L0X integrates a leading-edge SPAD array (Single Photon Avalanche Diodes) and embeds an ST second generation FlightSense™ patented technology.

The VL53L0X 940 nm VCSEL emitter (Vertical-Cavity Surface-Emitting Laser), is totally invisible to the human eye, coupled with internal physical infrared filters, it enables longer ranging distance, higher immunity to ambient light and better robustness to cover-glass optical cross-talk.

The main features of VL53L0X are listed below.

- Fully integrated miniature module:
  - 940 nm Laser VCSEL
  - VCSEL driver
  - Ranging sensor with an advanced embedded microcontroller
  - 4.4 mm x 2.4 mm x 1.0 mm size
- Fast, accurate distance ranging:
  - Measures absolute range up to 2 m
  - The reported range is independent of the target reflectance
  - Operates in high infrared ambient light levels
  - Advanced embedded optical cross-talk compensation to simplify cover glass selection
- Eye safe:
  - Class 1 laser device compliant with the latest standard IEC 60825-1:2014 - 3rd edition. The laser output remains within Class 1 limits as long as the STMicroelectronics recommended device settings are used and the operating conditions, specified in the STM32L4+ datasheets, are respected. The laser output power must not be increased by any means and no optics used with the intention of focusing the laser beam. Figure 15 shows the warning label for Class 1 laser products.
- Easy integration:
  - No additional optics
  - Single power supply
  - I^2C interface for device control and data transfer: I2C2 from the STM32L4S5VIT6U MCU is used
  - Xshutdown (Reset) and interrupt GPIO
  - Programmable I^2C address

Figure 15. Label for Class 1 laser products

6.11 STSAFE-A110

STSAFE-A110 is a highly secure solution that acts as a secure element, providing authentication and data management services to a local or remote host. It consists of a full turnkey solution with a secure operating system running on the latest generation of secure microcontrollers. STSAFE-A110 can be integrated into IoT (Internet of things) devices, smart-home, smart-city and industrial applications, consumer electronics devices, consumables and accessories. STSAFE-A110 can be mounted on:

- A device that authenticates to a remote host (IoT device case), the local host being used as a pass-through to the remote server,
- A peripheral that authenticates to localhost, for example, games, mobile accessories or consumables.

The main features of STSAFE-A110 are listed below:

- Authentication for:
  - Consumables and peripherals
  - eCloud Internet of things (IoT) connected objects
- Secure channel establishment with remote host including transport layer security (TLS) handshake
- Signature verification service (secure boot and firmware upgrade)
- Usage monitoring with secure counters
- Pairing and secure channel with the host application processor
- Wrapping and unwrapping of localhost envelopes
- Symmetric data encryption or decryption (up to 16 keys)
- On-chip key pair generation
- LPWAN security ready:
  - Preloading with Sigfox™ or LoRaWAN® credentials
  - Frame signature and verification
  - Frame encryption and decryption

Security features

- Latest generation of highly secure MCUs:
  - A unique serial number on each die
  - CC EAL5+ AVA_VAN5 Common Criteria certified
  - Active shield
  - Monitoring of environmental parameters
  - Protection mechanism against faults
  - Protection against side-channel attacks
- Advanced asymmetric cryptography:
  - Elliptic curve cryptography (ECC) with NIST or Brainpool 256-bit and 384-bit curves
  - Elliptic curve digital signature algorithm (ECDSA) with SHA-256 and SHA-384 for digital signature generation and verification
  - Elliptic curve Diffie-Hellman (ECDH) for key establishment
- Advanced symmetric cryptography:
  - Secure operating system with protection against logical and physical attacks
- Secure operating system
  - Secure STSAFE-A110 kernel for authentication and data management
  - Protection against logical and physical attacks

Hardware features

- 6 Kbytes of configurable non-volatile memory:
  - Highly reliable CMOS EEPROM technology
  - 30 years' data retention at 25 °C
  - 500 000 erase / program cycles endurance at 25 °C
  - 1.62 to 5.5 V continuous supply voltage
- Operating temperature: −40 to 105 °C

6.12 Buttons and LEDs

The black button (B1) located on the middle left side is the reset of the STM32L4S5VIT6Umicrocontroller. Refer to Figure 3. B-L4S5I-IOT01A Discovery kit for the IoT node layout (top view).

The blue button (B2) located on the top left side is available to be used as a digital input or as an alternate wake-up function.

When the button is depressed the logic state is LOW, otherwise, the logic state is HIGH.

Two green LEDs (LD1 and LD2), located on the top middle side are available for the user. To light a LED a high logic state HIGH must be written in the corresponding GPIO. Table 2 gives the assignment of the control ports to the LED indicators.

Two LEDs located on the top side, the red LD2 and the green LD1 (Refer to Figure 2), are available for the user. To light a LED, a low-logic state HIGH must be written in the corresponding GPIO register. Table 4 shows the assignment of the control ports to the LED indicators.

Table 4. Button and LED control port

Reference	Color	Name	Comment
B1	Black	Reset	-
B2	Blue	Wake-up	Wake-up alternate function
LD1	Green	LED1	PA5 (Alternate with ARD.D13)
LD2	Green	LED2	PB14
LD3	Yellow	LED3 (Wi-Fi®)	PC9, Wi-Fi® activity
LD4	Blue	LED4 (BLE)	PC9, Bluetooth® activity
LD5	Green	5V Power	5 V available
LD6	Bicolor (Red and green)	ST-LINK COM	Green during communication
LD7	Red	Fault Power	Current higher than 750 mA
LD8	Red	V_{BUS} OCRCR	PE3
LD9	Green	V_{BUS} OK	5 V USB available

6.13 I²C addresses of modules used on MB1297

Table 5 displays the I²C read and write addresses for the modules that are connected to the I2C2 bus.

Table 5. I²C addresses for each module

Modules	Description	SAD[6:0] + R/W	I2C write address	I2C read address
HTS221	Capacitive digital sensor for relative humidity and temperature	1011111x	0xBE	0xBF
LIS3MDL	3-axis magnetometer	0011110x	0x3C	0x3D
LPS22HB	MEMS nano pressure sensor	1011101x	0xBA	0xBB
LSM6DSL	3D accelerometer and 3D gyroscope	1101010x	0xD4	0xD5
VL53L0X	Time-of-Flight ranging and gesture detection sensor	0101001x	0x52	0x53
ST25DV04K	Dynamic NFC/RFID Tag IC	1010x11x	0xAE for system area 0xA6 for user memory	0xAF for system area 0xA7 for user memory
STSAFE-A110	Highly secure solution	0100000x	0x40	0x41

7 Connectors

Nine connectors are implemented on the B-L4S5I-IOT01A Discovery kit for the IoT node:

- CN1, CN2, CN3 and CN4 for ARDUINO® Uno V3 connector
- CN5: Tag connector
- CN7: ST-LINK USB connector
- CN8: ST-LINK debug connector
- CN9: USB_OTG_FS connector
- CN10: Pmod™ connector.

In addition, one jumper JP5 is used for I_{DD} measurements.

7.1 ARDUINO® Uno V3 connectors

CN1, CN2, CN3, and CN4 are female connectors (SMD component devices) compatible with ARDUINO® Uno V3. Most shields designed for ARDUINO® can fit the B-L4S5I-IOT01A Discovery kit for the IoT node.
Example connector references (Refer to Figure 16):

- CN4: Header 6X1_Female_SMD
- CN3: Header 8X1_Female_SMD
- CN2: Header 8X1_Female_SMD
- CN1: Header 10X1_Female_SMD

Figure 16. ARDUINO® Uno V3 connectors

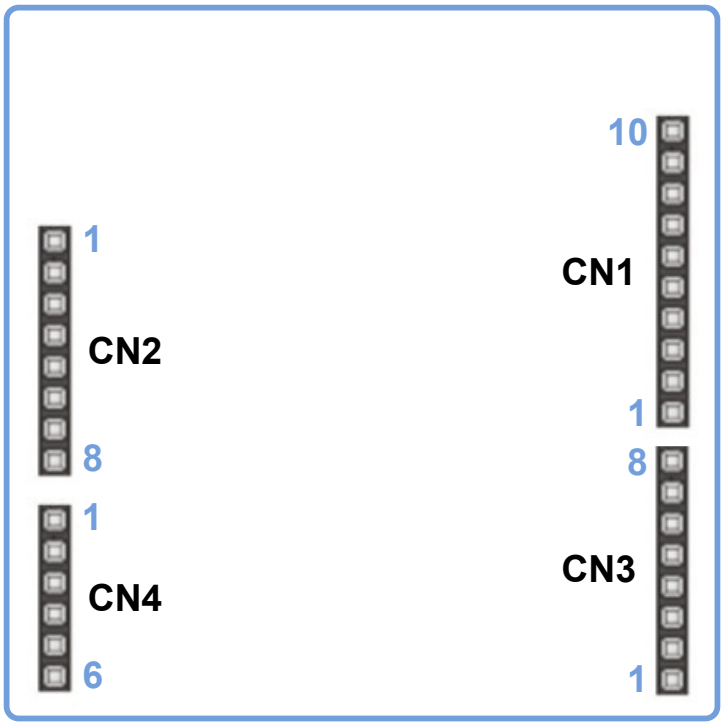


Table 6. **ARDUINO® connector pinout**

Connector	Pin number	Pin name	Signal name	STM32L 4+ pin	Function
CN2	1	E5V	-	-	-
	2	IOREF	-	-	3.3 V reference
	3	NRST	STM_NRST	NRST	Reset
	4	3.3V	-	-	3.3 V I/O
	5	5V	-	-	5 V
	6	GND	-	-	GND
	7	GND	-	-	GND
	8	VIN	-	-	Power input
CN4	1	A0	ARD.A0-ADC	PC5	ADC
	2	A1	ARD.A1-ADC	PC4	ADC
	3	A2	ARD.A2-ADC	PC3	ADC
	4	A3	ARD.A3-ADC	PC2	ADC
	5	A4	ARD.A4-ADC	PC1	ADC / I2C3_SDA
	6	A5	ARD.A5-ADC	PC0	ADC / I2C3_SCL
CN1	10	SCL / D15	ARD.D15-I2C1_SCL	PB8	I2C1_SCL
	9	SDA / D14	ARD.D14-I2C1_SDA	PB9	I2C1_SDA
	8	AVDD	VDDA	-	VDDA
	7	GND	GND	-	Ground
	6	SCK / D13	ARD.D13-SPI1_SCK / LED1	PA5	SPI1_SCK / LED1
	5	MISO / D12	ARD.D12-SPI1_MISO	PA6	SPI1_MISO
	4	PWM / MOSI / D11	ARD.D11-SPI1_MISO / PWM	PA7	SPI1_MOSI / TIMxx
	3	PWM / CS / D10	ARD.D10-SPI_SSN / PWM	PA2	TIM2_CH3
	2	PWM / D9	ARD.D9-PWM	PA15	TIM2_CH1
	1	D8	ARD.D8	PB2	GPIO
CN3	8	D7	ARD.D7	PA4	GPIO
	7	PWM / D6	ARD.D6-PWM	PB1	TIM3_CH4
	6	PWM / D5	ARD.D5-PWM	PB4	TIM3_CH1
	5	D4	ARD.D4	PA3	TIMxx
	4	PWM / D3	ARD.D3-PWM / INT1_EXTI0	PB0	TIM3_CH3 / EXTI0
	3	D2	ARD.D2-INT0_EXTI14	PD14	EXTI14
	2	TX / D1	ARD.D1-UART4_TX	PA0	UART4_TX
	1	RX / D0	ARD.D0-UART4_RX	PA1	UART4_RX

7.2 Tag connector CN5

The Tag connector is implemented on the B-L4S5I-IOT01A Discovery kit for the IoT node. The Tag connector is a 10-pin footprint supporting SWD mode, which is shared with the same signals as the ST-LINK. The TC2050-IDC-NL cable is used to link ST-LINK and Tag connector on the B-L4S5I-IOT01A Discovery kit for the IoT node so that the STM32L4+ can be easily programmed and debugged without any extra accessory.

Figure 17. Tag connector

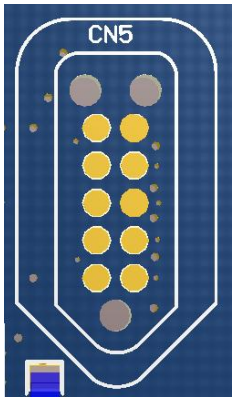


Figure 18. TC2050-IDC-NL cable

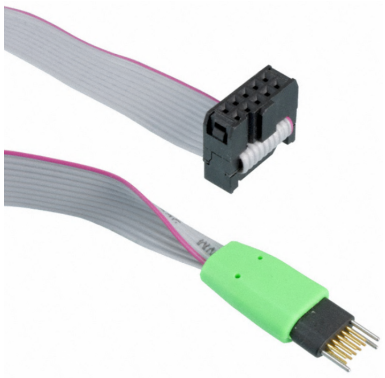


Table 7. Tag connector pinout

Connector	Pin number	Pin name	Signal name	STM32L 4+ pin	Function
CN5	1	3.3V	3V3_ST_LINK	-	Power
	2	SWD	SYS_JTMS-SWDIO	PA13	Serial wire data I/O
	3	GND	-	-	Ground
	4	SWCLK	SYS_JTCK-SWCLK	PA14	Serial wire clock
	5	GND	-	-	Ground
	6	SWO	STLINK_JTDO_SWO	PB3	Serial wire output
	7	NC	-	-	-
	8	NC	-	-	-
	9	NC	-	-	-
	10	NRST	STM_NRST	NRST	RESET

7.3 ST-LINK/V2-1 USB Micro-B

The USB connector is used to connect the embedded ST-LINK/V2-1 to the PC to program and debug the STM32L4S5VIT6U microcontroller.

Table 8. USB Micro-B connector pinout

Connector	Pin number	Pin name	Signal name	STM32L 4+ pin	Function
CN7	1	V_{BUS}	5V_USB_ST_LINK	-	5V power and detection
	2	DM	USB_STLK_N	PA11	USB differential pair M
	3	DP	USB_STLK_P	PA12	USB differential pair P
	4	ID	USB_STLK_ID	-	USB identification
	5	GND	-	-	Ground

7.4 ST-LINK debug connector CN8

The ST-LINK debug connector is a 1x4-pin, 2.54 mm pitch male connector. It provides access to the embedded SWJ-DP interface of the STM32F103CBT6 MCU. This SWJ-DP interface is a combined JTAG and serial wire debug port that enables either a serial wire debug or a JTAG probe, to be connected to the target.

Table 9. ST-LINK debug connector pinout

Connector	Pin number	Pin name	STM32F103CBT6	Function
CN7	1	3V3_ST_LINK	V_{BAT}, V_{DDA}, V_{DD_1}, V_{DD_2}, V_{DD_3}	3.3 V voltage supply
	2	STM_JTCK		TCK / SWCLK
	3	GND		GND
	4	STM_JTMS		JTMS / SWDIO

7.5 USB OTG FS Micro-AB

Table 10. USB OTG FS Micro-AB connector pinout

Connector	Pin number	Pin name	Signal name	STM32L 4+ pin	Function
CN9	1	V_{BUS}	USB_OTG_5V_VBUS	PA9	5V power and detection
	2	DM	USB_OTG_FS_DM	PA11	USB differential pair M
	3	DP	USB_OTG_FS_DP	PA12	USB differential pair P
	4	ID	USB_OTG_FS_ID	PA10	USB identification
	5	GND	-	-	Ground

Table 11. **USB OTG FS power management**

Pin number	Pin name	Signal name	STM32L4+ pin	Function
IC19-3	FAULTn	USB_OTG_FS_OVRCR_EXTI3	PE3	Overcurrent IT
IC19-4	ENn	USB_OTG_FS_PWR_EN	PD12	USB power enable

7.6 Pmod™ connector CN10

On the B-L4S5I-IOT01A Discovery kit for the IoT node, the Pmod™ connector provides flexibility in small form factor applications. Based on Digilent's Pmod™ standard popular in connectivity, the Pmod™ connector is implemented in types 2A and 4A. The related STM32L475VG I/Os for Pmod™ function are listed in Table 12. The Pmod™ connector is 2x6-pin with a 2.54 mm pitch and right angle female connector.

Table 12. Pmod™ solder bridge configuration

Alternate configuration (UART)			Standard configuration (SPI)			-			
STM32L 4+ pin	Solder bridge configuration	Pin name	STM32L 4+ pin	Solder bridge configuration	Pin name	Pmod™ pin number		Pin name	STM32L4+ pin
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
PD3	SB14 OFF SB19 ON	PMOD-UART2_CTS / SPI2_MISO	PD5	SB14 OFF SB19 ON	PMOD-UART2_Tx / SPI2_CSN	1	7	PMOD-IRQ_EXTI2	PD2
PD5	SB15 OFF SB12 ON	PMOD-UART2_TX / SPI2_CSN	PD4	SB15 OFF SB12 ON	PMOD-UART2_RTS / SPI2_MOSI	2	8	PMOD-RESET	PD0
PD6	SB18 OFF SB20 ON	PMODUART2_RX	PD3	SB18 OFF SB20 ON	PMOD-UART2_CTS / SPI2_MISO	3	9	NC	NC
PD4	SB21 OFF SB16 ON	PMOD-UART2_RTS / SPI2_MOSI	PD1	SB21 OFF SB16 ON	PMODSPI2_SCK	4	10	NC	NC
-	-	-	-	-	GND	5	11	GND	-
-	-	-	-	-	3.3V	6	12	3.3V	-

7.7 Jumper JP5 for I_{DD} measurements

The STM32 current measurement can be done on JP5. By default, a jumper is placed on JP5.

For current measurement configuration, the jumper on JP5 must be removed and an amp-meter must be placed on JP5.

Appendix A B-L4S5I-IOT01A Discovery kit for the IoT node I/O assignment

Table 13. **B-L4S5I-IOT01A Discovery kit for the IoT node I/O assignment**

Pin number	Pin name	Feature / comment	Signal / label
1	PE2	GPIO_Output	ST25DV04K RF_DISABLE
2	PE3	GPIO_EXTI3	USB_OTG_OVRCR_EXTI3
3	PE4	GPIO_EXTI4	ST25DV04K GPO
4	PE5	GPIO_EXTI5	SPSGRF-915-GPIO3_EXTI5
5	PE6	GPIO_EXTI6	SPBTLE-RF-IRQ_EXTI6
6	V_{BAT}	Voltage supply	V_{BAT}
7	PC13	GPIO_EXTI13	BUTTON_EXTI13
8	PC14 / OSC32_IN	RTC CLK	RCC_OSC32_IN
9	PC15 / OSC32_OUT	RTC CLK	RCC_OSC32_OUT
10	V_{SS}	GND	GND
11	V_{DD}	3.3 V	V_{DD_MCU}
12	PH0 / OSC_IN	8 MHz CLK	RCC_OSC_IN
13	PH1 / OSC_OUT	8 MHz CLK	RCC_OSC_OUT
14	NRST	Reset	STM__NRST
15	PC0	ADC1_IN1	ARD.A5-ADC
16	PC1	ADC1_IN2	ARD.A4-ADC
17	PC2	ADC1_IN3	ARD.A3-ADC
18	PC3	ADC1_IN4	ARD.A2-ADC
19	V_{SSA}	GND	GND
20	V_{REF-}	GND	GND
21	V_{REF+}	3.3 V	V_{DDA}
22	V_{DDA}	3.3 V	V_{DDA}
23	PA0	UART4-TX	ARD.D1-UART4_TX
24	PA1	UART4-RX	ARD.D0-UART4_RX
25	PA2	TIM2_CH3	ARD.D10-SPI_SSN/PWM
26	PA3	GPIO_Output	ARD.D4
27	V_{ss}	GND	V_{SS}
28	V_{DD}	3.3 V	V_{DD_MCU}
29	PA4	GPIO_Output	ARD.D7
30	PA5	SPI1_SCK	ARD.D13-SPI1_SCK / LED1
31	PA6	SPI1_MISO	ARD.D12-SPI1_MISO
32	PA7	SPI1_MOSI	ARD.D11-SPI1_MOSI / PWM
33	PC4	ADC1_IN13	ARD.A1-ADC
34	PC5	ADC1_IN14	ARD.A0-ADC
35	PB0	TIM3_CH3	ARD.D3-PWM / INT1_EXTI0
36	PB1	TIM3_CH4	ARD.D6-PWM

Pin number	Pin name	Feature / comment	Signal / label
37	PB2	GPIO_Output	ARD.D8
38	PE7	MEMS microphone	DFSDM1_DATIN2
39	PE8	GPIO_Output	ISM43362-RST
40	PE9	MEMS microphone	DFSDM1_CKOUT
41	PE10	QSPI NOR Flash memory	QUADSPI_CLK
42	PE11	QSPI NOR Flash memory	QUADSPI_NCS
43	PE12	QSPI NOR Flash memory	QUADSPI_BK1_IO0
44	PE13	QSPI NOR Flash memory	QUADSPI_BK1_IO1
45	PE14	QSPI NOR Flash memory	QUADSPI_BK1_IO2
46	PE15	QSPI NOR Flash memory	QUADSPI_BK1_IO3
47	PB10	I2C2_SCL	INTERNAL-I2C2_SCL
48	PB11	I2C2_SDA	INTERNAL-I2C2_SDA
49	V_{SS}	GND	V_{SS}
50	V_{DD}	3.3 V	V_{DD_MCU}
51	PB12	GPIO_Output	ISM43362-BOOT0
52	PB13	GPIO_Output	ISM43362-WAKEUP
53	PB14	GPIO_Output	LED2
54	PB15	GPIO_Output	SPSGRF-915-SDN
55	PD8	USART3_TX	INTERNAL-UART3_TX
56	PD9	USART3_RX	INTERNAL-UART3_RX
57	PD10	GPIO_EXTI10	LPS22HB_INT_DRDY_EXTI10
58	PD11	GPIO_EXTI11	LSM6DSL_INT1_EXTI11
59	PD12	GPIO_EXTI12	USB_OTG_FS_PWR_EN
60	PD13	GPIO_Output	SPBTLE-RF-SPI3_CSN
61	PD14	GPIO_EXTI14	ARD.D2-INT0_EXTI14
62	PD15	GPIO_EXTI15	HTS221_DRDY_EXTI15
63	PC6	GPIO_Output	VL53L0X_XSHUT
64	PC7	GPIO_EXTI17	VL53L0X_GPIO1_EXTI7
65	PC8	GPIO_EXTI18	LIS3MDL_DRDY_EXTI8
66	PC9	GPIO_EXTI9	LED3 (Wi-Fi®) & LED4 (BLE)
67	PA8	GPIO_Output	SPBTLE-RF-RST
68	PA9	USB_OTG	USB_OTG_FS_VBUS
69	PA10	USB_OTG	USB_OTG_FS_ID
70	PA11	USB_OTG	USB_OTG_FS_DM
71	PA12	USB_OTG	USB_OTG_FS_DP
72	PA13	ST-LINK	SYS_JTMS-SWDIO
73	V_{DDUSB}	3.3 V	V_{DD_MCU}
74	V_{SS}	GND	GND
75	V_{DD}	3.3 V	V_{DD_MCU}
76	PA14	ST-LINK	SYS_JTCK-SWCLK

Pin number	Pin name	Feature / comment	Signal / label
77	PA15	TIM2_CH1	ARD.D9-PWM
78	PC10	SPI3_CLK	INTERNAL-SPI3_SCK
79	PC11	SPI3_MISO	INTERNAL-SPI3_MISO
80	PC12	SPI3_MOSI	INTERNAL-SPI3_MOSI
81	PD0	GPIO_Output	PMOD-RESET
82	PD1	GPIO_Output	PMOD-SPI2_SCK
83	PD2	GPIO_EXTI2	PMOD-IRQ_EXTI2
84	PD3	USART2_CTS	PMOD-UART2_CTS/SPI2_MISO
85	PD4	USART2_RTS	PMOD-UART2_RTS/SPI2_MOSI
86	PD5	USART2_TX	PMOD-UART2_TX/SPI2_CSN
87	PD6	USART2_RX	PMOD-UART2_RX
88	PD7	GPIO_Output	STSAFE-A110-RESET
89	PB3	ST-LINK	SYS_JTDO-SWO
90	PB4	TIM3_CH1	ARD.D5-PWM
91	PB5	GPIO_Output	SPSGRF-915-SPI3_CSN
92	PB6	USART1_TX	ST-LINK-UART1_TX
93	PB7	USART1_RX	ST-LINK-UART1_RX
94	BOOT0	Boot	BOOT0
95	PB8	I2C1_SCL	ARD.D15-I2C1_SCL
96	PB9	I2C1_SDA	ARD.D14-I2C1_SDA
97	PE0	GPIO_Output	ISM43362-SPI3_CSN
98	PE1	GPIO_EXTI1	ISM43362-DRDY_EXTI1
99	V_{SS}	GND	GND
100	V_{DD}	3.3 V	V_{DD_MCU}

Appendix B Federal Communications Commission (FCC) and Industry Canada (IC) Compliance Statements

Applicable for IoT node Discovery kit products with order code B-L4S5I-IOT01A.

B.1 FCC Compliance Statement

FCC Compliance Statement

Contains FCC ID: O7P-362
Contains FCC ID: S9NSPBTLERF

Part 15.19

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Part 15.21

Any changes or modifications to this equipment not expressly approved by STMicroelectronics may cause harmful interference and void the user's authority to operate this equipment.

Part 15.105

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception which can be determined by turning the equipment off and on, the user is encouraged to try to correct interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Note: Use only shielded cables.

Responsible party (in the USA)

Terry Blanchard
Americas Region Legal | Group Vice President and Regional Legal Counsel, The Americas
STMicroelectronics, Inc.
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USA
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B.2 IC Compliance Statement

IC Compliance Statement

Contains/Contient IC: 10147A-362
Contains/Contient IC: 8976C-SPBTLERF

Compliance Statement

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

Licence-Exempt Radio Apparatus (ISED) This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:

1. This device may not cause interference.
2. This device must accept any interference, including interference that may cause undesired operation of the device.

Déclaration de conformité

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

Appareils radio exempts de licence (ISDE) L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique 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;
2. L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

RF exposure statement

To satisfy FCC and ISED Exposure requirements for mobile devices, a separation distance of 20 cm or more should be maintained between the antenna of this device and persons during operation. To ensure compliance, operation at closer than this distance is not recommended. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Pour satisfaire aux exigences FCC et ISED concernant l'exposition aux champs RF pour les appareils mobiles, une distance de séparation de 20 cm ou plus doit être maintenu entre l'antenne de ce dispositif et les personnes pendant le fonctionnement. Pour assurer la conformité, il est déconseillé d'utiliser cet équipement à une distance inférieure. Cet émetteur ne doit pas être co-situé ou fonctionner conjointement avec une autre antenne ou un autre émetteur.

Revision history

Table 14. **Document revision history**

Date	Revision	Changes
17-Apr-2020	1	Initial release.

Contents

List of tables

List of figures