Discovery kit for LTE Cat M/NBIoT with STM32L4 Series

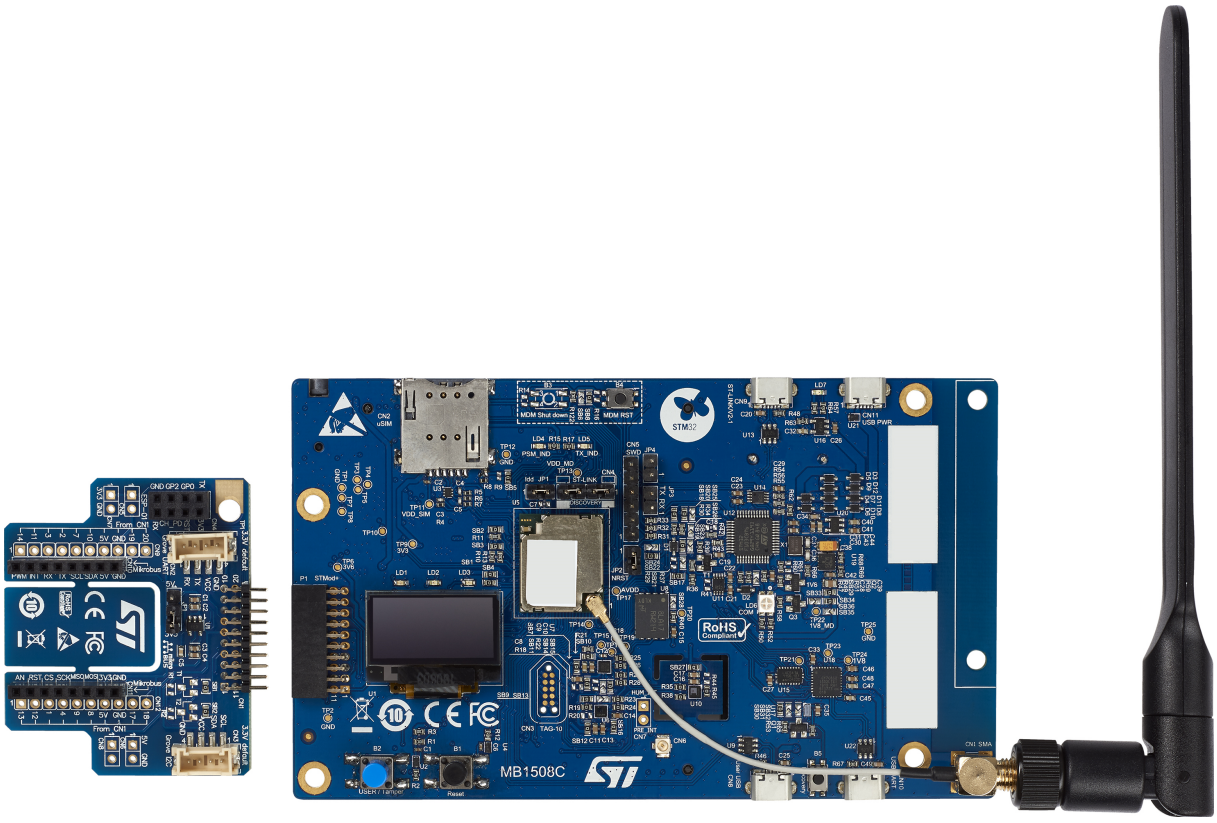
Introduction

The B-L462E-CELL1 Discovery kit is a turnkey development platform for cellular IoT devices. The Discovery kit contains a low-power Discovery main board powered by an LBAD0ZZ1SE module, a global coverage antenna, and a fan-out board. The LBAD0ZZ1SE module includes an STM32L462REY6TR microcontroller, an LBAD0XX1SC-DM ultra-small LTE Cat M/NB modem, and an ST4SIM-200M GSMA-certified embedded SIM with a prepaid cellular connectivity data plane. ST4SIM-200M can also be used as an embedded secure element (eSE) for application.

STMod+ and extended pins connectivity provide unlimited expansion capabilities with a large choice of specialized add-on boards. Moreover, the fan-out board supports add-on boards using mikroBUS™, ESP-01, Grove I^{2}C, Grove UART, and breadboard. The B-L462E-CELL1 Discovery kit includes an ST-LINK debugger/programmer and comes with the comprehensive STM32Cube software libraries together with packaged software examples to demonstrate end-to-end connectivity.

This document provides information about the Discovery kit hardware features and instruction to run the demonstration application software.

Figure 1. B-L462E-CELL1 Discovery kit for IoT nodes



Picture is not contractual.

1 Features

- LBAD0ZZ1SE module from Murata powered by STM32L462RE with built-in eSIM (ST4SIM-200M), LTE Cat M/NBIoT modem (LBAD0XX1SC-DM), and 1 Mbyte of Quad-SPI Flash memory
- Ultra-low-power STM32L4 Series STM32L462REY6TR microcontroller based on the Arm® Cortex®-M4 core with 512 Kbytes of Flash memory and 160 Kbytes of RAM in a WLCSP64 package
- 64 Mbytes of onboard Quad-SPI Flash memory from Micron®, exclusive with the 1 MByte of Quad-SPI Flash memory inside the module
- 16 Kbytes of I^2C EEPROM (M24128-DFMN6TP) from STMicroelectronics
- 0.96-inch 128 x 64 OLED screen with SPI interface
- Low-power Audio CODEC with PCM bus and I^2C interface (MAX9867ETJ+ from Maxim)
- Ultra-low-power 3D accelerometer and 3D magnetometer (LSM303AGR) from STMicroelectronics
- Capacitive digital sensor for relative humidity and temperature (HTS221) from STMicroelectronics
- 260-1260 hPa absolute digital output barometer (LPS22HH) from STMicroelectronics
- 3 user LEDs
- 2 push-buttons (user and reset)
- Board connectors:
  - SMA antenna connector
  - Two 50-pin 2.54 mm pitch headers
  - STMod+
  - micro-SIM card slot
  - 3.5 mm CTIA stereo headset jack including analog microphone input
  - USB Micro-B connectors for power, USARTs, USB device, and ST-LINK/V2-1
  - TAG10
  - mikroBUS™ expansion connectors
  - ESP-01 expansion connector
  - Grove Seeed Studio™ breadboard, I^2C, and UART expansion connectors
- Flexible power-supply options: ST-LINK USB, User USB, UART USB, Power USB, or three AAA batteries
- On-board ST-LINK/V2-1 debugger/programmer with USB re-enumeration capability: mass storage, Virtual COM port, and debug port
- End-to-end connectivity applications
- Low-power cellular network services from Truphone®
- Support of a wide choice of Integrated Development Environments (IDEs) including IAR Embedded Workbench®, MDK-ARM, and STM32CubeIDE

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

2 Ordering information

To order the B-L462E-CELL1 Discovery kit for IoT nodes, 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 references	Target STM32
B-L462E-CELL1	• MB1508 • MB1280(1)	STM32L462REY6TR

1. *Fan-out board.*

2.1 Codification

The meaning of the codification is explained in Table 2.

Table 2. Codification explanation

B-L462E-CELL1	Description	B-L462E-CELL1
B	Discovery kit with a variety of sensors	Sensor node
L462	MCU product line in STM32 32-bit Arm Cortex MCUs	STM32L462 in the STM32L4 Series
E	STM32 Flash memory size: • E for 512 Kbytes	512 Kbytes
CELL	Dedicated to cellular applications	Discovery kit for cellular applications

3 Development environment

The B-L462E-CELL1 Discovery kit for IoT nodes runs with the STM32L462RE 32-bit microcontroller based on the Arm® Cortex®-M4 core.

3.1 System requirements

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

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

3.2 Development toolchains

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

1. *On Windows® only.*

3.3 Demonstration software

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

4 Conventions

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

Table 3. ON/OFF convention

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

5 Delivery recommendations

Before first use, check the board for any damage that might have occurred during shipment, that all socketed components are firmly fixed in their sockets and that none are loose in the plastic bag.

6 References

Murata provides access to documents and support from CatM1/NB-IoT Type1SE support site for customers who purchase Evaluation kits for the Type1SE family. Follow the instruction provided in the Murata Type1SE overview to access the mymurata website and use the code found on the B-L462E-CELL1 insert card.

7 Hardware layout and configuration

The B-L462E-CELL1 Discovery kit for IoT nodes is designed around the LBAD0ZZ1SE Murata module. The hardware block diagram (Refer to Figure 2) illustrates the connection between LBAD0ZZ1SE and peripherals: OLED screen, sensors, USB FS connector, USARTs, audio, EEPROM, micro SIM card, and embedded ST-LINK/V2-1. Figure 3 and Figure 4 help the user to locate these features on the B-L462E-CELL1 Discovery kit for IoT nodes. Figure 5 and Figure 6 give the mechanical dimensions of the B-L462E-CELL1 board.

Figure 2. Hardware block diagram

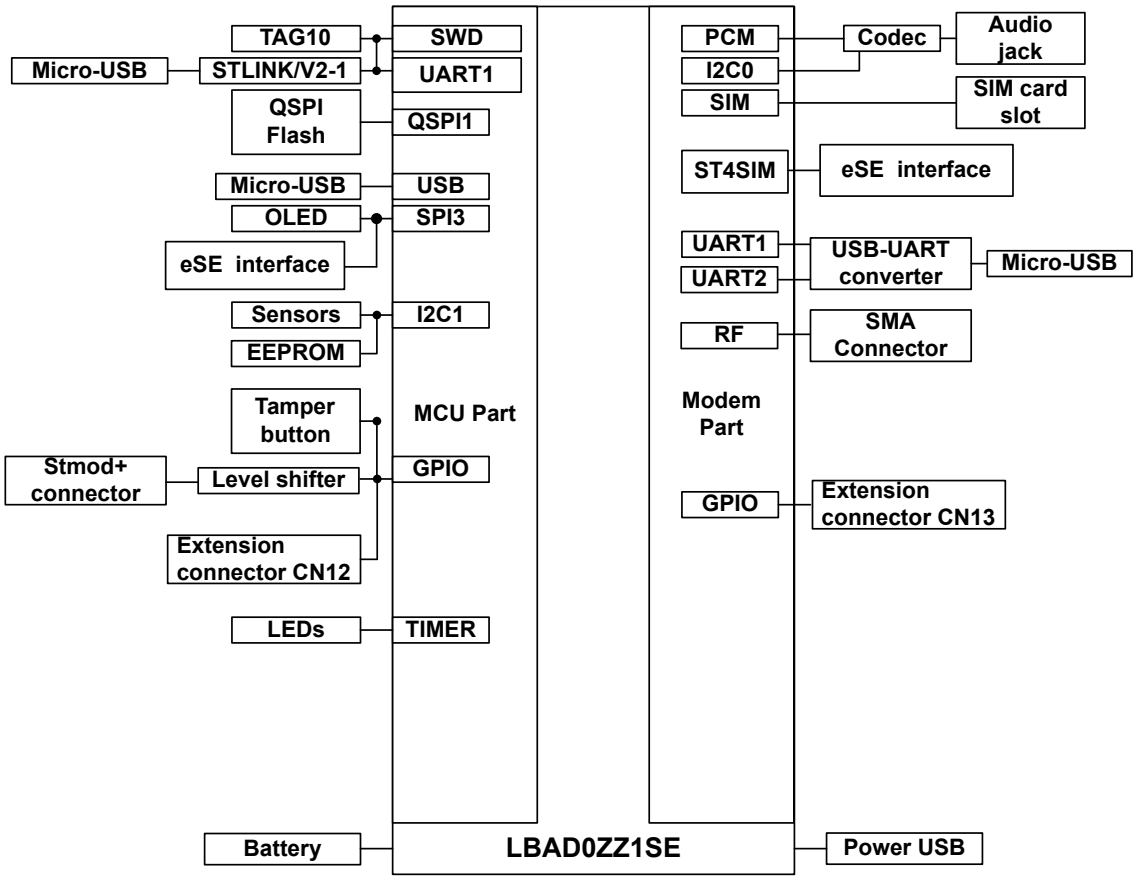


Figure 3. **B-L462E-CELL1 Discovery kit for IoT nodes (top view)**

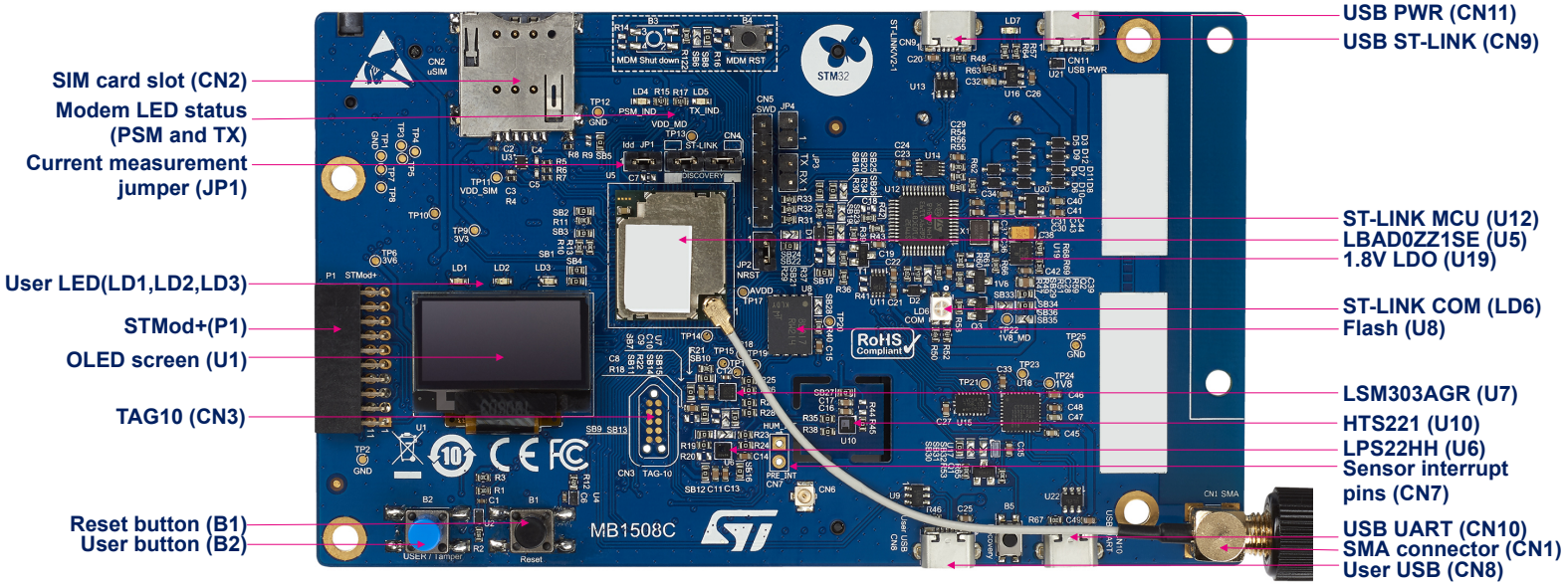


Figure 4. **B-L462E-CELL1 Discovery kit for IoT nodes (bottom view)**

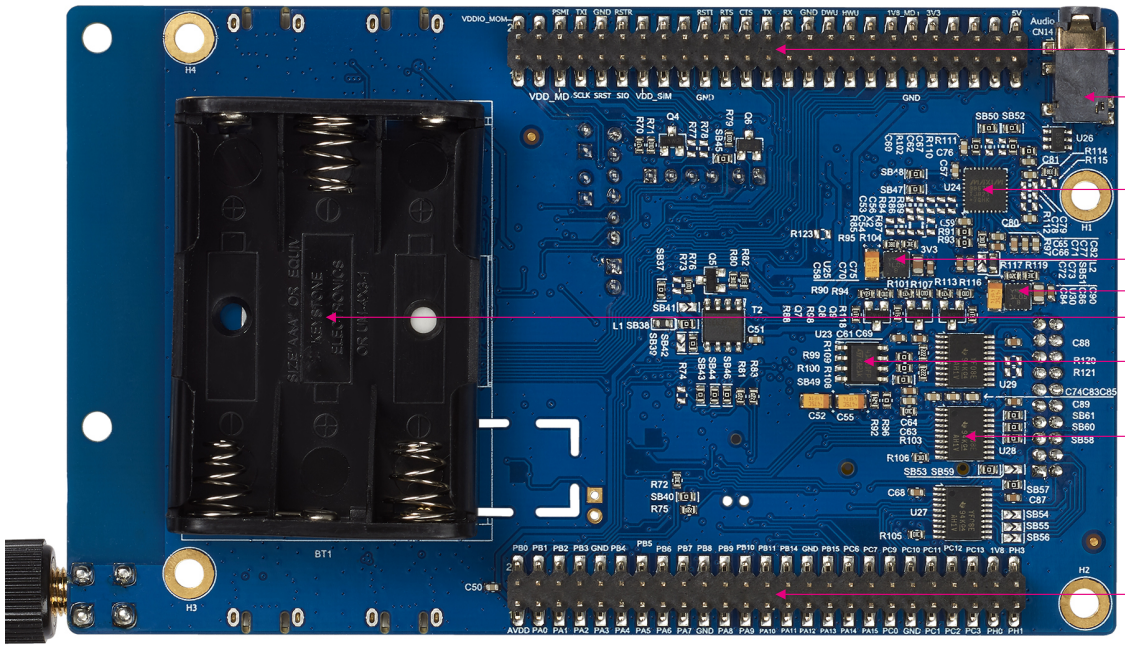


Figure 5. **B-L462E-CELL1 Discovery kit for IoT nodes mechanical drawing (top view)**

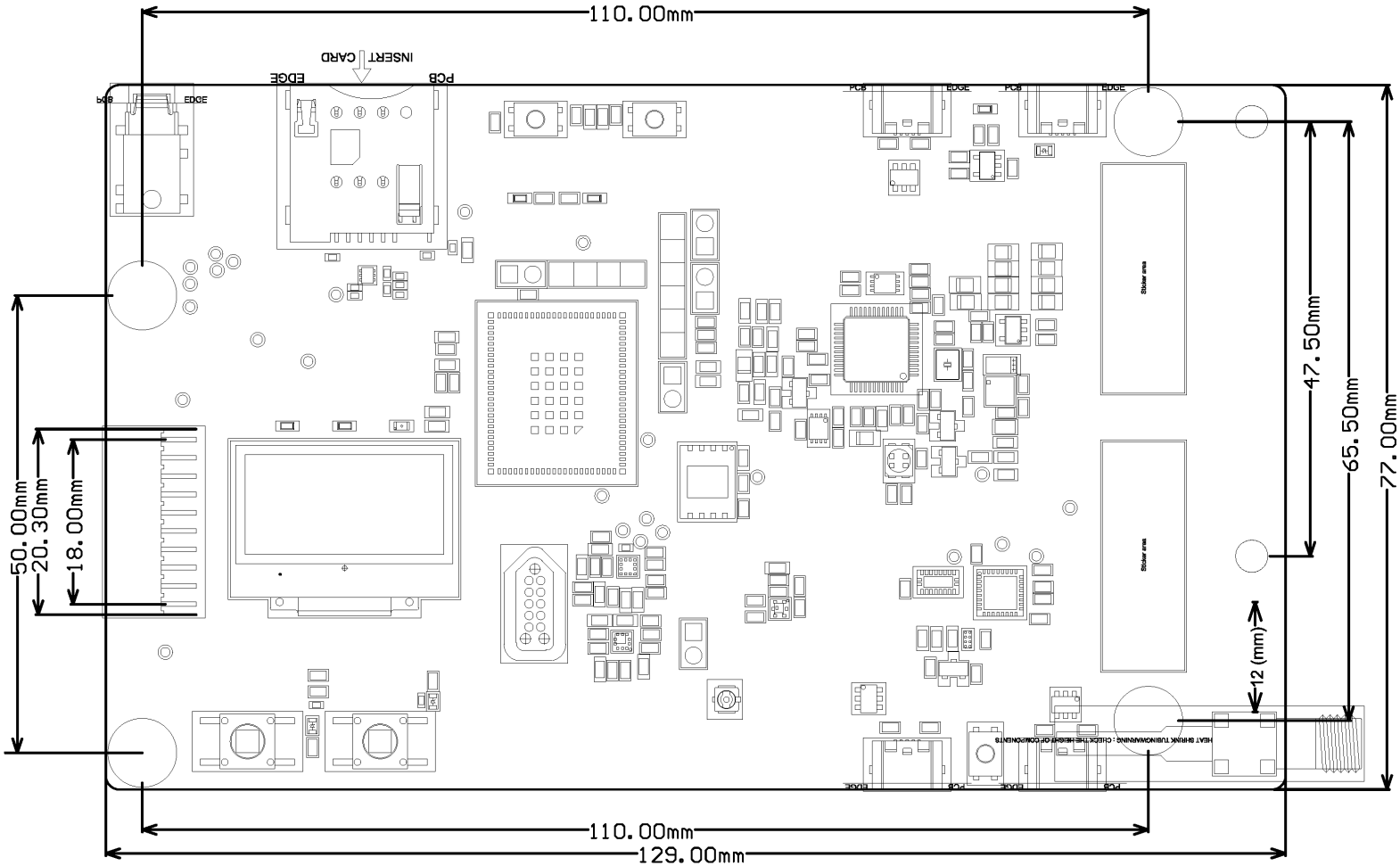
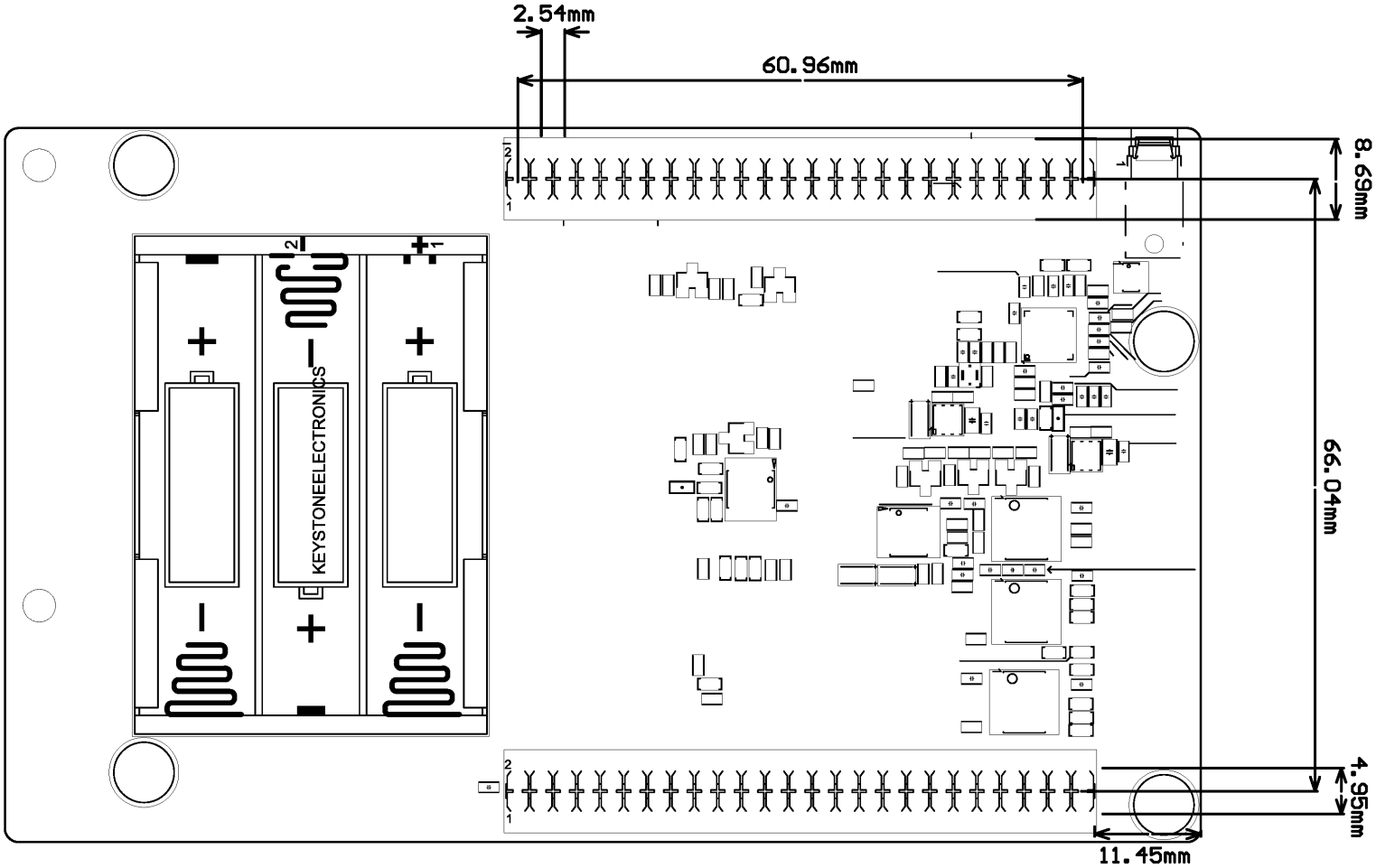


Figure 6. **B-L462E-CELL1 Discovery kit for IoT nodes mechanical drawing (bottom view)**



7.1 Embedded STLINK/V2-1

The ST-LINK/V2-1 programming and debugging tool is integrated on the B-L462E-CELL1 Discovery kit for IoT nodes. 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.

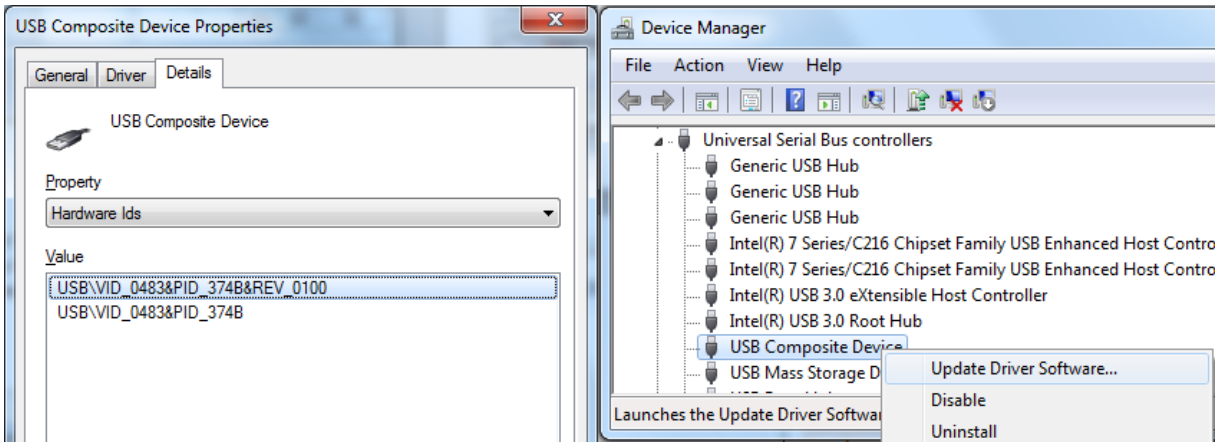
7.1.1 Drivers

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-L462E-CELL1 Discovery kit for IoT nodes 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 7.

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

Figure 7. USB composite device



7.1.2 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-L462E-CELL1 Discovery kit for IoT nodes and periodically, to stay up-to-date with the latest firmware version.

7.1.3 Target voltage level on STM32CubeProgrammer

The target voltage level is shown on the STM32CubeProgrammer. On the B-L462E-CELL1 Discovery kit for IoT nodes, the target (STM32L462RE on the module) voltage is 1.8 V.

Note: To reduce the power consumption for low-power measurement, the value of R62 and R55 sampling resistors is raised from 4.7 kΩ to 1 MΩ. In this case, the target voltage can not be correctly measured by ST-LINK and may be displayed as 1.6 V on STM32CubeProgrammer.

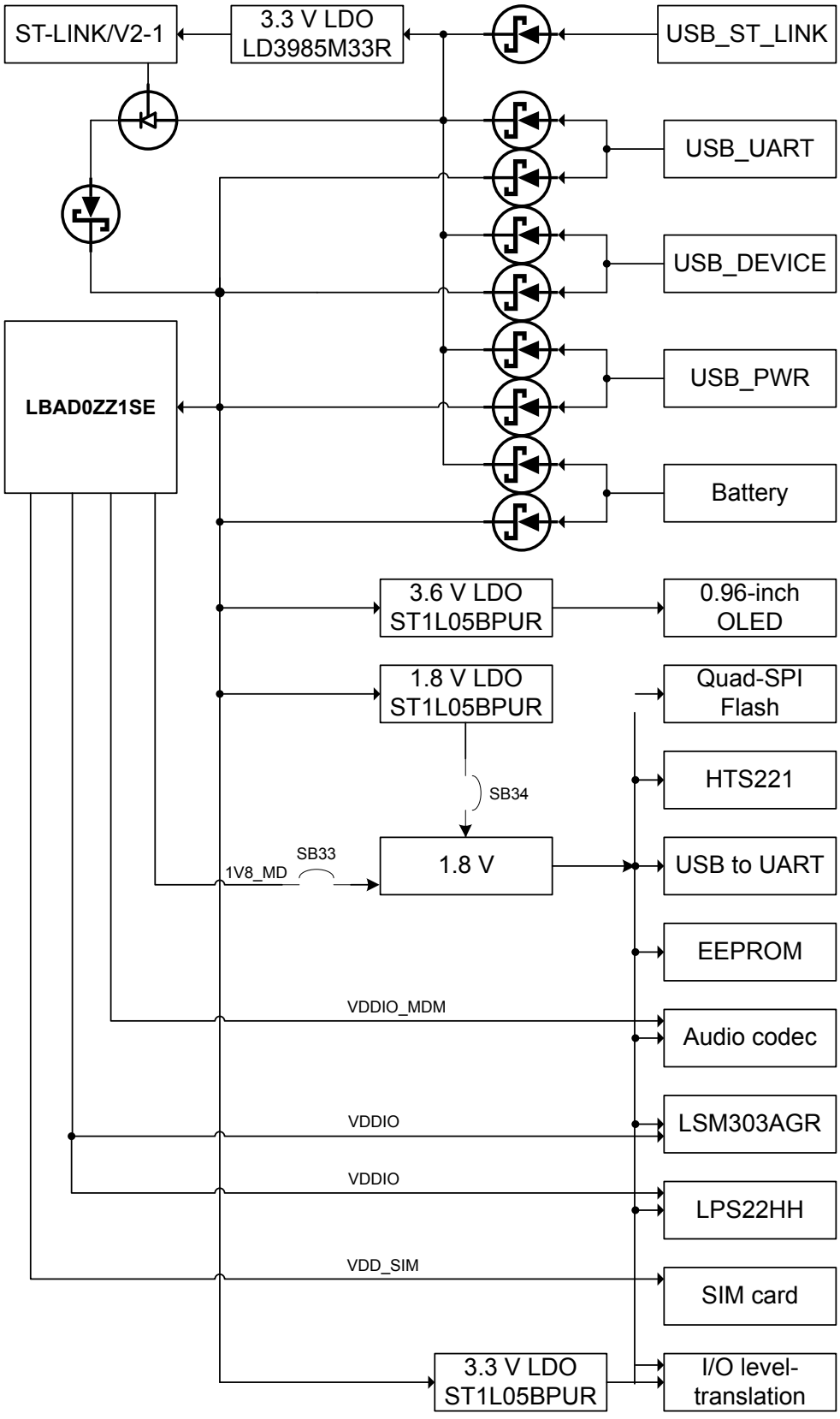
7.2 Power supply

The B-L462E-CELL1 Discovery kit for IoT nodes is designed to be powered by a 5 V DC power supply. It is possible to configure the B-L462E-CELL1 Discovery kit for IoT nodes to use any of the following five sources for the power supply: UartUsbVbus, Vbus, 5V_USB_CHG, 5V_USB_PWR, and EXT_BAT. Power sources are automatically selected by diodes.

All extern power sources are connected to the JP1 jumper, so JP1 can be used to measure the current which is consumed by the module.

- UartUsbVbus is provided by the CN10 UART USB connector.
- Vbus is provided by the CN8 user USB connector.
- 5V_USB_CHG is provided by the CN9 ST-LINK/V2-1 USB connector. This power source can be controlled by the onboard ST-LINK/V2-1.
- 5V_USB_PWR is provided by the CN11 power USB connector.
- EXT_BAT is connected to a battery case that contains three AAA batteries. As it can only provide a 4.5 V power source, this power source is not designed for long-time and huge-current applications. Low-power applications can consider using this as the main power source and other applications may use this as the back-up power source.

Figure 8. **Power tree**



7.3 Clock source

One clock source is described below:

- X1 8 MHz clock for the ST-LINK MCU.

The other clock source is the 32.768 KHz in the module which is used to be the RTC clock source for the STM32L462RE microcontroller.

7.4 Reset sources

The reset signal of the B-L462E-CELL1 Discovery kit for IoT nodes is active LOW and the reset sources include:

- A reset button B1
- An embedded ST-LINK/V2-1
- A TAG10 connector reset pad

7.5 USB device FS

The B-L462E-CELL1 Discovery kit for IoT nodes supports USB device function via the CN8 USB Micro-B connector.

7.6 Quad-SPI NOR Flash memory

64 Mbytes of onboard Quad-SPI Flash memory (MT25QU512ABB1EW9-0SIT from Micron) is connected to the Quad-SPI interface of STM32L462RE in LBAD0ZZ1SE. The Flash shares the same QSPI IO as on-module Flash memory. So solder bridge is used to select the target Flash memory (SB43 is OFF and SB28 is ON). On-module Flash is used by default.

7.7 Virtual COM port

The serial interface USART1 is directly available as a Virtual COM port of the PC connected to the CN9 ST-LINK/V2-1 USB connector. The Virtual COM port settings are configured with 115200 bps, 8-bit data, no parity, one stop bit, and no flow control.

7.8 STMicroelectronics sensors

Several STMicroelectronics sensors are available on the B-L462E-CELL1 Discovery kit for IoT nodes and are listed below:

- Ultra-low-power 3D accelerometer and 3D magnetometer (LSM303AGR)
- 260 hPa to 1260 hPa absolute digital output barometer (LPS22HH)
- Capacitive digital sensor for relative humidity and temperature (HTS221)

7.8.1 Ultra-low-power 3D accelerometer and 3D magnetometer (LSM303AGR)

LSM303AGR is an ultra-low-power high-performance system-in-package featuring a 3D digital linear acceleration sensor and a 3D digital magnetic sensor.

LSM303AGR has linear acceleration full scales of ±2g/±4g/±8g/16g and a magnetic field dynamic range of ±50 gauss.

LSM303AGR includes an I^2C serial bus interface that supports standard, fast mode, fast mode plus, and high-speed (100 kHz, 400 kHz, 1 MHz, and 3.4 MHz) and an SPI serial standard interface. On the B-L462E-CELL1 Discovery kit for IoT node the I2C1 bus from the STM32L462REY6TR is used.

The system can be configured to generate an interrupt signal for free-fall, motion detection, and magnetic field detection.

The magnetic and accelerometer blocks can be enabled or put into power-down mode separately.

LSM303AGR is available in a plastic land grid array package (LGA) and is guaranteed to operate over an extended temperature range from -40 °C to +85 °C.

- 3 magnetic field channels and 3 acceleration channels

- ±50 gauss magnetic dynamic range
- ±2/±4/±8/16 g selectable acceleration full scales
- 16-bit data output
- SPI / I^2C serial interfaces
- Analog supply voltage 1.71 V to 3.6 V
- Power-down mode / low-power mode
- Current consumption in power-down: 2 µA
- Accelerometer current consumption Magnetic sensor in power-down mode, 50 Hz ODR in low-power mode:7.7uA
- Programmable interrupt generators for freefall, motion detection, and magnetic field detection
- Embedded self-test
- Embedded temperature sensor
- Embedded FIFO
- ECOPACK®, RoHS, and “Green” compliant

7.8.2 260 hPa to 1260 hPa absolute digital output barometer (LPS22HH)

The absolute pressure-sensing device LPS22HH is an ultra-compact piezoresistive sensor that 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 I^2C or SPI. On the B-L462E-CELL1 Discovery kit for IoT nodes, the I2C1 bus from STM32L462REY6TR is used.

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

LPS22HH 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 LPS22HH are:

- From 260 hPa to 1260 hPa absolute pressure range
- Current consumption down to 4 µA
- Absolute pressure accuracy: 0.5 hPa
- Low-pressure sensor noise: 0.65 Pa
- High-performance TCO: 0.65 Pa/°C
- Embedded temperature compensation
- 24-bit pressure data output
- ODR from 1 Hz to 200 Hz
- SPI, I^2C, or MIPI I3CSM interfaces
- Embedded FIFO
- Interrupt functions: Data-Ready, FIFO flags, pressure thresholds
- Supply voltage: from 1.7 to 3.6 V
- High shock survivability: 22,000 g
- Small and thin package
- ECOPACK® lead-free compliant

7.8.3 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.

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 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 I^2C interfaces. On the B-L462E-CELL1 Discovery kit for IoT nodes, the I2C1 bus from STM32L462REY6TR is used.
- Factory calibrated: Tiny 2 mm x 2 mm x 0.9 mm package
- ECOPACK® compliant

7.9 EEPROM (M24128-DFMN6TP)

128-Kbit serial I²C bus EEPROM(M24128-DFMN6TP) is connected to the I2C1 interface of STM32L462REY6TR. Its features are:

- Compatible with all I^2C bus modes: – 1 MHz – 400 kHz – 100 kHz
- Memory array:
  - 128 Kbits (16 Kbytes) of EEPROM
  - Page size: 64 bytes
  - Additional Write lockable page (M24128-D order codes)
- Single supply voltage and high speed: 1 MHz clock from 1.7 V to 5.5 V
- Standby supply current: 1uA, device not selected, VIN = VSS or VCC, VCC = 1.8 V
- Write:
  - Byte Write within 5 ms
  - Page Write within 5 ms
- Operating temperature range from -40 °C up to +85 °C
- Random and Sequential Read modes
- Write protect of the whole memory array
- Enhanced ESD/Latch-Up protection
- More than 4 million write cycles
- More than 200-years data retention

7.10 OLED screen

9OL9935701000 is a 0.96-inch OLED screen with the SSD1315Z driver IC. On the B-L462E-CELL1 Discovery kit for IoT nodes, the SPI3 bus from STM32L462REY6TR is used to connect this OLED screen. It has the following features:

- Small molecular organic light-emitting diode
- Color: White
- Panel matrix: 128x64
- Driver IC: SSD1315Z
- Excellent quick response time
- Extremely thin thickness for best mechanism design: 1.42 mm
- High contrast: 2000:1
- Wide viewing angle: 160°
- 3/4 wire Serial Peripheral Interface
- Wide range of operating temperature: -40 °C to 70 °C
- Anti-glare polarizer

Note: The SPI3 is also shared with ST4SIM-200M. As ST4SIM is powered by the modem power supply, there is a need to control the LDO at the modem side by sending related AT commands.

7.11 Audio codec

MAX9867ETJ+ is an ultra-low-power stereo audio codec designed for portable consumer devices such as mobile phones and portable gaming consoles. The codec is connected to the modem through the PCM bus which is used to transmit voice data and the I^2C bus which provides a control for volume levels, signal mixing, and general operating modes. Its I^2C address for write commands is 0x30.

Note: VoLTE and audio features are not used in the current version of the LBAD0ZZ1SE module. The customer must contact Murata to enable such an option as needed.

7.12 Buttons and LEDs

The B1 black button located on the top left side is the reset of the STM32L462REY6TR microcontroller. Refer to Figure 3.

The B2 blue button located on the top left side is 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.

Three LEDs (LD1, LD2, and LD3), located on the top left side are available for the user. To light a LED a logic state HIGH must be written in the corresponding GPIO. As the GPIOs can be connected to timers in the chip, the user may use the PWM function to control the brightness of LEDs.

Table 4. Button and LED control port

Reference	Color	Name	Comment
B1	Black	Reset	-
B2	Blue	Wake-up	Alternate function Wake-up
LD1	Green	User LED1	PC6
LD2	Red	User LED2	PB15
LD3	Blue	User LED3	PB14
LD4	Green	LED4	PSM_IND, controlled by the modem, lights ON when the modem is not in low-power mode, and OFF when the modem is in low-power mode.
LD5	Green	LED5	TX_IND, controlled by the modem
reference	Bicolor (red and green)	ST-LINK COM	Green during communication
LD7	Red	Fault Power	Current upper than 750 mA

7.13 I²C addresses of modules used on MB1508

Table 5 displays the I²C read and write addresses for the modules that are connected to the I2C1 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
LPS22HH	MEMS nano pressure sensor	1011101x (SDA[0]=1])	0xBA	0xBB
LSM303AGR	3D accelerometer and 3D magnetometer	0011001x (Linear acceleration)	0x32 (Linear acceleration)	0x33 (Linear acceleration)
		0011110x (Magnetic field)	0x3C (Magnetic field)	0x3D (Magnetic field)
M24128-DFMN6TP	128-Kbit serial I²C bus EEPROM	1010000x (Memory array)	0xA0 (Memory array)	0xA1 (Memory array)
		1011000x (Identification page)	0xB0 (Identification page)	0xB1 (Identification page)

8 Connectors

Sixteen connectors are implemented on the B-L462E-CELL1 Discovery kit for IoT nodes:

- CN1 SMA connector for antenna
- CN2 SIM card slot
- CN3 Tag connector
- CN4 ST-LINK select jumper
- CN5 ST-LINK debug connector
- CN6 reserved U.FL connector
- CN7 INT pins of sensors
- CN8 USB connector for DEVICE
- CN9 USB connector for ST_LINK
- CN10 USB connector for UART
- CN11 USB connector for power
- CN12 25*2 pins connector for MCU
- CN13 25*2 pins connector for modem
- CN14 3.5mm stereo headphone connector
- P1 socket 10X2 STMod+

Also, the JP1 jumper is used for IDD measurements.

JP2 jumper is used to program reset.

CN4 jumper is used to program the LBAD0ZZ1SE module.

8.1 SMA connector for antenna

On the LBAD0ZZ1SE module, the U.FL connector is the only way to connect an external antenna. LBAD0ZZ1SE can use the SMA rod antenna through the CN1 cable which converts the SMA port to U.FL port. The antenna is permanently fixed to the SMA connector as per FCC requirement.

8.2 SIM card slot

CN2 is a micro-SIM card slot.

The SIM card slot only supports micro-SIM cards and it supports card detect function which can detect the presence of the SIM card. When the SIM-card exists, the CD signal pin is floating. Otherwise, the signal pin is pulled down. As R8 is soldered, the floating state is replaced by the pull-up state. Only a Class-C SIM card handling 1.8V is supported.

Table 6. SIM card slot

Connector	Pin number	Pin name	Signal name	Function
CN2	1	CD	SIM_DETECT	SIM card detection
	2	GND	-	Power
	3	GND	-	Power
	4	GND	-	Power
	5	GND	-	Power
	C1	VCC	VDD_SIM	Power
	C2	RST	SIM_RST	SIM RST
	C3	CLK	SIM_CLK	SIM clock
	C5	GND	-	Power
	C6	VPP	VDD_SIM	Power
	C7	I/O	SIM_DATA	SIM data

8.3 Tag connector

CN3 is a tag connector that provides a direct debug port for the MCU.

The tag connector is implemented on the B-L462E-CELL1 board. The tag connector is a 10-pin footprint supporting SWD mode, which is shared with the same signals as ST-LINK.

The TC2050-IDC-NL cable is used to link ST-LINK and tag connector on the B-L462E-CELL1 Discovery kit for IoT nodes, so that the STM32L4 in the module can be easily programmed and debugged without any extra accessory.

Figure 9. Tag connector

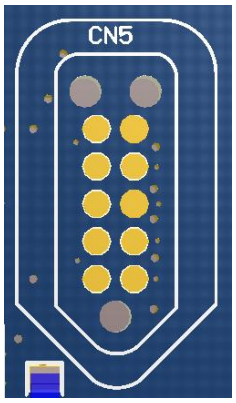


Figure 10. **TC2050-IDC-NL cable**

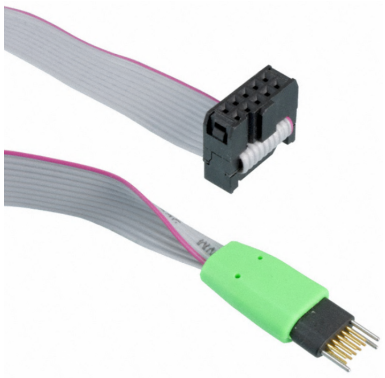


Table 7. **Tag connector pinout**

Connector	Pin number	Pin name	Signal name	STM32L 4 pin	Function
CN3	1	1.8V	1V8	-	Power
	2	TMS/SWDIO	TMS/SWDIO	PA13	Serial wire data I/O
	3	GND	-	-	Ground
	4	TCK/SWCLK	TCK/SWCLK	PA14	Serial wire clock
	5	GND	-	-	Ground
	6	SWO	SWO	PB3	Serial wire output
	7	NC	-	-	-
	8	NC	-	-	-
	9	NC	-	-	-
	10	RESET#	RESET#	NRST	RESET

8.4 ST-LINK select jumper

The ST-LINK select connector is a 4-pin, 2.54-mm pitch male connector. It is used to decide which target the ST-LINK is connected to.

Table 8. **ST-LINK select jumper**

Connector	Pin number	Pin name	Signal name	STM32L 4 pin	Function
CN4	1	T_JTCK	T_JTCK	-	When CN4 [1-2] and CN4 [3-4] are ON, the Discovery board is selected.
	2	TCK/SWCLK	TCK/SWCLK	PA14	
	3	T_JTMS	T_JTMS	-	
	4	TMS/SWDIO	TMS/SWDIO	PA13	

8.5 ST-LINK debug connector

The ST-LINK debug connector is a 6-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	Signal name	STM32L4 pin	Function
CN5	1	GND	GND	-	Power
	2	T_JTCK	TCK/SWCLK	PA14	Serial wire clock
	3	GND	GND	-	Power
	4	T_JTMS	TMS/SWDIO	PA13	Serial wire data I/O
	5	T_NRST	T_NRST	NRST	RESET
	6	T_SWO	T_SWO	PB3	Serial wire output

8.6 INT pins of sensors

Table 10. INT pins of sensors

Connector	Pin number	Pin name	Signal name	Function
CN7	1	DRDY	INT_HUM	HTS221 INT
	2	INT/DRDY	INT_PRE	LPS22HH INT

8.7 USB connector for the user device

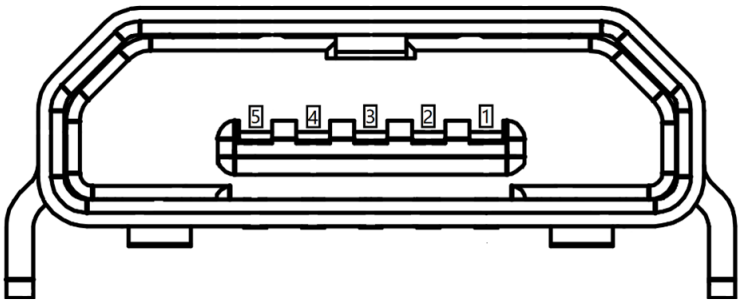
This USB connector is used to connect the USB device port in the STM32L462REY6TR microcontroller. Refer to Figure 11 for pin-number location.

This USB connector can be used for communication with external-host USB. USB driver is delivered as part of STM32Cube MCU Package including CDC and mass-storage device classes.

Table 11. USB connector for the user device

Connector	Pin number	Pin name	Signal name	STM32L4 pin	Function
CN8	1	VBUS	VBUS	-	Power
	2	DM	USB_DM	PA11	USB Device -
	3	DP	USB_DP	PA12	USB Device +
	4	ID	-	-	-
	5	GND	GND	-	Power

Figure 11. USB Micro-B connector (front view)



8.8 USB connector for ST-LINK

This USB connector is used to connect the embedded ST-LINK/V2-1 to the PC to program and debug the STM32L462REY6TR microcontroller. Refer to Figure 11 for pin-number location.

Table 12. USB connector for ST-LINK

Connector	Pin number	Pin name	Signal name	ST-LINK MCU pin	Function
CN9	1	VBUS	5V_USB_CHG	-	Power
	2	DM	STL_USB_D_N	PA11	USB ST-LINK -
	3	DP	STL_USB_D_P	PA12	USB ST-LINK +
	4	ID	-	-	-
	5	GND	GND	-	Power

8.9 USB connector for UART

This USB connector is used to connect the UARTs of the modem to debug and update the modem in LBAD0ZZ1SE. Refer to Figure 11 for pin-number location.

The user must refer to Murata documentation describing how to use the debug interface.

Table 13. USB connector for UART

Connector	Pin number	Pin name	Signal name	Function
CN10	1	VBUS	UartUsbVbus	Power
	2	DM	USBDM	USB UART -
	3	DP	USBDP	USB UART +
	4	ID	-	-
	5	GND	GND	Power

8.10 USB connector for power

This USB connector is only used to power the whole system and it has no communication functions. Refer to Figure 11 for pin-number location.

Table 14. USB connector for power

Connector	Pin number	Pin name	Signal name	Function
CN11	1	VBUS	5V_USB_PWR	Power
	2	DM	-	-
	3	DP	-	-
	4	ID	-	-
	5	GND	GND	Power

8.11 Extension pin header for MCU

This connector is a 50-pin, 2.54-mm pitch male connector. It is used to connect the MCU's pins in the module.

Table 15. Extension pin header for MCU

Connector	Pin number	Signal name	Function	How to disconnect with function block on B-L462E-CELL1 board
CN12	1	AVDD	Power	-
	2	PB0	QUADSPI_IO1(1)	-
	3	PA0	USART2_CTS	-
	4	PB1	QUADSPI_IO0(1)	-
	5	PA1	USART2_RTS	-
	6	PB2_R	CS_DISP	-
	7	PA2	USART2_TX	-
	8	PB3	SWO	-
	9	PA3	USART2_RX	-
	10	GND	Power	-
	11	PA4	SPI_NSS	PA4 is used on LBAD0ZZ1SE, it is not recommended to use PA4 as an extension pin for daughterboard on CN12.
	12	PB4	SPI1_MISO	-
	13	PA5	SPI1_SCK	-
	14	PB5	SPI1_MOSI	-
	15	PA6	QUADSPI_IO3(1)	-
	16	PB6	SF_EN	PB6 is used on LBAD0ZZ1SE, PB6 cannot be used as an extension pin.
	17	PA7	QUADSPI_IO2(1)	-
	18	PB7_R	NC_PWR_EN	PB7_R is used on LBAD0ZZ1SE, PB7_R cannot be used as an extension pin.
	19	GND	Power	-
	20	PB8	IIC_SCL	-
	21	PA8	RCC_MCO	-
	22	PB9	IIC_SDA	-
	23	PA9	USART1_TX	-
	24	PB10	QUADSPI_CLK(1)	-
	25	PA10	USART1_RX	SB46 OFF
	26	PB11	QUADSPI_nCS(1)	-
	27	PA11	USB_DM	-
	28	PB14	LED3	-
	29	PA12	USB_DP	-
	30	GND	Power	-
	31	PA13	SWDIO	-
	32	PB15	LED2	-

Connector	Pin number	Signal name	Function	How to disconnect with function block on B-L462E-CELL1 board
CN12	33	PA14	SWCLK	-
	34	PC6	LED1	-
	35	PA15	SPI1_NSS	-
	36	PC7	NC_RST_IND	PC7 is used on LBAD0ZZ1SE, it is not recommended to use PC7 as an extension pin for daughterboard on CN12.
	37	PC0	ADC1_IN1	-
	38	PC9	TIM3_CH4	-
	39	GND	Power	-
	40	PC10	SPI3_SCK	Cannot be disconnected from OLED and LBAD0ZZ1SE on B-L462E-CELL1 board, it is not recommended to use PC10 as extension pin for daughter board on CN12.
	41	PC1	ADC1_IN2	-
	42	PC11	D/C_DISP	Cannot be disconnected from OLED and LBAD0ZZ1SE on B-L462E-CELL1 board, it is not recommended to use PC11 as extension pin for daughter board on CN12.
	43	PC2	INT_ACC	SB14 and SB15 OFF.
	44	PC12	SPI3_MOSI	Cannot be disconnected from OLED and LBAD0ZZ1SE on B-L462E-CELL1 board, it is not recommended to use PC12 as extension pin for daughter board on CN12.
	45	PC3	INT_MAG	-
	46	PC13	User/Tamper Button	-
	47	PH0	Extern Clock In	-
	48	1V8	Power	-
	49	PH1	RST_DISP	-
	50	PH3	BOOT0	-

1. *All pins that are exposed to Quad-SPI are not recommended to use to control external devices.*

8.12 Extension pin header for modem

This connector is a 50-pin, 2.54-mm pitch male connector. It is used to connect the modem pins in LBAD0ZZ1SE.

Note that all signals that are started with FFU are not used with the current module version. Contact Murata to discuss any options.

Table 16. Extension pin header for modem

Connector	Pin number	Signal name	Function
CN13	1	FFU_I2C0_SCL	Audio codec I2C SCL
	2	VDDIO_MDM	Power
	3	FFU_I2C0_SDA	Audio codec I2C SDA
	4	PMU_VBACKUP	-
	5	VDD_MD	Power
	6	FFU_PSM_IND	-
	7	NC_SIM_CLK	SIM card signal clock
	8	FFU_TX_IND	-
	9	NC_SIM_RST	SIM card reset
	10	GND	Power
	11	NC_SIM_IO	SIM card data input/output
	12	NC_RST	Modem reset
	13	VDD_SIM	Power
	14	FFU_GNSS_CODES_IND	-
	15	NC_SIM_DETECT	SIM card detect
	16	FFU_GNSS_EXT_LNA	-
	17	FFU_CLKOUT	Audio Codec clock
	18	FFU_GNSS_SFN_IND	-
	19	GND	Power
	20	NC_RST_IND	-
	21	FFU_PCM_IN	Audio PCM signal in
	22	NC_UART0_RTS	Modem UART0 RTS
	23	FFU_PCM_OUT	Audio PCM signal out
	24	NC_UART0_CTS	Modem UART0 CTS
	25	FFU_PCM_FS	-
	26	NC_UART0_TX	Modem UART0 TX
	27	FFU_PCM_CLK	Audio PCM signal clock
	28	NC_UART0_RX	Modem UART0 RX
	29	RFT_UART1_TX	Modem UART1 TX
	30	GND	Power
	31	RFT_UART1_RX	Modem UART1 RX
	32	NC_DWU	-
	33	RFT_UART1_CTS	Modem UART1 CTS
	34	NC_HWU	-
	35	RFT_UART1_RTS	Modem UART1 RTS

Connector	Pin number	Signal name	Function
CN13	36	NC_PWR_BUTTON	-
	37	RFT_UART2_TX	Modem UART2 TX
	38	eSIM_SWP	-
	39	GND	Power
	40	1V8_MD	Power
	41	RFT_UART2_RX	Modem UART2 RX
	42	3V3	Power
	43	RFT_UART2_CTS	Modem UART2 CTS
	44	FFU_RFFE_VDDIO	-
	45	RFT_UART2_RTS	Modem UART2 RTS
	46	FFU_RFFE_SCLK	-
	47	PMU_AT_IN	-
	48	FFU_RFFE_SDATA	-
	49	PMU_AT_OUT	-
	50	5V	Power

8.13 3.5 mm stereo headphone connector

This headphone connector supports the CTIA standard which means the sequence of signals is Left, Right, GND and Mic.

8.14 Socket 10×2 STMod+

On the B-L462E-CELL1 Discovery kit for IoT nodes, the STMod+ connector provides flexibility in a small form factor application.

The related STM32L462REY6TR I/Os for STMod+ are listed in Table 17. The STMod+ connector is a 20-pin 2.00 mm pitch right-angle female connector.

Table 17. Socket 10×2 STMod+

Connector	Pin number	Signal name	Solder bridge[1]		STM32L4 pin	Function
CN12	1	PA0_C	-	-	PA0	UART2_CTS/SPI_CS
	2	PC12_C	SB56 ON	SB60OFF	PC12	SPI3_MOSIp
		PA2_C	**SB56 OFF**	**SB60ON**	**PA2**	**UART2_TX**
	3	PC11_C	SB55 ON	SB58OFF	PC11	SPI3_MISOp
		PA3_C	**SB55 OFF**	**SB58ON**	**PA3**	**UART2_RX**
	4	PC10_C	SB54 ON	SB61OFF	PC10	SPI3_SCK
		PA1_C	**SB54 OFF**	**SB61ON**	**PA1**	**UART2_RTS**
	5	GND	-	-	-	Power
	6	5V	-	-	-	Power
	7	PB8_C	-	-	PB8	I2C1_SCL
	8	PB5_C	-	-	PB5	SPI3_MOSIs
	9	PB4_C	-	-	PB4	SPI3_MISOs
	10	PB9_C	-	-	PB9	I2C1_SDA

Connector	Pin number	Signal name	Solder bridge[1]		STM32L4 pin	Function
CN12	11	PC1_C	-	-	PC1	INT
	12	PH0_C	-	-	PH0	RESET
	13	PC0_C	-	-	PC0	ADC1_IN1
	14	PC9_C	-	-	PC9	TIM3_CH4
	15	5V	-	-	-	Power
	16	GND	-	-	-	Power
	17	PA8_C	-	-	PA8	I/O
	18	PA5_C	-	-	PA5	I/O
	19	PA15_C	-	-	PA15	I/O
	20	PB14_C	-	-	PB14	I/O

1. *Default solder bridge state is shown in bold*

8.15 Jumper description

The STM32 current measurement can be done on JP1. By default, the JP1 jumper is ON.

For the current measurement configuration, the JP1 jumper is OFF and an ammeter must be placed on JP1.

JP2 connects the NRST of the SWD protocol and the NRST of the LBAD0ZZ1SE module. By default, the JP2 jumper is ON.

JP3 is the ST-LINK serial port network. It can be connected to other devices to read data through jumpers. By default, the JP3 jumper is OFF.

JP4 is the ST-LINK NRST network, which can control the status of ST-LINK MCU. By default, the JP4 jumper is OFF.

CN4 is used to select the ST-LINK network. By default, CN4[1-2] and CN4[3-4] are ON.

CN5 is used for ST-LINK debug connector. By default, the CN5 jumper is OFF.

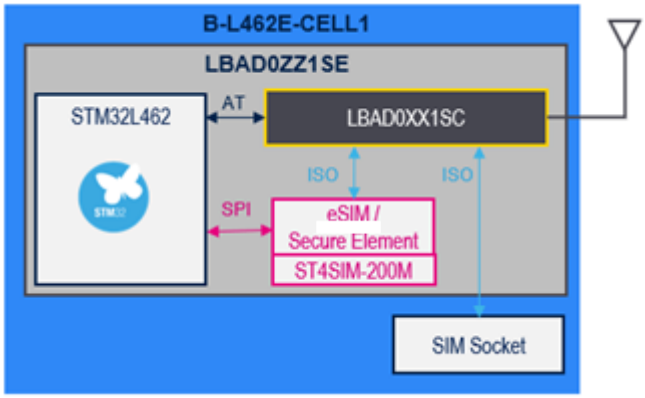
9 Cellular and end-to-end data plane connectivity setup

The Discovery board comes with a pre-programmed application that demonstrates an out-of-the-box end-to-end with low-power connectivity over LTE Cat M or NB-IoT technology.

For flexibility, the Discovery board supports the dual SIM feature which allows switching between a plastic SIM card inserted in a SIM socket or the embedded SIM (eSIM) inside the LBAD0ZZ1SE module.

The SIM selection policy is controlled by the modem firmware running on LBAD0XX1SC and stored in its configuration files which can be modified via AT command. By default, the SIM selection policy is controlled by the software package provided by STMicroelectronics dedicated for this board and the user does not need to send explicitly an AT command.

Figure 12. LBAD0ZZ1SE structure diagram



ST4SIM-200M supports also an embedded Secure Element (eSE). The eSE can be used to store application (cloud) credentials (device certificates and keys). The eSE service can be accessed via ISO, modem firmware, or from the STM32 application through the SPI interface.

9.1 SIM card socket

CN2 is a micro-SIM (3FF) card slot that supports only the class-C SIM card (1.8V). The modem firmware detects the presence of the SIM card and monitors in runtime SIM removal or insertion. By default, when a SIM card is inserted, it is used for cellular connectivity, otherwise, eSIM provides connectivity to cellular networks.

Runtime detection of SIM insertion/removal may not be supported by the default pre-programmed application, but a newer version of such application can be downloaded from *www.st.com*. If the runtime detection function is not supported, the user does need to force a reboot by pressing the black “reset button”, after a SIM card is inserted or removed to force the application to select the SIM slot and use the SIM for the cellular connectivity.

Note: The modem firmware is certified by GCF and PTCRB. The user may use a plastic SIM card from any mobile operator but the modem firmware may not have passed the certification from that specific operator. Therefore, the usage of a plastic SIM card is only at the user's responsibility and it may need an additional procedure to activate the SIM card. The user may contact Murata to get information about the list of operators on which the modem firmware is certified.

When a SIM card is used, the cellular middleware can automatically set the APN to be used during registration to the network. thanks to a pre-defined table IMSI (MCC/MNC) to APN. However, if the IMSI is unknown, the end-customer may need to define explicitly the APN as defined in the user manual *X-CUBE-CELLULAR cellular connectivity Expansion Package for STM32Cube* (UM2426).

9.2 eSIM

eSIM is the new standard in SIM technology, developed by the GSMA and already widely accepted by the telecoms market.

eSIM is a smart, rewritable, and multi-network SIM which is embedded into the module itself and allows to swap profiles without removing the SIM. An embedded SIM allows, as a result, to store multiple MNO profiles on a single device.

An embedded SIM (hosted in ST4SIM-200M) is pre-integrated inside LBAD0ZZ1SE. ST4SIM-200M is GSMA qualified product pre-integrated with Remote SIM Provisioning platform and interoperable with all GSMA qualified platforms.

The embedded SIM is pre-provisioned with Truphone® global connectivity profile allowing an out-of-the-box cellular connectivity experience. The network coverage can be found on the Truphone® web portal.

Before using the eSIM for connectivity, the user must activate the SIM data plane as defined by the following procedure:

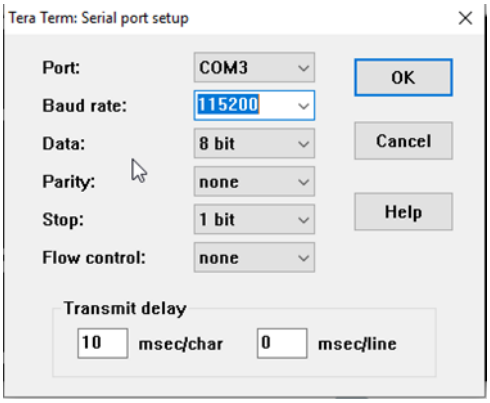
Step 1: Retrieve the ICCID of the Truphone® profile

To retrieve ICCID, the user just needs to connect a PC to the CN9 USB ST-LINK connector and launch a terminal connected to the COM port associated with the USB ST-LINK.

Refer to Section 7.1 to set up the USB ST-LINK driver.

The terminal configuration must be the following one:

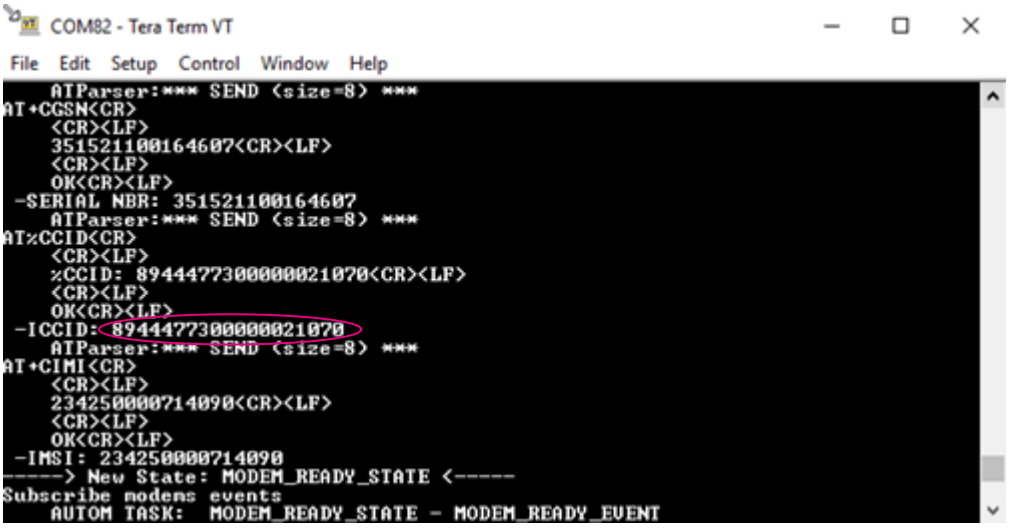
Figure 13. Terminal configuration



When the PC is connected to the board and powered ON, the pre-programmed application displays information on the board OLED display and generates logs on the terminal console.

ICCID can be captured on the terminal console as shown in Figure 14.

Figure 14. Terminal console showing ICCID



In this example, ICCID is `89444773000000021070`

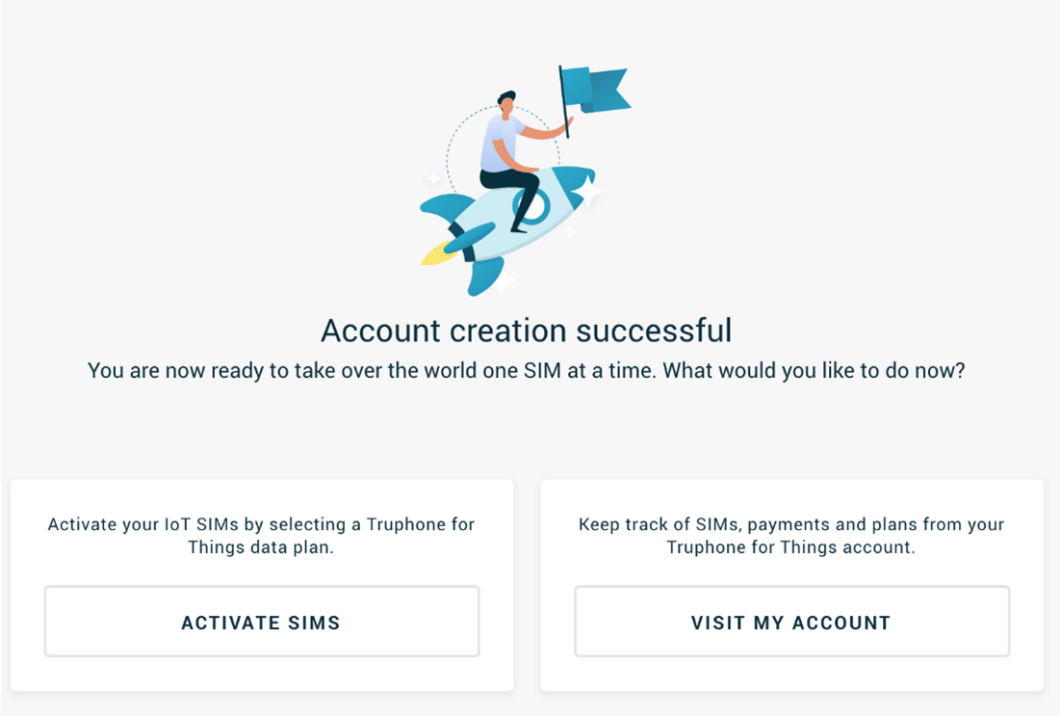
Note: If the user accidentally overwrites or deletes the original pre-programmed application, he can still load a new application from B-L462E-CELL1 and retrieve a new version of the application related to this board. If such trace is no longer available with the newer application, or if the user wants to read ICCID at any time, he may manually enter the AT command `at AT%CCID` via the terminal console as shown in Figure 15:

Figure 15. at AT%CCID command response

Step 2: Connect to the Truphone® web portal to activate the eSIM profile

The user must connect to the Truphone® web portal https://iot.truphone.com (using Chrome, Firefox, Safari, or Edge browser) and follow the provided instructions to create a user account if needed. Once logged in, the user can activate the SIM cards (eSIMs) right after completing registration as shown in Figure 16:

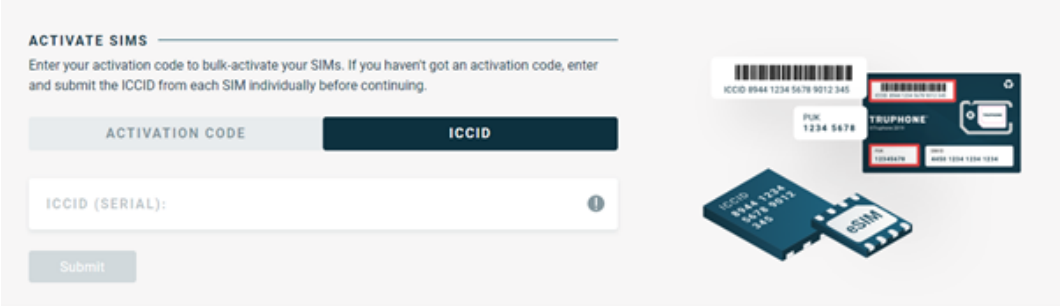
Figure 16. Account creation screen



Click on “Activate SIMs” and a new page appears to invite the user to enter the ICCID of the eSIM to be activated.

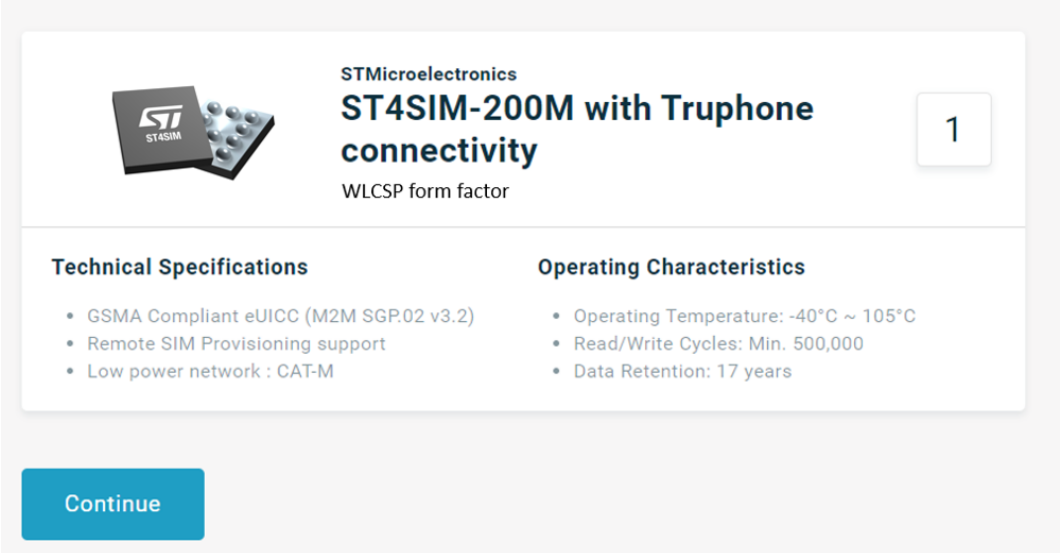
To activate one or a small number of SIMs, the user simply needs to enter ICCID and click Submit. Multiple ICCIDs may also be entered.

Figure 17. Activation screen



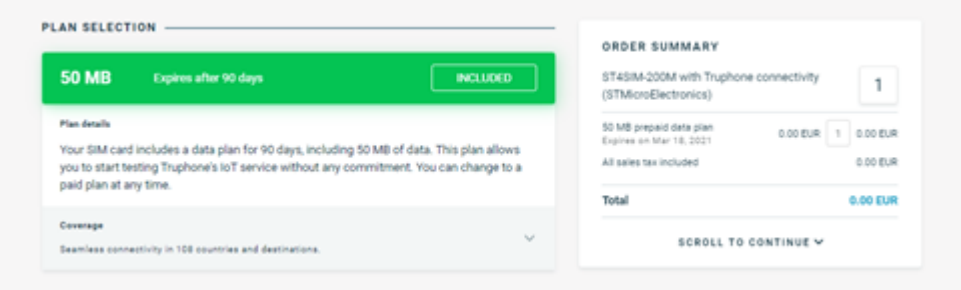
Once the user enters the ICCIDs to activate, then the type of SIMs about to activate is presented. To proceed, the user clicks on `continue`

Figure 18. SIM description details screen



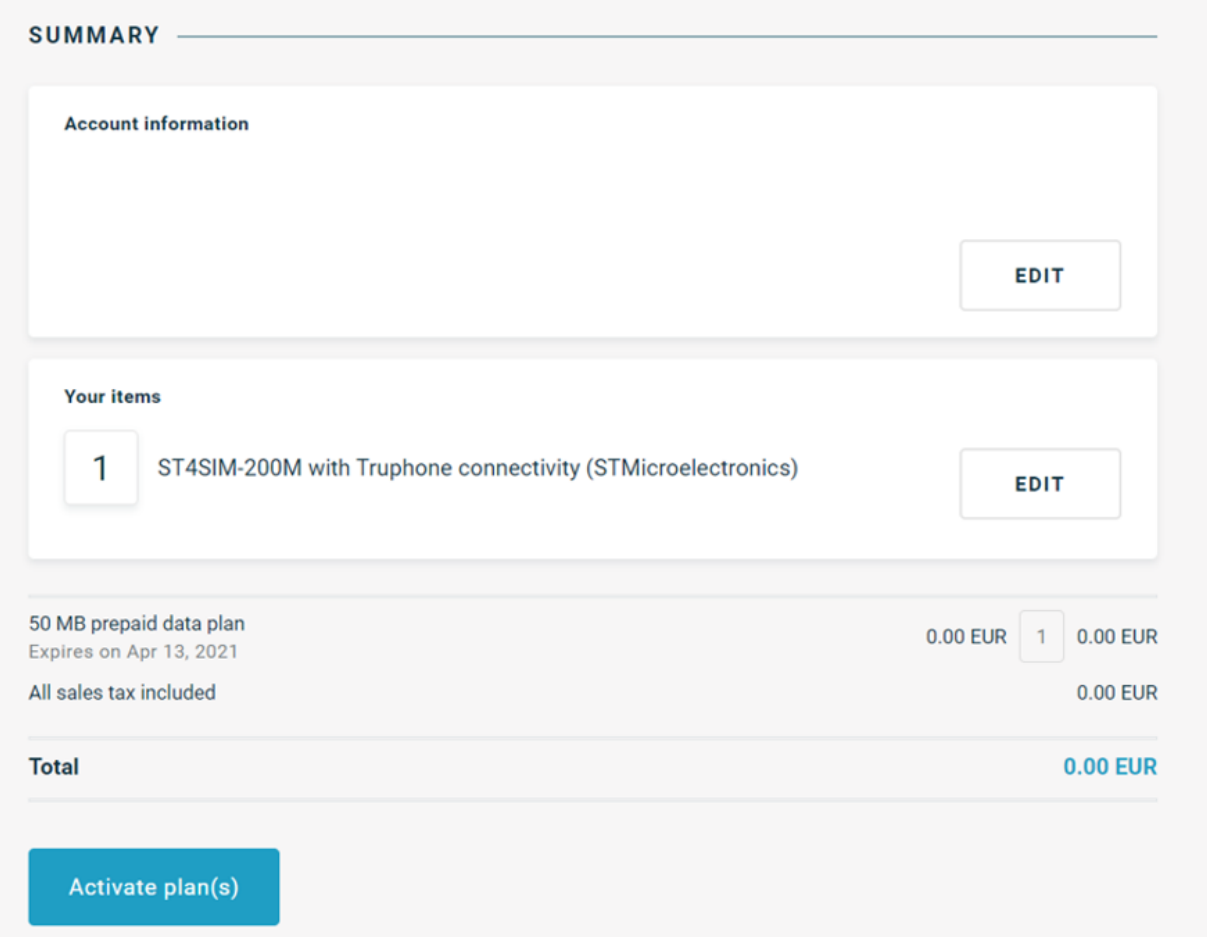
SIM includes a free 50-Mbyte complementary data available for 90 days after activation

Figure 19. Data plan selection screen



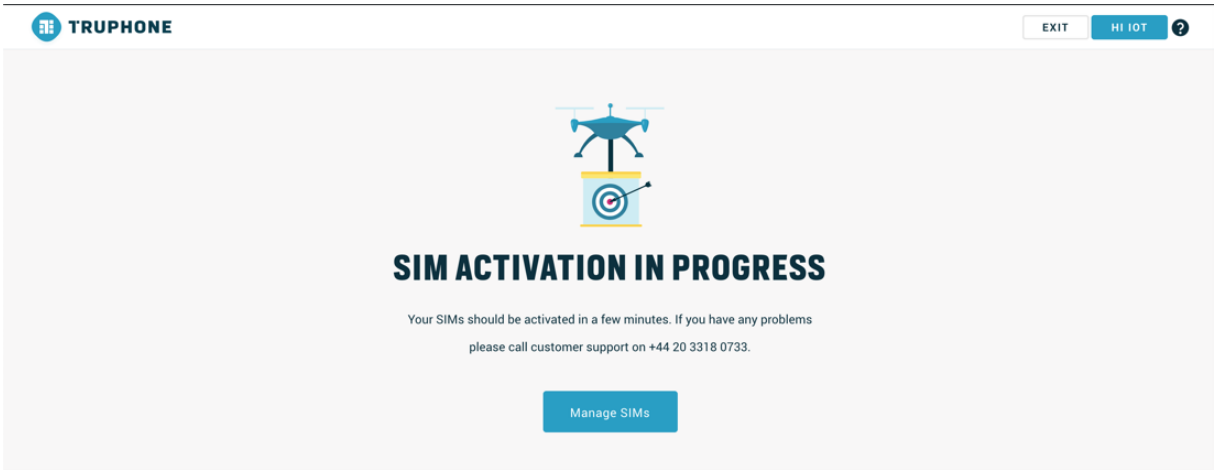
Review the activation details and click `Activate plan(s).`

Figure 20. User account details



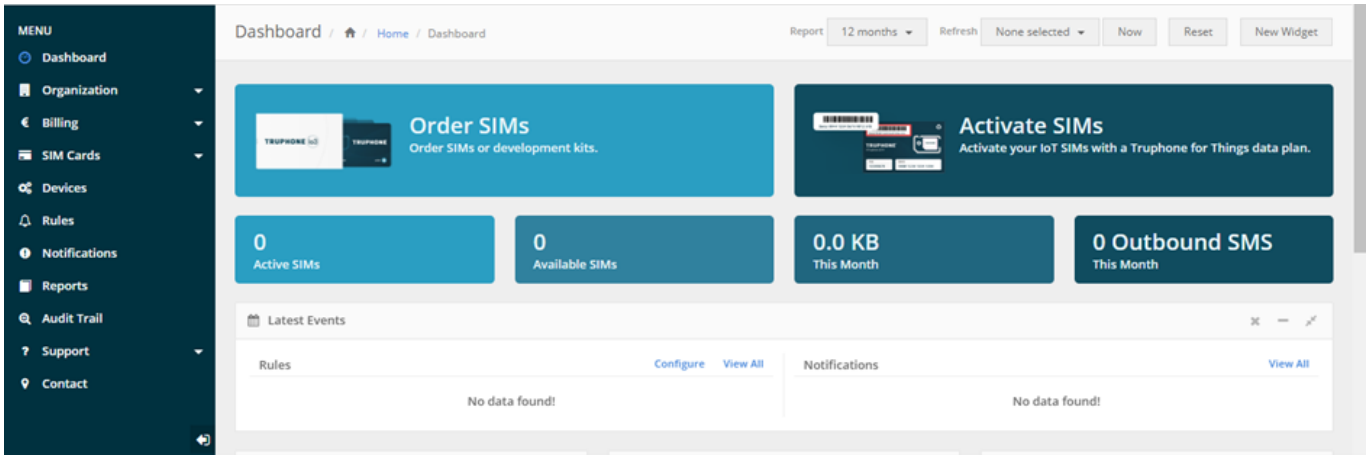
The activation of the SIM card may take a few minutes to complete and the SIM card status is shown on the IoT portal's dashboard once it is activated.

Figure 21. SIM activation progress screen



After the activation process, the user has access to all the functionalities to manage the SIM cards and connectivity as well as the activation of any additional SIM cards to the same user account.

Figure 22. Dashboard screenshot



Click on “Activate SIMs” and a new page appears to invite the user to enter the ICCID of the eSIM to be activated.

Step 3: Perform Network search and registration

To force the device to search and register to a cellular network known as PLMN selection, the user simply needs to reboot the board either by pressing the black reset button or disconnect and reconnect the USB ST-LINK cable.

The first time the boards registers to the network it may take some time, normally a few seconds but it can take up to 20 minutes to find a network, depending on the radio environment, used technology (Cat M or NB-IoT), and Truphone® network availability.

9.3 Embedded secure element

An eSE (embedded secure element) applet can also be hosted in the ST4SIM-200M. It can be used to store application credentials (Certificates and keys). The access to eSE is controlled and exposed via a software library provided by STMicroelectronics as part of the application software developed for the board.

The eSE can be accessed at any time irrespective of the SIM slot that is used for the connectivity. Indeed, a plastic SIM card can be used for connectivity while eSE can still be used to access application credentials and related security services. The only constraint is that when eSE is used or accessed (either via ISO or SPI), the modem hardware cannot enter in its deepest low power as the modem firmware controls the power supply of the ST4SIM-200M module.

Note: eSE applet is by default not present in ST4SIM-200M. To enable such a feature, the user must contact STMicroelectronics.

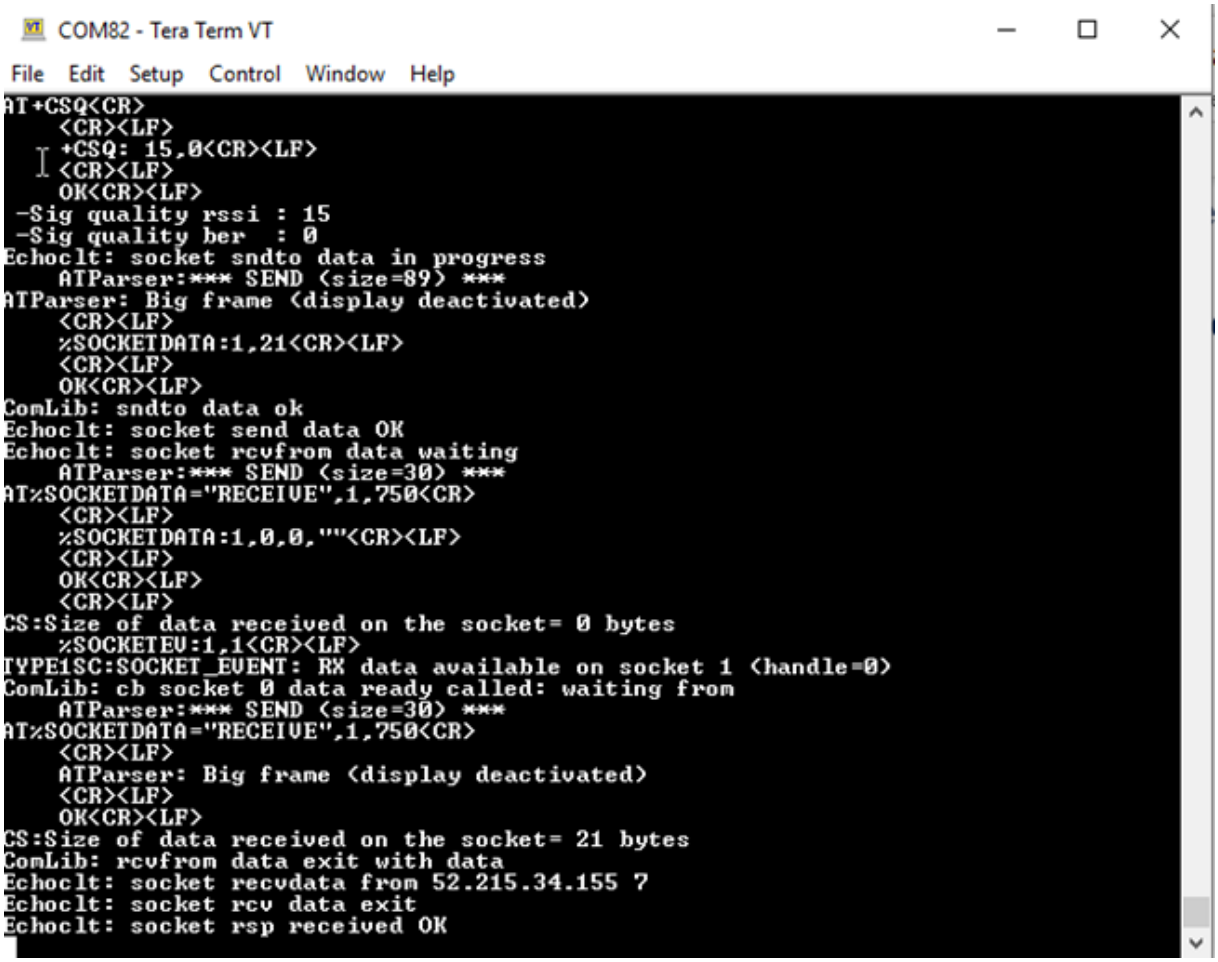
9.4 End-to-end connectivity

9.4.1 End-to-end data transfer

Once the cellular connectivity is activated and the device is registered on the network, the application pre-programmed on STM32 sends regularly (every 2 seconds) an echo message to an echo server located on the internet. The user can see the trace of the communication result as shown in the terminal window.

Note that the RSSI level is also monitored every 10 seconds and displayed (AT+CSQ) on the terminal console.

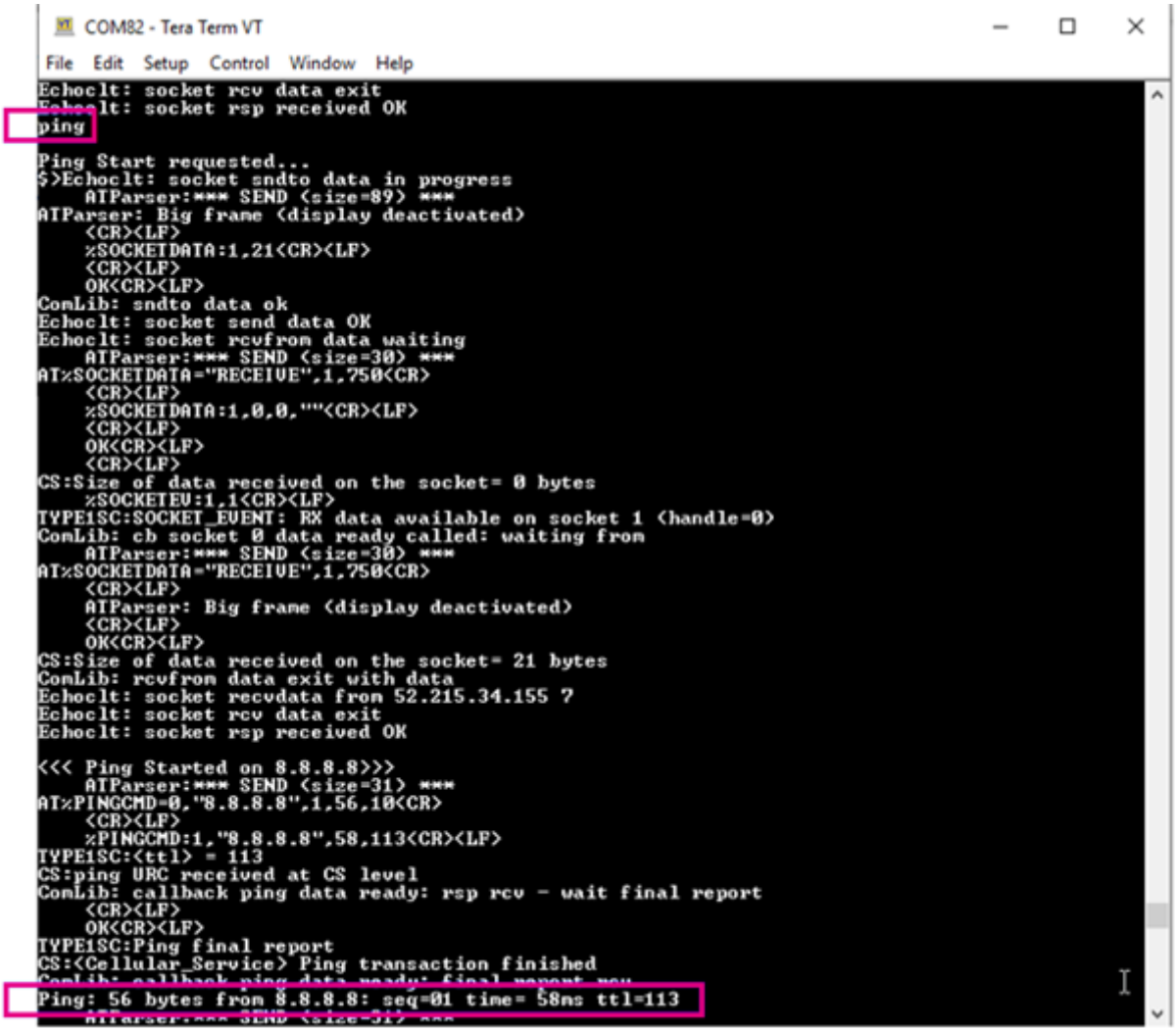
Figure 23. Terminal console trace



9.4.2 End-to-end ping

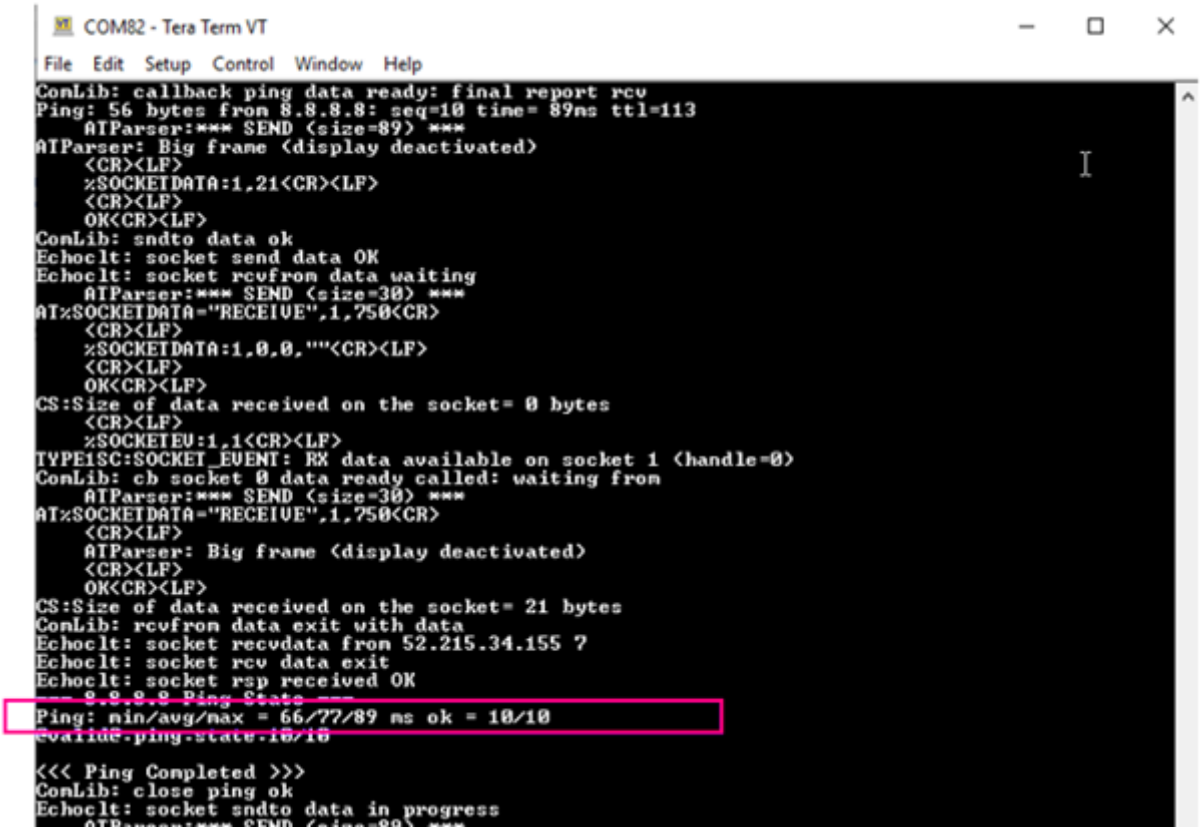
When registered to the network, the user can verify the quality (latency, round-trip) of the end-to-end internet connectivity by sending ICMP ping to a server reachable via the internet. By default, the device pings the Google DNS server at 8.8.8.8. For that, the user can enter the command *ping* using the terminal as shown in Figure 24.

Figure 24. Terminal console ping command



The user can also check the statistics min/average/max round-trip of 10 pings and displayed on the terminal as shown in Figure 25.

Figure 25. Terminal console ping command statistics



10 B-L462E-CELL1 board information

10.1 Product marking

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

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

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

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

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

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

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

10.2 Board revision history

Revision C03

The revision C03 of the MB1508 is the initially released version.

10.3 Known limitations

Revision C03

None

Appendix A B-L462E-CELL1 Discovery kit for IoT nodes I/O assignment

Note: The reader must refer to the latest version of the module datasheet to get the latest pin name. He can also use the latest version of the product specification from Murata.

Table 18. B-L462E-CELL1 Discovery kit for IoT nodes I/O assignment

LBAD0ZZ1SE pin number	LBAD0ZZ1SE pin name(1)	Feature/comment	Signal name of Discovery kit
1	USART2_RTS	PA1/USART2_RTS	USART2_RTS
2	USART2_RX	PA3/USART2_RX	USART2_RX
3	USART2_TX	PA2/USART2_TX	USART2_TX
4	USART2_CTS	PA0/USART2_CTS	USART2_CTS
5	VDDA	ADC power	AVDD
6	VSSA	ADC GND	GND
7	NRST	Reset STM32	NRST
8	NC	-	FFU_RFFE_SCLK(2)
9	NC	-	FFU_RFFE_SDATA(2)
10	GPIO_EXTI7	PC7/GPIO_EXTI7	GPIO_EXIT7
11	NC_RST_IND	Modem reset indicator (internal usage)	NC_RST_IND
12	NC	-	NC_UART0_RTS(2)
13	NC	-	NC_UART0_CTS(2)
14	NC	-	NC_UART0_TX(2)
15	NC	-	NC_UART0_RX(2)
16	RFT_UART2_CTS	Recovery UART_CTS	UART2_CTS
17	RFT_UART2_TX	Recovery UART_TX	UART2_TX
18	RFT_UART2_RTS	Recovery UART_RTS	UART2_RTS
19	RFT_UART2_RX	Recovery UART_RX	UART2_RX
20	NC	-	FFU_TX_IND(2)
21	NC	-	FFU_GNSS_COEX_IND(2)
22	NC	-	FFU_GNSS_EXT_LNA(2)
23	RFT_UART1_RTS	Log UART_RTS	UART1_RTS
24	RFT_UART1_TX	Log UART_TX	UART1_TX
25	RFT_UART1_RX	Log UART_RX	UART1_RX
26	RFT_UART1_CTS	Log UART_CTS	UART1_CTS
27	NC	-	NC_DWU(2)
28	GND	GND	GND
29	NC	-	NC_HWU(2)
30	NC	-	VDDIO_MDM(2)
31	NC	-	PCM_OUT(2)
32	NC	-	PCM_FS(2)
33	NC	-	PCM_IN(2)

LBAD0ZZ1SE pin number	LBAD0ZZ1SE pin name(1)	Feature/comment	Signal name of Discovery kit
34	NC	-	PCM_CLK(2)
35	NC	-	PMU_AT_OUT(2)
36	NC	-	PMU_VBACKUP(2)
37	PMU_AT_IN	Anti-tamper	PMU_AT_IN
38	NC	-	CLKOUT(2)
39	NC	-	NC_RST(2)
40	NC	-	FFU_GNSS_SFN_IND(2)
41	NC	-	NC_PWR_BUTTON
42	GND	GND	GND(2)
43	VDD	Module power	VDD_MD
44	VDD	Module power	VDD_MD
45	VDD	Module power	VDD_MD
46	GND	GND	GND
47	NC	-	FFU_PSM_IND(2)
48	NC	-	PB7_R(2)
49	NC_SIM_CLK	SIM clock	SIM_CLK
50	NC_VSIM	SIM power supply	VDD_SIM
51	GND	GND	GND
52	NC_SIM_DETECT	SIM detect	SIM_DETECT
53	NC_SIM_RST	SIM reset	SIM_RST
54	PH1_OSC_OUT	PH1/RCC_OSC_OUT	RST_DISP
55	PH0_OSC_IN	PH0/RCC_OSC_IN	PH0_OSC_IN
56	NC	-	FFU_RFFE_VDDIO(2)
57	NC_SIM_IO	SIM data	SIM_DATA
58	ADC1_IN1	PC0/ADC1_IN1	ADC1_IN1
59	ADC1_IN3	PC2/ADC1_IN3	ADC1_IN3
60	ADC1_IN2	PC1/ADC1_IN2	INT_ACC
61	ADC1_IN4	PC3/ADC1_IN4	INT_MAG
62	RTC_TAMP1	PC13/RTC_TAMP1	RTC_TAMP1
63	BOOT0	PH3/BOOT0	BOOT0
64	SF_EN	PB6/SF_EN	SF_EN
65	RCC_MCO	PA8/RCC_MCO	RCC_MCO
66	NC	-	I2C0_SCL(2)
67	NC	-	I2C0_SDA(2)
68	VDD_1V8	Reserved for codec supply/MCU VBAT/MCU VDDA	1V8_MD
69	I2C1_SDA	PB9/I2C1_SDA	I2C1_SDA
70	I2C1_SCL	PB8/I2C1_SCL	I2C1_SCL
71	VBAT	Backup supply	1V8_MD

LBAD0ZZ1SE pin number	LBAD0ZZ1SE pin name(1)	Feature/comment	Signal name of Discovery kit
72	SPI1_SCK	PA5/SPI1_SCK	SPI1_SCK
73	SPI1_MOSI	PB5/SPI1_MOSI	SPI1_MOSI
74	SPI1_MISO	PB4/SPI1_MISO/NJTRST	SPI1_MISO
75	SPI1_NSS	PA15/SPI1_NSS/JTDI	SPI1_NSS
76	TIM2_CH2	PB3/TIM2_CH2/JTDO/ TRACESWO	SWO
77	NC	-	D/C_DISP(2)
78	NC	-	SPI3_MOSI(2)
79	GND	GND	GND
80	NC	-	SPI3_SCK(2)
81	eSIM_SWP	SWP for NFC to ST33	eSIM_SWP
82	NC	-	SPI3_NSS(2)
83	NC	-	CS_DISP(2)
84	VDDUSB	3.3V supply for modem USB	3V3
85	SWCLK	PA14/JTCK/SWCLK	TCK/SWCLK
86	SWDIO	PA13/JTMS/SWDIO	TMS/SWDIO
87	USB_DP	PA12/USB_DP	USB_DP
88	USB_DM	PA11/USB_DM	USB_DM
89	USART1_RX	PA10/USART1_RX	STLK_RX
90	USART1_TX	PA9/USART1_TX	STLK_TX
91	TIM15_CH2	PB15/TIM15_CH2	LED2
92	TIM15_CH1	PB14/TIM15_CH1	LED3
93	TIM3_CH4	PC9/TIM3_CH4	TIM3_CH4
94	TIM3_CH1	PC6/TIM3_CH1	LED1
95	QUADSPI_IO0	PB1/QUADSPI_BK1_IO0	QSPI_IO0
96	QUADSPI_CLK	PB10/QUADSPI_CLK	QSPI_CLK
97	QUADSPI_nCS	PB11/QUADSPI_BK1_NCS	QSPI_NCS
98	SF_nCS	Internal serial flash chip select	SF_nCS
99	QUADSPI_IO1	PB0/QUADSPI_BK1_IO1	QSPI_IO1
100	QUADSPI_IO3	PA6/QUADSPI_BK1_IO3	QSPI_IO3
101	QUADSPI_IO2	PA7/QUADSPI_BK1_IO2	QSPI_IO2
102-126	GND	GND	GND

1. *Pin name may be updated, refer to the latest version of module datasheet.*
2. *Signals are only for debug or internal usage.*

Appendix B STMod+fan-out expansion board

Refer to the user manual *STMod+ fan-out expansion board for STM32 Discovery kits and Evaluation boards* (UM2695).

Appendix C Antenna parameters

Figure 26. **Electrical and physical properties**

Electrical Properties	
Frequency	698~960/1561/1575.42/1602 /1710~2170 2300~2700MHz
Impedance	50 0hm Nominal
V.S.W.R	⩽1.92/3.0
Return Loss	-6/-10 dB Max
Radiation	Omni-directional
Gain (Peak)	3 dBi
Polarization	Linear, Vertical
Admitted Power	2 W
Connector	SMA Plug

Physical Properties	
Antenna Material	ABS/PC/PBT
Antenna Color .	Black
Cable Type	RG-178
Operating Temp	-40 ~ +85 °C
Storage Temp	-40 ~ +85 °C

Figure 27. **S-parameter test**

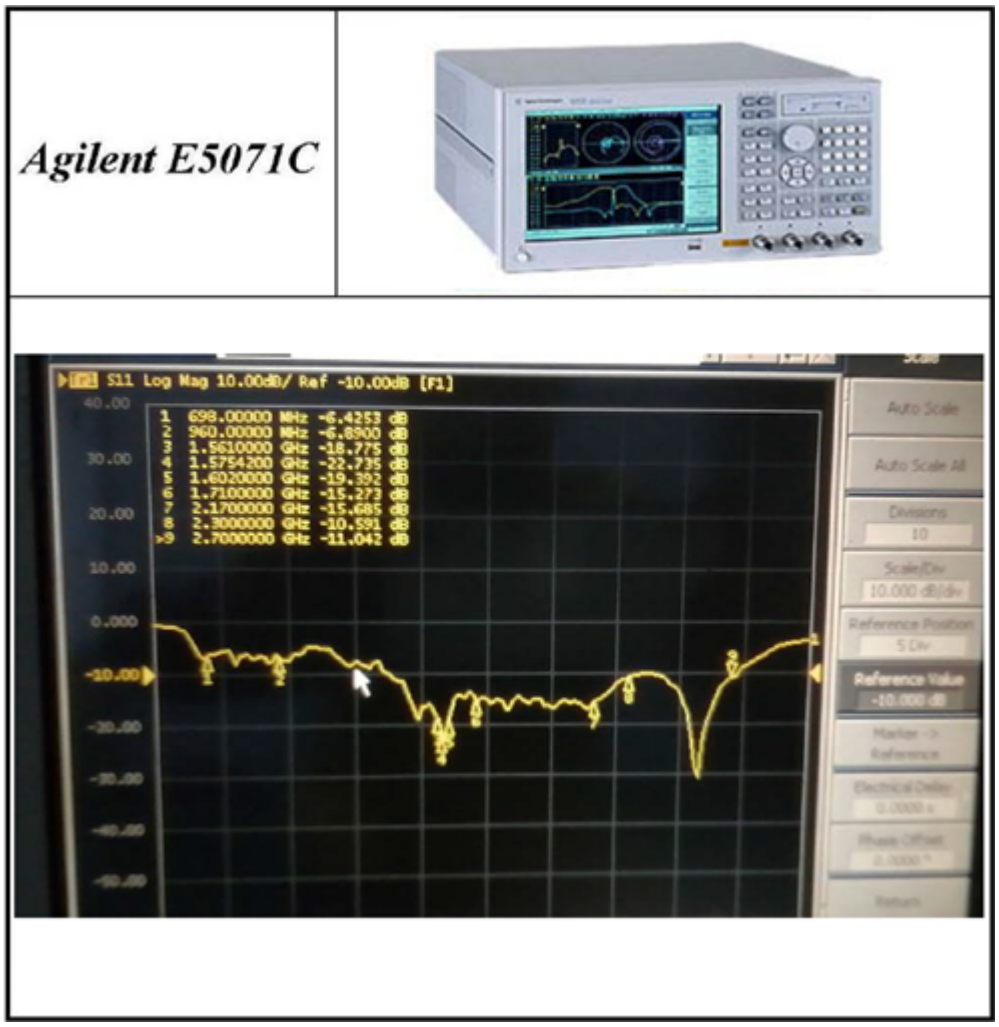
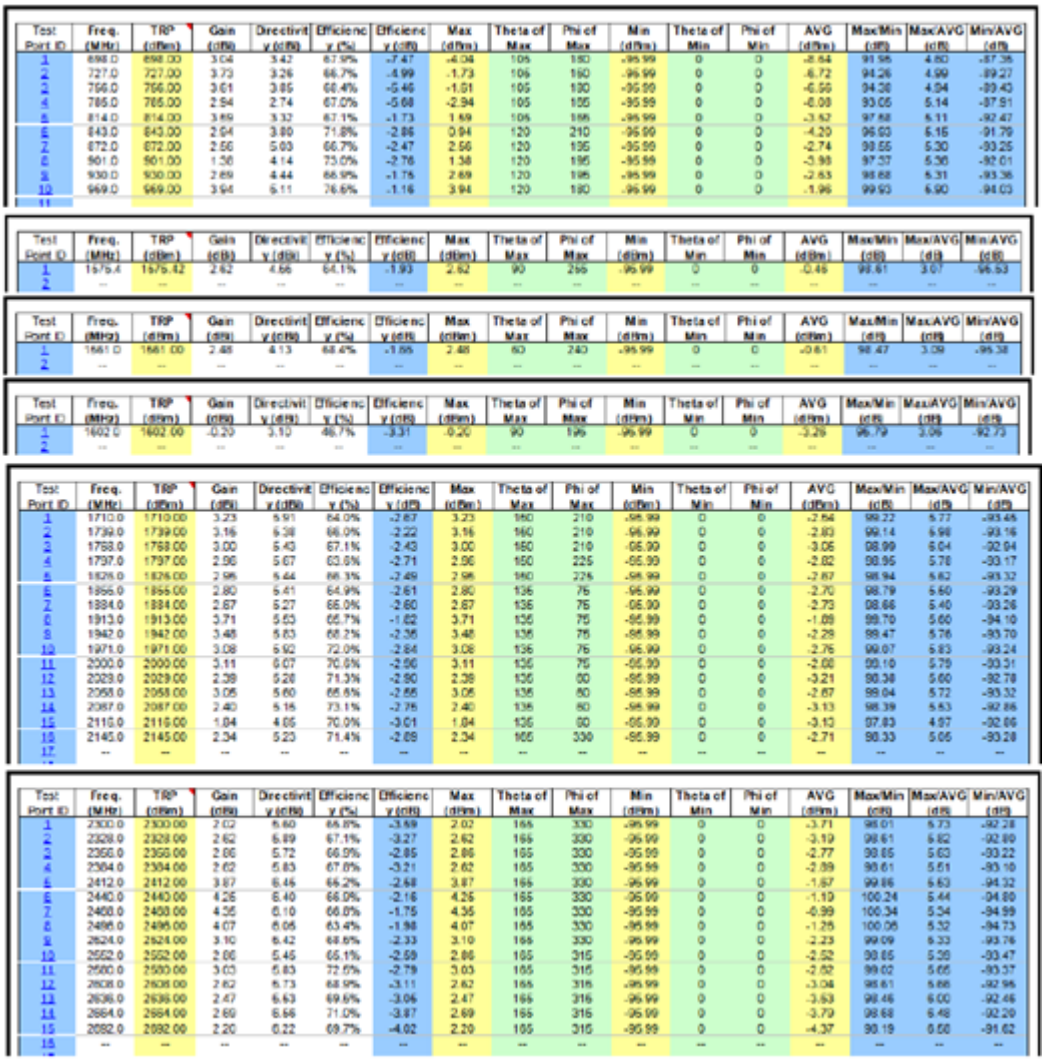


Figure 28. **Test efficiency**



Test Port ID	Freq. (MHz)	TRP (dBm)	Gain (dBi)	Directivity (dBi)	Efficiency (%)	Efficiency (dB)	Max (dBm)	Theta of Max	Phi of Max	Min (dBm)	Theta of Min	Phi of Min	AVG (dBm)	Max/Min (dB)	Max/AVG (dB)	Min/AVG (dB)
1	698.0	698.00	3.04	3.42	87.9%	-0.47	-4.04	105	160	-99.99	0	0	-2.64	91.95	4.80	-97.35
2	727.0	727.00	3.73	3.26	86.7%	-0.99	-1.73	105	160	-99.99	0	0	-6.72	94.26	4.99	-99.27
3	756.0	756.00	3.61	3.85	88.4%	-0.46	-1.51	105	160	-99.99	0	0	-6.56	94.38	4.84	-99.40
4	785.0	785.00	2.54	2.74	87.0%	-0.68	-2.94	105	155	-99.99	0	0	-6.08	93.05	5.14	-97.91
5	814.0	814.00	3.69	3.32	87.1%	-0.73	1.69	105	155	-99.99	0	0	-3.62	97.68	5.11	-97.47
6	843.0	843.00	2.64	3.80	71.8%	-2.86	0.94	120	210	-99.99	0	0	-4.20	96.63	5.15	-91.79
7	872.0	872.00	2.56	5.03	66.7%	-2.47	2.56	120	195	-99.99	0	0	-2.74	99.55	5.30	-93.25
8	901.0	901.00	1.36	4.14	73.0%	-2.76	1.38	120	195	-99.99	0	0	-5.98	97.37	5.36	-92.01
9	930.0	930.00	2.69	4.44	68.9%	-1.75	2.69	120	195	-99.99	0	0	-2.63	98.68	5.31	-93.36
10	959.0	959.00	3.94	5.11	76.6%	-1.16	3.94	120	180	-99.99	0	0	-1.96	99.93	5.90	-94.03
11																

Test Port ID	Freq. (MHz)	TRP (dBm)	Gain (dBi)	Directivity (dBi)	Efficiency (%)	Efficiency (dB)	Max (dBm)	Theta of Max	Phi of Max	Min (dBm)	Theta of Min	Phi of Min	AVG (dBm)	Max/Min (dB)	Max/AVG (dB)	Min/AVG (dB)
1	1575.4	1575.42	2.62	4.66	64.1%	-1.93	2.62	90	255	-99.99	0	0	-0.46	99.61	3.07	-96.53
2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Test Port ID	Freq. (MHz)	TRP (dBm)	Gain (dBi)	Directivity (dBi)	Efficiency (%)	Efficiency (dB)	Max (dBm)	Theta of Max	Phi of Max	Min (dBm)	Theta of Min	Phi of Min	AVG (dBm)	Max/Min (dB)	Max/AVG (dB)	Min/AVG (dB)
1	1661.0	1661.00	2.48	4.13	68.4%	-1.65	2.48	60	240	-99.99	0	0	-0.61	98.47	3.09	-96.38
2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Test Port ID	Freq. (MHz)	TRP (dBm)	Gain (dBi)	Directivity (dBi)	Efficiency (%)	Efficiency (dB)	Max (dBm)	Theta of Max	Phi of Max	Min (dBm)	Theta of Min	Phi of Min	AVG (dBm)	Max/Min (dB)	Max/AVG (dB)	Min/AVG (dB)
1	1602.0	1602.00	-0.20	3.10	46.7%	-3.31	-0.20	90	195	-99.99	0	0	-3.26	99.79	3.06	-92.73
2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Test Port ID	Freq. (MHz)	TRP (dBm)	Gain (dBi)	Directivity (dBi)	Efficiency (%)	Efficiency (dB)	Max (dBm)	Theta of Max	Phi of Max	Min (dBm)	Theta of Min	Phi of Min	AVG (dBm)	Max/Min (dB)	Max/AVG (dB)	Min/AVG (dB)
1	1710.0	1710.00	3.23	5.91	84.0%	-0.67	3.23	160	210	-99.99	0	0	-2.54	99.22	5.77	-93.45
2	1739.0	1739.00	3.16	6.38	86.0%	-0.22	3.16	160	210	-99.99	0	0	-2.83	99.14	5.98	-93.16
3	1768.0	1768.00	3.00	5.43	87.1%	-0.43	3.00	160	210	-99.99	0	0	-3.05	98.99	6.04	-92.94
4	1797.0	1797.00	2.96	5.67	83.8%	-0.71	2.96	160	225	-99.99	0	0	-3.02	98.95	5.78	-93.17
5	1826.0	1826.00	2.98	5.44	86.3%	-0.49	2.98	160	225	-99.99	0	0	-2.87	98.84	5.62	-93.32
6	1855.0	1855.00	2.80	5.41	84.9%	-0.61	2.80	135	75	-99.99	0	0	-2.70	98.79	5.50	-93.29
7	1884.0	1884.00	2.67	5.27	86.0%	-0.60	2.67	135	75	-99.99	0	0	-2.73	98.66	5.40	-93.26
8	1913.0	1913.00	3.71	5.63	86.7%	-1.62	3.71	135	75	-99.99	0	0	-1.69	99.70	5.60	-94.10
9	1942.0	1942.00	3.46	5.63	86.2%	-0.35	3.46	135	75	-99.99	0	0	-2.28	99.47	5.76	-93.70
10	1971.0	1971.00	3.08	5.92	72.0%	-2.84	3.08	135	75	-99.99	0	0	-2.76	99.07	5.83	-93.24
11	2000.0	2000.00	3.11	6.07	70.6%	-2.90	3.11	135	75	-99.99	0	0	-2.68	99.10	5.79	-93.31
12	2029.0	2029.00	2.38	5.28	71.3%	-2.90	2.38	135	60	-99.99	0	0	-3.21	98.38	5.60	-92.78
13	2058.0	2058.00	3.05	5.60	65.5%	-2.85	3.05	135	60	-99.99	0	0	-2.67	99.04	5.72	-93.32
14	2087.0	2087.00	2.40	5.15	73.1%	-2.75	2.40	135	60	-99.99	0	0	-3.13	98.39	5.53	-92.86
15	2116.0	2116.00	1.84	4.65	70.0%	-3.01	1.84	135	60	-99.99	0	0	-3.10	97.83	4.97	-92.66
16	2145.0	2145.00	2.34	5.23	71.4%	-2.69	2.34	165	330	-99.99	0	0	-2.71	98.33	5.05	-93.28
17	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Test Port ID	Freq. (MHz)	TRP (dBm)	Gain (dBi)	Directivity (dBi)	Efficiency (%)	Efficiency (dB)	Max (dBm)	Theta of Max	Phi of Max	Min (dBm)	Theta of Min	Phi of Min	AVG (dBm)	Max/Min (dB)	Max/AVG (dB)	Min/AVG (dB)
1	2300.0	2300.00	2.62	6.60	66.8%	-1.59	2.62	165	330	-99.99	0	0	-3.71	98.61	6.33	-92.28
2	2328.0	2328.00	2.62	6.89	67.1%	-1.27	2.62	165	330	-99.99	0	0	-3.19	98.61	5.82	-92.80
3	2356.0	2356.00	2.86	5.72	66.9%	-1.85	2.86	165	330	-99.99	0	0	-2.77	98.85	5.63	-93.22
4	2384.0	2384.00	2.62	6.83	67.0%	-1.21	2.62	165	330	-99.99	0	0	-2.89	98.61	5.51	-93.10
5	2412.0	2412.00	3.87	6.46	66.2%	-1.68	3.87	165	330	-99.99	0	0	-1.67	99.86	5.53	-94.32
6	2440.0	2440.00	4.25	6.40	66.0%	-1.16	4.25	165	330	-99.99	0	0	-1.19	100.24	5.44	-94.89
7	2468.0	2468.00	4.35	6.10	66.8%	-1.75	4.35	165	330	-99.99	0	0	-0.99	100.34	5.34	-94.99
8	2496.0	2496.00	4.07	6.06	63.4%	-1.98	4.07	165	330	-99.99	0	0	-1.26	100.06	5.32	-94.73
9	2624.0	2624.00	3.10	6.42	68.8%	-2.33	3.10	165	330	-99.99	0	0	-2.23	99.09	5.33	-93.76
10	2552.0	2552.00	2.86	5.45	65.1%	-2.59	2.86	165	315	-99.99	0	0	-2.52	98.85	5.09	-93.47
11	2580.0	2580.00	3.03	5.83	72.5%	-2.79	3.03	165	315	-99.99	0	0	-2.52	99.02	5.05	-93.57
12	2608.0	2608.00	2.62	6.73	68.9%	-3.11	2.62	165	315	-99.99	0	0	-3.04	98.61	5.66	-92.96
13	2636.0	2636.00	2.47	6.63	69.6%	-3.06	2.47	165	315	-99.99	0	0	-3.63	98.46	6.00	-92.46
14	2664.0	2664.00	2.69	6.66	71.0%	-3.87	2.69	165	315	-99.99	0	0	-3.79	98.68	6.48	-92.20
15	2692.0	2692.00	2.20	6.22	69.7%	-4.02	2.20	165	315	-99.99	0	0	-4.37	98.19	6.58	-91.62
16	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Appendix D Federal Communications Commission (FCC) and Innovation, Science and Economic Development Canada (ISED) Compliance Statements

For FCC and ISED regulatory information regarding embedded LBAD0ZZ1SE Murata module, refer to section 10 of LBAD0ZZ1SE-493 Product Specification No. JEBMM0 1897, Dec 2, 2020.

D.1 FCC Compliance Statement

Part 15.19

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

Part 15.21

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

Part 15.105

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

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

Note: Use only shielded cables.

Responsible party (in the USA)

Terry Blanchard
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Telephone: +1 972-466-7845

D.2 ISED Compliance Statement

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

Compliance Statement

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

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

Déclaration de conformité

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

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

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.

D.3 CE / RED

EN 55032 / CISPR32 (2012) Class B product

Warning: this device is compliant with Class B of EN55032 / CISPR32. In a residential environment, this equipment may cause radio interference.

Avertissement : cet équipement est conforme à la Classe B de la EN55032 / CISPR 32. Dans un environnement résidentiel, cet équipement peut créer des interférences radio.

Simplified CE declaration of conformity:

ST Microelectronics hereby declares that the device B-L462E-CELL1 conforms with the essential requirements of Directive 2014/53/EU. The declaration of conformity can be found at *www.st.com*.

Revision history

Table 19. **Document revision history**

Date	Revision	Changes
23-Mar-2021	1	Initial release.

Contents

List of tables

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