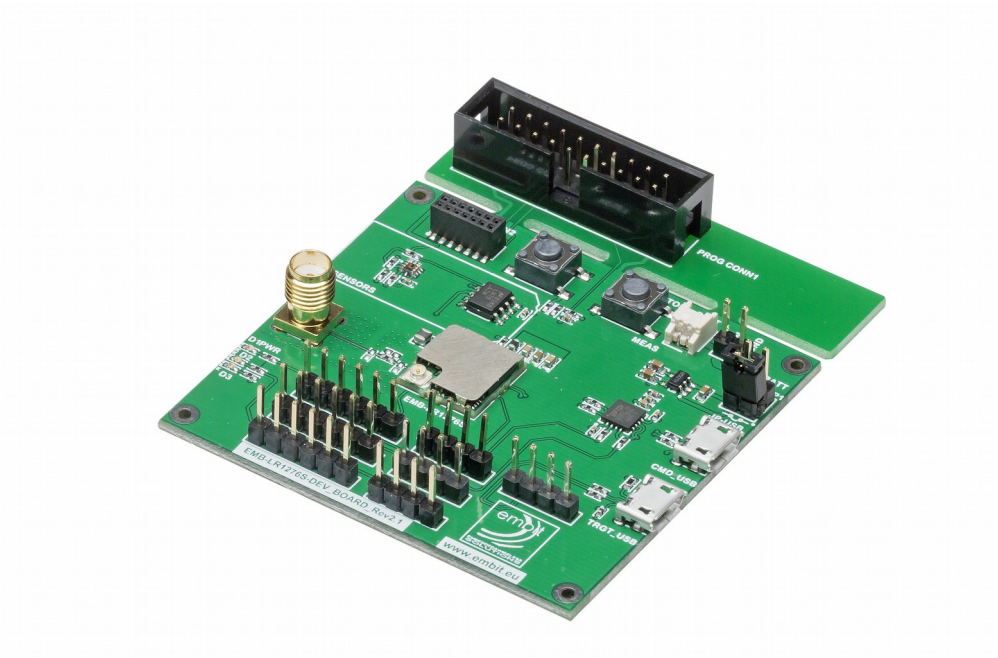
EMB-LR1276S Dev Board
User Guide

Rev. 2.1



Embit s.r.l.

Document information

Versions & Revisions

Revision	Date	Author	Comments
0.1	2019-02-18	Embit-MDD	Initial release
1.0	2019-05-03	Embit-MDD	Revision 1.0
2.0	2019-04-17	Embit-MDD	Revision 2.0
2.1	2019-07-30	Embit-MDD	Revision 2.1

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1 Introduction

The Evaluation Board **EMB-LR1276S Dev Board** allows the user to exploit all the capabilities of Embit's module **EMB-LR1276S** [1], simplifying the implementation of a prototype of a LoRa® communication system.

The board provides a simple connection to a computer or an external processor via USB. For testing purpose, several pin headers are present to exploit the capabilities of the module and ease the development of custom designs.

2 Description

2.1 Kit Overview

The **EMB-LR1276S Dev Board** is a hardware platform to evaluate the Embit's LoRa® module **EMB-LR1276S**.

The kit (Figure 1) contains:

- 2 EMB-LR1276S Dev Board (A)
- 2 external 868 MHz antenna (B)
- 2 USB type A to Micro-B cable (C)
- 2 Pigtail connectors (D)
- 1 Segger J-Link Lite Programmer (with flat cable and mini USB cable) (E)

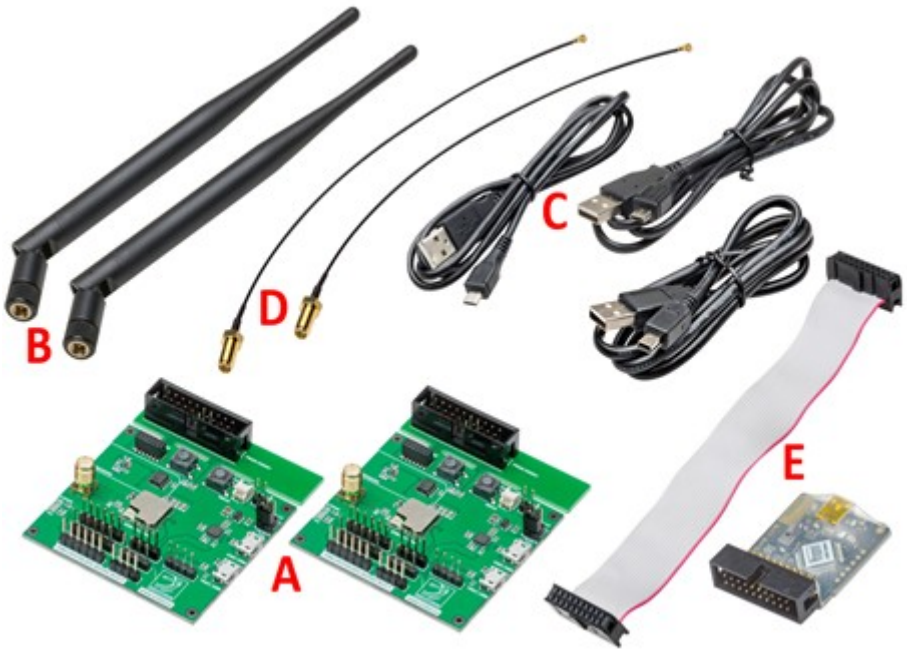

Figure 1. EMB-LR1276S Evaluation Kit.

2.2 Hardware and Layout Configuration

Figure 2 illustrates the connections between the **EMB-LR1276S** and the peripherals (LEDs, push buttons, antenna, debugger, USB 2.0 Micro-B connector, external battery) placed on the board as indicated in Figure 3.

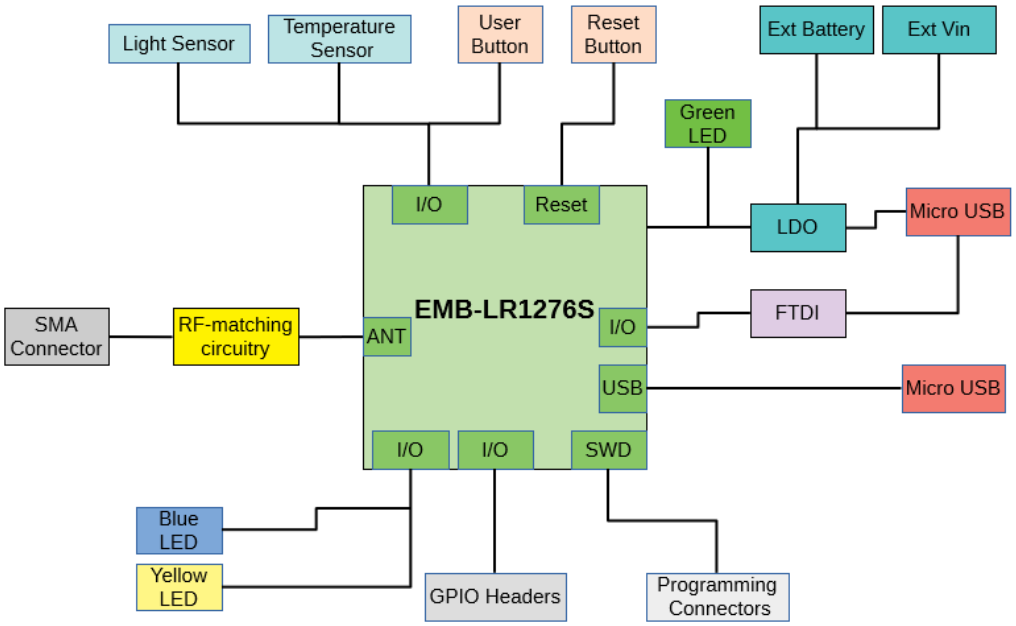

Figure 2. EMB-LR1276S Dev Board Rev 2.1 block diagram.

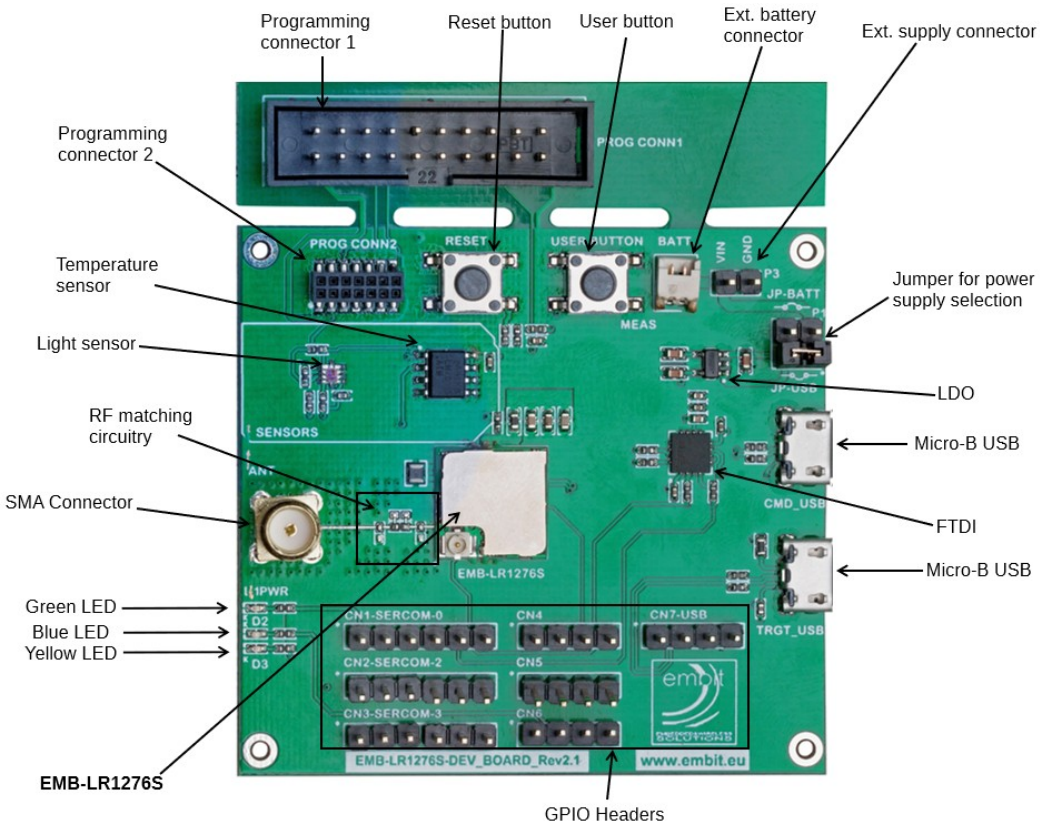

Figure 3. EMB-LR1276S Dev Board Rev 2.1 layout configuration.

3 Hardware User Guide

3.1 EMB-LR1276S

EMB-LR1276S (Figure 4) is the new sub-1GHz **Embit**'s wireless module that supports the **LoRaWAN®** long range wireless protocol. It comes in a very small form factor (11.5 x 11.5 mm) and integrates all the costumers needs to develop complete and secure solutions.

Please refer to **EMB-LR1276S** datasheet [1] for detailed description.

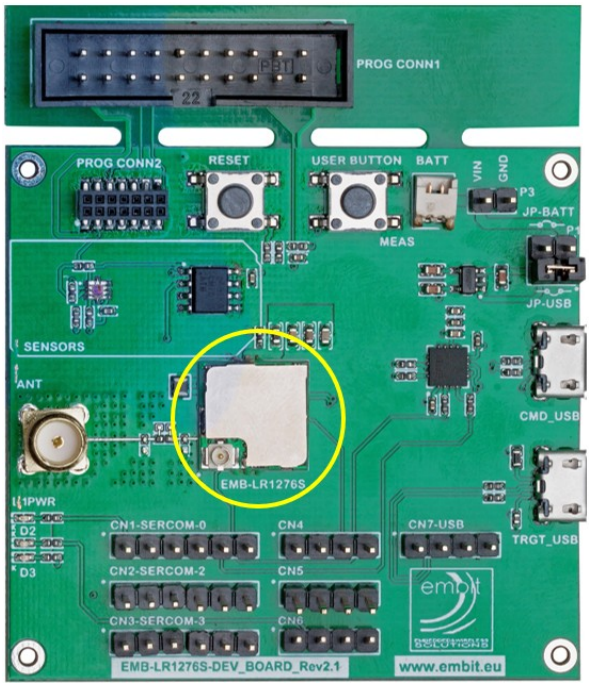

Figure 4. EMB-LR1276S.

3.2 Power Supply Connectors

The **EMB-LR1276S Dev Board** is designed to be powered in various ways:

- CMD_USB (Micro-B USB connector)
- TRGT_USB (Micro-B USB connector)
- External header (P3)
- External battery (BATT)

3.2.1 CMD_USB and TRGT_USB Connectors

The board circuitry can be powered directly form a USB bus by plugging the micro USB cable to one of the USB connector, CMD_USB or TRGT_USB (Figure 5).

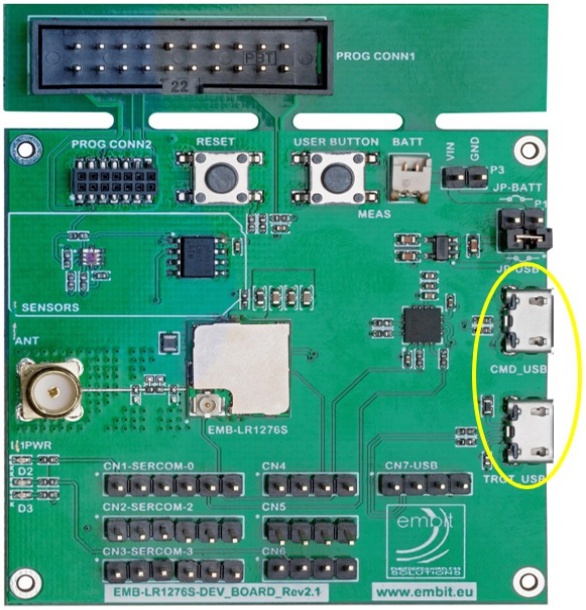

Figure 5. CMD_USB and TRGT_USB connectors.

The power line on the board is regulated with a 3.3V dc linear regulator. Be sure that the USB supply is capable to deliver enough current to supply the module.

When the board is powered from one of the USB connector, the jumper must be fitted on *JP-USB* of P1.

3.2.2 External Header (P3)

The board can be powered also using the Header P3 (Figure 6) with a maximum of 6V. The pin on the right (as shown in the figure) is ground, the pin on the left is Vin.

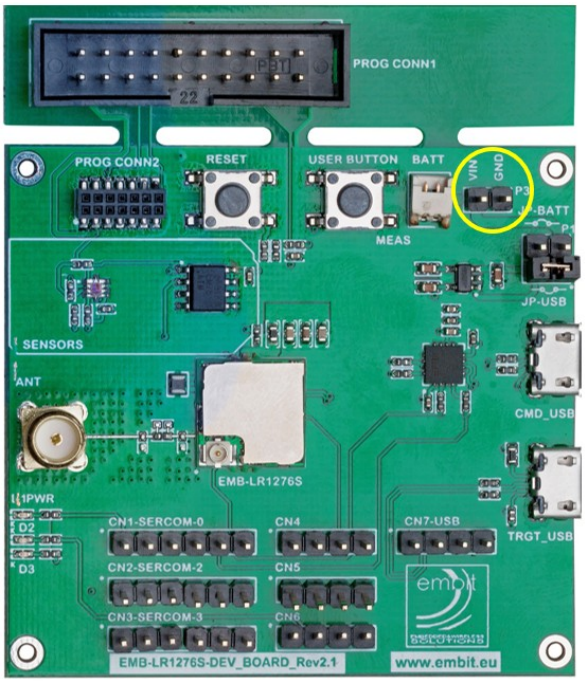

Figure 6. External header P3.

When the board is powered from this header, the jumper must be fitted on *JP-BATT* of P1.

3.2.3 External Battery (BATT)

It is possible to plug an external battery to the BATT connector, 1.25mm pitch (Figure 7).

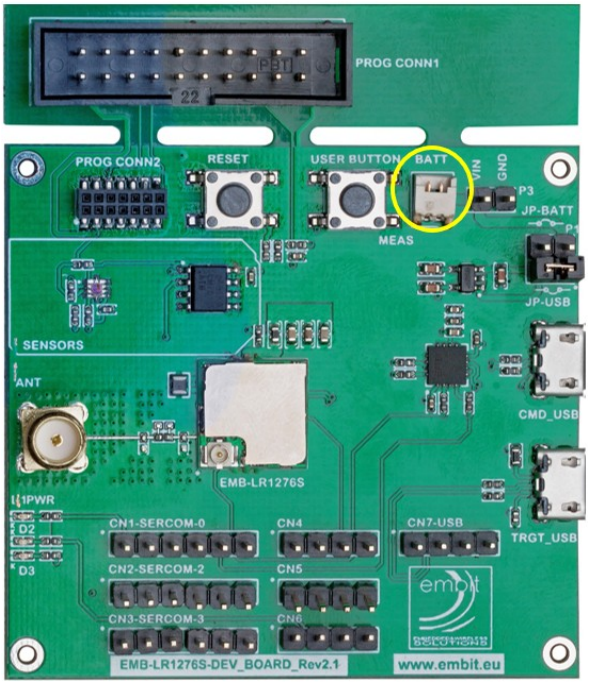

Figure 7. External battery connector.

Please be sure that the orientation of the battery is correct before to plug it in to the connector. Ground pin is on the right, Vdd pin is on the left. Battery voltage **must not** exceed 6V.

When the board is powered from this header, the jumper must be fitted on *JP-BATT* of P1.

3.3 Communication Interfaces

The **EMB-LR1276S Dev Board** headers CN1 (Figure 8), CN2 (Figure 9), CN3 (Figure 10), CN4 (Figure 11), CN5 (Figure 12), CN6 (Figure 13), CN7 (Figure 14) offer access to the I/O of the microcontroller in order to expand the board (e.g., by connecting sensors). The headers have a standard pitch of 2.54 mm.

Please note that not all the Sercom pins support I2C mode.

Pins Supporting I2C HS Mode
A5, A6, C3, G3, E4

3.3.1 CN1-SERCOM-0

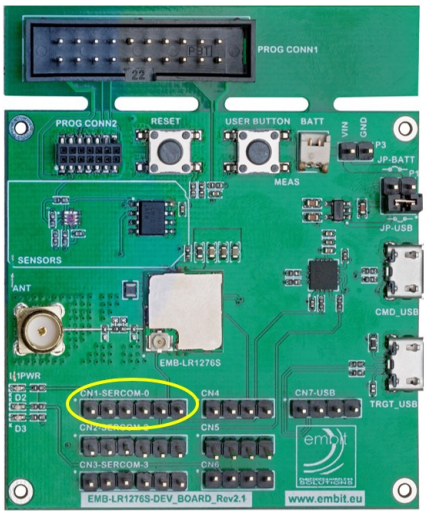

Figure 8. CN1 - Sercom0 header.

Pin	Pin Name	EMB-LR1276S Pin	Type	Functionality
1	Vdd	-	Power	+3.3V
2	PA04	A1	Analog Input or Digital I/O	AIN4 AIN0 SERCOM0[Pad0] PA04
3	PA05	A2	Analog Input or Digital I/O	AIN5 AIN1 SERCOM0[Pad1] PA05
4	PA06	A3	Analog Input or Digital I/O	AIN6 AIN2 SERCOM0[Pad2] PA06
5	PA07	A4	Analog Input or Digital I/O	AIN7 AIN3 SERCOM0[Pad3] PA07
6	GND	-	Power (Ground)	GND

3.3.2 CN2-SERCOM-2

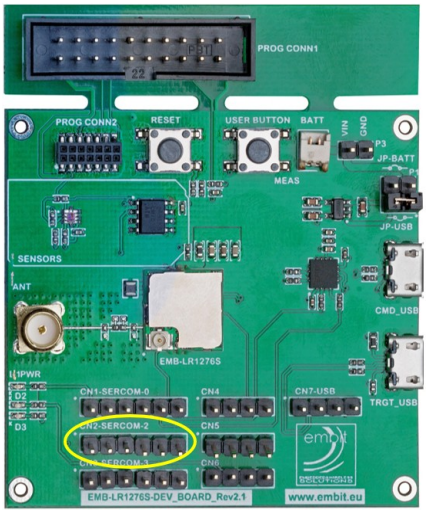

Figure 9. CN2 - Sercom2 header.

Pin	Pin Name	EMB-LR1276S Pin	Type	Functionality
1	Vdd	-	Power	+3.3V
2	PA08	A5	Analog Input or Digital I/O	AIN16 SERCOM0[Pad0] SERCOM2[Pad0] PA08
3	PA09	A6	Analog Input or Digital I/O	AIN17 SERCOM0[Pad1] SERCOM2[Pad1] PA09
4	PA14	C2	Digital I/O	SERCOM2[Pad2] SERCOM4[Pad2] PA14
5	PA15	C1	Digital I/O	SERCOM2[Pad3] SERCOM4[Pad3] PA15
6	GND	-	Power (Ground)	GND

3.3.3 CN3-SERCOM-3

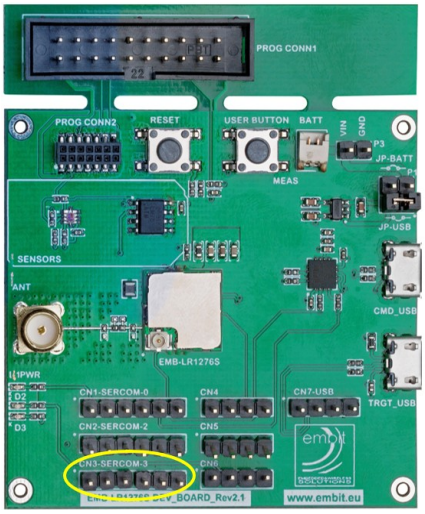

Figure 10. CN3 - Sercom3 header.

Pin	Pin Name	EMB-LR1276S Pin	Type	Functionality
1	Vdd	-	Power	+3.3V
2	PA22	G3	Digital I/O	SERCOM3[Pad0] SERCOM5[Pad0] PA22
3	PA23	E4	Analog Input or Digital I/O	SERCOM3[Pad1] SERCOM5[Pad1] PA23
4	PA18	G2	Digital I/O	SERCOM1[Pad2] SERCOM3[Pad2] PA18
5	PA19	D1	Digital I/O	SERCOM1[Pad3] SERCOM3[Pad3] PA19
6	GND	-	Power (Ground)	GND

3.3.4 CN4

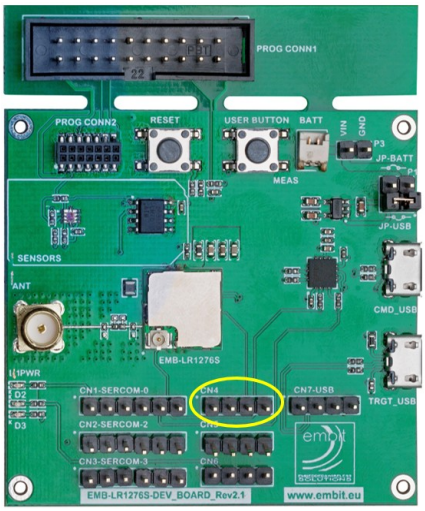

Figure 11. CN4 header.

Pin	Pin Name	EMB-LR1276S Pin	Type	Functionality
1	Vdd	-	Power	+3.3V
2	-	-	-	Not Connected
3	PB03	C6	Analog Input or Digital I/O	AIN11 SERCOM5[Pad1] PB03
4	GND	-	Power (Ground)	GND

3.3.5 CN5

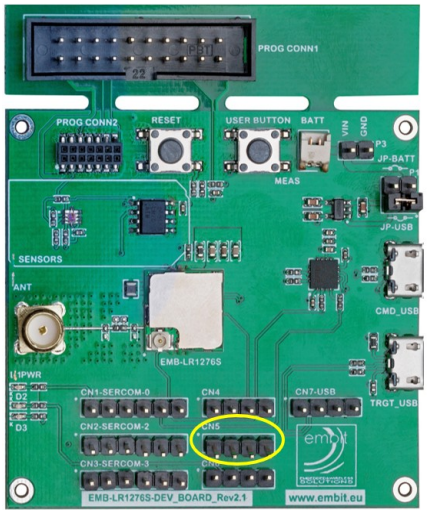

Figure 12. CN5 header.

Pin	Pin Name	EMB-LR1276S Pin	Type	Functionality
1	Vdd	-	Power	+3.3V
2	PA30_SW CLK	D4	Digital I/O - JTAG	SERCOM1[Pad2] PA30 SWCLK
3	PA31_SW DIO	D5	Digital I/O - JTAG	SERCOM1[Pad3] PA31 SWDIO
4	GND	-	Power (Ground)	GND

3.3.6 CN6

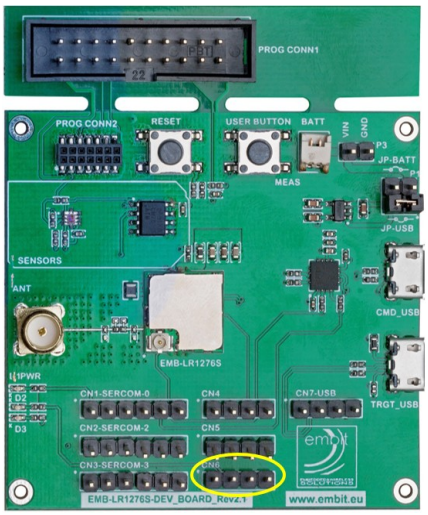

Figure 13. CN6 header.

Pin	Pin Name	EMB-LR1276S Pin	Type	Functionality
1	PB23	C5	Digital I/O	SERCOM5[Pad3] PB23
2	PA13	C3	Digital I/O	SERCOM2[Pad1] SEFCOM4[Pad1] PA13
3	PB02	E6	Analog Input or Digital I/O	AIN10 SERCOM5[Pad0] PB02
4	GND	-	Power (Ground)	GND

3.3.7 CN7-USB

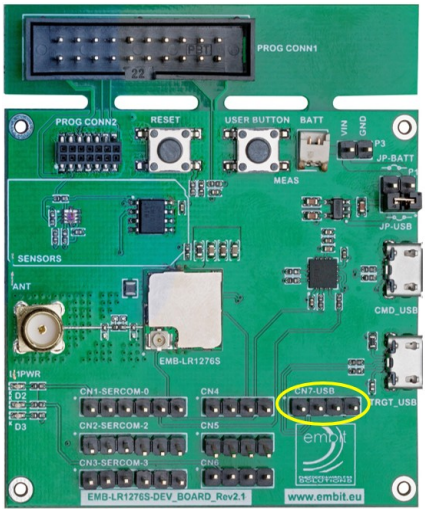

Figure 14. CN7 - USB header.

Pin	Pin Name	EMB-LR1276S Pin	Type	Functionality
1	PA24	D3	Digital I/O	SERCOM3[Pad2] SERCOM5[Pad2] USB_P PA25
2	PA25	D2	Digital I/O	SERCOM3[Pad3] SERCOM5[Pad3] USB_N PA24
3	PA15	C1	Digital I/O	SERCOM2[Pad3] SERCOM4[Pad3] PA15
4	GND	-	Power (Ground)	GND

3.4 Debugging Interface Connectors

On the **EMB-LR1276S Dev Board** there are 2 types of connector for programming the module. One of this is the standard JTAG connector 2x10 ways 2.54mm pitch male header (Figure 15a).

The second one has a custom pin-out specifically designed by Embit in order to provide compatibility with every microcontroller used in Embit's module. The connector is a 2x7 ways 1.27mm pitch female header (Figure 15b). With the adapter (Embit Multiprog), the debug hardware associated with the microcontroller (*ATSAMR34* in this case) can be connected to the board. In this case the JTAG connector (PROG CONN1) is not needed and you can cut the part of the PCB which includes this connect making the board smaller.

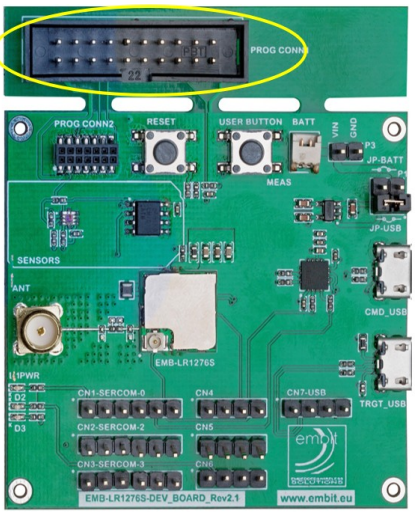

Figure 15a. Debugging interface connector JTAG.

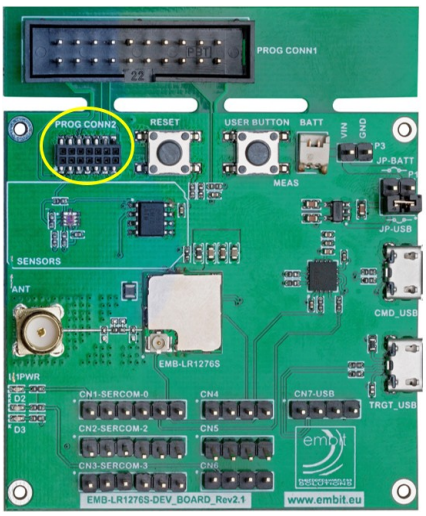

Figure 15b. Debugging interface connector for Embit Multiprog.

3.5 Direct USB

For USB applications, there is a directly connected USB port designated TRGT_USB exposed as a Micro-B jack (Figure 16).

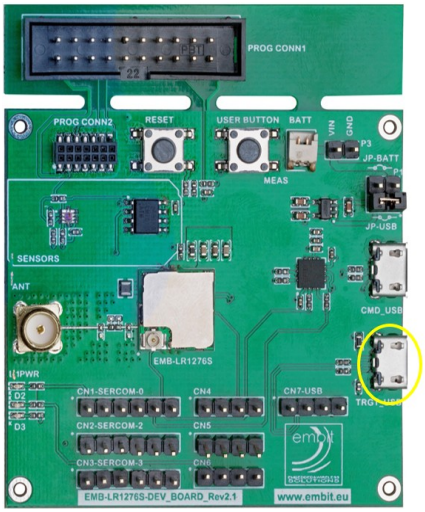

Figure 16. Direct USB connector.

The USB lines are also routed to the header CN7-USB.

3.6 USB to UART connector

This connector, designated CMD_USB and exposed as a Micro-B jack (Figure 17), allows to access from a PC to the SERCOM0 (UART) of the module through a virtual serial port over USB (FTDI USB-to-Serial UART converter). The UART to USB conversion implements a full UART with hardware flow control (TX, RX, RTS, CTS). Those UART lines are also routed to the header CN1-SERCOM-0.

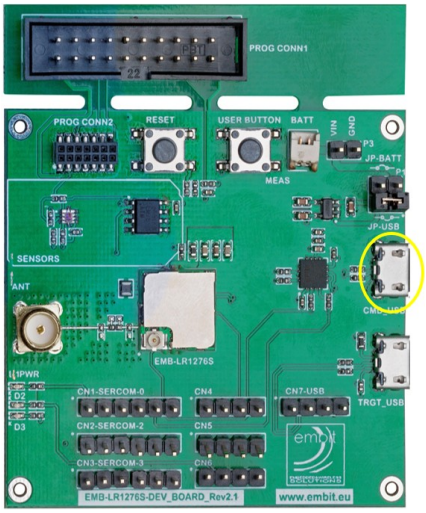

Figure 17. USB-to-Uart connector.

3.7 On Board Sensors

On the **EMB-LR1276S Dev Board** there are two sensors (Figure 18):

- Digital Temperature Sensor (*LM75A* by Texas Instruments)[3]
- Light Sensor (*Si1141-A11* by Silicon Labs) [4]

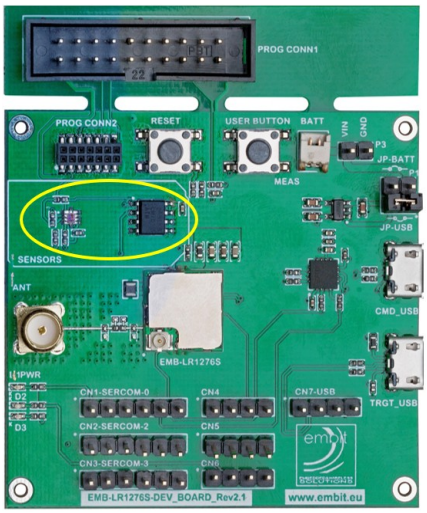

Figure 18. Light and temperature sensors.

Both sensors use the I2C bus and they are connected to A5 (SDA) and A6 (SCL) pins of the **EMB-LR1276S** module.

SERCOM-2 is used to communicate with the sensors.

3.8 User Button

The User Button (Figure 19) is connected to one GPIO that can handle interrupts. By pushing the button the corresponding line is grounded.

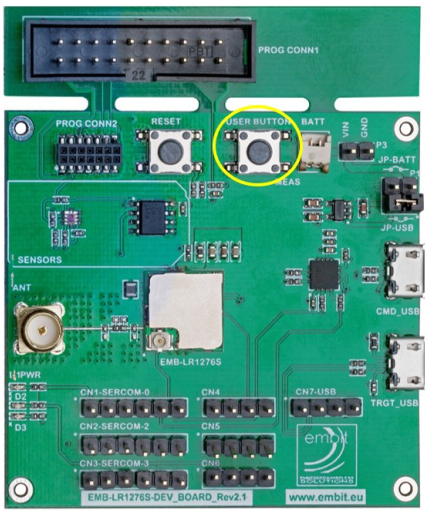

Figure 19. User button.

Button	Signal	EMB-LR1276S Pin	Type
User Button	PB23	C5	Input

3.9 LEDs

There are three LEDs on the board (Figure 20):

- *D1*: Green LED, it lights up when the board is powered
- *D2*: Blue LED, it is connected to a GPIO line
- *D3*: Yellow LED, it is connected to a GPIO line

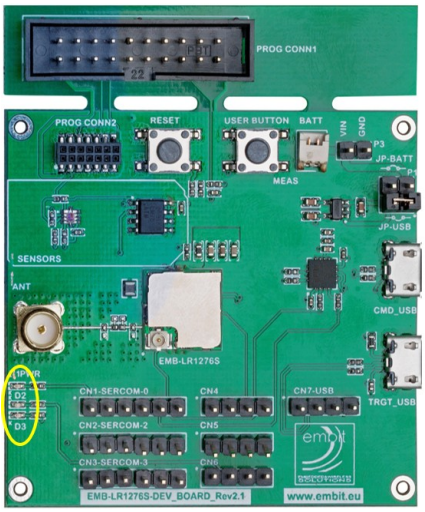

Figure 20. LEDs.

LED	Signal	EMB-LR1276S Pin	Color
D1	3.3V	-	Green
D2	PA13	C3	Blue
D3	PB02	E6	Yellow

3.10 RESET

The hardware reset of the module can be forced by pressing the RESET button (Figure 21). The switch signal is kept high by a 10kOhm pull-up resistor and the signal is routed to the RESET# pin on the module (E5) through a 1kOhm series resistor. By pressing the RESET button the RESET# line is grounded.

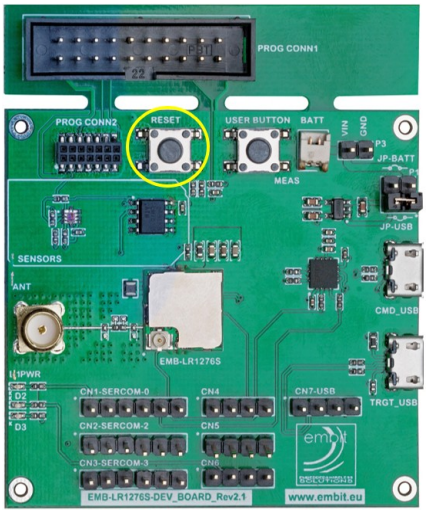

Figure 21. Reset button.

The programming interface is allowed to force the reset line too.

3.11 RF Antenna

The antenna must be connected to the SMA connector *ANT* (Figure 22) for any RF communication purpose. The path between the RF_OUT pad of the **EMB-LR1276S** module and the SMA connector contains a matching circuitry (Figure 23) that can be mounted and adjusted by advanced users.

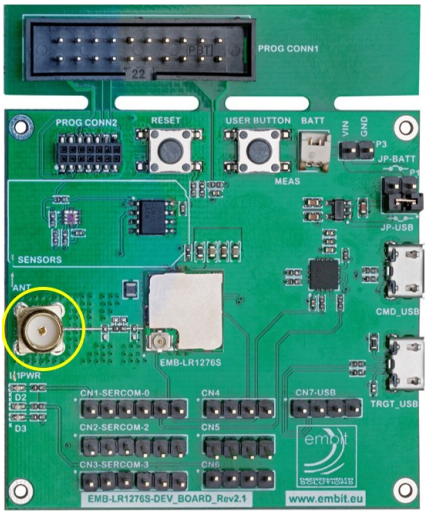

Figure 22. SMA connector.

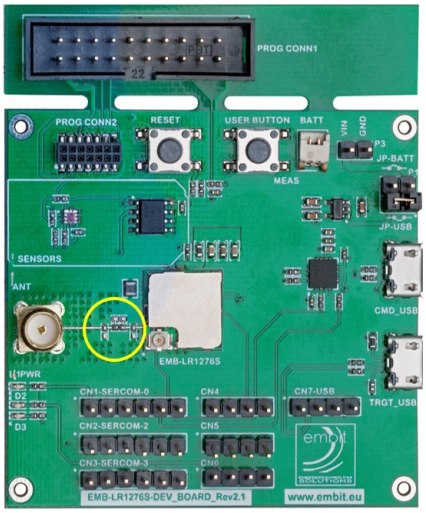

Figure 23. RF matching circuitry.

NOTE: If you want to use the u.FL connector on the EMB-LR1276S you need to remove the components of the matching network.

3.12 Board Revision History

Rev 1.0: The first release for early costumers.

Rev 2.0: Final version of the board for internal use.

Rev 2.1: Final version of the board commercially available.

4 Firmware User Guide

4.1 Quick Start

A firmware is preloaded in the **EMB-LR1276S** Flash memory in factory. This firmware allows the user to control the LoRa® module simply sending commands on the USB interface.

Costumers can use the board in two ways:

1. As a **modem**: connecting the board to a host (a PC for example) through the USB connector (CMD_USB) it is possible to send the EBI commands [2] in order to join an existing LoRaWAN® network.

2. As **micro embedded**: developing their own firmware and discover all the potentialities of the **EMB-LR1276S** using its peripherals. In this case EBI commands are not needed.

4.2 EMB-LR1276S with EBI Commands

In order to start using Embit Evaluation Kit with **EBI commands**, you must follow these steps:

- Place the jumper on *JP-USB* of P1.
- Mount the antenna on the SMA connector.
- Connect the USB cable included to the CMD_USB connector and plug it to a PC. The green led D1 is lit.
- The board will be recognized as a Virtual Com Port.
- Now it is possible to communicate with the module using commands described in the EBI-LoRa document [2].

To send commands you can use a terminal that allows you to send hex values.

Please refer to the document "Embit Binary Interface – LoRa specific Documentation" [2].

4.3 EMB-LR1276S as Micro Embedded

In order to develop your own firmware and use all the features of the **EMB-LR1276S** you need to:

- Download and install Atmel Studio 7.0 (minimum version)
- Update to the latest ASF version available
- Download and install JLink Software and Documentation Pack v6.42 (minimum version)
- Create your own firmware starting form the example project provided by Embit

- Download your project in to the **EMB-LR1276S** Flash memory (see section 4.3.1)

4.3.1 Download your own firmware

To download your own firmware just plug the JTAG connector from the JLink to the PROG CONN1 (or to the Multiprog and then plug the Multiprog in to the *PROG CONN2)* of the **EMB-LR1276S Dev Board**.

Power up the board with the USB cable or a battery (please be sure that the jumper is in the correct position on P1 header). The green led is lit.

When you are going to download your firmware from Atmel Studio for the first time into the **EMB-LR1276S**, you will receive a warning as in Figure 24.

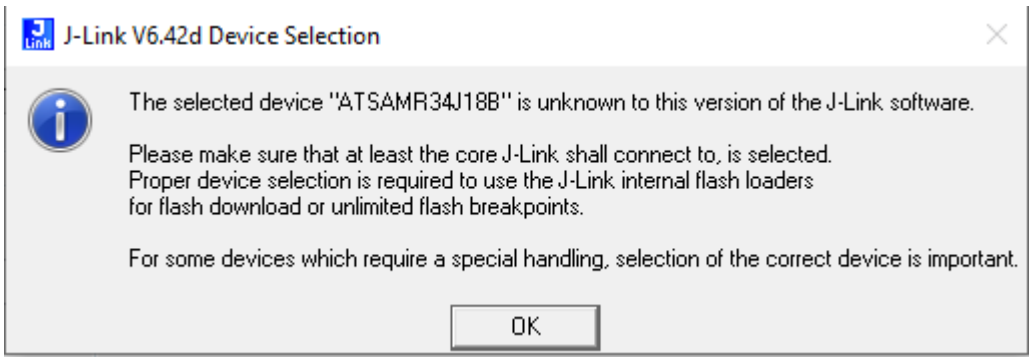

Figure 24. JLink warning.

Click OK and a list of all the devices supported by the JLink will appear (Figure 25). To facilitate the finding of the device, select "Atmel" from the drop-down Manufacturer menu and scroll down the list until you will find *ATSAMR34J18*. Select it and click OK.

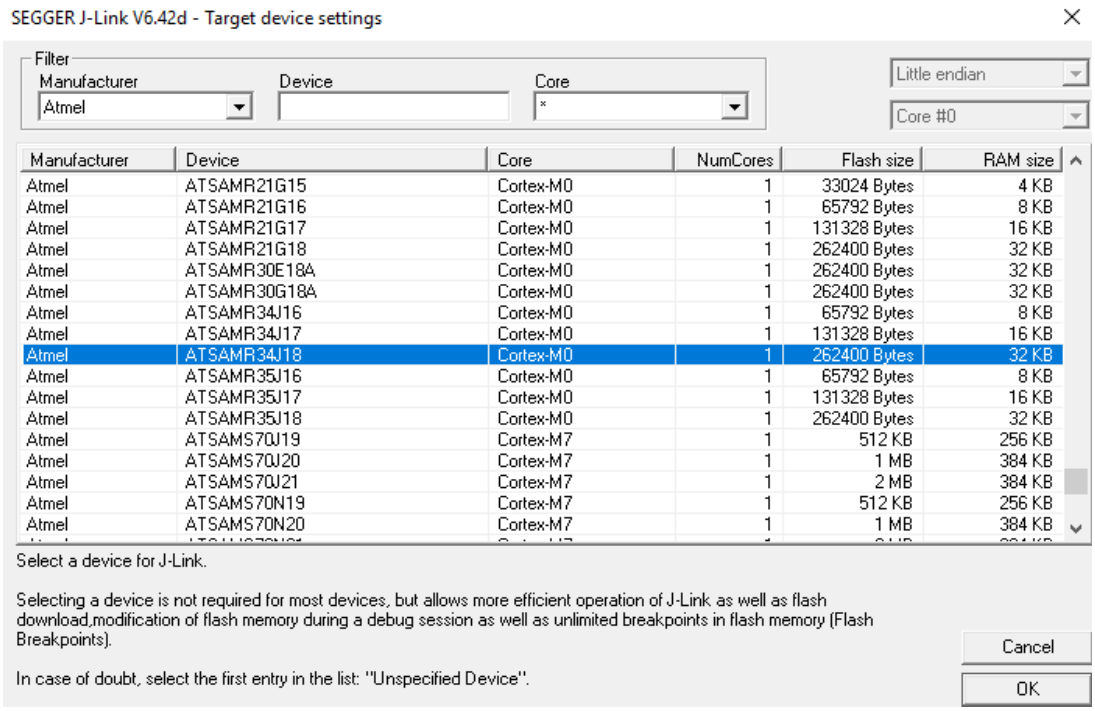

Figure 25. JLink target devices list

The firmware will be downloaded into the Flash of the **EMB-LR1276S**.

5 Create Your Own LoRaWAN® Network

Embit gives to the users the possibility to create **their own LoRaWAN® network**. To setup the network you will need:

- EMB-LR1276S (or EMB-LR1272E) as end-nodes
- EMB-Picocell (or GW1301) as gateway
- An account on a LoRaWAN® network server (A2A, TTN, etc.)

Please refer to documentation "EMB-GW1301-O Quick start Guide" [5] which explain ho to configure your gateway with the LoRaWAN® network server chosen.

6 References

[1] Embit, EMB-LR1276S Datasheet Rev 1.0

[2] Embit, Embit Binary Interface – LoRa specific documentation v.1.0.1

[3] Texas Instruments, LM75A Datasheet

[4] Silicon Labs, Si1141/42/43 Datasheet

[5] Embit, EMB-GW1301-0 Quick Start Guide Rev 1.0

7 Disclaimer of liability

The user must read carefully all the documentation available before using the product. In particular, care must be taken in order to comply with the regulations (e.g., power limits, duty cycle limits, etc.).

7.1 Handling Precautions

This product is an ESD sensitive device. Handling precautions should be carefully observed.

7.2 Limitations

Every operation involving a modification on the internal components of the module will void the warranty.

7.3 Disclaimer of Liability

The information provided in this and other documents associated to the product might contain technical inaccuracies as well as typing errors. Regulations might also vary in time. Updates to these documents are performed periodically and the information provided in these manuals might change without notice. The user is required to ensure that the documentation is updated and the information contained is valid. Embit reserves the right to change any of the technical/functional specifications as well as to discontinue manufacture or support of any of its products without any written announcement.

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