

The logo for Embit, featuring the word "embit" in a lowercase, sans-serif font. To the right of the text is a stylized graphic consisting of several curved, overlapping lines that suggest a globe or a signal. The logo is positioned on a light green background that is part of a horizontal bar at the top of the page.

EMB-LR1302-mPCIe User Manual

Embit s.r.l.

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Document information

Versions & Revisions

Revision	Date	Author	Comments
Preliminary	2021-02-02	Embit	
Revision 1	2021-12-03	Embit	
Revision 1.1	2021-12-09	Embit	Minor modification on the Electrical Characteristics section

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1 Introduction

EMB-LR1302-mPCIe provides long range connectivity using ultra-long range spread spectrum communication and high interference immunity on the 868/915 MHz radio band. This device is characterized by up to 10x less power consumption than previous solutions, has a better thermal design and it is capable of handling a higher amount of traffic than preceding devices.

EMB-LR1302-mPCIe is designed around the Semtech SX1302 which is a new generation of digital baseband LoRa[®] chip for gateways. It offers up to 8 LoRa[®] channels in the 868 MHz (or 915 MHz) frequency allowing it to receive up to 64 LoRa[®] packets simultaneously. It is able to achieve a sensitivity of up to *-140* and a RF output power of *+27 dBm* making it the ideal device to use in LoRa[®] gateways applications. It supports two new spreading factors: SF5 and SF6. This enables users to reach higher data rate communication.

1.1 Specifications

- Operating Voltage: 5V
- Current Consumption: 421mA (Tx@+27dBm); 39mA (Rx)
- Modulation: LoRa[®] Spread Spectrum, FSK, GFSK
- Operating Frequency: 868MHz (EU) / 915MHz (US)
- Frequency Range: 860MHz to 1020MHz
- Operating Temperature: -40°C to +85°C
- RF Output Power: Up to +27dBm
- Interfaces: mPCIe Interface
- Sensitivity: Up to -140 dBm
- Dimensions: 30.00×50.95×1.00 mm
- Features: On-board uFL antenna connector,
8 LoRa[®] Channels

2 Description

2.1 SX1302 Module

The SX1302 is a new generation of baseband LoRa[®] chip for gateways. It excels in reducing current consumption, simplifies the thermal design of gateways and it is capable of handling a higher amount of traffic than preceding devices.

Main features:

- **RF standard supported:** LoRaWAN[®]
- **Frequency band:** 868 MHz, 915MHz
- **libloragw** is the driver of the SX1302, that provides API for LoRa[®] packet exchange using the SX1302 (developed by Semtech, customized and ported by Embit[®] to this specific platform).
- **packet_forwarder** is the application that allows the exchange of LoRaWAN[®] packet with a LoRaWAN[®] server. It forwards RF packets received by the gateway to a server through an IP/UDP link, and emits RF packets that are sent by the server.
- **Sample Projects:**
 - Semtech source code available [SX1302-Hal](#)
 - **helper programs:** util_pkt_logger, util_spi_stress, util_tx_test, util_tx_continuous

2.2 SX1250 Module

The two **SX1250** [2] are a half-duplex sub-1 GHz RF to IQ transceiver designed to work along with Semtech's SX1302 baseband engine, to design a high-performing LoRaWAN[®] gateway.

The SX1250 is capable of low power operation in the 150-960 MHz ISM frequency bands. It has a maximum signal bandwidth of 500 kHz both in transmission and reception.

The SX1250 transceiver is controlled by its companion baseband chip SX1302 through an SPI interface.

2.3 Crypto Element

The Crypto element is a high-security cryptographic device which combines world-class hardware-based key storage with hardware cryptographic accelerators to implement various authentication and encryption protocols.

The includes an EEPROM array which can be used for storage of up to 16 keys, certificates, miscellaneous read/write, secret data, and security configurations. Access to the various sections of memory can be restricted in a variety of ways and then the configuration can be locked to prevent changes.

It can be used as an Ecosystem control and Anti-Counterfeiting and validates if a system or component is authentic and came from the OEM shown on the name plate.

Access to the device is made through a standard I2C Interface at speeds of up to 1 Mb/s.

2.4 External Antenna Connection

The **EMB-LR1302-mPCIe** has a U.FL connector for 868MHz antenna (or 915MHz for US market).

3 Connections

3.1 Pin Out Description

Number	Pin Name	Type	Description
1	SX1261_NSS	Input	SPI Slave Select for SX1261
2	VCC	Power	5V
3	NC	NC	Not Connected
4	GND	Power (GND)	Ground
5	POWER_ENABLE	Input	SX1302/3 Enable Pin
6	GPIO6	I/O	General Purpose IO
7	CLKREQ#	NC	Not Connected
8	SPI-MOSI	Input	SX1302/3 SPI MOSI
9	GND	Power (GND)	Ground
10	SPI-MISO	Output	SX1302/3 SPI MISO
11	PPS	Input	GPS PPS Input
12	SPI-SCLK	Input	SX1302/3 SPI Clock
13	REFCLK+	NC	Not Connected
14	SPI-CSN	Input	SX1302/3 SPI Chip Select
15	GND	Power (GND)	Ground
16	UIM_VPP	NC	Not Connected

Connections

17	SX1261_DIO1	NC	SX1261 Radio DIO1 Pin
18	GND	Power (GND)	Ground
19	SX1261_BUSY	Output	SX1261 Busy Pin
20	W_DISABLE#	NC	Not Connected
21	GND	Power (GND)	Ground
22	SX1303_RESET	Input	SX1302/3 Reset Pin (Active High)
23	PERn0	NC	Not Connected
24	VCC	Power	5V
25	PERp0	NC	Not Connected
26	GND	Power (GND)	Ground
27	GND	Power (GND)	Ground
28	1.5V	NC	Not Connected
29	GND	Power (GND)	Ground
30	I2C_SCL	Input	I2C Clock Pin
31	PETn0	NC	Not Connected
32	I2C_SDA	Input/Output	I2C data Pin
33	PETp0	NC	Not Connected
34	GND	Power (GND)	Ground
35	GND	Power (GND)	Ground
36	USB_D-	NC	Not Connected
37	GND	Power (GND)	Ground
38	USB_D+	NC	Not Connected
39	VCC	Power	5V
40	GND	Power (GND)	Ground
41	VCC	Power	5V
42	SX1261_NRESET	Input	SX1261 Reset Pin (Active Low)
43	GND	Power (GND)	Ground
44	LED_WLAN#	NC	Not Connected
45	Reserved	NC	Not Connected
46	LED_WPAN#	NC	Not Connected
47	Reserved	NC	Not Connected
48	1.5V	NC	Not Connected
49	Reserved	NC	Not Connected
50	GND	Power (GND)	Ground
51	Reserved	NC	Not Connected
52	VCC	Power	5V

Table 1: mPCIe Interface Pin Out.

4 Electrical Characteristics

4.1 Absolute Minimum and Maximum Ratings

Parameter	Min	Max	Unit
Power Supply Voltage	-0.5	5.5	Vdc
Storage Temperature	-40	125	°C

Table 2: Absolute minimum and maximum ratings.

4.2 Operating Conditions

Parameter	Min	Typ	Max	Unit
Power Supply Voltage (Vcc) USB	3.0	5	5.5	V
Operating Temperature range	-40	25	+85	°C
Logic Low Input threshold	-0.3		0.3*Vcc	V
Logic High Input threshold	0.7*Vcc		Vcc+0.3	V
Logic Low Output Level	0		0.4	V
Logic High Output Level	Vcc-0.6		Vcc	V

Table 3: Operating Conditions.

4.3 Power Consumption

Mode	Typ. value	Unit
Transmission @ +27dBm	421	mA
Transmission @ +20dBm	262	mA
Transmission @ +14dBm	148	mA
Reception	39	mA

Table 4: Power Consumption.

4.4 RF Characteristics

Condition	Min.	Typ.	Max.	Unit
Output Power			+27	dBm
Receiver sensitivity SF12; BW=125KHz		-140		dBm
Receiver sensitivity SF11; BW=125KHz		-137		dBm
Receiver sensitivity SF10; BW=125KHz		-134.5		dBm
Receiver sensitivity SF9; BW=125KHz		-131.5		dBm
Receiver sensitivity SF8; BW=125KHz		-129		dBm
Receiver sensitivity SF7; BW=125KHz		-125.5		dBm
Receiver sensitivity SF6; BW=125KHz		-124		dBm
Receiver sensitivity SF5; BW=125KHz		-121		dBm
Receiver sensitivity SF9; BW=250KHz		-125.5		dBm

Table 5: Receiver Sensitivity.

5 Regulatory Compliance

5.1 Introduction

The purpose of this chapter is to describe which behavior the user **MUST** have in order to operate the device under compliance with current regulations. The details described here are then to be read carefully and applied literally. Also, please read carefully all the other documentation available in order to understand all the limits and ensure compliance of the final application.

The module **EMB-LR1302-mPCIe** will be certified for CE, FCC and IC compliance. The different regulations have different limitations and impose different approaches to the module that will be discussed in different chapters. Any aspect that both the regulations have in common will be described in an appropriate chapter in order to keep readability of this document at maximum.

The main aspect that the user **MUST** consider is the output power. The module itself is compliant and ready to be used but care must be taken in setting an appropriate output power when programming the devices. The module can output up to 27 dBm of conducted power. Please follow the directives in this document to set the appropriate output power for the antenna you are using. Any other antenna that is not covered in the certification must not be used unless a new certification is performed.

5.2 Compliance: Important information

The module is to be used in accordance with the current guide. Any hardware modification on the module will void the certification.

The antennas used must be one of those indicated by the manufacturer and the output power must be set as required by the present document.

The EMB-LR1302-mPCIe can operate using the external antenna attached via the U.FL connector. For the specific FCC certification, the list of allowed antennas are indicated in the following table. The use of any other antenna is permitted only with a FCC Class two permissive Change.

Antenna code	Antenna type	Antenna gain
EMB-ANT915-RD	Rubber duck RP-SMA Antenna	+2 dBi

NB: in the standard use of the device a minimum distance of 20 cm between the radiant element and the human body has to be maintained.

5.3 FCC: Data

FCC ID: Z7H-EMBLR1302
Brand: Embit
Model: EMB-LR1302-mPCIe
Power supply: 5V VDC
Transmission frequency: 902-928 MHz

The device complies with part 15 of the FCC Rules. Operation is subjected to the following 2 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.

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 instructions, 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 the 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 a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

5.4 FCC: Maximum Output power

The FCC regulation allows for up to 30 dB or output power plus up to 6 dBi of assembly gain which translates into up to +36 dBm of EIRP. The modules EMB-LR1302-mPCIe can output up to +27 dBm and so, when using the allowed antenna, will have no problems with the output power limit. Spurious emission and spectral density doesn't limit the output power neither on the EMB-LR1302-mPCIe and so every output power setting can be used.

5.5 FCC: Device labeling

Please notice that if the FCC identification number is not visible when the module is installed inside another device, the device into which the module is installed must display a label referring to the enclosed module. This exterior label can use wording such as the following: "Contains FCC ID: Z7H-EMBLR1302" or similar.

5.6 IC: Data

IC ID: 21487-EMBLR1302

Brand: Embit

Model: EMB-LR1302-mPCIe

Power supply: 5V VDC

Transmission frequency: 902-918 MHz

The device complies with the Industry Canada RSS Rules. Operation is subjected to the following 2 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.

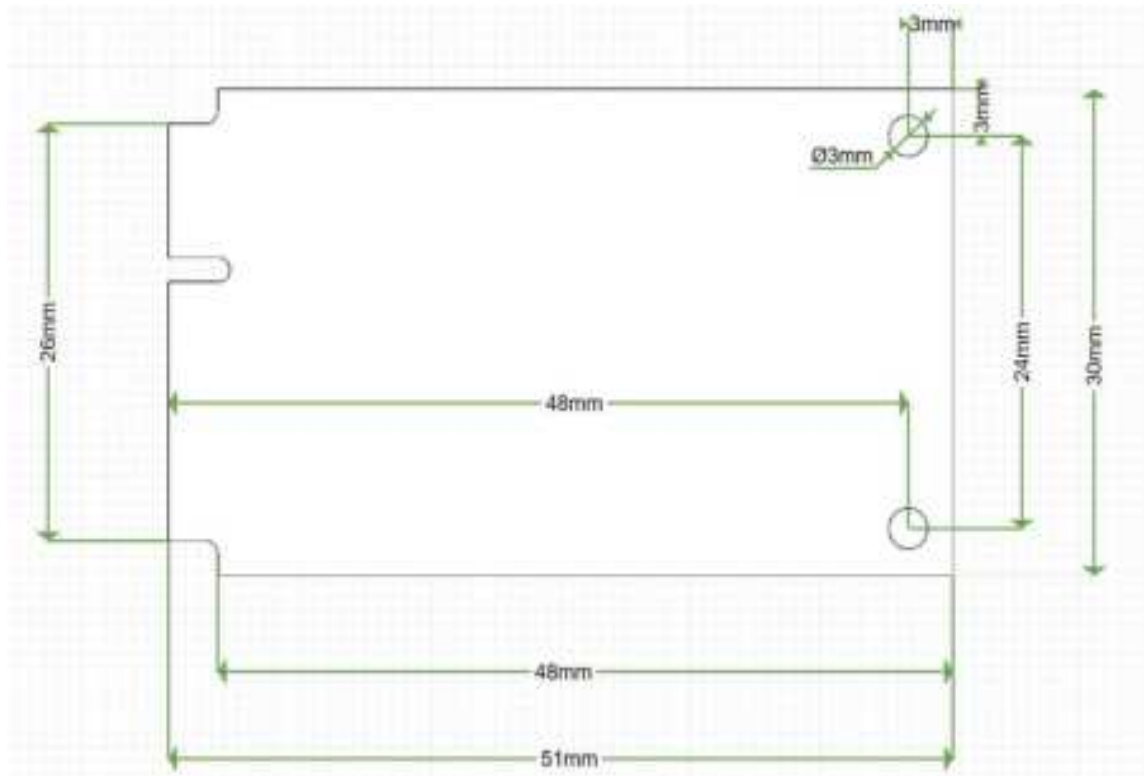
5.7 IC: Maximum Output power

The IC regulation allows for up to 30 dB or output power plus up to 6 dBi of assembly gain which translates into up to +36 dBm of EIRP. The modules EMB-LR1302-mPCIe can output up to +27 dBm and so, when using the allowed antenna, will have no problems with the output power limit. Spurious emission and spectral density doesn't limit the output power neither on the EMB-LR1302-mPCIe and so every output power setting can be used.

NB: in the standard use of the device a minimum distance of 20 cm between the radiant element and the human body has to be maintained

6 Mechanical Characteristics

Figure 4: EMB-LR1302-mPCIe mechanical dimensions.



7 References

- [1] Semtech, SX1302 Datasheet from www.semtech.com
- [2] Semtech, SX1250 Datasheet from www.semtech.com
- [3] Semtech, SX1261 Datasheet from www.semtech.com

8 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.).

8.1 Handling Precautions



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

8.2 Limitations

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

8.3 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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