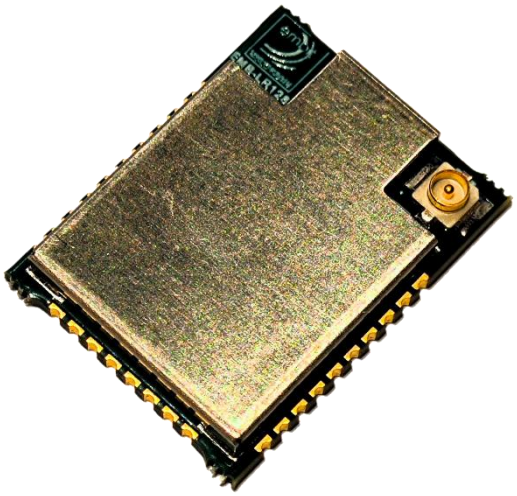
EMB-LR1280S
Datasheet



Embit s.r.l.

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Document information

Versions & Revisions

Revision	Date	Author	Comments
0.5	2021-02-18	Embit	Preliminary version
1.0	2021-05-05	Embit	Initial release
1.1	2026-01-07	Embit	Update in antenna information
1.2	2026-02-06	Embit	Added FCC and IC Warnings
1.3	2026-02-24	Embit	Correction Pinout

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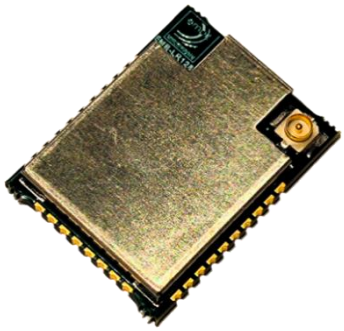
1 Introduction



EMB-LR1280S is the new ultra-low power 2.4 GHz band-based OEM Embit module. It exploits Semtech® proprietary spread spectrum modulation technique to provide long range connectivity and high-interference immunity, outperforming any other 2.4 GHz technology in terms of communication range. The radio is fully compliant with the worldwide 2.4 GHz frequency band regulation and can operate anywhere around the world. Also, the use of the 2.4 GHz ISM radio band, being not subject to duty cycle, allows to enhance the overall transmission rate with respect to others sub-GHz solutions.

EMB-LR1280S is based on Semtech®'s SX1280 long range 2.4 GHz transceiver coupled with the STM32L073 MCU. The MCU is equipped with up to 192 KB Flash memory and up to 20 KB of RAM memory. The module integrates two crystals, one at 52 MHz and one at 32 KHz and a Crypto Unit to protect the communication between the module and external interfaces, enhancing data security.

EMB-LR1280S can communicate with other devices through a wide range of serial interfaces: UART, I2C, USB, SPI, several digital and analog I/O ports useful for the management of external devices and interfaces. Moreover, the extremely reduced low power consumption provided by the STM32L073 MCU, makes the **EMB-LR1280S** particularly suitable to implement long life battery powered devices.

1.1 Specifications

- Operating Voltage: 1.8 ÷ 3.6 V
- MCU: Arm Cortex-M0+ 32-bit STM32L073 20 KB RAM, 192 KB Flash
- Transceiver: Semtech® SX1280
- RF output power: up to 12 dBm
- RF sensitivity: down to -132 dBm at 595 bps
- Modulation: LoRa® Spread Spectrum, FLRC, (G)FSK
- Operating Frequency: 2.4 GHz
- Frequency Range: 2400 MHz to 2485 MHz
- Interfaces: UART/LPUART/I2C/SPI/ADC/USB/GPIOs
- Dimensions: 15.5 x 20 x 2.3 mm
- Temperature Range: -40°C to +85°C
- U.FL Connector or ceramic antenna
- Crypto unit to protect communication

1.2 Applications

The device can be used in several applications where LoRa® gateway is needed, such as:

- Internet of Things (IoT)
- Automated Meter reading
- Smart cities
- Home Building Automation
- Wireless Alarm and Security System
- Machine to Machine (M2M)

- Industrial Monitoring and Control
- Smart lighting
- Long Range Irrigation System

2 Description

2.1 Block Diagram

The **EMB-LR1280S** block diagram is shown below:

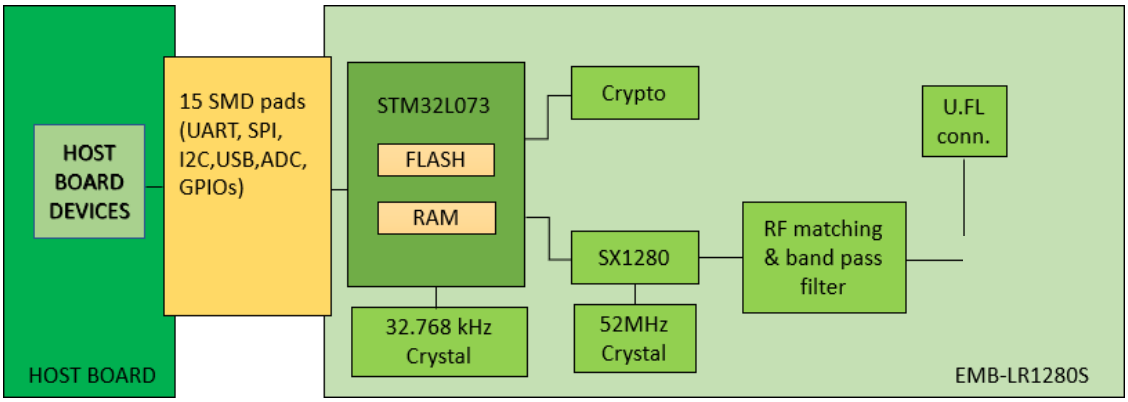


Figure 1: EMB-LR1280S block diagram.

2.2 STM32L073

The **EMB-LR1280S** embeds an STM32L073 [1] MCU. It is an ultra-low-power, high-performance microcontroller based on an ARM Cortex M0+ 32-bit core operating at 32MHz. It is characterized by high-speed embedded memories (192 KBytes of data EEPROM, 20 KBytes of RAM) and a Memory Protection Unit (**MPU**). The power management is highly effective and flexible thanks to the availability of 8 power modes, internal voltage adaptation and multiple internal/external clock sources. The MCU offers a wide range of standard and advanced interfaces such as I2C, SPI, USART, LPUART and a crystal-less USB. Moreover, it embeds multiple analog and digital resources: 12-bit ADC with hardware oversampling, one RTC unit, multiple timers (with one low power timer), SysTick, programmable watchdog timer and multiple GPIOs.

The MCU is programmed and debugged via SWD (ARM Serial Wire Debug) that represents a fast 2-pin standard interface.

2.3 Transceiver

The Semtech® **SX1280**[2] is a half-duplex transceiver that provides ultra-long range communication, high interference immunity with minimized current consumption in the 2.4 GHz band. Other than LoRa®, the **SX1280** supports FLRC and (G)FSK radio modulations and it is compatible with the BLE physical layer. The maximum transmit power is 12.5 dBm with a receiver sensitivity of -132 dBm @595 bps with LoRa® modulation @SF12 and 203KHz Bandwidth. The transceiver also offers a ranging engine with time-of-flight functionalities.

2.4 Antenna

The **EMB-LR1280S** features a 50-ohm, single-ended U.FL antenna connector.

2.5 Security Element

The **EMB-LR1280S** features a crypto unit for protection, encryption and data security. This Security 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.
It 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: it validates if a system or component is authentic and came from the OEM shown on the nameplate. The access to the device is made through a standard I2C interface at

speeds of up to 1 Mb/s.

2.6 Crystals

The **EMB-LR1280S** embeds two crystals:

- One 52MHz crystal required by the digital PLL of the transceiver to perform RF and baseband frequency conversion.
- One 32KHz crystal to be used as external clock source.

2.7 Firmware

The **EMB-LR1280S** comes with Semtech® LoRa® 2.4 GHz stack, extended with Embit additional features and with proprietary **LoRaEMB** stack.

2.8 Development tools

To work with **EMB-LR1280S** the following tools are suggested:

- **STM32CubeIDE**
- **SEGGER J-Link** debugger and programmer

Embit also provides ready-to-use firmware that allows the module to act as a simple modem over UART. This AT-like protocol is named **"EBI" (Embit Binary Interface)**. By exploiting a set of binary commands, it is possible to configure the module, send/receive data over the air and develop complex applications without the need of writing complex custom firmware.

3 Size and footprint

3.1 Size

The mechanical dimensions of **EMB-LR1280S** are 15.5 x 20 mm with a thickness of 3.2 mm (considering the shield).

The module has a total of 28 pins (10 on each side edge and 8 on bottom side) with 1.27 mm pitch and 1.02 x 0.81 as dimensions. Positioning is shown in the following image (Figure 2).

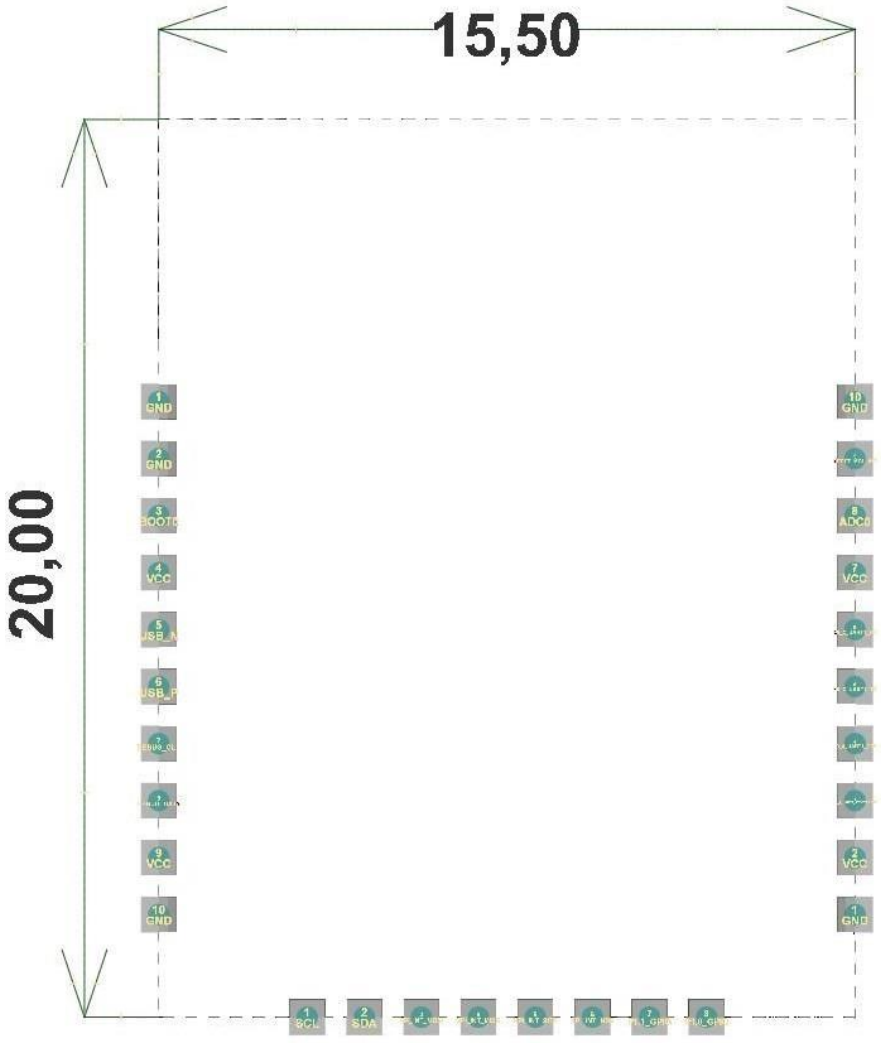


Figure 2: Connector positions

3.2 Suggested footprint

The **EMB-LR1280S** suggested footprint consists in 28 LGA pads positioned as following (Figure 3 and Figure 4, all sizes are in mm).

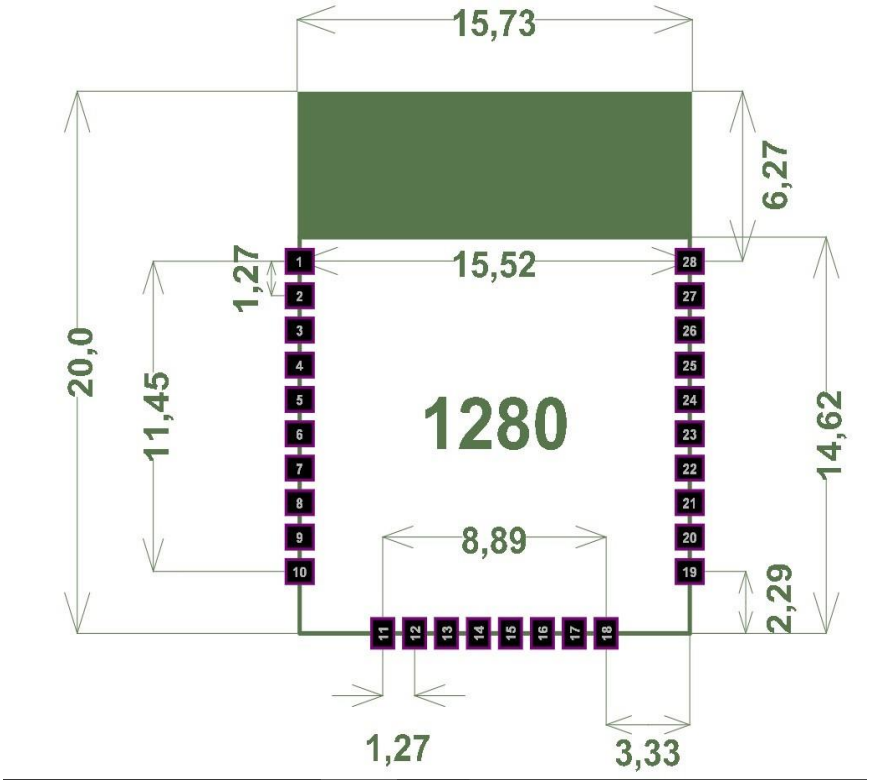


Figure 3: EMB-LR1280S suggested footprint

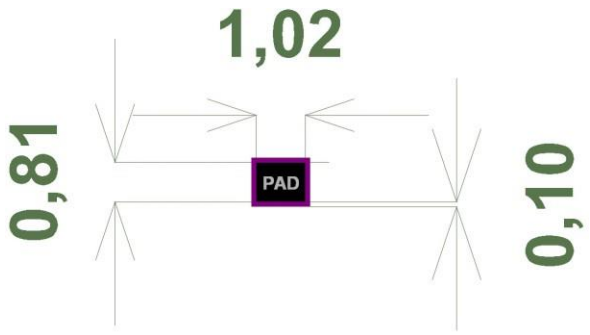


Figure 4: Pad

3.3 Notes

- The area underneath the module must be kept free of components (both top and bottom layers) and must be covered with solder resist.
- The PCB top layer underneath the module must be free of nets, power planes and vias. The bottom layer shall provide a ground plane.
- The module power supply must be as clean as possible. It must be decoupled placing a ceramic capacitor as near as possible to the Vcc pins. Additional filtering made by a ferrite bead is recommended.
- Noisy electronic components (such as switching power supply) must be placed as far as possible and adequately decoupled.
- The ground pins of the module shall be connected to a solid ground plane.

Note: Taking no account of these recommendations may affect the radio performances.

4 Connections

4.1 Module pinout

Number	Pin Name	Type	Description
1	GND1	GND	Ground
2	GND2	GND	Ground
3	BOOT0	BOOT0 Input	BOOT0 pin
4	VCC	Power Input	Supply voltage
5	PA11_USB_N	Digital I/O	USB N
6	PA12_USB_P	Digital I/O	USB P
7	DEBUG_CLK	JTAG	SWD Debug port clock
8	DEBUG_DATA	JTAG	SWD Debug port data
9	VCC	Power Input	Supply voltage
10	GND3	GND	Ground
11	PB8_I2C_SCL	Digital I/O	I2C1 SCL
12	PB9_I2C_SDA	Digital I/O	I2C1 SDA
13	PB15_SPI_MOSI	Digital I/O	SPI MOSI
14	PB14_SPI_MISO	Digital I/O	SPI MISO
15	PB10_SPI_SCK	Digital I/O	SPI SCK, LPUART RX
16	PB12_SPI_NSS	Digital I/O	SPI NSS
17	PA1_GPIO0	Analog/Digital I/O	ADC_IN1
18	PA2_GPIO1	Analog/Digital I/O	ADC_IN2, LPUART TX
19	GND4	GND	Ground
20	VCC	Power Input	Supply voltage
21	PB3_UART_CTS	Digital I/O	UART CTS
22	PB4_UART_RTS	Digital I/O	UART RTS
23	PA9_UART_TX	Digital I/O	UART TX
24	PA10_UART_RX	Digital I/O	UART RX
25	VCC	Power Input	Supply voltage
26	PA0_ADC	Analog/Digital I/O	ADC_IN0
27	NRESET	Reset input	System reset input (active low)
28	GND5	GND	Ground

Table 1: EMB-LR1280S Interface Pin Out.

Note: All Digital I/O support the MCU interrupt request.

4.2 Typical application circuit

The external supply shall include protection from spikes, short circuits and it requires adequate decoupling.

- Voltage glitches on VCC supply may cause reset or malfunctioning of the microcontroller.
- Slow voltage ramp on VCC or NRESET may cause malfunctioning of the microcontroller.
- Do not reset or turn off the power of the module while writing to the flash; otherwise, memory corruption may occur.

5 Electrical characteristic

5.1 Absolute Maximum Ratings

Parameter	Value	Unit
Power Supply Voltage	+3.9	V
Voltage on any pin	+3.9	V
Rf input power (P_{max})	+10	dBm
Storage Temp. Range	-40 ~ +85	ºC

Table 2: Absolute maximum ratings.

5.2 Operating Conditions

Parameter	Min	Max	Unit
Power Supply Voltage (Vcc)	+1.8	+3.6	V
Operating Temperature range	-40	+85	°C
Logic Input Low Voltage	Vss	0.3*Vcc	V
Logic Input High Voltage	0.7*Vcc	Vcc	V
Logic Output Low Level	Vss	Vss + 0.45	V
Logic Output High Level	Vcc-0.45	Vcc	V

Table 3: Operating Conditions.

5.3 Power Consumption

Mode	Typ. value	Unit
Transmit @+12.5 dBm	34	mA
Receive	9.5	mA
Sleep	2.5	µA
XLP Sleep	≤1	µA

Table 4: Power Consumption.

5.4 RF Characteristics

Condition	Min.	Typ.	Max.	Unit
RF Frequency range	2400		2485	MHz
Frequency tolerance		±10		ppm
Programmable Output Power Range	-18		+12.5	dBm
RF Data Rate LoRa®	0.595		253.9	kbps
Receiver sensitivity SF5; BW=203 KHz		-109		dBm
Receiver sensitivity SF6; BW=203 KHz		-111		dBm
Receiver sensitivity SF7; BW=203 KHz		-115		dBm
Receiver sensitivity SF8; BW=203 KHz		-118		dBm
Receiver sensitivity SF9; BW=203 KHz		-121		dBm
Receiver sensitivity SF10; BW=203 KHz		-124		dBm
Receiver sensitivity SF11; BW=203 KHz		-127		dBm
Receiver sensitivity SF12; BW=203 KHz		-130		dBm

Table 5: RF characteristics.

6 References

[1] STM, STM32L073CZ Datasheet from www.st.com

[2] Semtech, SX1280 Datasheet from www.semtech.com

7 Module warning language requirements

7.1 FCC Warning:

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.

Caution: Any changes or modifications to this device not explicitly approved by manufacturer could void your authority to operate this equipment.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

- This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.
- This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter. Country Code selection feature to be disabled for products marketed to the US/Canada.

This device is intended only for OEM integrators under the following conditions:

- The antenna must be installed such that 20 cm is maintained between the antenna and users, and
- the transmitter module may not be co-located with any other transmitter or antenna,

as long as the two conditions above are met, further transmitter testing will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed.

Important Note: In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

End Product Labeling

The final end product must be labeled in a visible area with the following "Contains FCC ID: Z7H-EMBLR128X”

Integration instructions for host product manufacturers according to KDB 996369 D03 OEM Manual v01

List of applicable FCC rules
CFR 47 FCC PART 15 SUBPART C has been investigated. It is applicable to the modular transmitter

Specific operational use conditions
This module is stand-alone modular. If the end product will involve the Multiple simultaneously transmitting condition or different operational conditions for a stand-alone modular transmitter in a host, host manufacturer have to consult with module manufacturer for the installation method in end system.

Limited module procedures
Not applicable

Trace antenna designs
Not applicable

RF exposure considerations
This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

Antennas
This radio transmitter FCC ID: Z7H-EMBLR128X has been approved by Federal Communications Commission to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Antenna No.	Operate frequency band	Antenna Type	Maximum antenna gain
MS.151001A	2400-2500MHz	Dipole Antenna	2.0dBi
L00-002/ L00-023	2400-2690 MHz	Monopole Antenna	2.15dBi

Table 6: Approved antennas.

Label and compliance information
The final end product must be labeled in a visible area with the following "Contains FCC ID: Z7H-EMBLR128X".

Information on test modes and additional testing requirements
Host manufacturer is strongly recommended to confirm compliance with FCC requirements for the transmitter when the module is installed in the host.

Additional testing, Part 15 Subpart B disclaimer
Host manufacturer is responsible for compliance of the host system with module installed with all other applicable requirements for the system such as Part 15 B.

Note EMI Considerations
Host manufacture is recommended to use D04 Module Integration Guide recommending as "best practice" RF design engineering testing and evaluation in case non-linear interactions generate additional non-compliant limits due to module placement to host components or properties.

How to make changes
This module is stand-alone modular. If the end product will involve the Multiple simultaneously transmitting condition or different operational conditions for a stand-alone modular transmitter in a host, host manufacturer have to consult with module manufacturer for the installation method in end system. According to the KDB 996369 D02 Q&A Q12, that a host manufacture only needs to do an evaluation (i.e., no C2PC required when no emission exceeds the limit of any individual device (including unintentional radiators) as a composite. The host manufacturer must fix any failure.

7.2 IC Statement

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

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

L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

- L' appareil ne doit pas produire de brouillage;
- L' appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

IC Caution
Any changes or modifications to this unit not expressly approved by Embit for compliance could void the user's authority to operate the equipment. The integrator will be responsible to satisfy SAR/RF Exposure requirements, when the module integrated into the host device.

Tout changement ou modification à cette unité qui n'est pas expressément approuvé par Embit aux fins de conformité pourrait annuler l'autorisation de l'utilisateur de faire fonctionner l'équipement. L'intégrateur sera chargé de satisfaire aux exigences d'exposition SAR/RF, lorsque le module sera intégré dans le dispositif hôte.

Label and compliance information
The final host device, into which this RF module is integrated, has to be labeled with an auxiliary label stating the IC of the RF module, such as "Contains transmitter module IC: 21487-EMBLR128X".

Informations sur l'étiquette et la conformité
Le périphérique hôte final, dans lequel ce module RF est intégré, doit être marqué avec une étiquette auxiliaire indiquant le circuit intégré du module RF, telle que "contient le module émetteur IC: 21487-EMBLR128X".

Radio Frequency Exposure Statement for IC / Déclaration d'exposition aux radiofréquences pour IC

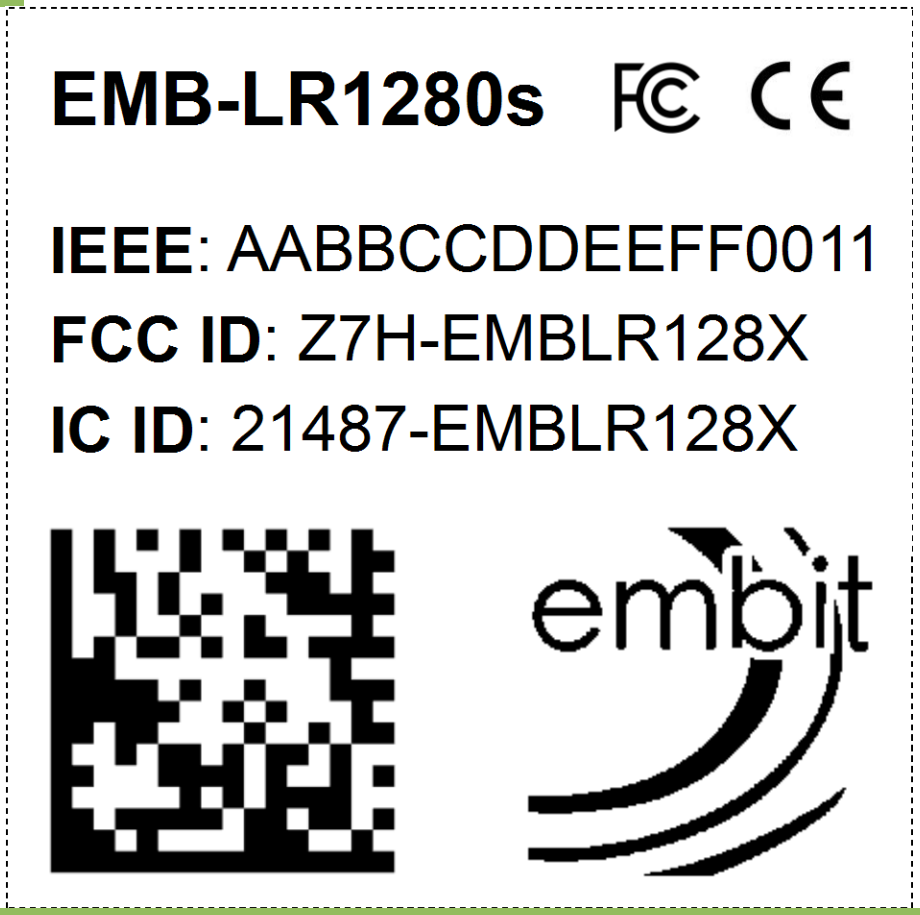
The device has been evaluated to meet general RF exposure requirements. The device can be used in mobile exposure conditions. The min separation distance is 20cm.

L'appareil a été évalué pour répondre aux exigences générales en matière d'exposition aux RF. L'appareil peut être utilisé dans des conditions d'exposition mobiles. La distance de séparation minimale est de 20 cm. (TBD)

This radio transmitter [IC: 21487-EMBLR128X] has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed in Table 6, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Cet émetteur radio [IC: 21487-EMBLR128X] a été approuvé par Innovation, Sciences et Développement économique Canada pour fonctionner avec les types d'antenne énumérés ci-dessous, avec le gain maximal admissible indiqué. Les types d'antenne non inclus dans cette liste qui ont un gain supérieur au gain maximum indiqué pour tout type répertorié sont strictement interdits pour une utilisation avec cet appareil.

8 LABEL



9 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.).

9.1 Handling Precautions

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

9.2 Limitations

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

9.3 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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