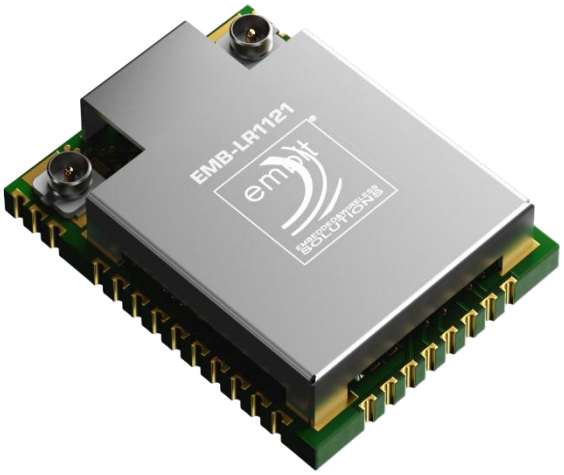
EMB-LR1121-e/mesh
Datasheet



Rev 1.3

Document information

Versions & Revisions

Revision	Date	Author	Comments
1.0	2025-02-04	Embit	Initial release
1.1	2025-05-06	Embit	Correction of Images and update
1.2	2025-06-18	Embit and NeoCortec	Correction of Pin configuration and Introduction specification
1.3	2025-08-06	Embit and NeoCortec	Pin nWU and nWES in the pinout

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1 Introduction

EMB-LR1121-e/mesh is the new ultra-low-power OEM module from Embit, designed for long-range wireless communication across both sub-GHz and 2.4 GHz ISM bands. At its core, it features Semtech®'s proprietary spread spectrum modulation, delivering outstanding range and robustness in harsh RF environments.

The **sub-GHz band** (in 868 MHz LoRa Band) is especially suited for long-distance communication with minimal power consumption. Signals in this band exhibit **superior propagation characteristics**, such as better **penetration through walls, foliage, and urban infrastructure**, and **longer range** with lower attenuation compared to higher-frequency bands.

In parallel, the module also supports operation in the **2.4 GHz ISM band**, which, unlike regional sub-GHz allocations, is **globally license-free and not subject to duty-cycle restrictions**. This allows for higher transmission throughput and seamless deployment across different regulatory regions.

EMB-LR1121-e/mesh is based on Semtech®'s LR1121 multi-band LoRa sub-GHz and Long Range 2.4 GHz transceiver coupled with the STM32U0x MCU. The module is featuring the **NeoMesh** protocol stack from NeoCortec. **NeoMesh** is a wireless mesh protocol designed for massive-scale IoT networks — combining ultra-low power operation, automatic self-organization, and robust data delivery across thousands of battery-powered devices.

Where traditional mesh networks rely on fixed roles (routers, leaf nodes, coordinators), **NeoMesh** is flat and fully decentralized. All devices have the same role: they generate, receive, and intelligently route data. This makes deployment simpler, power consumption lower, and scalability virtually unlimited.

The **EMB-LR1121-e/mesh** module offers **NeoMesh** in a range of different configurations. It can be configured for operation in 868, 915 and 2400 MHz bands. Additionally, it can be configured to use either GFSK or LoRa modulation. This allows for configuring the module to suit a broad range of applications balancing range and current consumption.

1.1 Specifications

EMB-LR1121	-e/mesh
Operating Voltage:	2.5 - 3.6 V
MCU	Arm Cortex-M0+ 32-bit STM32U083
RAM	40 KB
FLASH size	256 KB
Transceiver	Semtech® LR1121
RF output power	up to 22 dBm (US915 MHz band)
RF sensitivity	down to -132 dBm at 595 bps
Modulation:	LoRa® Spread Spectrum, (G)FSK
Operating Frequency:	868 MHz, 915 MHz and 2.4 GHz
Frequency Range:	150 MHz to 960MHz (sub-GHz), 2400 MHz to 2485 MHz
Interfaces:	UART
Dimensions:	15.5 x 20 x 2.3 mm
Temperature Range	-40°C to +85°C
U.FL Connector or ceramic antenna	

Table 1 - General Specification of EMB-LR1121-e/mesh

1.2 Applications

The device can be used in several applications, 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-LR1121-e/mesh** block diagram is shown below:

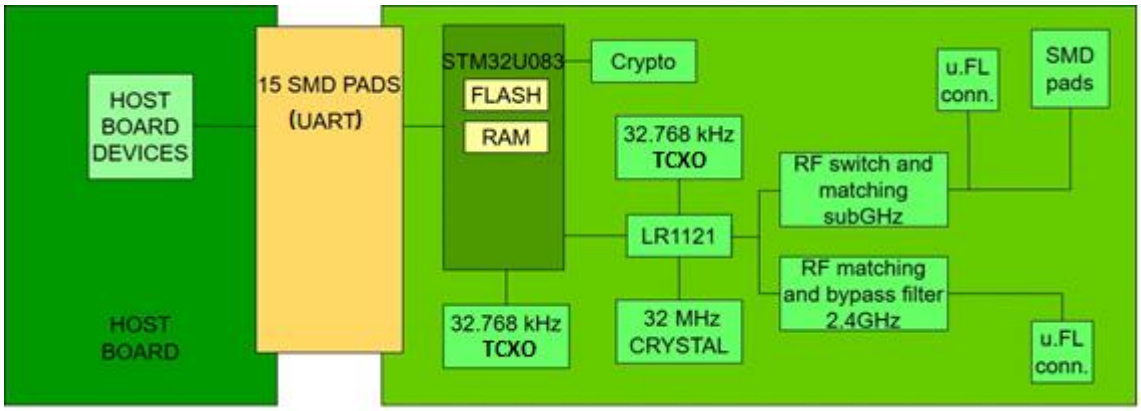

Figure 1 - EMB-LR1121-e/mesh schematics

2.2 EMB-LR1121-e/mesh NeoMesh Controller

The EMB-LR1121-e/mesh embeds a STM32U0x MCU. The MCU hosts the NeoMesh protocol stack and exposes the NeoMesh AAPI & SAPI interfaces on a UART. The EMB-LR1121-e/mesh does not offer the option to upload custom software. The module shall be used in conjunction with an external host controller which can host the application layer. NeoMesh AAPI & SAPI specifications can be found on the NeoCortec website www.neocortec.com

Embit offers the option to provide customer specific firmware which can contain application layer functionality. Please contact Embit for further details on this option.

2.3 Transceiver

The Semtech® **LR1121**[2] is a half-duplex transceiver that provides ultra-long range communication, high interference immunity with minimized current consumption in the subGHz and 2.4 GHz band.

Other than LoRa®, the **LR1121** supports (G)FSK radio modulations. The maximum transmit power is 11.5 dBm at 2.4 GHz and 22 dBm at sub-GHz band with a receiver sensitivity of - 142 dBm @595 bps with LoRa® modulation @SF12 and 62.5KHz Bandwidth.

NeoMesh support a subset of LoRa and GFSK modulation settings. Please refer to the specific firmware version for further details.

2.4 Antenna

The **EMB-LR1121-E** comes with two antenna options:

- 2 External antenna connectors: 50 Ω single-ended U.FL connector
- For subGHz provide Ground-signal-Ground pins

2.5 Crystals

The **EMB-LR1121-e/mesh** embeds two crystals:

- One 32MHz crystal required by the digital PLL of the transceiver to perform RF and baseband frequency conversion.
- One 32kHz TCXO crystal connected to the MCU.

2.6 Firmware

The **EMB-LR1121-e/mesh** comes with the NeoMesh firmware preloaded.

2.7 PC tools

To work with **EMB-LR1121-e/mesh** the following tools are suggested:

- **NeoCortec Demo Application for sending and receiving data**
- **NeoCortec Configuration Application for modifying settings and updating firmware**

Please access the NeoCortec website (www.neocortec.com) to download the latest version of the PC tools.

3 Size and footprint

3.1 Size

The mechanical dimensions of **EMB-LR1121-e/mesh** are 15.5 x 20 mm with a thickness of 3.2 mm (considering the shield).

The module has a total of 31 pins (10 on each side edge, 8 on bottom side and 3 pins at the top left of the board) with 1.27 mm pitch and 1.02 x 0.81 as dimensions. Positioning is shown in the following image (Figure 2).

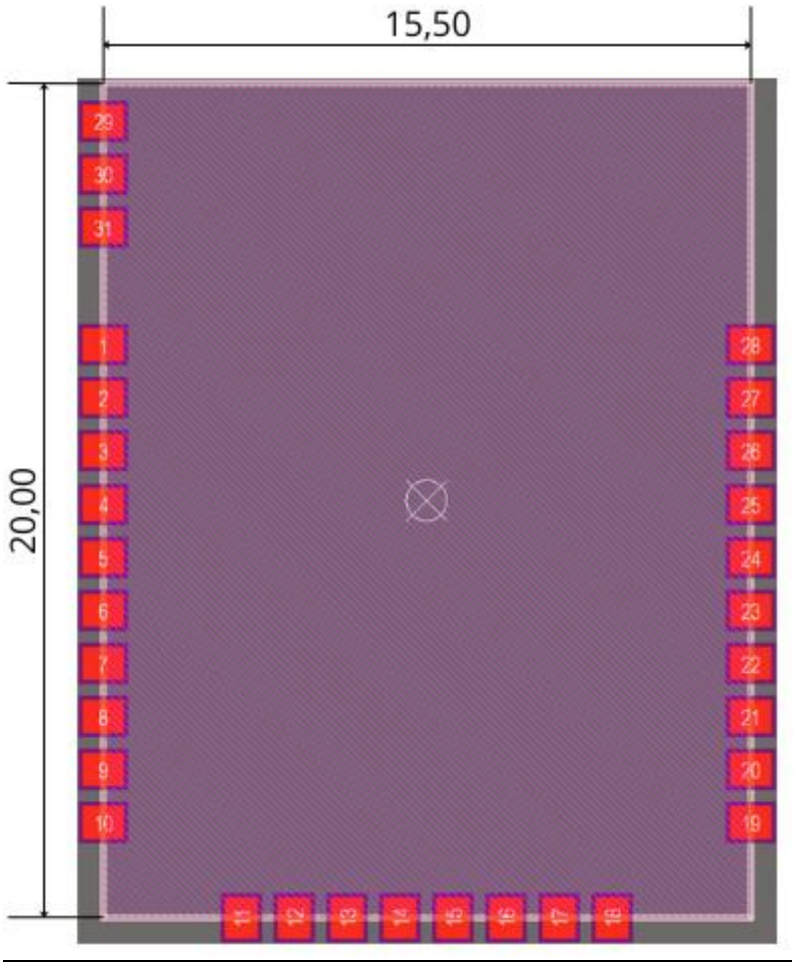

Figure 2 - Connector positions

3.2 Suggested footprint

The **EMB-LR1121-e/mesh** suggested footprint consists in 31 LGA pads positioned as following (Figure 3 and Figure 4, all sizes are in mm).

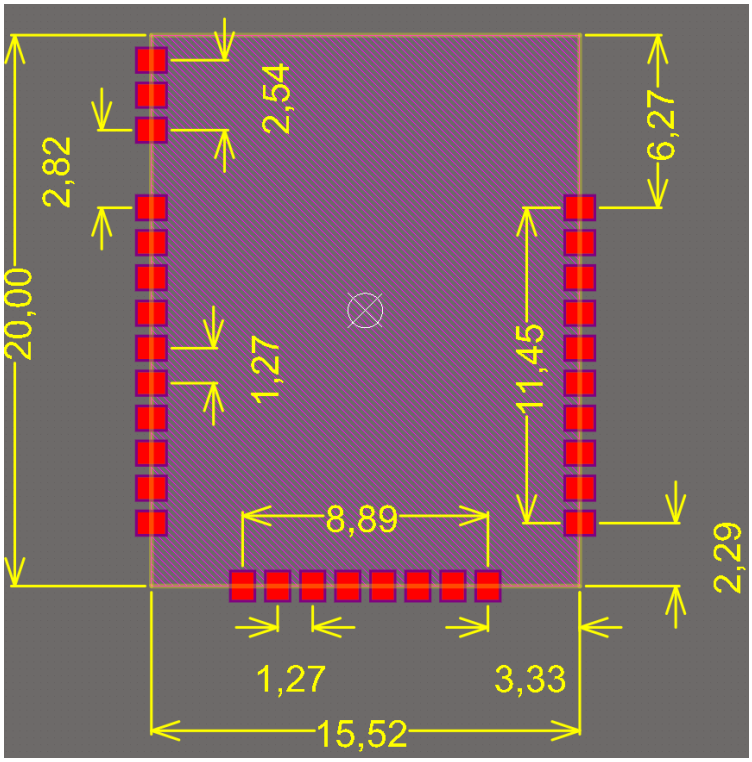

Figure 3 - EMB-LR1121-e suggested footprint

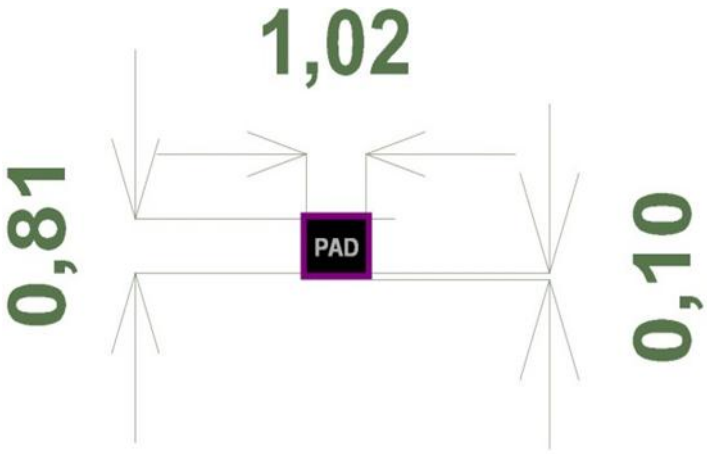

Figure 4 - Pad

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 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

	EMB-LR1121-e/mesh		
Number	**Pin Name**	**Type**	**Description**
1	GND1	GND	Ground
2	GND2	GND	Ground
3	BOOT0	Not functional	Not functional
4	VCC	Power Input	Supply voltage
5	PA4	Digital I/O	I/O
6	PA3	Digital Output	nWU Output pin
7	DEBUG_CLK	Not functional	Not functional
8	DEBUG_DATA	Not functional	Not functional
9	VCC	Power Input	Supply voltage
10	GND3	GND	Ground
11	PB6_I2C_SCL	Not functional	Not functional
12	PB7_I2C_SDA	Not functional	Not functional
13	PA12_SPI_MOSI	Not functional	Not functional
14	PA11_SPI_MISO	Not functional	Not functional
15	PA1_SPI_SCK	Not functional	Not functional
16	PA10_SPI_NSS	Not functional	Not functional
17	LR_IRQ	Not functional	Not functional
18	PB0	Digital Input	nWES Input Pin
19	GND4	GND	Ground
20	VCC	Power Input	Supply voltage
21	PB1_UART_RTS	Digital Output	AAPI UART CTS
22	PA6_UART_CTS	Not functional	Not Functional
23	PA5_UART_TX	Digital Output	AAPI / SAPI UART TX
24	PA7_UART_RX	Digital Input	AAPI / SAPI UART RX
25	VCC	Power Input	Supply voltage
26	PA0_ADC	Not functional	Not functional
27	NRESET	Reset input	System reset input (active low)
28	GND5	GND	Ground
29	GND6	GND	Ground
30	RF_SIG	RF	RF sub-GHz input/output
31	GND7	GND	Ground

Table 2 - EMB-LR1121-e/mesh Interface Pin Out

The pin descripted above has the following behaviour:

- nWU (Output): Active-low output signal. Pulled low when the module has new data available for transmission to the host controller. Remains high when idle.
- nWES (Input): Active-low input signal. Used during node installation to trigger the module's initialization mode(*) when driven low. If unused, this pin must be held high and remain stable.

*__Note__: for detailed usage and information see the Integration Manual

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[1].
- 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	+3.6	V
Voltage on any pin	+3.6	V
Rf input power (P_{max})	0	dBm
Storage Temp. Range	-40 ~ +85	ºC

Table 3 - Absolute Maximum Ratings

5.2 Operating Conditions

Parameter	Min	Max	Unit
Power Supply Voltage (Vcc)	+2.5	+3.3	V
Operating Temperature range	-40	+85	ºC
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 4 - Operating Conditions

5.3 Power Consumption

Mode	Typ. value	Unit
Transmit @+11.5 dBm (2.4 GHz)	23	mA
Transmit @+14 dBm (868 MHz)	27	mA
Transmit @+22 dBm (915 MHz)	124	mA
Receive (2.4 GHz)	7	mA
Receive (868 MHz)	6	mA

Table 5 - Power Consumption

Average current consumption of the EMB-LR1121-e/mesh is dependent on the configuration of the module. A tool is available which can estimate the average current consumption based on settings.

5.4 RF characteristics

Condition	Min.	Typ.	Max.	Unit
RF Frequency range (sub-GHz)	150		928	MHz
Frequency tolerance		±10		ppm
Programmable Output Power Range (LPA)	-17		+13	dBm
Programmable Output Power Range (HPA)	-9		+20	dBm
RF Data Rate LoRa®	0.292		101.5	kbps
RX sensitivity SF7; BW=125 KHz		-118		dBm
RX sensitivity SF12; BW=125 KHz		-132.5		dBm
RX sensitivity SF7; BW=250 KHz		-116		dBm
RX sensitivity SF12; BW=250 KHz		-130		dBm
RX sensitivity SF7; BW=500 KHz		-112		dBm
RX sensitivity SF12; BW=500 KHz		-124.5		dBm

Table 6 RF - characteristics sub-Ghz

Condition	Min.	Typ.	Max.	Unit
RF Frequency range (2.4 GHz)	2400		2485	MHz
Frequency tolerance		±10		ppm
Programmable Output Power Range (LPA)	-17		+10.5	dBm
RF Data Rate LoRa®	0.292		101.5	kbps
Rx sensitivity SF5; BW=406 KHz		-111		dBm
RX sensitivity SF7; BW=406 KHz		-129		dBm
RX sensitivity SF5; BW=812 KHz		-108		dBm
RX sensitivity SF7; BW=812 KHz		-112		dBm

Table 7 RF - characteristics 2.4 GHz

6 References

[1] STM, STM32U083KC Datasheet from www.st.com

[2] Semtech, LR1121 Datasheet from www.semtech.com

7 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.

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 Trademarks

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