ELECROW LR1302 LoRaWAN Gateway Module User Manual

Contents

ELECROW LR1302 LoRaWAN Gateway Module

Product Information

Technical Specifications:

- **Region Frequency:** EU868, US915
- **Sensitivity:** -125dBm @125K/SF7, -139dBm @125K/SF12
- **TX Power:** 26 dBm (with 3.3V power supply), 20.614dBm (with 3.3V power supply)
- **LEDs:** Power: Green, Config: Red, TX: Green, RX: Blue
- **Form Factor:** Mini PCIe, 52pin Golden Finger
- **Power Consumption (SPI version):** Standby: 7.5 mA, TX maximum power: 415 mA, RX: 40 mA
- **Power Consumption (USB version):** Standby: 20 mA, TX maximum power: 425 mA, RX: 53 mA
- **LBT(Listen Before Talk):** Support
- **Antenna Connector:** U.FL
- **Operating Temperature:** Not specified
- **Dimensions:** Not specified
- **Certification:** CE, FCC

Product Usage Instructions

Hardware Preparation:

1. Install the LR1302 LoRaWAN HAT for RPI_PRD and LR1302_LoRaWAN module on Raspberry Pi.
2. If using the USB version, connect its Type C port to the Raspberry Pi USB port using a Type C USB cable.

Software Preparation:

1. Download the latest Raspberry Pi OS Lite image.
2. Use Balena Etcher to write the Raspberry Pi OS image to the SD card.

Raspberry PI Setup Steps:

1. Power off the Raspberry Pi and insert the LR1302 module into the Hat on the Raspberry Pi 40-pin connector.
2. Tighten the LR1302 module as per instructions.
3. Enable Raspbian I2C and SPI interfaces.

Configuring TTN:

1. Login to the TTNv3 console and click on ‘Go to Gateway’.
2. Click ‘Add Gateway’ and note down the gateway EUI and server address.
3. Select the appropriate frequency based on the module used (EU868 or US915).
4. Edit the global_conf.json.sx1250 file as specified in the manual.

Frequently Asked Questions

- **What are the recommended Raspberry Pi OS image and software for this product?**
  The recommended Raspberry Pi OS image is Raspberry Pi OS Lite, and Balena Etcher is recommended for writing the image to the SD card.
- **How do I configure TTN for this product?**
  Follow the steps outlined in the manual to log in to TTNv3 console, add a gateway, and configure it with the necessary settings including gateway EUI, server address, and frequency selection.

Description

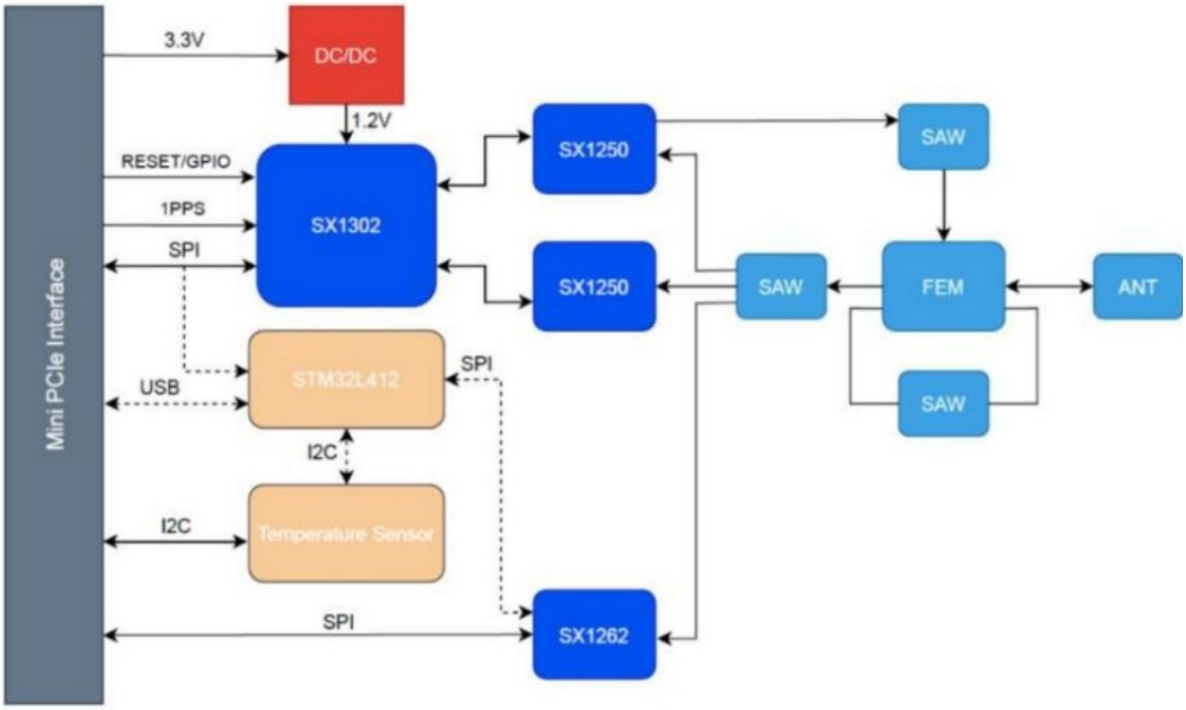
- The LR1302 module is a new generation LoRaWAN® gateway module with a mini PCIe form factor. Based on the Semtech SX1302 baseband LoRaWAN® chip, the LR1302 frees up the potential for long-distance wireless transmission for gateway products. Compared to previous SX1301 and SX1308 LoRa® chips, it has higher sensitivity, lower power consumption, and lower operating temperatures. The LR1302 LoRaWAN® Gateway module is available in SPI and USB versions on both US915 and EU868 bands, giving you multiple LoRaWAN® frequency schemes to choose from, including EU868 and US915.
- The LR1302 is designed for M2M and iot applications and can be used in a wide range of scenarios that support LPWAN gateways. When developing LoRa® gateway devices, including LoRaWAN® gateways, hotspots, etc., it will be your best choice to greatly reduce technical difficulty and time consumption.

Feature

- Uses Semtech SX1302 baseband LoRa® chip for extremely low power consumption and superior performance.
- Mini-PCIe shape with standard 52-pin gold finger for easy integration with various gateway devices.
- Ultra-low operating temperature without additional heat dissipation reduces the volume of the LoRaWAN® gateway.
- SX1250 TX/RX front end, sensitivity as low as -139 dBm@SF12; TX power up to 26 dBm @3.3V.
- Passed CE and FCC certification. Simplify the final product certification process.

Hardware overview

Schematic drawing



Technical specifications

Region	EU868	US915
Frequency	863-870MHz	902-928MHz
Sensitivity	-125dBm @125K/SF7 -139dBm @125K/SF12	-125dBm @125K/SF7 -139dBm @125K/SF12
TX Power	26 dBm (with 3.3V power supply)	20.614dBm (with 3.3V power supply)
LEDs	Power: Green Config: Red TX: Green RX: Blue	
Form Factor	Mini PCIe, 52pin Golden Finger	
Power Consumption (SPI version)	Standby: 7.5 mA TX maximum power: 415 mA RX: 40 mA	
Power Consumption (USB version)	Standby: 20 mA TX maximum power: 425 mA RX: 53 mA	
LBT(Listen Before Talk)	Support	
Antenna Connector	U.FL	
Operating Temperature	-40°C to 85°C	
Dimensions	30 mm (width) × 50.95 mm (length)	
Certification	CE	FCC

Interface function

IO port follows:

NO	MiniPClePin	LR1302 Pin	IO type	Fuction
1	WAKE#	NC		
2	3.3Vaux	3V3	Power	
3	COEX1	NC		
4	GND	GND	Ground	
5	COEX2	NC		
6	1.5V	NC		
7	CLKREQ#	NC		
8	UIM PWR	SX1261 BUSY	DO	SX1261 BUSY Pin
9	GND	GND	Ground	
10	UIM DATA	SX1261 RST	DI	SX1261 Reset Pin
11	REFCLK-	NC		
12	UIM CLK	NC		
13	REFCLK+	NC		
14	NIM RESET	NC		
15	GND	GND	Ground	
16	UIM VPP	NC		
17	Reserved	NC		
18	GND	GND	Ground	
19	Reserved	1PPS	DI	GPS 1PPS
20	W DISABLE#	NC		
21	GND	GND	Ground	
22	PERST#	RESET	DI	SPI version: Active HIGH: USB version: Active LOW
23	PERn0	NC		
24	3.3Vaux	3V3	Power	
25	PERp0	SX1261 CSN		SX1261 Chip Select
26	GND	GND	Ground	
27	GND	GND	Ground	
28	1.5V	NC		
29	GND	GND	Ground	
30	SMB CLK	12C SCL	DI	Temperature Sensor 12C Clock
31	PETn0	SX1261_IO2	DIO	SX1261 DIO2 Pin
32	SMB DATA	I2C SDA	DIO	Temperature Sensor 12C Data
33	PETp0	SX1261_IO1	DIO	SX1261 DIO1Pin
34	GND	GND	Ground	
35	GND	GND	Ground	
36	USB D-	USB D-	DIO	USB differential data -
37	GND	GND	Ground	
38	USB D+	USB D+	DIO	USB differential data +
39	3.3Vaux	3V3	Power	
40	GND	GND	Ground	
41	3.3Vaux	3V3	Power	
42	LED WWAN#	NC		
43	GND	GND	Ground	
44	LED WLAN#	NC		
45	Reserved	SPI SCK	DI	SPI Clock
46	LED WPAN#	NC		
47	Reserved	SPI MISO	DO	SPI MISO
48	1.5V	NC		
49	Reserved	SPI MOSI	DI	SPI MOSI
50	GND	GND	Ground	
51	Reserved	SX1302 CSN	DI	SX1302 Chip select
52	3.3Vaux	3V3	Power	

Apply:

1. LPWAN gateway device development
2. Any remote wireless communication application development
3. LoRa® and LoRaWAN® Applied learning and research

Usage

Hardware preparation:

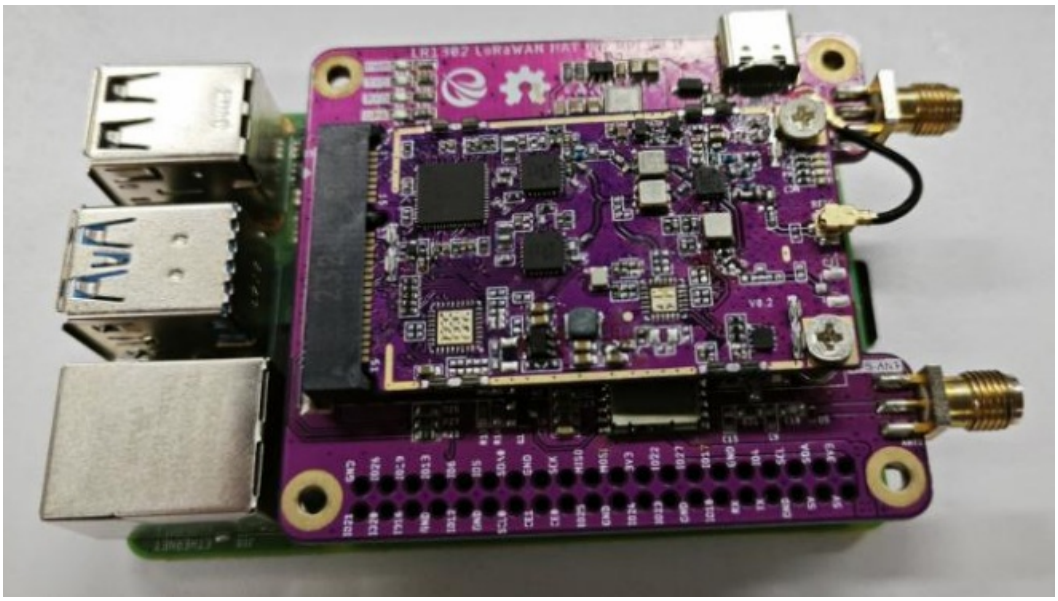
1. LR1302 LoRaWAN® gateway module
2. Raspberry Pi boards with 40-pin GPIO connectors (e.g. Raspberry Pi 4B or Raspberry 3B+)
3. LR1302 LoRaWAN HAT for RPI_PRD for Raspberry Pi
4. Raspberry PI power adapter
5. LoRa® antenna
6. 8G or larger SD card and card reader
7. Type C USB cable (if using the USB version of WM1302 LoRaWAN® gateway module)

Software preparation:

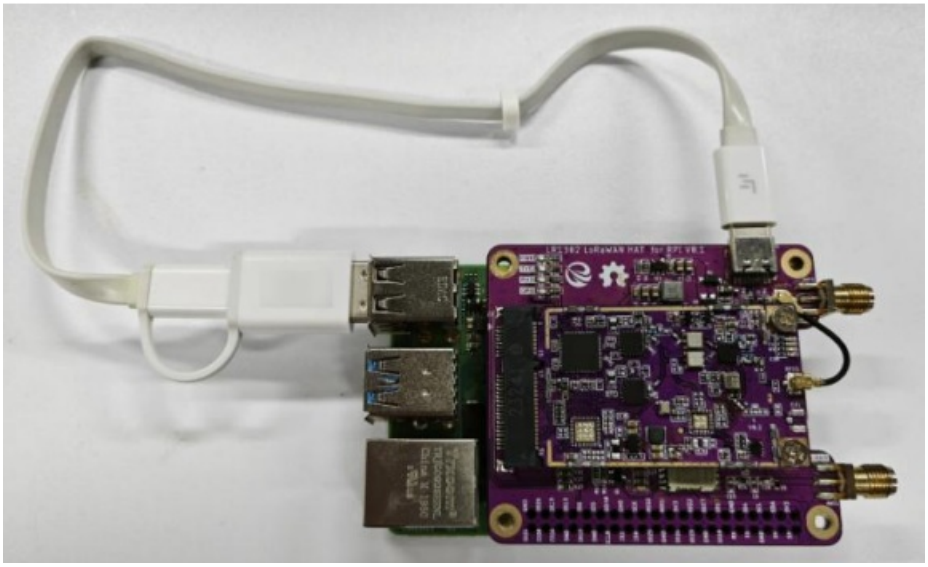
1. **Latest Raspberry Pi OS image:** Raspberry Pi OS Lite is recommended
2. **Balena Etcher:** Refresh the Raspberry Pi OS image to the SD card

Raspberry PI setup steps:

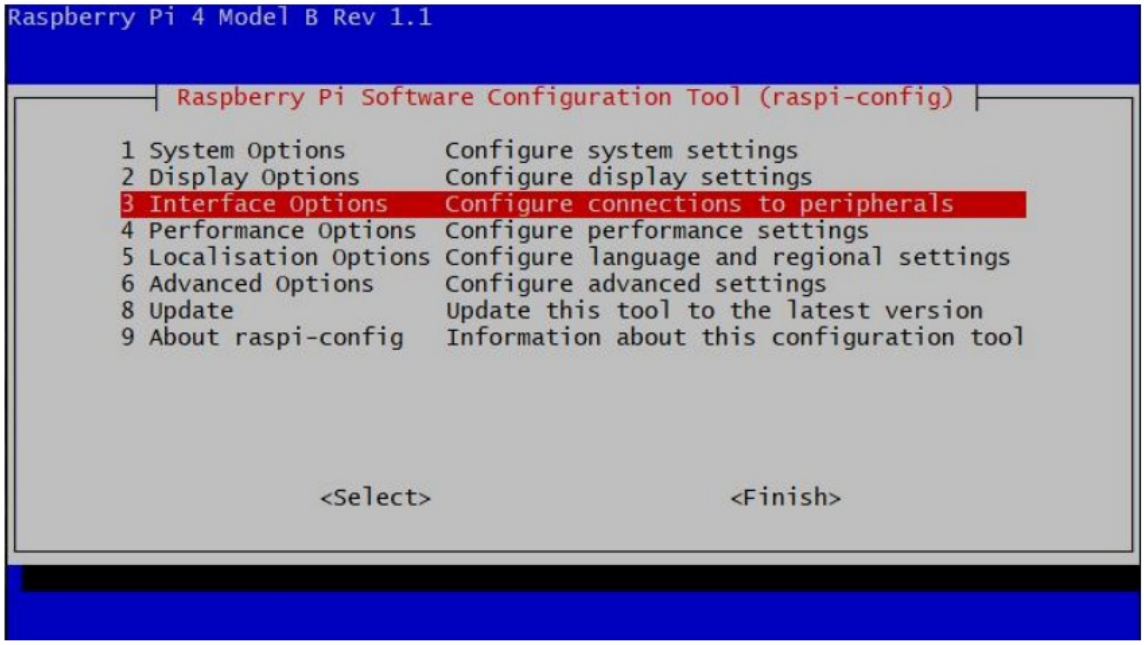
- **Step 1:**
  - Install the LR1302 LoRaWAN HAT for RPI_PRD and install the LR1302_LoRaWAN Easily install the Hat to the Raspberry Pi 40-pin connector. First power off the Raspberry Pi, insert the LR1302 module into the Hat and tighten it as shown below



  - If you are using the USB version of the LR1302 module, also connect its Type C port to the Raspberry Pi USB port using a Type C USB cable.



- **Step 2:** Enable Raspbian I2C and SPI interfaces
  - The LR1302 module communicates with the Raspberry Pi via SPI and I2C. However, both interfaces are not enabled by default in Raspbian, so developers need to enable them before using LR1302. Here, we introduce a command-line approach to enable the SPI and I2C interfaces.
  - First, log in to the Raspberry Pi via SSH or using the display (don't use the serial console because the GPS module on the Pi Hat takes over the Pi's hardware UART pins), Then enter the command line to open the Rasberry Pi software configuration tool sudo raspi-config:
    sudo raspi-config

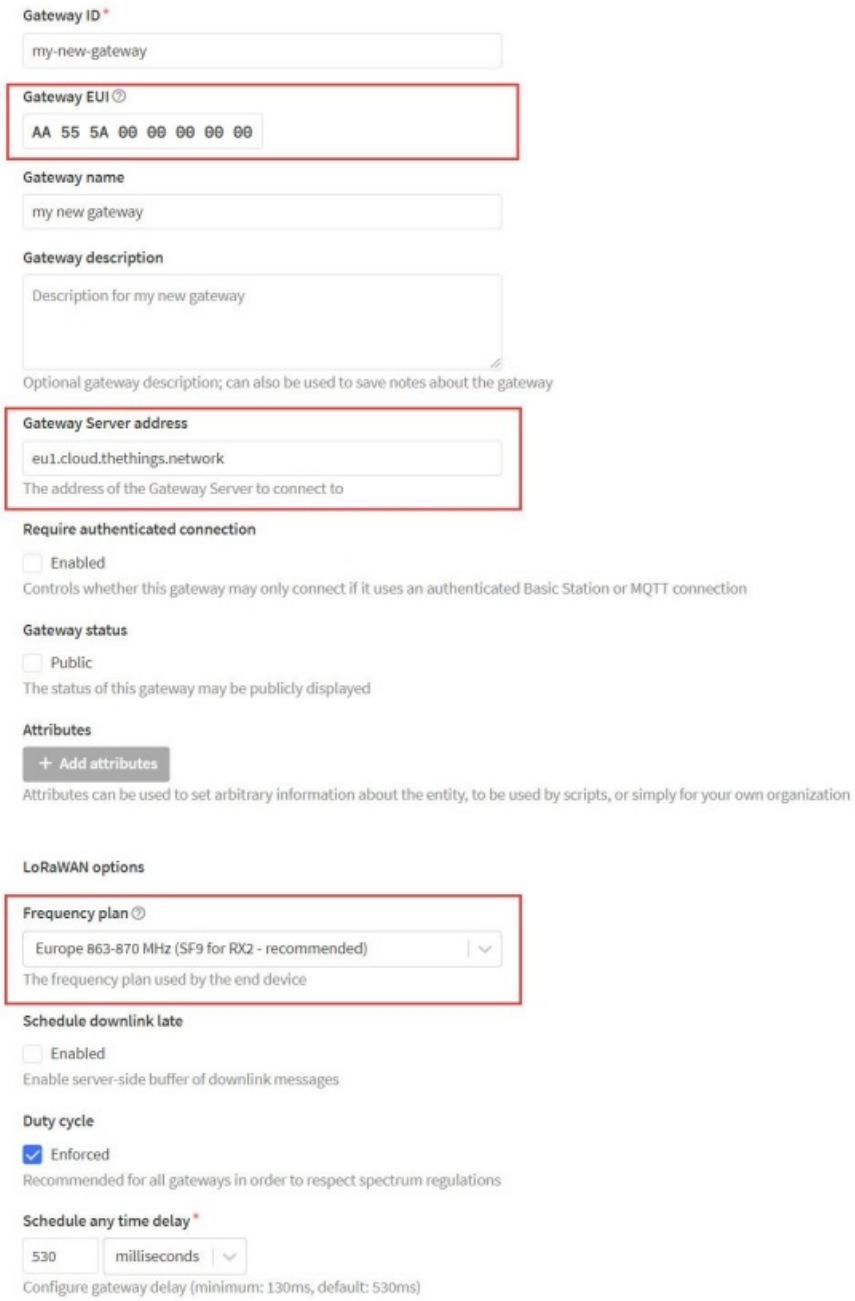


    1. Select "Interface Options"
    2. Select SPI and select Yes to enable it
    3. Select I2C and select Yes to enable it
    4. Select Serial Port, then select No "Do you want to log in shell…" And select Yes "Do you want serial port hardware…"
    5. After that, restart the Raspberry Pi to make sure these Settings work.
- **Step 3.** Obtain and compile the SX1302 source
  - Now let's install git from github and download sx1302_hal (libraries and programs for SX1302 LoRa Gateway) :
    - sudo apt update

    - sudo apt install -y git
    - cd ~
    - git clone https://github.com/Elecrow-RD/LR1302_loraWAN/LR1302_HAL
  - Move to the sx1302_hal folder and compile everything:
    - cd ~/sx1302_hal
    - Make

Configuring TTN:

- Log in to the TTNv3 console, click Go to Gateway, and then click Add Gateway on the Add Gateway page. Pay attention to the gateway EUI, gateway server address, and corresponding frequency. Retain the default Settings for other Settings. (reference Lora_Basic_Gateway_Module wiki, specific steps about TTN create part, **https://www.elecrow.com/wiki/index.php?title=Lora_Basic_Gateway_Module**).
- Gateway EUI: The 64-bit extended unique identifier of the gateway, which this wiki sets to “AA555A0000000000”
- Gateway Server address: The address of the server that the gateway will connect to, copies it to the clipboard, and the developer will later need to save it to the configuration file
- Frequency selection: If using the EU868 module, select the European “Europe 863-870 MHz (SF9 for RX2)”, if using the US915 module, select the United States “902-928 MHz, FSB 2”.

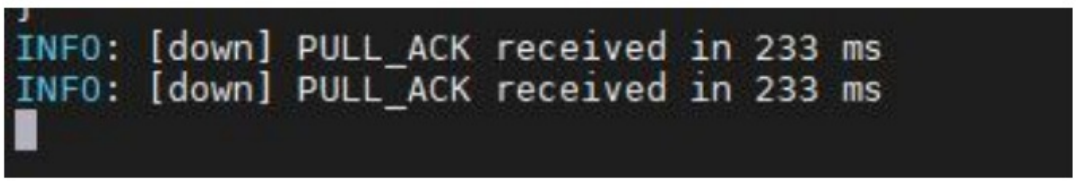


- After adding the gateway, go back to Raspberry Pi, press CTRL + c to stop lora_pkt_fwd, and then edit the global_conf.json.sx1250.xxxx configuration file with the text editor nano:
  - Please select one of the following comands based on your module
  - for WM1302 LoRaWAN Gateway Module (SPI) – EU868 nano global_conf.json.sx1250.EU868
  - for WM1302 LoRaWAN Gateway Module (USB) – EU868 nano global_conf.json.sx1250.EU868.USB
  - for WM1302 LoRaWAN Gateway Module (SPI) – US915 nano global_conf.json.sx1250.US915
  - for WM1302 LoRaWAN Gateway Module (USB) – US915 nano global_conf.json.sx1250.US915.USB
- Basically, you just need to change these parameters: “Server address,” “serv_port_up, “and “serv_port_down” are at the end of the configuration file. Copy the gateway server address to “server_address” and change “serv_port_up “and “serv_port_down” to 1700. These parameters should be edited as follows:
  - “gateway_conf”: {
  - “gateway_ID”: “AA555A0000000000”,
  - /* change with default server address/ports */
  - “server_address”: “eu1.cloud.thethings.network”,
  - “serv_port_up”: 1700,
  - “serv_port_down”: 1700,

- Press “CTRL + x” to save these changes, then y, and finally Enter to close the text editor.
- Restart lora_pkt_fwd and you will find that the Raspberry Pi Gateway is connected to TTN.
  Note: Make sure that when you run lora_pkt_fwd, there is the reset_lgw.sh file in the current path.
    - Please select one of the following comands based on your module
    - for WM1302 LoRaWAN Gateway Module (SPI) – EU868 ./lora_pkt_fwd -c global_conf.json.sx1250.EU868
    - for WM1302 LoRaWAN Gateway Module (USB) – EU868 ./lora_pkt_fwd -c global_conf.json.sx1250.EU868.USB
    - for WM1302 LoRaWAN Gateway Module (SPI) – US915 ./lora_pkt_fwd -c global_conf.json.sx1250.US915
    - for WM1302 LoRaWAN Gateway Module (USB) – US915 ./lora_pkt_fwd -c global_conf.json.sx1250.US915.USB

Run the LoraWan gateway with Raspberry PI:

1. Connect to the Internet (wifi or wired)
2. Run program
    1. Open the Raspberry PI shell
    2. Run command
       Note: Make sure that when you run lora_pkt_fwd, there is the reset_lgw.sh file in the current path.
        - **868 SPI Mode:**
          sudo /home/pi/sx1302_hal/packet_forwarder/lora_pkt_fwd -c /home/pi/sx1302_hal/packet_forwarder/global_conf.json.sx1250.EU868
        - **868 USB Mode**
          sudo /home/pi/sx1302_hal/packet_forwarder/lora_pkt_fwd -c /home/pi/sx1302_hal/packet_forwarder/global_conf.json.sx1250.EU868.USB
        - **915 SPI Mode**
          Sudo /home/pi/sx1302_hal/packet_forwarder/lora_pkt_fwd -c /home/pi/sx1302_hal/packet_forwarder/global_conf.json.sx1250.US915.USB
        - **915 USB Mode**
          Sudo /home/pi/sx1302_hal/packet_forwarder/lora_pkt_fwd -c /home/pi/sx1302_hal/packet_forwarder/global_conf.json.sx1250.US915.USB
3. Check whether the network is connected to the TTN server and the heartbeat packet is received



FCC

FCC Caution: Any changes or modifications not expressly approved by the party responsible for compliance could void the user’s authority to operate this equipment.
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
2. this device must accept any interference received, including interference that may cause undesired operation.

This device and its antenna(s) must not be co-located or operating in conjunction with any other antenna or transmitter. 15.105 Information to the user. (b) For a Class B digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

Note: 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.

This equipment complies with FCC radiation exposure limits set forth for an uncon- trolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator and your body. Radiation

Exposure Statement:

- This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment.
- This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.
- The availability of some specific channels and/or operational frequency bands are country dependent and are firmware programmed at the factory to match the intended destination.
- The firmware setting is not accessible by the end user.
- The final end product must be labelled in a visible area with the following:
- “Contains Transmitter Module “FCC ID: 2BDNA-LR1302-ELE”

Requirement per KDB996369 D03

List of applicable FCC rules

- List the FCC rules that are applicable to the modular transmitter. These are the rules that specifically establish the bands of operation, the power, spurious emissions, and operating fundamental frequencies. DO NOT list compliance to unintentional-radiator rules (Part 15 Subpart B) since that is not a condition of a module grant that is extended to a host manufacturer. See alsoSection 2.10 below concerning the need to notify host manufacturers that further testing is required.3
- Explanation: This module meets the requirements of FCC part 15C (15.247).it Specifically identified AC Power Line Conducted Emission, Radiated Spurious emissions, Band edge and RF Conducted Spurious Emissions,
- Conducted Peak Output Power, Bandwidth, Power Spectral Density, Antenna Requirement.

Summarize the specific operational use conditions

- Describe use conditions that are applicable to the modular transmitter, including for example any limits on

antennas, etc. For example, if point-to- point antennas are used that require reduction in power or compensation for cable loss, then this information must be in the instructions. If the use condition limitations extend to professional users, then instructions must state that this information also extends to the host manufacturer's instruction manual. In addition, certain information may also be needed, such as peak gain per frequency band and minimum gain, specifically for master devices in 5 GHz DFS bands.

- Explanation: The product antenna uses an irreplaceable antenna with a gain of 3.35dBi 2.4 Single Modular
- If a modular transmitter is approved as a "Single Modular," then the module manufacturer is responsible for approving the host environment that the Single Modular is used with. The manufacturer of a Single Modular must describe, both in the filing and in the installation instructions, the alternative means that the Single Modular manufacturer uses to verify that the host meets the necessary requirements to satisfy the module limiting conditions. A
- Single Modular manufacturer has the flexibility to define its alternative method to address the conditions that limit the initial approval, such as: shielding, minimum signaling amplitude, buffered modulation/data inputs, or power supply regulation. The alternative method could include that the limited module manufacturer reviews detailed test data or host designs prior to giving the host manufacturer approval.
- This Single Modular procedure is also applicable for RF exposure evaluation when it is necessary to demonstrate compliance in a specific host. The module manufacturer must state how control of the product into which the modular transmitter will be installed will be maintained such that full compliance of the product is always ensured. For additional hosts other than the specific host originally granted with a limited module, a Class II permissive change is required on the module grant to register the additional host as a specific host also approved with the module. Explanation: The module is a single module.

Trace antenna designs
For a modular transmitter with trace antenna designs, see the guidance in Question 11 of KDB Publication 996369 D02 FAQ – Modules for Micro-Strip Antennas and traces. The integration information shall include for the TCB review the integration instructions for the following aspects: layout of trace design, parts list (BOM), antenna, connectors, and isolation requirements.

- Information that includes permitted variances (e.g., trace boundary limits, thickness, length, width, shape(s), dielectric constant, and impedance as applicable for each type of antenna);
- Each design shall be considered a different type (e.g., antenna length in multiple(s) of frequency, the wavelength, and antenna shape (traces in phase) can affect antenna gain and must be considered);
- The parameters shall be provided in a manner permitting host manufacturers to design the printed circuit (PC) board layout;
- Appropriate parts by manufacturer and specifications;
- Test procedures for design verification;
- Production test procedures for ensuring compliance
  The module grantee shall provide a notice that any deviation(s) from the defined parameters of the antenna trace, as described by the instructions, require that the host product manufacturer must notify the module grantee that they wish to change the antenna trace design. In this case, a Class II permissive change application is required to be filed by the grantee, or the host manufacturer can take responsibility through the change in FCC ID (new application) procedure followed by a Class II permissive change application

RF exposure considerations
It is essential for module grantees to clearly and explicitly state the RF exposure conditions that permit a host

product manufacturer to use the module. Two types of instructions are required for RF exposure information: (1) to the host product manufacturer, to define the application conditions (mobile, portable – xx cm from a person's body); and (2) additional text needed for the host product manufacturer to provide to end users in their end-product manuals. If RF exposure statements and use conditions are not provided, then the host product manufacturer is required to take responsibility of the module through a change in FCC ID (new application).
Explanation: The module complies with FCC radiofrequency radiation exposure limits for uncontrolled environments. The device is installed and operated with a distance of more than 20 cm between the radiator and your body." This module follows FCC statement design, FCC ID: 2BDNA-LR1302-ELE

Antennas

- A list of antennas included in the application for certification must be provided in the instructions. For modular transmitters approved as limited modules, all applicable professional installer instructions must be included as part of the information to the host product manufacturer. The antenna list shall also identify the antenna types (monopole, PIFA, dipole, etc. (note that for example an "omni-directional antenna" is not considered to be a specific "antenna type").
- For situations where the host product manufacturer is responsible for an external connector, for example with an RF pin and antenna trace design, the integration instructions shall inform the installer that unique antenna connector must be used on the Part 15 authorized transmitters used in the host product.
- The module manufacturers shall provide a list of acceptable unique connectors.
  Explanation: The product antenna uses an irreplaceable antenna with a gain of 3.35dBi

Label and compliance information
Grantees are responsible for the continued compliance of their modules to the FCC rules. This includes advising host product manufacturers that they need to provide a physical or e-label stating "Contains FCC ID" with their finished product. See Guidelines for Labeling and User Information for RF Devices – KDB Publication 784748.
Explanation: The host system using this module, should have label in a visible area indicated the following texts: "Contains FCC ID: 2BDNA-LR1302-ELE

Information on test modes and additional testing requirements5

- Additional guidance for testing host products is given in KDB Publication 996369 D04 Module Integration Guide. Test modes should take into consideration different operational conditions for a stand-alone modular transmitter in a host, as well as for multiple simultaneously transmitting modules or other transmitters in a host product.
- The grantee should provide information on how to configure test modes for host product evaluation for different operational conditions for a stand-alone modular transmitter in a host, versus with multiple, simultaneously transmitting modules or other transmitters in a host.
- Grantees can increase the utility of their modular transmitters by providing special means, modes, or instructions that simulates or characterizes a connection by enabling a transmitter. This can greatly simplify a host manufacturer's determination that a module as installed in a host complies with FCC requirements.
  Explanation: Shenzhen Elecrow Limited can increase the utility of our modular transmitters by providing instructions that simulates or characterizes a connection by enabling a transmitter.

Additional testing, Part 15 Subpart B disclaimer

- The grantee should include a statement that the modular transmitter is only FCC authorized for the specific rule parts (i.e., FCC transmitter rules) listed on the grant, and that the host product manufacturer is responsible for

compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. If the grantee markets their product as being Part 15

- Subpart B compliant (when it also contains unintentional-radiator digital circuity), then the grantee shall provide a notice stating that the final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

  Explanation: The module without unintentional-radiator digital circuity, so the module does not require an evaluation by FCC Part 15 Subpart B. The host shoule be evaluated by the FCC Subpart B.

Documents / Resources

	ELECROW LR1302 LoRaWAN Gateway Module [pdf] User Manual LR1302-ELE, 2BDNA-LR1302-ELE, 2BDNALR1302ELE, LR1302 LoRaWAN Gateway Module, LR1302, Gateway, Module, Gateway Module, LR1302 Gateway Module, LoRaWAN Gateway Module

References

- Elecrow Wiki
- User Manual