

LR1302_LoRaWAN Gateway Module

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.

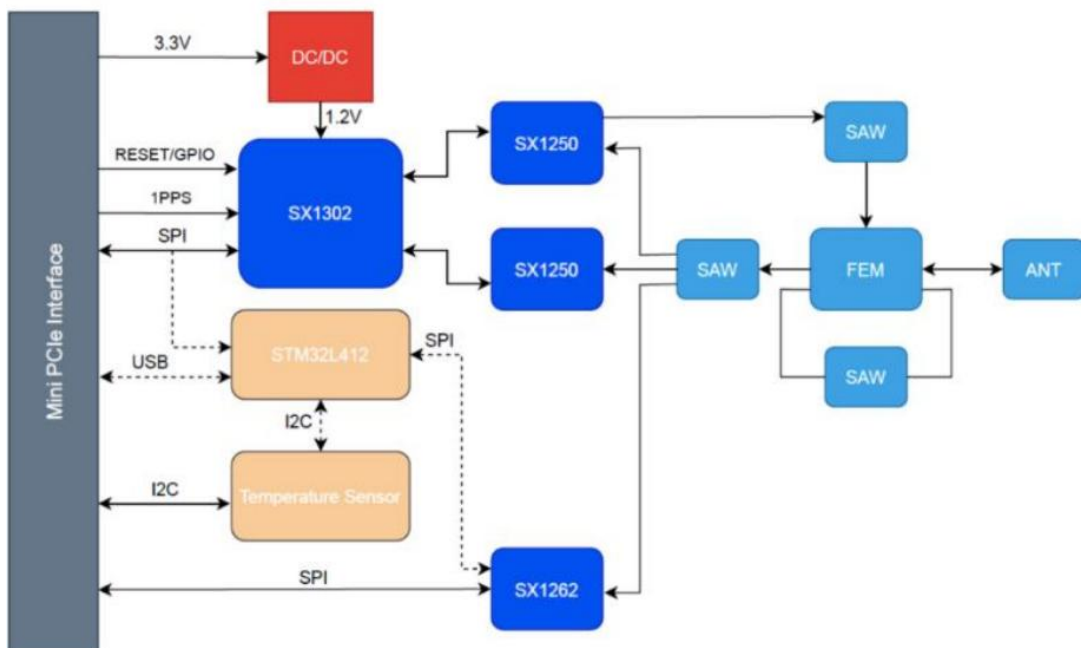
The LR1302 is designed for M2M and IoT applications and can be used in a wide range of scenarios that support LPWAN gateways. When developing LoRa® gateway devices, including LoRaWAN® gateways, hotspots, etc., it will be your best choice to greatly reduce technical difficulty and time consumption.

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	-125dBm @125K/SF7
	-139dBm @125K/SF12	-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	I2C SCL	DI	Temperature Sensor I2C Clock
31	PETn0	SX1261_I02	DIO	SX1261 DIO2 Pin
32	SMB DATA	I2C SDA	DIO	Temperature Sensor I2C Data
33	PETp0	SX1261_I01	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)

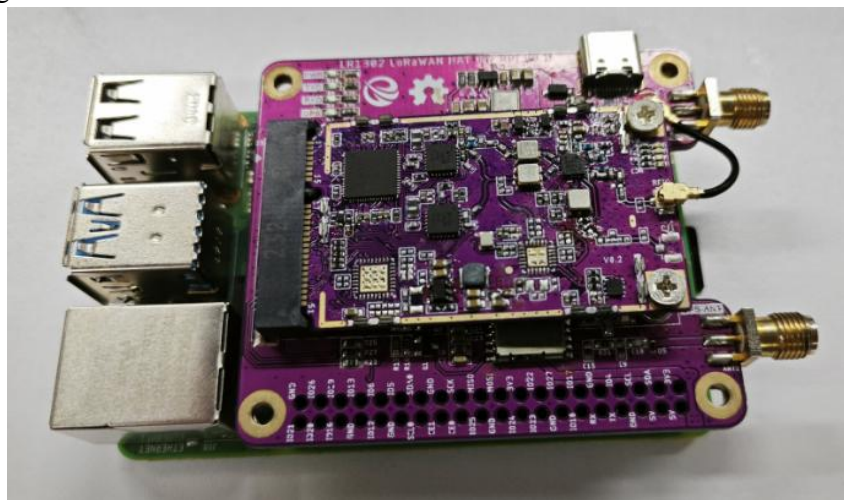
Software preparation:

- (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

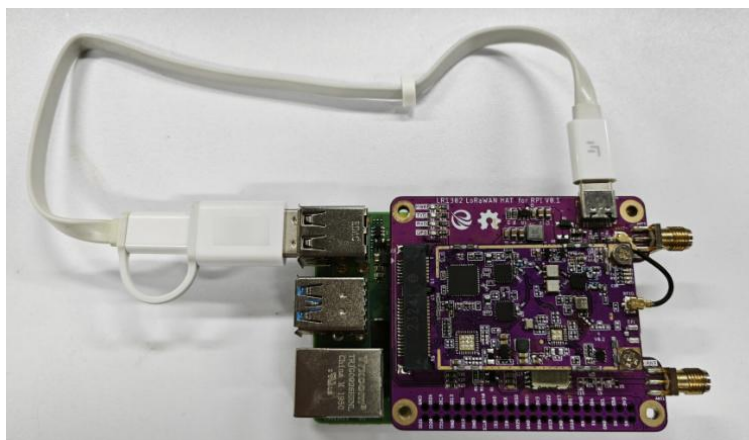
A. Raspberry PI setup steps:

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.

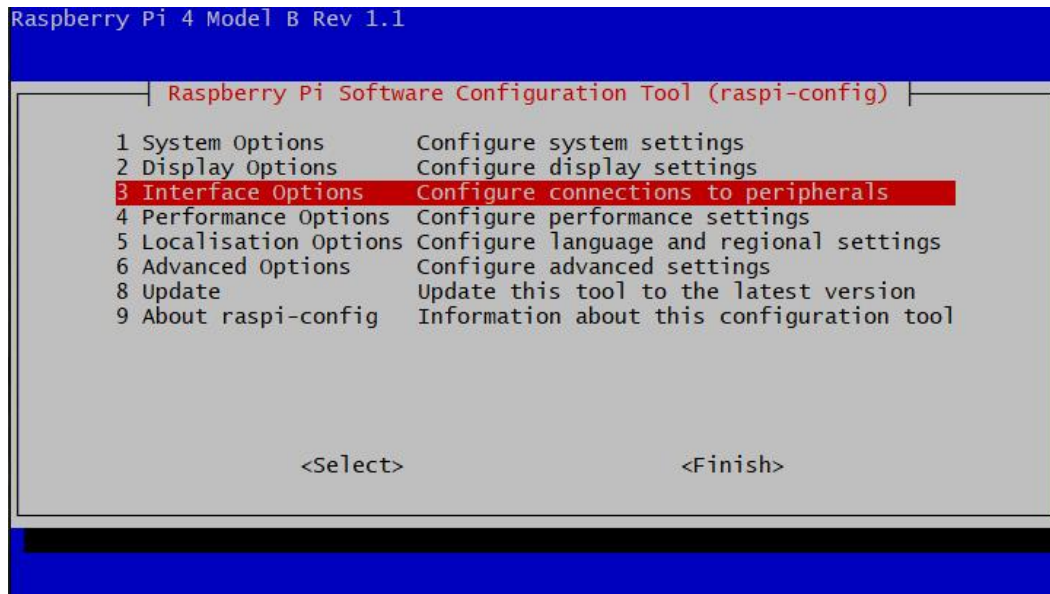


Step 2: Enable Raspbian I2C and SPI interfaces

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 Raspberry 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

B. 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".

Gateway ID *

my-new-gateway

Gateway EUI ?

AA 55 5A 00 00 00 00 00

Gateway name

my new gateway

Gateway description

Description for my new gateway

Optional gateway description; can also be used to save notes about the gateway

Gateway Server address

eu1.cloud.thethings.network

The address of the Gateway Server to connect to

Require authenticated connection

☐ Enabled

Controls whether this gateway may only connect if it uses an authenticated Basic Station or MQTT connection

Gateway status

☐ Public

The status of this gateway may be publicly displayed

Attributes

+ Add attributes

Attributes can be used to set arbitrary information about the entity, to be used by scripts, or simply for your own organization

LoRaWAN options

Frequency plan ?

Europe 863-870 MHz (SF9 for RX2 - recommended) | v

The frequency plan used by the end device

Schedule downlink late

☐ Enabled

Enable server-side buffer of downlink messages

Duty cycle

☒ Enforced

Recommended for all gateways in order to respect spectrum regulations

Schedule any time delay *

530 | milliseconds | v

Configure gateway delay (minimum: 130ms, default: 530ms)

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
```

C. 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
```

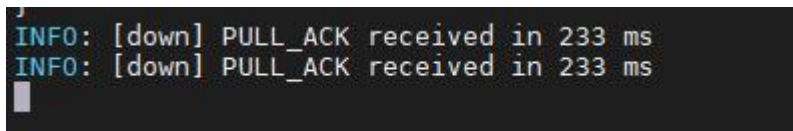
915 SPI Mode:

```
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



```
INFO: [down] PULL_ACK received in 233 ms  
INFO: [down] PULL_ACK received in 233 ms
```

FCC Requirement

FCC WARNING

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, and (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 uncontrolled 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

2.2 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 also Section 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.

2.3 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.

2.5 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.

a) 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); b) 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); c) The parameters shall be provided in a manner permitting host manufacturers to design the printed circuit (PC) board layout; d) Appropriate parts by manufacturer and specifications; e) Test procedures for design verification; and f) 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

2.6 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

2.7 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

2.8 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

2.9 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.

2.10 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 circuitry), 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 circuitry, so the module does not require an evaluation by FCC Part 15 Subpart B. The host should be evaluated by the FCC Subpart B.