LSD4WN-2L917M90
User Manual

Documentation Edition：Rev02

Recently updated：March 15, 2017

Document revision history

version	revision date	revision note
1.0.0	2017-10-30	Initial version

Catalogue

1 Summary

LSD4WN-2L917M90 is a LoRaWAN End Node module developed by Lierda Technology Group.This module integrates the LoRaWAN™ protocol stack, which conforms to LoRaWAN™ Specification 1.0.2 standard issued by LoRa Alliance.Hardware support 902.3-926.8 MHz ultra-wide band.

The module uses the serial interface to communicate with the user equipment data, instruction interaction.It can easily provide users with fast LoRaWAN network access and wireless data services.

LSD4WN-2L917M90 module with low power consumption, transmission distance, anti-interference ability, suitable for a variety of applications: Internet of things low power applications (IoT), automatic meter reading, smart city, industrial automation, smart home.

Product features

- working voltage：DC 2.5-3.6V ；
- physical layer：NA915；
- Transmit power：17.0±1.5dBm(max)；
- Ultra-high reception sensitivity：-135±1dBm(@SF=12)；
- Far away from the effective communication distance：5Km（Urban road environment,Non-wilderness environment）；
- Meet LoRaWAN™ Specification 1.0.2 standard;
- Internal integration LoRaWAN™ protocol stack, support Class A \ Class C device type;

- Low power consumption: standby current ≤ 2.0 uA;
- UART communication, external interface for the stamp hole, simple command configuration module parameters.

2 Product technical parameters

The technical parameters of this module are described below, including the protocol standard, interface characteristic, mechanical characteristic, DC characteristic parameter, RF characteristic parameter and environmental characteristic parameter.

Table 2-1 Module technical parameters

parameter	content		
protocol standard	describe		Remarks
	protocol version	LoRaWAN™ Specification 1.0.2	Update time June 2017
	physical layer	NA915	
	net topology	Star	Access LoRaWAN gateway, the formation of star - star network topology
	device type	Class A\Class C	Do not support Class B
	Network access mode	OTAA\ABP	
	Send addressing mode	broadcast	
	modulation mode	LoRa	
	data rate	SF12~SF7	
Interface characteri -stics	Serial interface	2 wire UART	compatible3.3V TTL\CMOS
	Serial baud rate	2400\4800\9600\38400\19200\115200bps	The user can configure the serial baud rate of the transparent mode, and the command mode is

			fixed to 9600 bps.
	Main antenna interface	Stamp hole 50Ω output	
Mechanical properties	Interface package type	Stamp hole (2×11pin×2.0mm)	
	PCBA size	25.5(L) ×22(W) ×3.5 (H) mm	(GB/T1804-c)

Table 2-2 DC characteristic parameter

Main parameter	test condition	least value	representative value	crest value	unit	remarks
working voltage	-	2.5	3.3	3.6	V	Guaranteed maximum output power20dBm
working current						
average current	normal work, 9600Bps	-	2.4	-	mA	
	RTC on	-	2	3	uA	
peak point current;	maximum output	-	-	135	mA	

Table 2-3 RF characteristic parameters

Main parameter	test condition	least value	representative value	crest value	unit	remarks
Working band	est voltage: 3.3V Test temperature: room temperature	902.3	914.5	926.8	MHz	
emission characteristic	Carrier output, PA_BOOST ON, 25°Cambient temperature					

Maximum transmit power	PA_BOOST output, Power full load, use 9020A spectrometer to test	18.09	17.33	16.41	dBm	
second harmonic			-40		dBm	
emission current (RF part)	RF maximum transmit power output, instrument load		120		mA	the current is related to the antenna environment
Receiving characteristics	PER = 1%, CR = 4/6, CRC ON, Preamble Length = 12, Packet Length = 10					
receiving sensitivity	SF12	-	-136	-	dBm	flatness<0.5 dB
	SF7	-	-123	-	dBm	
receive current (RF part)		-	13	-	mA	
frequency characteristic	frequency stability: 15ppm@-40℃~85℃					

Table 2-4 Environmental characteristic parameters

main parameter	test condition	least value	representative value	crest value	unit	remarks
working temperature	-	-40	-	+85	℃	
Storage temperature	-	-40	-	+125	℃	
working humidity	-	5	-	95	%	
ESD protect	-	-	-	TBD	V	

3 Product Function Description

This module withthe user board connection, including the serial interface, reset, wake up, mode control, status output and power supply interface. The block diagram of the module is shown in Table 3-1.

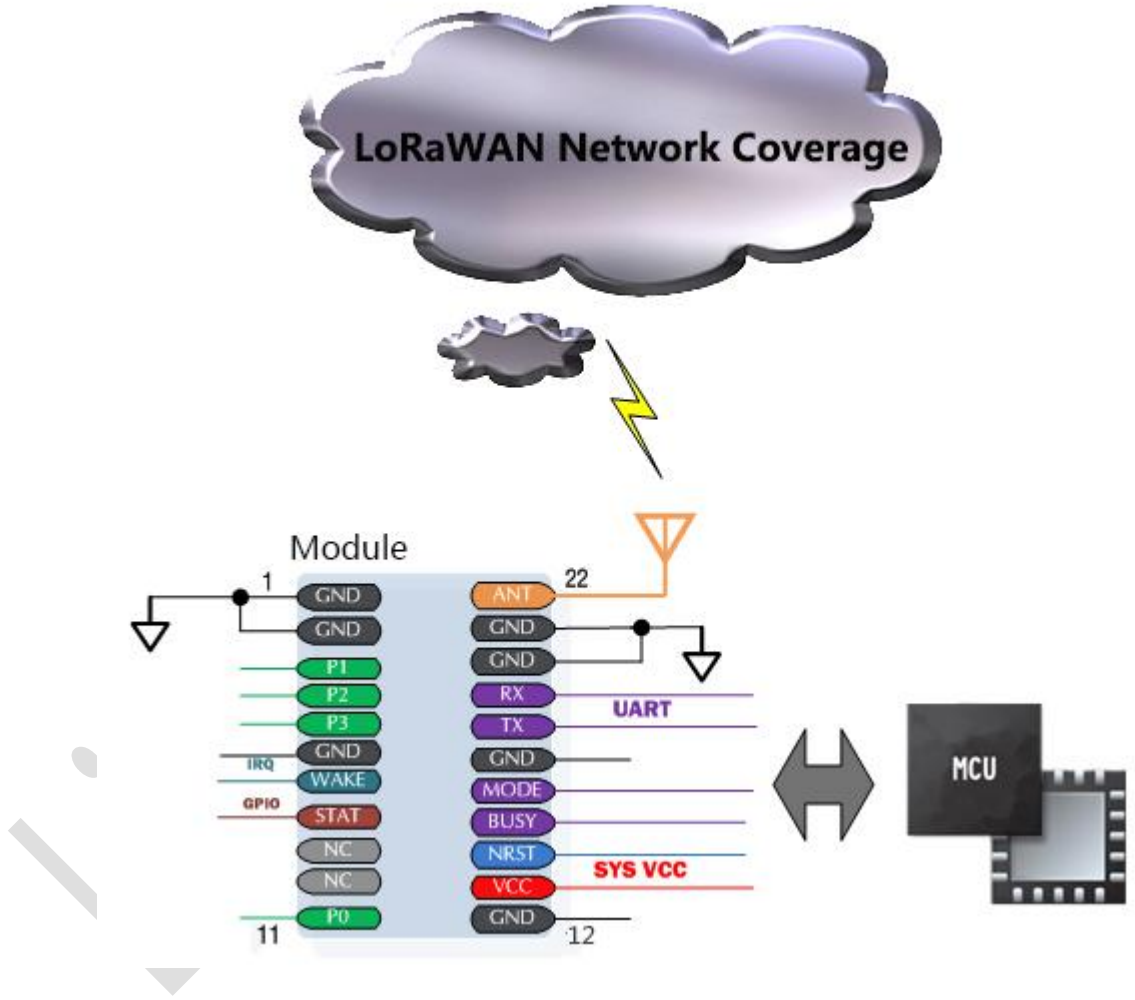

Table 3-1 Module application

3.1 Functional description

This module integrates the LoRaWAN™ protocol stack, which conforms to LoRaWAN™ Specification 1.0.2 issued by LoRa Alliance.It also supports Class A/Class C device type.From the empty band support, the module features

include:

a) LoRaWAN NA915 application

This module interacts with the user through the serial port.

The module operating mode is designed for transparent mode and command mode.

The user configures the LoRaWAN network parameter in the command mode via the AT command (if not configured, the default parameter configuration will be used).Module in the transparent mode, the user can configure the parameters by using serial data transceiver, requiring the module to output detailed information (the remaining data, RSSI, packet size, the number of retransmission, etc.).After receiving a frame of data, the BUSY pin is pulled low (busy) until the data transfer is completed (success or failure).If the transmission fails, the STAT pin is pulled low while the BUSY pin is high (not busy).The STAT pin returns to the high state when the user writes a new frame of data or reads the transmission failure message through the command mode.

For the first time, you need to configure the necessary network parameters of the module and execute the save command. Then, reset the module (the module initializes the network with the new parameters) and switch to the transparent mode.

The module will automatically join the set LoRaWAN network. The user can determine the status of the STAT pin and enter the command mode to query

the current data transmission results and other details.

The module supports operating mode and sleep mode. The user enters or exits sleep mode by controlling the WAKE pin. The working mode is subdivided into two sub-modes.The user selects the sub-mode through the MODE pin, and the working sub-mode is defined as shown in Table 3-1.

Table 3-1 Work mode of module

work mode	description
transparent transmission mode	Forward user data. You can choose the details of the output, etc., to facilitate debugging
command mode	Read the status or configuration parameters through the AT command. Some parameters need to use the save instruction and reset to take effect.

3.1.1 Command mode

In the command mode, the user can send AT commands through the serial port to access the module. The client sends an instruction to the module, which parses the received command and returns a command response frame indicating the execution result of the received command.

3.1.2 Transparent transmission mode

In transparent transfer mode, the module forwards user data directly.If you turn on the ADR mechanism of the LoRaWAN network, a simple flow control mechanism is introduced in order to ensure the reliability and integrity of the data transmission because the maximum data length of each empty port

packet may change dynamically.

1)、Flow control mechanism

The user determines the length of a frame of data. When the serial port exceeds the 2-byte transmission time does not receive the new serial data data or reaches the FIFO storage limit, it is judged that one frame of data transmission is completed.It immediately pull down the BUSY pin (busy) and the serial port is received and the sending operation is performed. After the transmission is complete (successful or failed), the BUSY pin is re-pulled high, and if the WAKE pin is still high, re-enable the module's serial port reception.

2)、Physical subcontracting mechanism

The actual physical packetization is determined by Network Server, and the user can query the response parameters via the AT command or request detailed information to obtain the packet case.

In general, the maximum load value N corresponding to different rates is shown in Table 3-2.

Table 3-2　The maximum load value corresponding to the different rates

SF	N（MAX）
7	222
8	222
9	115
10	51
11	51
12	51

3）、Server response

According to LoRaWAN network Class A operating characteristics, for any packet of data, the user server can give a response. If the module receives the user server data, it will immediately output through the serial port. Therefore, due to the reason for the data frame packet, the user's one frame of data may receive a number of response packets.

4 Mechanical properties

4.1 Product appearance

Product physical map as shown in 4-1 and 4-2, the EUI and S \ N, etc. in the labelfor reference only and specific to the actual subject.The label of the small black spots identified as the module Pin1:

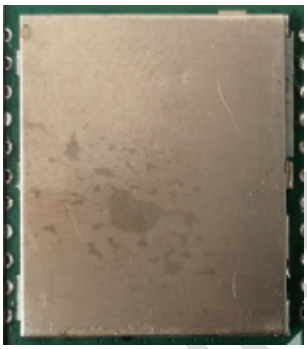

Table 4-1 LSD4WN-2L917M90 TOP layout

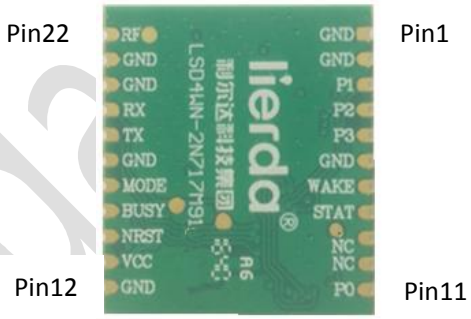

Table 4-2 LSD4WN-2L917M90 BOT layout

4.1 Module assembly drawing

The module assembly diagram is shown in Figure 4-3 (in mm) and the left view is Top View.

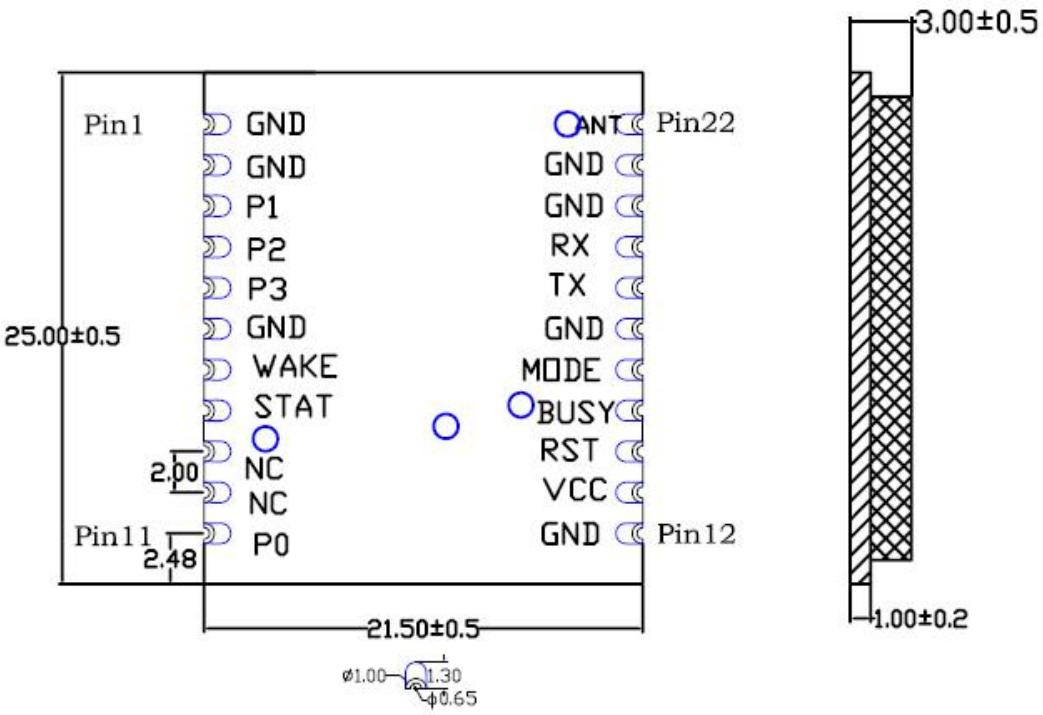

Figure 4-3 Module assembly drawing

4.2 Module Board PCB Package Dimensions

Please design motherboard module PCB package according to Figure 4-2, our company can provide the module PCB packaging.

5 Interface specification

5.1 Pin definition

All I \ O ports are CMOS compatible with TTL. The module pin functions are shown in Table 5-1:

Table 5-1 Pin definition

Pin	functional definition	Port type	default value[3]	describtion
1	GND	Power	-	Connect the system ground
2	GND	Power	-	Connect the system ground
3	P1	I/O	Low	Extended functionality[1], such as GPIO/ADC

4	P2	I/O	Low	Extended functionality[1], such as GPIO/ADC
5	P3	I/O	Low	Extended functionality[1], such as GPIO/ADC
6	GND	Power	-	Connect the system ground
7	WAKE	Input	Float	Wake up \ close the module
8	STAT	Ouptut	Low	Status indication
9	NC	NC	-	Floating treatment
10	NC	NC	-	Floating treatment
11	P0	I/O	Low	Extended functionality[1], such as GPIO/ADC
12	GND	Power	-	Connect the system ground
13	VCC	Power	-	System power supply, power supply range of 2.5 ~ 3.6V
14	NRST	Reset	PULL-UP	Reset module, internal weak pull-up, active low. If the user does not use, can float it.
15	BUSY	Output	Low	Module busy signal output
16	MODE	Input	Low	Operating mode control, according to the user control level, the internal automatic pull\ down
17	GND	Power	-	Connect the system ground
18	TXD	Output	High	The port of transmission(TX)
19	RXD	Input	High-impendance	The port of receiving(RX)
20	GND	Power	-	Connect the system ground
21	GND	Power	-	Connect the system ground
22	ANT	RF	-	RF export. Note that the use of 50Ω impedance line

Note 1：The extended function is used to open the IO operation.

Note 2：Light blue is the smallest use of the client system

Note 3：The default value indicates that the user has not configured any of the modules after the first power-on.

5.2 Hardware interface description

When using the LSD4WN-2L917M90 module for hardware design, according to the practical application, it is necessary to select and design the interface and its peripheral circuit.

The LSD4WN-2L917M90 module application interface includes the following:

- External power
- Reset
- Mode control
- UART interface
- Module status indicator
- Sleep control
- Extended GPIO

5.2.1 External power

Users in the use of this module, the first need to ensure that the external power supply sufficient power supply capacity, and the power supply area needs to be strictly controlled between 2.5V ~ 3.6V. Higher than the module power supply range, will cause the module's main chip is damaged. Lowering than the module power supply range will affect the RF circuit work,so it can not guarantee the maximum output power.

5.2.2 Reset

The user supplies the module NRST pin with a low pulse of at least 1ms (or directly pulls down) and will reset the module. You need to wait for a reset delay time of 150ms after module reset to ensure that the module system initialization is complete. The module reset pin function is shown in Table 5-2:

Table 5-2 Reset pin function

Inter-face	Pin	definition	I/O	describtion	remarks
reset	14	NRST	Input	high level: Module normal operation low level: Module remains reset (reset MCU)	After the module is reset, the user needs to wait for the reset delay time to operate the module.

5.2.3 Mode control

The module has two modes of operation in which the user selects the mode through the MODE pin. If the user does not know the module's current operating mode, the user can read the status of the pin to get. Table 5-3 shows the function of the module mode control pin.

Table 5-3 Mode control pin function

interface	Pin	definition	I/O	Describtion	remark
Mode control	16	MODE	Input	If the module detects a signal: High level: A high level pulse (rising edge & high level) is detected to enter and resides in command mode	

				Low level: A low level pulse (falling edge & low level) is detected to enter and resides in the transparent mode	

5.2.4 UART interface

Module provides a UART interface, combined with custom software flow control to complete the serial communication. The default serial port is set to 9600N81 and the external interface level is 3.3V TTL \ CMOS level.The user pulls the WAKE pin each time the data is sent. Wait 10ms after the wake-up module (so that the module is ready to serial port, etc.). The user pulls down the WAKE pin, and the module goes into sleep mode. The serial interface functions are shown in Table 5-4:

Table 5-4 Serial interface

interface	pin	Definition	I/O	describtion	Remark
UART	18	TXD	Output	The port of transmission(TX)	The TX signal direction of the module
	19	RXD	Input	The port of receiving(RX)	The RX signal direction of the module
	15	BUSY	Output	Module busy signal output Module initialization (reset or WAKE wakeup): High level — Module is free. Indicates that the user MCU can continue to write data to the module. Module initialization (reset or WAKE wakeup): Low — Module busy.	The maximum packet size specified for the port rate is shown in Table 3.2

<table>
<tr><td></td><td></td><td></td><td></td><td>
<table>
<tr><td></td><td>
<table>
<tr><td>level</td><td>Indicates that the user MCU pauses writing data to the module.</td></tr>
</table>
</td></tr>
<tr><td>Data communication phase</td><td>
<table>
<tr><td>High level</td><td>Module is free. Indicates that the user MCU can continue to write data to the module.</td></tr>
<tr><td>Low level</td><td>Module busy. Indicates that the user MCU pauses writing data to the module.</td></tr>
</table>
</td></tr>
</table>
</td><td></td></tr>
<tr><td></td><td>7</td><td>WAKE</td><td>Input</td><td>
Module wake up \ sleep
<table>
<tr><td>High level</td><td>Before sending data, the user must pull the WAKE pin and wait 10ms to wake up the module</td></tr>
<tr><td>low level</td><td>Module enters sleep mode</td></tr>
</table>
</td><td></td></tr>
</table>

5.2.5 Module status indication

The STAT pin of the module currently defines two functions :

（1） The module first joins the network operation when it first accesses the LoRaWAN network. During the JOIN process, the STAT pin is always held low until the module successfully joins the network. STAT output at this time

high, the module can normally handle the user's serial data. The user now can through a specific AT command to further obtain detailed status information.

Note: In the search network process, the user at this time through a specific AT command to further obtain detailed status information. After the user query is complete, the transparent mode is switched immediately.

（2） After the module accesses the LoRaWAN network, the module dynamically updates the network status of the module. The status change is output via the STAT pin. If the module is operating abnormally, the STAT pin is output low. The user can now through a specific AT command to further obtain detailed status information.

Table 5-6 shows the status indication pin functions：

Table 5-6 Status indicator pin

<table>
<tr><th>interface</th><th>Pin</th><th>definition</th><th>I/O</th><th>Describetion</th><th>remark</th></tr>
<tr><td>State output</td><td>8</td><td>STAT</td><td>Output</td><td>If the module is in
Connect Network stage: STAT pin indicates the network status
High level: Module network success
low level: Module is not network, waiting for the network success
Data communication phase: STATpin indicates the network status
High level: The network status of the module is</td><td>The specific exception status can be read by a specific AT command</td></tr>
</table>

					normal	
					Low level	The network status of the module is abnormal

5.2.6 Sleep control

In order to meet the low-power application scenarios, the user can make module enter the sleep state by pulling down the sleep pin WAKE and keeping it for at least 5ms when the user does not need to use it. In the sleep state, the module will not carry out any data operations, but will still save the network information. The user can wake up the module by pulling the WAKE pin high for at least 5ms. Wake up after the normal data can be carried out.Sleep control is shown in Table 5-7:

Table 5-7 Sleep pin

interface	Pin	denifition	I/O	Describetion	Remark
Sleep pin	7	WAKE	Input	If the wake pin is in: High level — Wake up module and the module is in normal working condition; Low level — The control module goes to sleep	

5.2.6 Extended GPIO

Module provides P0-P3 extended GPIO port, the user can now AT + GPIO instruction, control the designated GPIO port output high \ low. To extend the

GPIO description, as shown in Table 5-8:

Table 5-8 Extended GPIO

interface	pin	definition	I/O	Describetion	Remark
GPIO	11	P0	Output	Control the output high or low by the AT + GPIO instruction	
GPIO	3	P1	Output	Control the output high or low by the AT + GPIO instruction	
GPIO	4	P2	Output	Control the output high or low by the AT + GPIO instruction	
GPIO	5	P3	Output	Control the output high or low by the AT + GPIO instruction	

5.3 Typical application circuit

User interface: serial port, GPIO, power and so on

Antenna interface: 50Ω stamp hole output

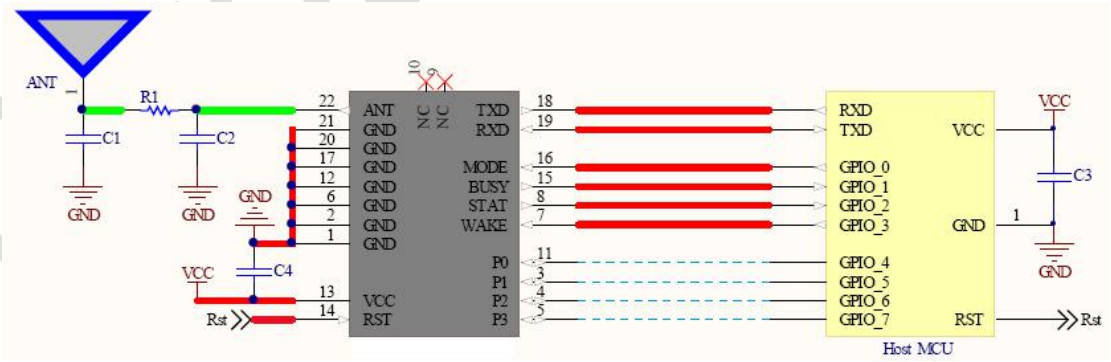

Table 5-1 LSD4WN-2L917M90 Typical application circuit

instruction :

1 : Bold Trace is required for the system connection (recommended).

2 : The green trace of the antenna exit (ANT <-> PIN22) requires 50Ω

impedance matching.

3 ：By default, R1 is 0Ω. C1, C2 for the empty posted. C4 empty (only reserved).

4、R1, C1, C2 parameters of the specific value, determined by the product after the antenna match.

5、Antenna layout design, please refer to our company "RF PCB LAYOUT design rules (for sub-1GHZ and Bluetooth module) _WSN_160824".

5.3.1 Antenna design proposal

Antenna design is directly related to the product's communication performance. Different terminals according to the antenna size, cost, performance will choose different types of antenna. Short-range antenna in the more common PCB antenna, chip (ceramic) antenna, spring antenna, whip antenna and so on. When selecting an antenna, it is important to consider the following important parameters: radiation changes in different directions around the antenna, antenna efficiency, bandwidth required for antenna operation, and power to be supplied to the antenna. Among them, the antenna bandwidth is typically defined as a frequency range in which the reflected wave is below -10 dB or VSWR is less than 2, the antenna reflection power is less than 10%.

Currently for LoRa table applications, our company mainly provides dipole antenna.

Important Notes:

1. Welcome to use the products of the Lierda Technology Co., Ltd.. Before using the products of our company, please read this warning first. If you have already used the product which indicates that you have read and accepted the warning. Using the product indicates that you have read and accepted this warning.

2. The final interpretation and modification of all the information provided to this tool are reserved. No more notification will be given if the information were updated.

FCC Statement

Any Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the 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.

FCC Radiation Exposure Statement:

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.

FCC Label Instructions:

The outside of final products that contains this module device must display a label referring to the enclosed module. This exterior label can use wording such as: "Contains Transmitter Module FCC ID: 2AOFDLSD4WN2L917M90 or Contains FCC ID: 2AOFDLSD4WN2L917M90" , Any similar wording that expresses the same meaning may be used.