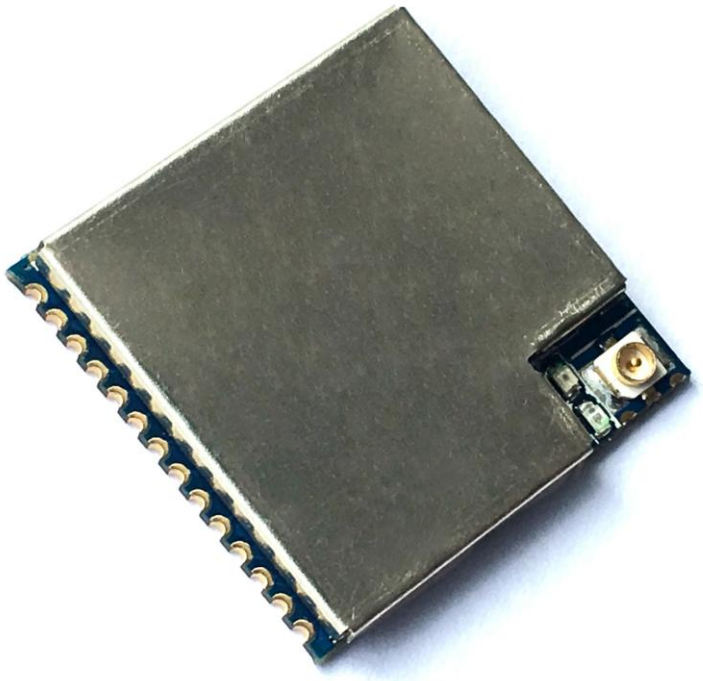
# Spread Spectrum Wireless MESH Networking Module RF1276MN
# ——Distributed MESH Networking ——
# Instruction Manual
# Version：V2.0



**Catalogue**

## 1、Product Overview

RF1276MN is a high-performance, low power consumption, long distance micropower wireless MESH network module, the embedded wireless MESH network protocol, the MESH is distributed peer-to-peer MESH network, can make full use of the network routing redundancy, excellent self-healing network, stability, and excellent data throughput. The mesh process consumes very short time. It can work as long as it is connected to the power supply, supporting level 7 routing, network coverage reached more than 10 km.

The physical layer adopts many advanced wireless communication technologies such as frequency-hopping, self-adaptive rate, safe and reliable full-network self-networking technology, interleaving error correction coding, etc. The link layer adopts intelligent collision avoidance algorithm with excellent anti-interference ability.

## 2、Product Feature

- Based on LoRa$^{TM}$ spread spectrum modulation technology.
- 380-510MHz, 868MHz and 902-928MHz Free application frequency band
- Production without debugging,3.3 -5.5V wide voltage range, can be customized for 2.1-3.6V
- Micropower emission, standard power is 100mw,Seven levels can be set

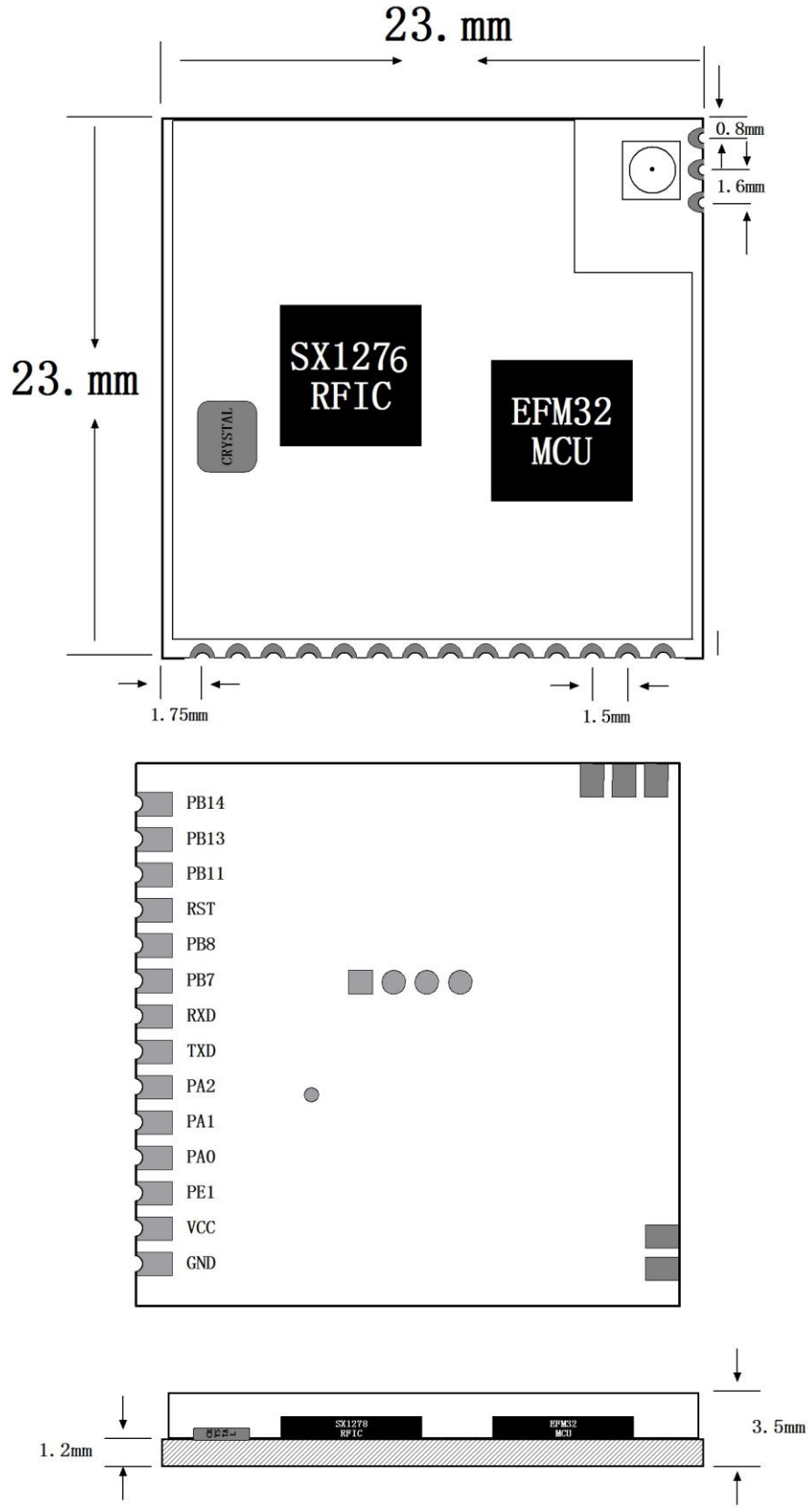
| Level | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| Power | 2.5mw | 5mw | 9mw | 18mw | 35mw | 64mw | 100mw |

- Receiving sensitivity up to -148dBm,Maximum launch power +20dBm
- Adopt high efficiency forward error correction coding technology and frequency hopping mechanism, strong anti-interference ability, low error rate.
- MESH protocol hierarchical processing, provides a stable link.
- Distributed routing, a mesh network completely.
- Work as long as it is connected to the power supply,only needs to be done for the first time communication network function, establish a routing table.
- Module parameters can be set by software or microcontroller command flexibly
- 1.5mm standard half hole welding disk, easy for embedded installation.
- Built-in watchdog to ensure long-term reliable and stable operation.
- Open space single effective communication distance can be 2~ 4km.

## 3、Application Fields

- ✓ Smart home,smart transport ,sensor network
- ✓ Industrial automation, agricultural modernization, intelligent building;
- ✓ Water, electricity, gas and warm meter automatic centralized meter reading system;
- ✓ Water conservancy, oil field, mine, meteorological information acquisition equipment;
- ✓ Street lamp control system,grid monitoring, wind-solar hybrid system
- ✓ Industrial equipment data wireless transmission ,industrial environmental monitoring;
- ✓ Everything else needs to be wireless instead of wired.

## 4、Dimensions & Construction



## 5、Pin Definition

| Number | Pin Symbol | Pin Function | Pin Description |
|---|---|---|---|
| 1 | PB14 | GPIO | Reserved IO port |
| 2 | PB13 | GPIO | Reserved IO port |
| 3 | PB11 | GPIO | Reserved IO port |
| 4 | RST | Hardware reset | Low level enable |
| 5 | PB8 | GPIO | Reserved IO port |
| 6 | PB7 | GPIO | Reserved IO port |
| 7 | RXD | Data entry pin | Level data input foot, connect the user's TXD. |
| 8 | TXD | Data output pin | Level data output foot, connect the user's RXD. |
| 9 | PA2 | GPIO | Reserved IO port |
| 10 | PA1 | GPIO | Reserved IO port |
| 11 | PA0 | GPIO | Reserved IO port |
| 12 | PE1 | GPIO | Reserved IO port |
| 13 | VCC | Power supply | Power range 3.3V-5.5V( customized 2.1-3.6V) |
| 14 | GND | PGND | GND（ usually connected to the user's GND.） |

Note：TXD,RXD 3.3V level, if the user's MCU is 5V, it is suggested to make level conversion for stability,.

## 6、Technical Parameters

Modulation Mode: LoRa™ spread spectrum.
Working Frequency: 380-510MHz, 868MHz and 902-928MHz
Transmission Power: 20dBm.
Receiving Sensitivity: -148dbm.
Serial Port Speed: 1200bps ~ 57600bps (default 9600bps)
Interface Check: 8E1/8O1/8N1 (optional)
Working Voltage: 3.3 ~ 5.5V (customized 2.1 ~ 3.6v) (output 20dBm)
Emission Current: less than 120mA (transmitting power 20dBm)
Receiving Current: less than 15.2mA.
Forwarding Time: 200ms
Working Temperature: -40 ~ +80 ℃ (industrial level)
Working Humidity: 10% ~ 90% relative humidity, no condensation.

# 7、Network Introduction and Application.

## 7.1 Introduction of Group Network Jump

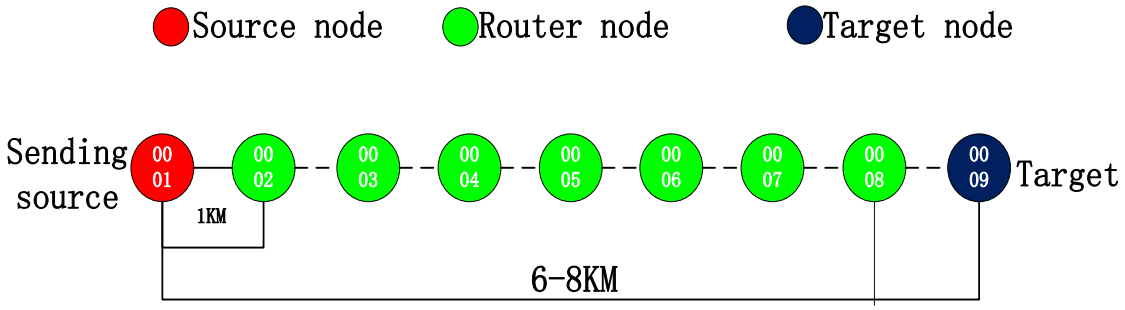



Figure 7.1 Seven - level eight - hop network schematic diagram

Description: The seven - level eight - hop network refers to the data sent by the source to the final destination, which passes through seven routing nodes on the way. If the distance between the two points is 1km, the transmission distance of a network can reach 6-8km or even further. And each participant in the network can be the target of communication.

## 7.2 Introduction of Networking Applications.

A basic MESH network consists of multiple node modules(slave or node) and a concentrator module(master or root).The slave module and master module have two-way data interaction, which can be repeated by the slave module several times.The data flow from master to slave is called down and vice versa.The downstream data transmission mode is broadcast (all nodes can receive the data sent by the master);Uplink data transmission mode is unicast (slave sends data to the nearest master) ,the selection of routing is done automatically. If you have more than one concentrator master, the slave transfer data will automatically upload to the recently communicated master, and the other master will not receive it.

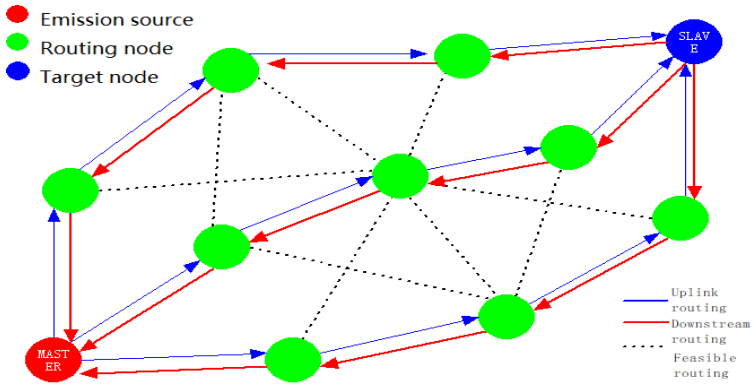



Figure 7.2.1 MESH network data transmission schematic diagram

With the RF1276MN module, you can easily build a MESH network with a minimum of 2 points or up to thousands of points. MESH network is a completely distributed symmetric network, only a single device type can be used in theory. Because it is a distributed peer network, there is no center or node in the whole network, and all nodes have equal rights in the network.

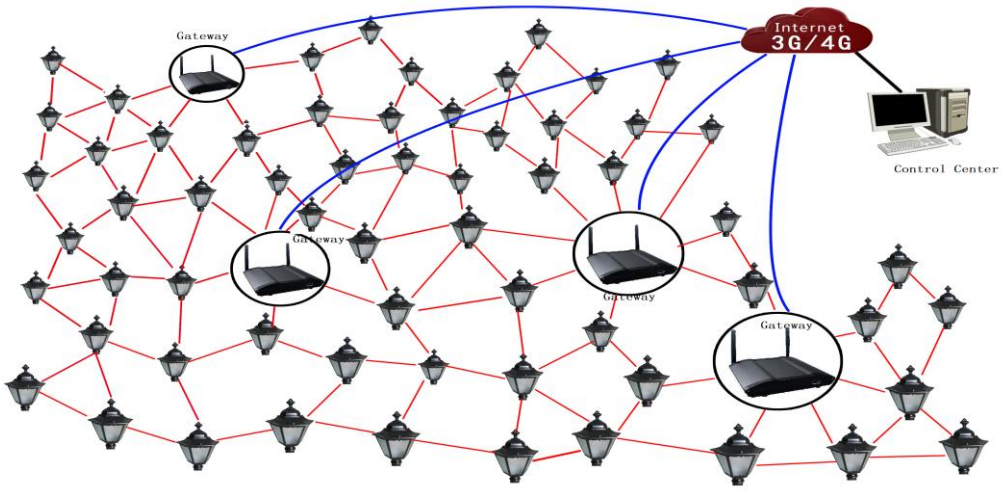



Figure 7.2.2 RF1276MN module network application schematic diagram

The RF1276MN module can easily form good performance, mature and stable distributed ad-hoc network MESH network, represents the most advanced level, ad-hoc network technology can replace the cable, point to multipoint and centralized network mode, greatly expand the network coverage and network robustness, and can effectively reduce the equipment cost and maintenance cost.

The RF1276MN module is applied in the field of self-organizing network, such as sensor network,wireless meter reading, smart home, etc., which has obvious technical advantage and price advantage.For example, the RF1276MN of wireless meter reading scheme, can only need to send a broadcast message within a very short time to realize the entire network instrument set copy, don't need to copy to read one by one, a single instrument greatly saved copy reading time.In the absence of

external interference and isolated nodes, the success rate of single- time net copying of MESH wireless meter is 100%.

## 8、Introduction to Distributed Routing Protocol

Mobile ad-hoc network (MANET) is a multiple of mobile nodes have routing function multiple hops network, data transmission needs collaboration of multiple nodes to complete, so part of the routing protocol in MANET is crucial.Compared with the traditional wired network, MANET has its own characteristics, such as distributed control, the dynamic change of network topology, the wireless transmission bandwidth and node ability is limited, poor security, routing with short survival time, etc.The ideal MANET routing protocol should have the following characteristics.：

- Distribution of the law,distributed algorithm: more suitable for decentralized distributed control network.
- Strong adaptability:adaptable to rapidly changing network topology.
- No loop:no loop is the basic requirement of any routing protocol, which can avoid routing errors and bandwidth waste.
- Low cost of routing calculation and maintenance control:the most complete and powerful function with minimal control overhead is the goal of all routing protocols to work together.
- Suitable for large-scale network;good robustness and extensibility.

The single-path routing protocol is not suitable for MANET, for the following reasons:

1. Wireless network node mobility is high, bandwidth resources are limited, and the connection interrupt rate is high, resulting in high network splitting opportunity.Single path routing algorithm is too expensive and slow to converge.
2. Routing need to be established by flooding technology, and when the nodes move led to the original route expires, The maintenance of single path routing also requires flood, which will occupy network bandwidth.when the network has a number of medium and even a large number of routing need maintenance, frequent tech-oriented flood makes on-demand routing protocol routing control overhead is very large.
3. Single path routing protocol does not take fairness into account , tend to take heavy load distribution to the source to destination node on the nodes of the shortest path, unable to get well and track the entire network topology information.
4. Single path routing protocol data sent using only one path, unable to send data in parallel or concurrently, It leads to low network transmission rate, increasing delay time and unbalancing network load, resulting in network congestion.

The path of the MANET from any source node to the destination node is usually multiple, and the nodes have random mobility, so the topology of the entire network changes frequently.The multi-path

routing protocol can overcome the disadvantages of the single path routing protocol, and can make full use of network resources, balance network load, improve communication performance and avoid network shock.MESH by private on-demand lightweight dynamic multipath routing protocols, this protocol is for hardware resources strict mobile ad-hoc network design, suitable for mobile speed, fast wireless network topology changes.Routing protocol can maximum limit reduce routing overhead, establish and maintain process can be in multiple paths in parallel data packets to send, can sense the change of network topology and right by the updated without the need for flood, seamless switching between different routing.The main features are as follows: each node maintains as much routing information as possible;There is no routing loop;Good route stability and fast establishment;Capable of maintaining full use of wireless signal redundancy, constantly routing maintenance and update, no additional overhead;The routing algorithm weighs many factors such as distance vector, signal energy, link quality and battery voltage, etc.It is very sensitive to the change of network topology structure, and the routing can be optimized quickly.High network throughput;Support 7- level routing, network size.

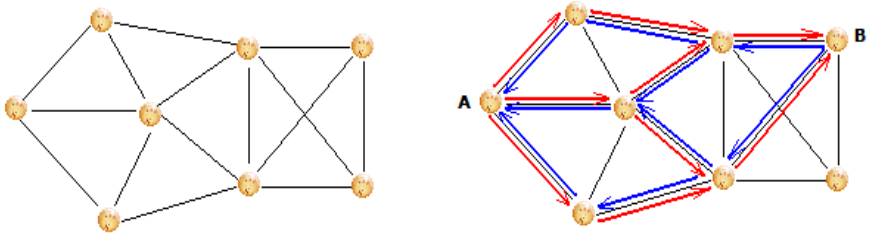



Figure 8.1 Multipath schematic diagram

MESH multipath routing schematic diagram as shown above, network topology diagram as shown on the left, black line represents the link between nodes.The right side is the data link established by A and B, the red line is the path from A to B, and the blue line is the reverse path.The route is built through flood, and there is no closed loop between multiple paths, allowing multiple paths to intersect.Each node chooses as many nodes as possible for its next hop route, and the data message can be dynamically switched between multiple paths and can be transmitted in parallel.Failure routing detection, new path discovery, network topology change by listening to the handshake between adjacent nodes to perceive, neither need to carry out flood or additional overhead.All nodes, including source node, only need to look for his next hop relay nodes, and don't need to make sure the whole path .Therefore, the cost of routing protocol is very small, which is suitable for the fast changing mobile network of topology structure. It can quickly find the real-time best route, and support the large-scale network of 7 level routes.

MESH Routing protocol combines multiple selection algorithms for Routing, including distance vector, signal quality (link state) and node residual power - MMBCR (Min-Max Battery Cost Routing).The distance vector algorithm determines the path based on the distance of the destination,

and each node maintains a vector table, which lists the best distance from the current known target to each target.Nodes can choose nodes that are closer to the destination than themselves as forwarding routes based on this vector table.According to the distance vector algorithm, the shortest path between two nodes can be found, but it is not necessarily the best path.

Unlike wired networks, for MANET, wireless signals are easily affected by external interference, resulting in short survival time and poor stability of data link.The routing protocol must be able to correctly select the path with good signal quality and link stability to ensure the stability, real time, reliability and anti-interference ability of the network. MESH routing protocol can quickly detect multiple routing instant link quality, can choose the best link quality path in a very short time as routing path, and can choose closest path as routing path when necessary.MESH link-state routing algorithm diagram as shown below, A through B relay to C is A - B - C path interference for unstable link, but this is also A to have another link quality good path C A - D - E - C.Although the path of a-b-c is closer, the success rate of the receiving of the link instability message is very low, which will greatly increase the probability of retransmission of the message.However, if a-d-e-c is selected, although the distance is far away, it can guarantee the reliability and real-time performance of the message transmission.


Figure 8.2 MESH Link state algorithm route selection schematic diagram

In addition, for MANET, routing selection needs to fully consider the power of the node battery, and should avoid the nodes with low battery power.MESH routing protocol adopts MMBCR algorithm, which will automatically select the nodes with relatively large amount of power to route.MESH node routing algorithm diagram as shown below, soc can B relay to C is A - B - C but node B remaining power is low, at the same time A to C with another A bit far from the path of A - D - E - C, path of nodes in the remaining power is higher.The choice of A-B-C is closer, but it will soon run out of B.If you choose a-d-e-c, although the distance is far away, it will increase the service life of the whole network and reduce the maintenance cost of the system.

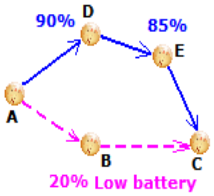


Figure 8.3 MESH node residual power routing schematic diagram

MESH routing protocol is an ideal routing protocol for MANET design. It has the characteristics of distributed, robust, self-healing capability, light weight, multi-path, no loop, large network scale and suitable for mobile network.

# 9、Parameter Configuration

After connecting the module to the computer, we can modify the parameters through the computer software of our company, or send the command setting directly through the user's SCM, and refer to the computer communication protocol.

## 9.1 Hardware Connection

1、Confirm the interface level of the module,TTL.

2、Switch the computer serial port to the corresponding level and then connect the module,as shown in figure 9.1.

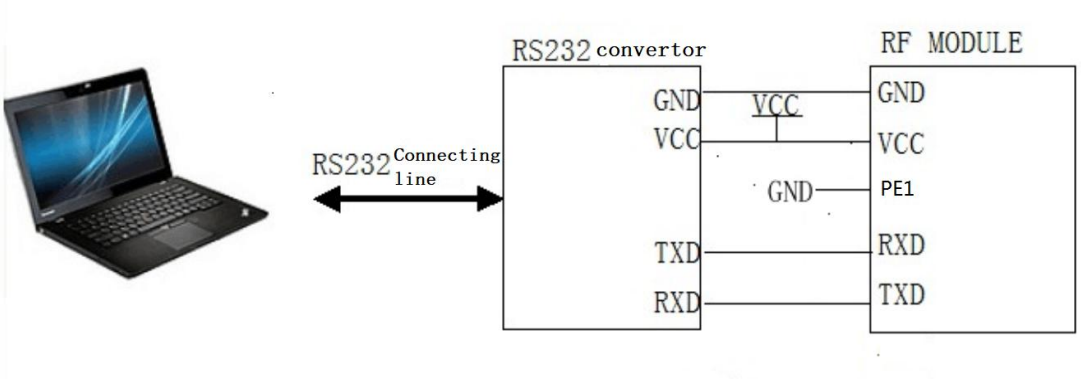


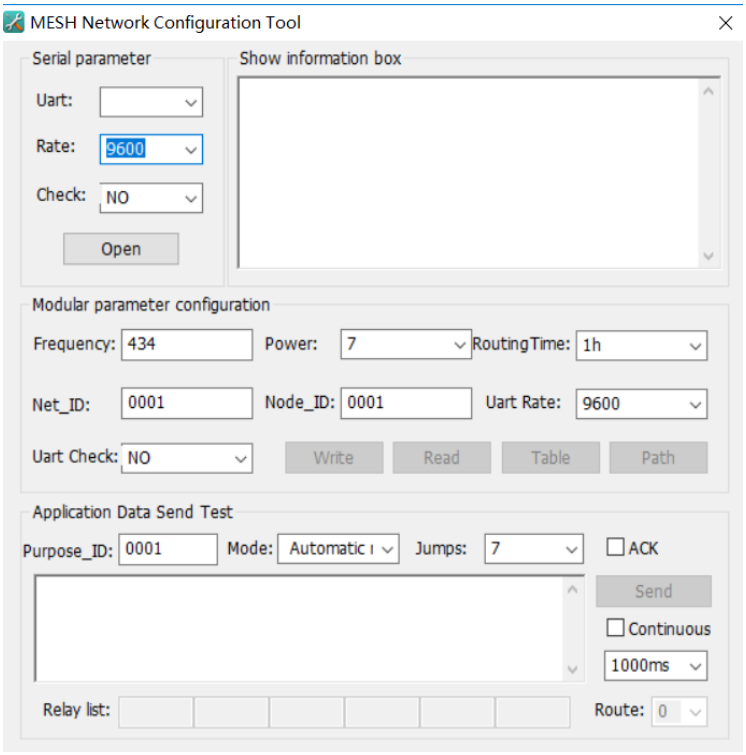

Figure 9.1 Wireless module and computer connection diagram (TTL)

## 9.2 Parameter Configuration

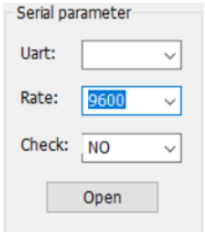
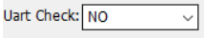
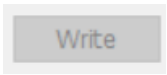
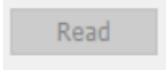
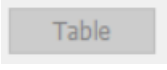
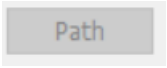
First, the serial port parameters of the module can be confirmed, and the serial port parameters can be obtained through the serial debugging assistant.Method is to open the serial debugging assistants, choose corresponding port, port parameter is set to 9600 BPS, no check, 8 data bits, 1 stop bit, connection module,A power supply will send the current serial port parameters of the module and display it on the debugging assistant.as shown in figure 9.2.1.

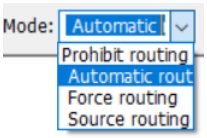
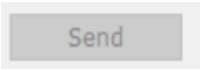
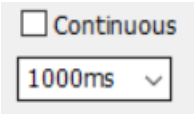
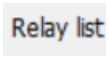

Figure 9.2.1 Use serial debugging assistant to obtain the current serial port parameters and software version

## 9.3 The User interface of MESH Network configuration RF tool.




## 9.4 Configuration RF tool Description

| Graphic Symbol | Name | Function Description |
|---|---|---|
|  | Serial parameter | Open the module to connect the COM port corresponding to the computer, select the same serial port parameter as the module to read or write module parameters normally. |
|  | Frequency configuration | According to the user demand, can set the module's launch frequency.Note: this parameter should avoid the multiple frequency of 32M, otherwise it will affect the communication distance. |
|  | Power configuration | According to the user's demand, the transmitting power can be set by itself, and the higher the power, the farther the transmission distance is. |
|  | Routing Time | The effective routing path stored in the module does not occur during the setting time, and the path will be cleared automatically at the end of the lifetime. |
|  | Network ID configuration | Can be configured as 1~65535;<br>Only modules under the same network address can communicate. |
|  | Node ID configuration | Can be configured as 1~65535;<br>As an identifier in the network. |
|  | Uart rate | The default is 9600bps, configured to be the same as the connection device (the baud rate read by the serial debugging assistant). |
|  | Uart check | The default is uncheckable, configured to be the same as the connection device. |
|  | Writing configuration | Write the parameters in the current software page to the module. |
|  | Reading configuration | Read the configuration read configuration |
|  | View routing | The node, the next level and the target node of the node are displayed graphically.Easy user view path (detailed below) |
|  | Check path | The complete network path structure is displayed graphically or graphically.Note: this feature can only be viewed in the source module (detailed below) |
|  | Destination Address | Communication object identification code. |

| | | |
|---|---|---|
|  | Routing Type | Prohibit routing:No routing is prohibited.<br>Automatic routing： After First communication save the path successfully , no secondary search network process.<br>Forced routing: Every time thereis a process of finding a network when sending the date<br>Source routing:Transmitted by the set path. |
|  | ACK request | Enable ACK reply after check.(Not recommended) |
|  | Sending data | Sending data |
|  | Sending data continuously | Sending data continuously(optional interval) |
|  | Source routing path configuration | According to the requirement, the routing path will be filled in. The module will push the data according to the set path, and the maximum can be set to 6 routes. |

## 9.4.1 Check the Routing Function

The following is the entire routing process for the 00 01 source sending data to the target of 00 03, of which 00 02 is the routing node between the source and target.

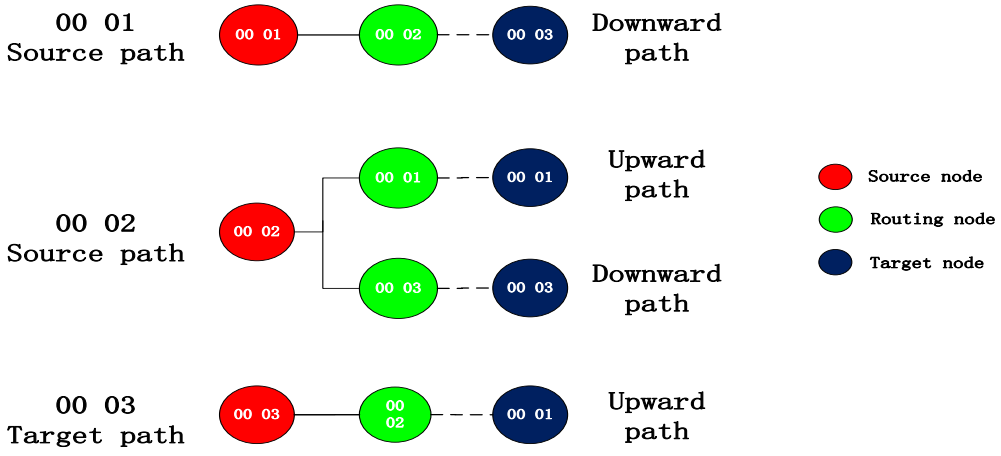



Figure9.4.1 Routing diagram

Explanation:Each participant in the network can view the local node, the next hop node, and the final destination node through the "view route" function in the upper computer.

### 9.4.2 Check the Full Routing Path Functionality.

The following is the entire routing process from the source to the target of 0001, of which 00 02-00 08 is the routing node between the source and target.

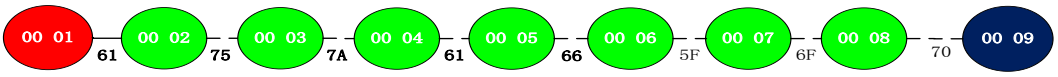



Figure9.4.2 Full path diagram

Explanation: the source module in the network can view the route of the entire path and the field strength between the two points through the "full path" in the master device.The larger the field strength, the stronger the signal.

Note: The customer can use this function to make the routing table of the whole network on the MCU.

## 10、Details of operation command

#### 10.1 Frame Format of command

##### 10.1.1 Universal Frame Format

| Frame Type | Frame Number | Command Type | Load Length | Load | CRC Check |
|---|---|---|---|---|---|
| 1 byte | 1 byte | 1 byte | 1 byte | N byte | 1 byte |
| Frame Header | | | | Frame Load | Frame End |

##### 10.1.2 Instruction of Frame Header

###### 10.1.2.1 Frame Type

The frame type is used to identify different application frame types.The standard type is defined as follows:

| Frame Type | Type Name | Instruction |
|---|---|---|
| 1 0x01 | Internal used | read and write the configuration parameters of modules, the route information and version number. |
| 0x05 | Application Data | Used for networking protocol application layer interfaces. Such as sending the data. |

.

1

#### 10.1.2.2 Frame Number

The frame number is currently unused and the value is fixed to 0x00.

#### 10.1.2.3 Command Type

The command type has different definitions under various frame type identifiers, and the specific reference is as follows:

As the frame type begin with 0X01, the command type has the following meanings:

| Command Type | Command Instruction |
|---|---|
| 0x01 | Writing configuration information request. |
| 0x81 | Writing configuration information |
| 0x02 | The acknowledge from Reading the configuration information |
| 0x82 | The acknowledge from Reading the configuration information |
| 0X03 | Reading the routing table of mesh |
| 0X83 | The acknowledge from Reading the routing table |
| 0x06 | Reading the version number |
| 0x86 | The acknowledge from Reading the version number |
| 0x07 | Reset the module |
| 0x87 | The acknowledge from Reset the module. |
| 0X08 | Read the entire routing table |

| | |
|---|---|
| 0X88 | The acknowledge from Read the entire routing table |

As the frame type begin with 0X05, the command is used for user data transmitting. It has two types:'0x01' and '0x81'

| Command Type | Command Instruction |
|---|---|
| 0x01 | Sending the data via Routing |
| 0x81 | The acknowledge from sending the data via Routing |

#### 10.1.2.4 Load Length

The load length is the data byte length that beginning with frame load and end with the CRC check. The maximum load length of this agreement is 117 bytes.

### 10.1.3 Frame Load

The frame load refers to the parts beginning from the 'Load length' and ending with the 'CRC check'. Its format is determined by the types of frames and the types of commands. The universal format is as follows:

#### 10.1.3.1 The frame load about parameter Configuration and reading.

The command begins with '0x01 0x00 0x01' and '0x01 0x00 0x02'

| Configuration Flag | Transmittig Frequency | Transmitting Power | Routing Lifetime | Network ID | Node ID | Port Rate | Port Check |
|---|---|---|---|---|---|---|---|
| 2byte | 3byte | 1byte | 1byte | 1byte | 1byte | 1byte | 1byte |
| Frame Load | | | | | | | |

#### 10.1.3.2 The frame load about Prohibit Routing， Automatic Routing and Mandatory Routing

The command begins with ‘0x05 0x00 0x01’

| Destination Address | ACK Request | Sending radius | Routing Type | Data Length | Data |
|---|---|---|---|---|---|
| 2byte | 3byte | 1byte | 1byte | 1byte | N byte |
| Frame Load | | | | | |

#### 10.1.3.3 Source Data Request Frame Load Format

The command begins with ‘0x05 0x00 0x01’

| Destination Address | ACK Request | Sending radius | Routing Type | Repeater Number | Repeater List | Data Length | Data |
|---|---|---|---|---|---|---|---|
| 2byte | 3byte | 1byte | 1byte | 1byte | 1byte | N*2byte | N byte |
| Frame load | | | | | | | |

#### 10.1.3.4 Frame End（CRC check）

The frame end is one byte checksum. This checksum is the result of XOR operation from the first byte to the last second byte (before the CRC check). When user check the correction of the Frame, the result of XOR operation of all the Frame should be ZERO.

## 10.2 Frame Format of Parameter Configuration Command

### 10.2.1 Read and Write the Configuration Parameter

#### 10.2.1.1 Read the Configuration Parameter

| | |
|---|---|
| **Command** | 01 00 02 0D A5 A5 00 00 00 00 00 00 00 00 00 00 00 0E |
| **Acknowledge from module** | 01 00 82 0D A5 A5 6D 00 12 07 17 00 01 00 01 03 00 E2 |

Details about ‘the command of Read the configuration parameter’：
01：Frame type. This Frame is internal used. The frame can read and write the configuration parameters of modules, the route information and version number.
00：Frame number，fixed "00"
02：Command type. ‘02’ represents ‘Read configuration parameter’
0D：Load length. There are 13 bytes in the frame load.
A5 A5：the fixed value for the command of ‘read configuration parameter’
00 00 00：Working frequency
00：Transmitting power
00：Routing life time， 0-23 Each represents 1 to 24 hours
00 00：Network ID
00 00：Node ID
00：Port rate 00-1200 、01-2400 、02-4800 、03-9600 、04-19200 、05-57600 、06-115200
00：Port check 00-NO 、01-ODD 、02-EVEN
0E：CRC Check

Acknowledge from the module after executing the command of ‘read the configuration parameter’:

01：Frame type. This Frame is internal used. The frame can read and write the configuration parameters of modules, the route information and version number.
00：Frame number，fixed "00"
82：Command type. Acknowledge of ‘Read the configuration parameter’
0D：Load length. There are 13 bytes in the frame load.
A5 A5：the fixed value for the command of ‘read configuration parameter’.
6D 00 12：Working frequency. The calculation fomula is frequency *10^9/61035 and convert it to Hex value.For example: 433MH：433*10^9/61035=7094290. Convert Demical value 7094290 to Hex value 6C4012. So the Hex code for 433MHz is 0x6C, 0x40, 0x12.
07：Transmitting power, Level 7.(Maximum power)
17：Routing life time， 0-23 Each represents 1 to 24 hours
00 01：Network ID
00 01：Node ID
03：Port rate 0-1200、1-2400、2-4800、3-9600、4-19200、5-57600、6-115200
00：Port check 00-NO、01-ODD、02-EVEN
E2：CRC Check

#### 10.2.1.2 Write the Configuration Parameter

| | |
|---|---|
| **Command** | 01 00 01 0D A5 A5 6D 00 12 07 17 00 01 00 01 03 00 61 |
| **Acknowledge from module** | 01 00 81 0D A5 A5 6D 00 12 07 17 00 01 00 01 03 00 E1<br>39 36 30 30 20 20 4E 20 38 20 31 20 59 4C 5F 38 30 30 4D 4E<br>5F 31 30 30 4D 57 20 56 33 2E 35 0D 0A |

Details about ‘the command of Write the configuration parameter’：
01：Frame type. Read and write parameters data types
00：Frame number，fixed "00"
01：Command type. ‘01’ represents ‘Write configuration parameter’
0D：Load length. There are 13 bytes in the frame load.
A5 A5：the fixed value for the command of ‘write configuration parameter’.
6D 00 12：Working frequency. The calculation fomula is frequency *10^9/61035 and convert it to Hex value.For example: 433MH：433*10^9/61035=7094290. Convert Demical value 7094290 to Hex value 6C4012. So the Hex code for 433MHz is 0x6C, 0x40, 0x12.
07：Transmitting power
17：Routing lifetime， 0-23 Each represents 1 to 24 hours
00 01：Network ID
00 01：Node ID
03：Port rate 0-1200、1-2400、2-4800、3-9600、4-19200、5-57600、6-115200
00：Port check 00-NO、01-ODD、02-EVEN
61：CRC Check

Acknowledge from the module after executing the command of write the configuration parameter':

01：Frame type. Read and write parameters data types
00：Frame number，fixed "00"
81：Command type. Acknowledge of 'Write the configuration parameter'
0D：Load length. There are 13 bytes in the frame load.
A5 A5：the fixed value for the command of 'write configuration parameter'.
6D 00 12：Working frequency.
07：Transmitting power
17：Routing lifetime， 0-23 Each represents 1 to 24 hours
00 01：Network ID
00 01：Node ID
03：Port rate 0-1200、1-2400、2-4800、3-9600、4-19200、5-57600、6-115200
00：Port check 00-NO、01-ODD、02-EVEN
E1：CRC Check
Note:The rest of the hex data is the information of version number. It displays by the hex command The module will display the version number when it restart.

### 10.2.2 Read the Routing Information of Mesh network

We use the the route from source Node ID '00 01' to the Destination node'00 02' as the example to express the command of Read Routing.

| **Command** | 01 00 03 00 02 |
|---|---|
| **Acknowledge from module** | 01 00 83 3C 00 01 02 1D 00 02 00 00 02 7D 51 01 00 |

Details about 'the command of 'Read the Routing information'：
01：Frame type. This Frame is internal used. The frame can read and write the configuration parameters of modules, the route information and version number.
00：Frame number，fixed "00"
03：Command type . Read the routing information of mesh network.
00：Load length. There is no byte in the frame load.
02：CRC Check

Acknowledge from the module after executing the command of 'Read the routing information':
01：Frame type. This Frame is internal used. The frame can read and write the configuration parameters of modules, the route information and version number.
00：Frame number，fixed "00"

83：Command type. Acknowledge of ‘Read the routing information’
3C：The maximum storage path of Routing table
00 01：Source Node ID
02 1D：Load length. There are two bytes about the load length. There are 541 bytes in the frame load.
00 02：Destination Node ID.
00：Routing information,.00- routing successfully, 01- routing is building, 02- routing failed, 03- Invalid routing.
00 02：The Node ID of Next hop.
7D 51 01 00：The remaining life time of this routing, The unit is second, If this value is "0", the module will automatically delete the routing path.

**Note: the above example is only part of the content, There are 541 bytes in the frame load. If the frame load is not full, the remaining are filled with "FF".**

### 10.2.3 Read the Version of module firmware.

| | |
|---|---|
| **Command** | 01 00 06 00 07 |
| **Acknowledge from module** | 01 00 86 18 59 4C 5F 38 30 30 4D 20 56 31 2E 30 20 32 30 31 37 2D 30 39 2D 30 35 00 D1 |

Details about ‘the command of ‘Read the Version of module firmware’：
01：Frame type. This Frame is internal used. The frame can read and write the configuration parameters of modules, the route information and version number.
00：Frame number，fixed "00"
06：Command type. Read the Version of module firmware.
00：Load Length. There is no byte in the frame load.
07：CRC Check

Acknowledge from the module after executing the command of ‘Read the Version of module firmware’ :
01：Frame type. This Frame is internal used. The frame can read and write the configuration parameters of modules, the route information and version number.
00：Frame number，fixed "00"
83：Command type. Acknowledge of ‘Read the Version of module firmware’
18：Load Length. There are 18 bytes in the frame load.
The version displays by the hex code.
D1: CRC Check

### 10.2.4 Reset the module

| | |
|---|---|
| **Request** | 01 00 07 00 06 |
| **Reply** | 01 00 87 01 00 87 39 36 30 30 20 20 4E 20 38 20 31 20 59 4C 5F 38 30 30 4D 4E 5F 31 30 30 4D 57 20 56 33 2E 35 0D 0A |

Details about ‘the command of ‘Reset the module’：
01：Frame type. This Frame is internal used.
00：Frame number. Fixed "00"
07：Command type. Reset the module.
00：Load length. There is no byte in the frame load.
06：CRC Check

Acknowledge from the module after executing the command of ‘Reset the module’ :

01：Frame type. This Frame is internal used.
00：Frame number，fixed "00"
87：Command type. Acknowledge of ‘Reset the module’
01：Load length
00：Load length
87：CRC Check
The version displays by the hex code. The reset module will display the version number after reset the module.

## 10.3 Frame Format of Application Data(Such as sending the data packet)

There are two types Frame Format of Application Data. The Frame Format depends on the type of routing.

### 10.3.1 The Frame Format of Prohibit Routing、Automatic Routing and Mandatory Routing

| Frame Type | Frame Number | Command Type | Load Length | Destination Address | ACK Request | Sending Radius | Routing Type | Data | User's Data | CRC Check |
|---|---|---|---|---|---|---|---|---|---|---|
| 1byte | 1byte | 1byte | 1byte | 2bytes | 1byte | 1byte | 1byte | 1byte | N bytes | 1 byte |
| Frame Header | | | | Frame Load | | | | | | XOR |

**Example：05 00 01 09 00 02 00 07 01 03 AA AA AA A0**

**Frame Type：** This Frame is used for sending the user data. User should follow the Frame Format to send the data.

**Frame Number：** 00 -Fixed

**Command Type：**01 -Sending the data.

**Load Length：**09- The load length is the data byte length that beginning with frame load and end with the CRC check.

**Destination Address：**00 02

**ACK Request：**00—No ACK reply、01--ACK reply. We recommend No Ack reply in the application.

**Sending Radius：**07 . There are 7 level hops in the network. It is fixed value.

**Routing Style：**00—Prohibit Routing、01—Automatic Routing、02—Mandatory Routing、03—Source Routing. We recommend 00, 01, 02.

**Data Length：**03. There are 3 bytes of user data.

**User Data：**AA AA AA

**CRC Check：**A0

### 10.3.2 Source Routing Data Frame Load Format

| Frame Type | Frame Number | Command Type | Load Length | Target Address | ACK Request | Sending Radius | Routing Type | Repeater Number | Repeater List | Data Length | User Data | Check |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 byte | 1 byte | 1 byte | 1 byte | 2 byte | 1 byte | 1 byte | 1 byte | 1 byte | N*2 byte | 1 byte | N byte | 1 byte |

| Frame Header | Frame Load | XOR |
|---|---|---|

**Example：05 00 01 10 00 02 00 07 03 03 00 03 00 04 00 05 03 AA AA AA BA**

Frame Type： This Frame is used for sending the user data. User should follow the Frame Format to send the data.

Frame Number： 00 -Fixed

Command Type： 01 -Sending the data.

Load Length：10- The load length is the data byte length that beginning with frame load and end with the CRC check.

**Destination Address**：00 02

**ACK Request**：00—No ACK reply、01--ACK reply. We recommend No Ack reply in the application.

**Sending Radius**：07 . There are 7 level hops in the network. It is fixed value.

**Routing Style**：03—Source Routing. It is fixed value.

**The number of Repeaters in the path**：03—00 03、 00 04、 00 05

**Data Length**：03 Sending 3 bytes

**User Data**：AA AA AA

**CRC Check**：BA

## 11、Wireless Firmware Upgrade

The RF tool for RF1276MN integrates wireless upgrade functions so that users can upgrade and modify them via RF tool. The operation is described as follows.

**The prepared tool before upgrade:**

1: RF1276T standard module, that is used for transmitting upgrade program, a RF1276MN module to be upgraded.

2：Computer、RF tool、upgrade firmware.

3：RF1276MN,connecting wires.

**Procedure：**

1, Connect the RF1276T module with Laptop via USB adapter. Select the firmware as click ’open’ in the upgrade tool. Choose the ‘No longer target device’.

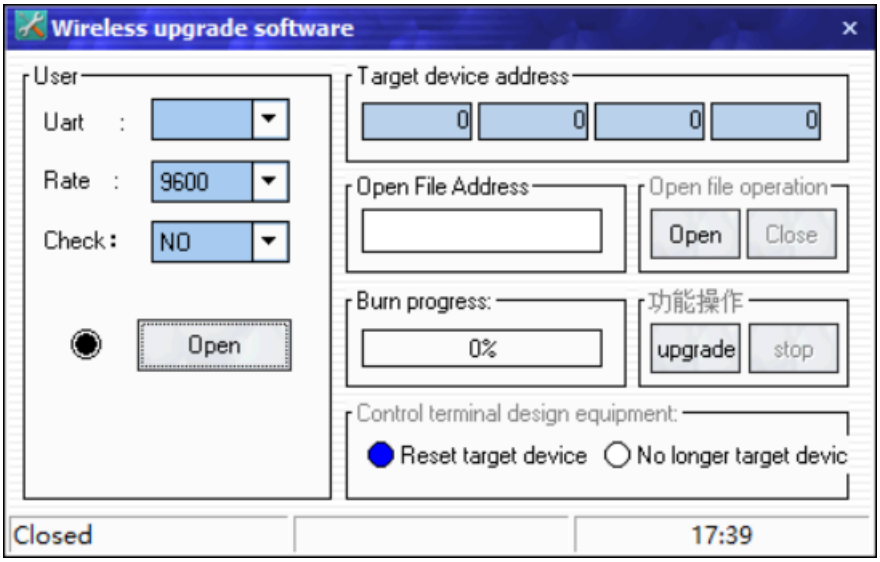



Figure 11.1 Upgrade tool interface diagram

Note: the table address on the upgrade tool does not need to be filled.

2, Enter to the RF1276MN module into the upgrade mode by hex command via serial port. The hex command is as follow:

Command：01 00 09 08 64 6f 77 6e 6c 6f 61 64 14

Acknowledge：01 00 89 01 00 89

When the module enters the upgrade mode, users click the ‘upgrade’ button on the upgrade tool. The RF1276MN module will start to upgrade. After the upgrade is completed, the module will start automatically and the new version number will be printed.

Note: The firmware upgrade will not erase the setting parameters of the module.

## 12、Antenna Selection

The antenna is an important part of the communication system. The performance of the antenna directly affects the index of the communication system, and the user must pay attention to its performance when selecting the antenna.There are generally two aspects:

(1) antenna type -- whether the radio coverage of the antenna meets the system design requirements;

(2) electrical performance -- the frequency bandwidth, gain, impedance and rated power of the antenna meet the requirements of the system design. Generally, the impedance of the antenna is 50, and the standing wave ratio is less than 1.2.

Our company offers a variety of antenna solutions, the user selects according to the actual situation, in order to achieve the best transmission effect.


Spring Antenna


Glue Stick Antenna


Folded Antenna


Small Suction Antenna


Big Suction Antenna

## 13、Notes

Considering the complexity of air transmission and the inherent characteristics of wireless data transmission, we should pay attention to the following problems.

1) data delay

Because wireless communication transmitted from terminal to receive a certain amount of data, or wait for some time no began to launch the new data, wireless transmitter to the receiver of wireless communication there are a few tens of milliseconds to delay (specific delay by serial port rate, air rate and packet size), from wireless communication receiver to terminal equipment also need a certain amount of time, but also under the condition of delay time is fixed.

2) flow control

In order to ensure the data integrity, please try to compress the packet size of single sent, avoid the data overflow due to insufficient cache, and reduce the probability of packet loss.

3) error control

The RF1276MN module has strong anti-interference ability, but under extreme conditions, it is inevitable to receive poor reception or packet loss.At this point, customers can increase the development of the link layer protocol of the system, such as increasing the loss of packet retransmission function, which can improve the reliability and flexibility of wireless network.

## 14、Attentions

(1) when installing the module, the position of the antenna should not be too close to the MCU of your product to prevent interference;

(2) when power supply is supplied, please confirm that the ground line of the module is connected to the ground wire of your product;

(3) when working normally, do not touch the module and the antenna part so as to achieve the best transmission effect.

## 15、Eliminate of Frequent Malfunction

Note: if the LED light is always on, this should not be ignored because the module has a protection program and will automatically recover.If it is often bright, find out why.The receiving and receiving of LED light is not normal. The customer needs to send the data again.

| Fault phenomenon | Fault Reason | Solution |
|---|---|---|
| Low transmission distance | Complex environment and many obstacles. | Use in an open environment with a high antenna or lead to the outside. |
| | Bad weather, such as haze, rain, snow, dust and so on. | Avoid using in inclement weather, or replace high power modules. |
| | The antenna does not match and the antenna gain is small. | Select the matching antenna and try to use the high gain antenna. |
| | High transmission rate | Reduced communication rate, including serial port rate and air speed. |
| | There may be a similar frequency or strong magnetic or power interference. | Replace the channel or away from the source. |
| Unable to communicate properly | Incorrect connection | Refer to the manual wiring diagram for correct wiring. |
| | Poor contact | Reconnect the power cord and signal wire, and weld as securely as possible. |
| | The module does not match the level of the device. | Match TTL/RS232/RS485 interface. |
| | The module does not match the device parameters. | Reconfigure parameters, baud rate, check, e |
| | The parameters between receive and receive modules do not match. | Reconfiguration parameters, frequency, channel, air speed, etc. |
| | Large data throughout | Subcontract transmission, or replacement of higher performance modules. |
| | The module level conversion chip is burnt. | Replace RS232, RS485 chip. |
| | The module body has been corrupted. | Replace the new module |

| | | |
|---|---|---|
| | The user's device has been damaged. | Switch to a wireless module after the cable test is successful. |
| High Error Rate | There is interference with the same frequency signal nearby. | Stay away from interference sources or modify frequency and channel avoidance. |
| | The antenna feedback system does not match well. | Replace the good antenna feedback system. |
| | Serial port or air baud rate setting is incorrect. | Device rate, module serial port rate, module air transmission rate are the same. |
| | Excessive communication rate | Communicate rate as low as possible, especially in the air. |
| | Large power ripple | Replace the stable power supply. |
| | The interface cable is too long. | Replace the cable or shorten the cable length. |
| LED Light is Always on when the Module is Sent and Received. | When the module sends the data, the power is under voltage. | Improve power performance |
| | The module RF chip has been damaged. | Replace module |
| | The antenna is poor in wave ratio. | Replace antenna |

Statement: The company reserves the right of final interpretation and modification of the manual of this product without notice.