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| F8914 User Manual | Document Version | Page |
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F8914 User Manual

The user manual is suitable for the following model:

| Model | Product Type |
|---------|--------------------------|
| F8914-N | ZigBee Terminal |
| F8914-E | ZigBee Terminal(with PA) |



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Chapter 1 Brief Introduction of Product

1.1 General

F8914 is a kind of data terminal device that provides data transfer function by ZigBee network.

It adopts high-powered industrial CPU and embedded real time operating system. It supports RS232, RS485 (or RS422) and ZigBee port that can conveniently and transparently connect one device to a cellular network, allowing you to connect to your existing serial and ZigBee devices with only basic configuration. It has low power consumption states in which the power consumption 2.2mA@12VDC. It has compatible digital I/O channel, ADC function.

It has been widely used on M2M fields, such as intelligent transportation, smart grid, industrial automation, telemetry, finance, POS, water supply, environment protection, post, weather, and so on.

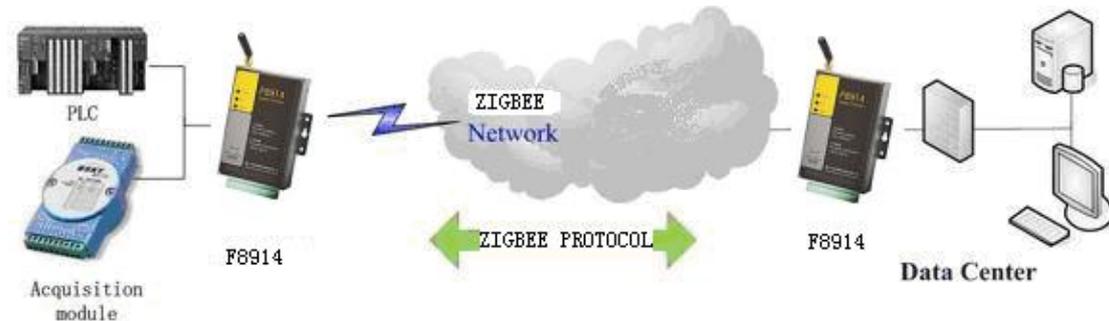


Figure 1-1 F8914 Application Topology

1.2 Features and Benefits

Design for Industrial Application

- ◆ High-powered industrial ZigBee module
- ◆ Support low power consumption mode, including multi-sleep and trigger modes to reduce the power dissipation farthest
- ◆ Housing: iron, providing IP30 protection
- ◆ Power range: DC 5~35V

Stability and Reliability

- ◆ Support hardware and software WDT
- ◆ Support auto recovery mechanism
- ◆ RS232/RS485/RS422 port: 15KV ESD protection
- ◆ SIM/UIM port: 15KV ESD protection
- ◆ Power port: reverse-voltage and over-voltage protection
- ◆ Antenna port: lightning protection(optional)

Standard and Convenience

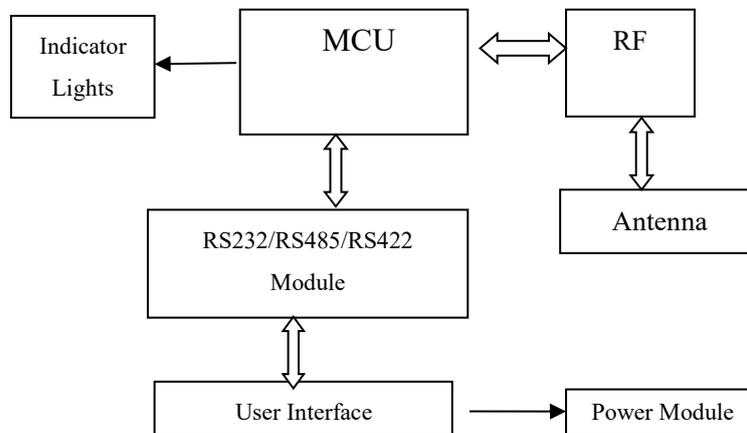
- ◆ Adopt terminal block interface, convenient for industrial application
- ◆ Support standard RS232 and RS485(or RS422) port that can connect to serial devices directly
- ◆ TTL logic level RS232 interface can be customized
- ◆ Support intellectual mode, enter into communication state automatically when powered
- ◆ Support several work modes
- ◆ Convenient configuration and maintenance interface

High-performance

- ◆ Support ZigBee wireless short-distance data transmission
- ◆ Support repeater and terminal device function
- ◆ Support Point-to-Point, Point-to-Multipoint, Peer-to-Peer and Mesh network
- ◆ Support 65000 nodes
- ◆ Support center node, route node and terminal node
- ◆ Support broadcast and target address transfer
- ◆ Support wide communication range
- ◆ Supply 5 I/O channels, 3 analog inputs and 2 pulse input counters.

1.3 Working Principle

The principle chart of the F8914 is as following:



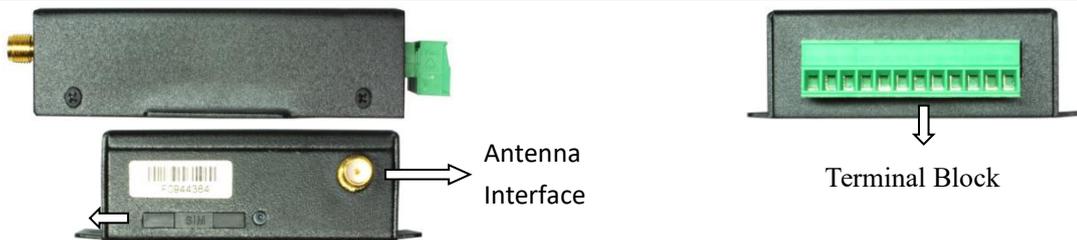
1.4 Specifications

ZigBee Specification

| Item | Content |
|--------------------------------|---|
| ZigBee Module | Industrial ZigBee module |
| Standard and Band | IEEE 802.15.4 ISM 2.4 GHz |
| Indoor/Urban Range | 30m 90m(With PA) |
| Outdoor/RF Line-of-Sight Range | 500m 2000m(With PA) |
| Transmit Power | 2.82mw (+4.5dBm) 100 mw (+20dBm) (With PA) |
| Bandwidth | 250Kbps |
| Receiver Sensitivity | -97dBm -103dBm(With PA) |
| Network Topology | Point-to-Point, Peer-to-Peer and Mesh |
| Channels | 11 to 26 |
| Max Serial Buffer Size | 300 Bytes |

Interface Type

| Item | Content |
|-----------|---|
| Serial | 1 RS232 port and 1 RS485(orRS422) port, 15KV ESD protection Data bits: 8 Stop bits: 1, 2 Parity: none, odd, even Baud rate: 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 bps |
| Indicator | "Power", "ACT", "Online" |
| Antenna | Standard SMA female interface, 50 ohm, lightning protection(optional) |
| Power | Terminal block interface, reverse-voltage and over-voltage protection |



Power Input

| Item | Content |
|----------------|-------------|
| Standard Power | DC 12V/0.5A |
| Power Range | DC 5~35V |

Power Consumption

| Working States | | Power Consumption |
|----------------|----------------|-------------------|
| F8914-N | RX Mode | ≤15mA/12V@4.5dBm |
| | TX Mode | ≤20mA/12V@4.5dBm |
| | Timing wake up | ≤3.5mA/12V@4.5dBm |
| | Deep Sleep | ≤2.5mA/12V@4.5dBm |
| F8914-E | RX Mode | ≤15mA/12V@21dBm |
| | TX Mode | ≤80mA/12V@21dBm |
| | Timing wake up | ≤4.5mA/12V@21dBm |
| | Deep Sleep | ≤3.5mA/12V@21dBm |

Physical Characteristics

| Item | Content |
|------------|---------------------------------|
| Housing | Iron, providing IP30 protection |
| Dimensions | 91x58.5x22 mm |
| Weight | 205g |

Environmental Limits

| Item | Content |
|-----------------------|--------------------------|
| Operating Temperature | -40~+85°C (-104~+185 °F) |
| Storage Temperature | -40~+125°C (-104~+257°F) |
| Operating Humidity | 95% (Non-condensing) |

Chapter 2 Installation Introduction

2.1 General

The F8914 must be installed correctly to make it work properly. There is need only one coordinator in a network, the other nodes should be set as routers or end devices.

Install the coordinator first, then install the routers or end devices from near to distant.

Warning: Forbid to install the F8914 when powered!

2.2 Encasement List

| Name | Quantity | Remark |
|--------------------|----------|----------|
| F8914 host | 1 | |
| Power adapter | 1 | |
| RS232 data cable | 1 | optional |
| RS485 data cable | 1 | optional |
| Manual CD | 1 | |
| Certification card | 1 | |
| Maintenance card | 1 | |

Table 2-1 Encasement List

2.3 Installation and Cable Connection

Dimension: (unit: mm)

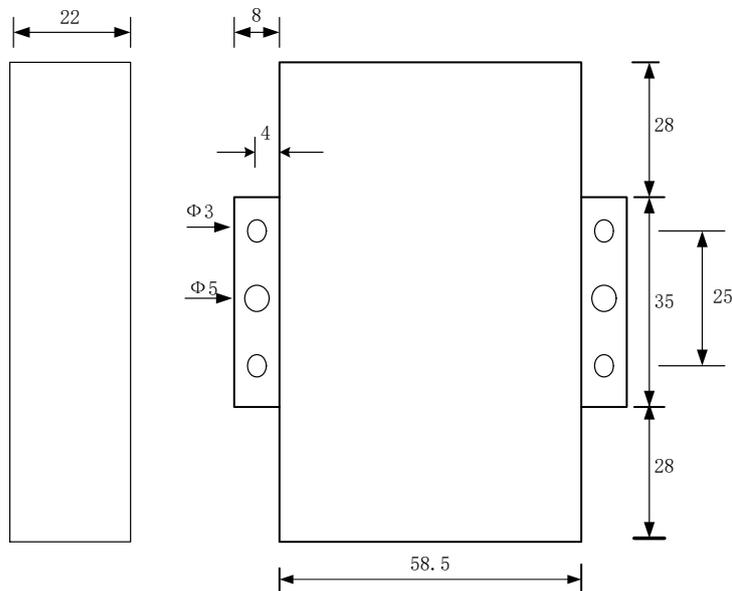


Figure 2-1 Installation Chart

Installation of antenna:

Screw the SMA male pin of the antenna to the female SMA outlet of F8914 tightly.

Warning: The antenna must be screwed tightly, or the signal quality of antenna will be influenced!

Antenna install note:

- 1, Install the antenna far away from the large area metal and ground.
- 2, Keep the antennas visual.
- 3, Minimize obstructions between the antennas.
- 4, Reduce the extension cords of the antenna.

The performance of different antenna installation types, as the figure 2-2.

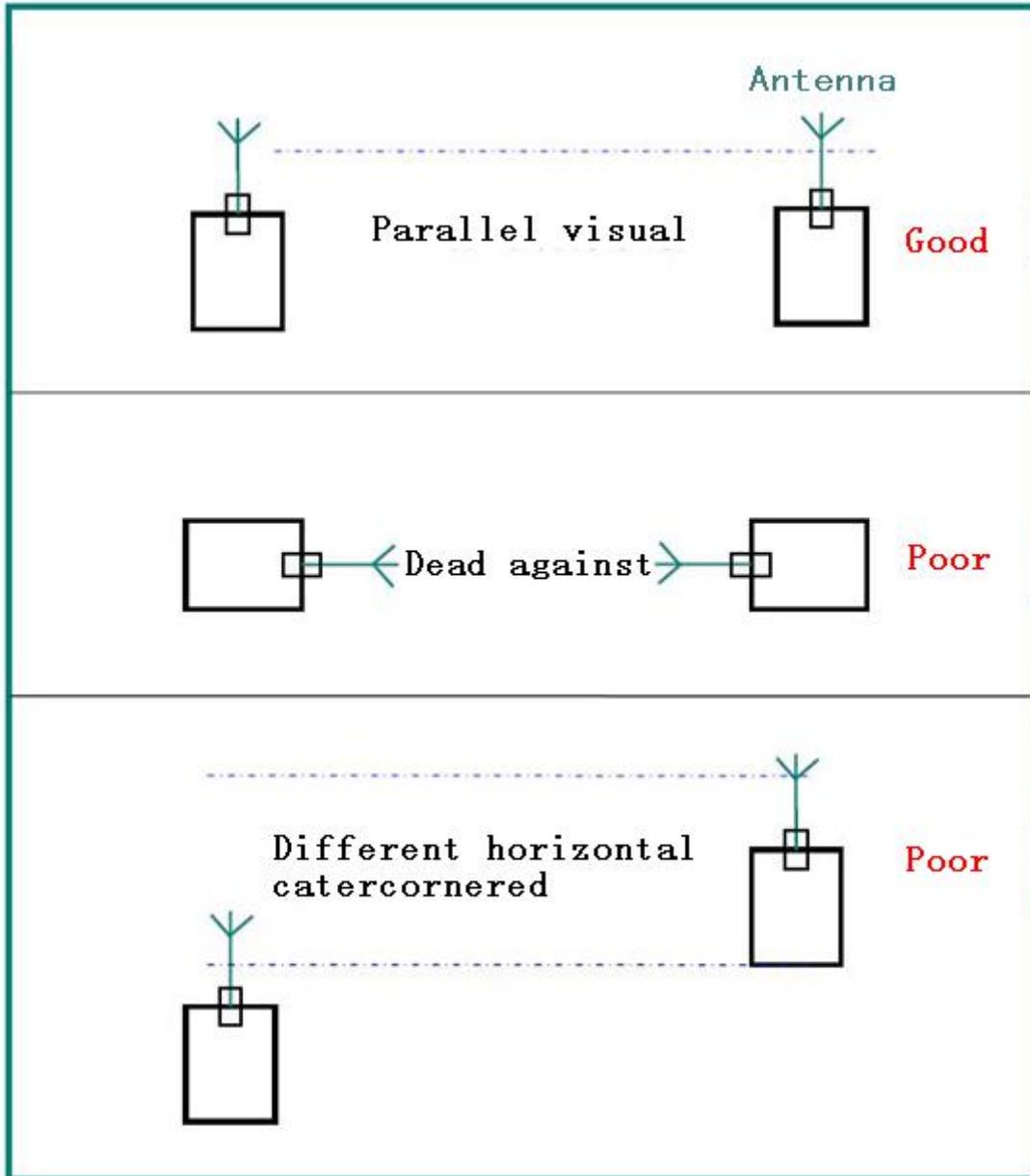


Figure 2-2 Installation antenna mode

User Interface Signal Definition

| Pin Number | Signal Name | Default Function | Extensible Function |
|------------|-------------|---|----------------------------------|
| 1 | PWR | Power input anode | N/A |
| 2 | GND | Power Ground | N/A |
| 3 | GND | Power Ground | N/A |
| 4 | RX | RS232 RX | N/A |
| 5 | TX | RS232 TX | N/A |
| 6 | A | RS485 anode | N/A |
| 7 | B | RS485 cathode | N/A |
| 8 | IO1 | GPIO | pulse input count/sleep control |
| 9 | IO2 | GPIO | pulse input count/sleep indicate |
| 10 | IO3 | ADC, analog input function (voltage acquisition 0 ~ 5 V) | GPIO |
| 11 | IO2 | ADC, analog input function (current collection 0 ~ 20 mA) | GPIO |
| 12 | IO1 | ADC, analog input function (current collection 0 ~ 20 mA) | GPIO |


Installation of cable:

F8914 adopts industrial terminal block interface. The recommended cable is 28-16AWG. The detail description of standard layout adapter and communication cables as the following:

Adapter (Rating Output 12VDC/0.5A):

| Cable Color | Power Output Polarity |
|-------------------------|-----------------------|
| Black & White Alternate | Anode |
| Black | Cathode |

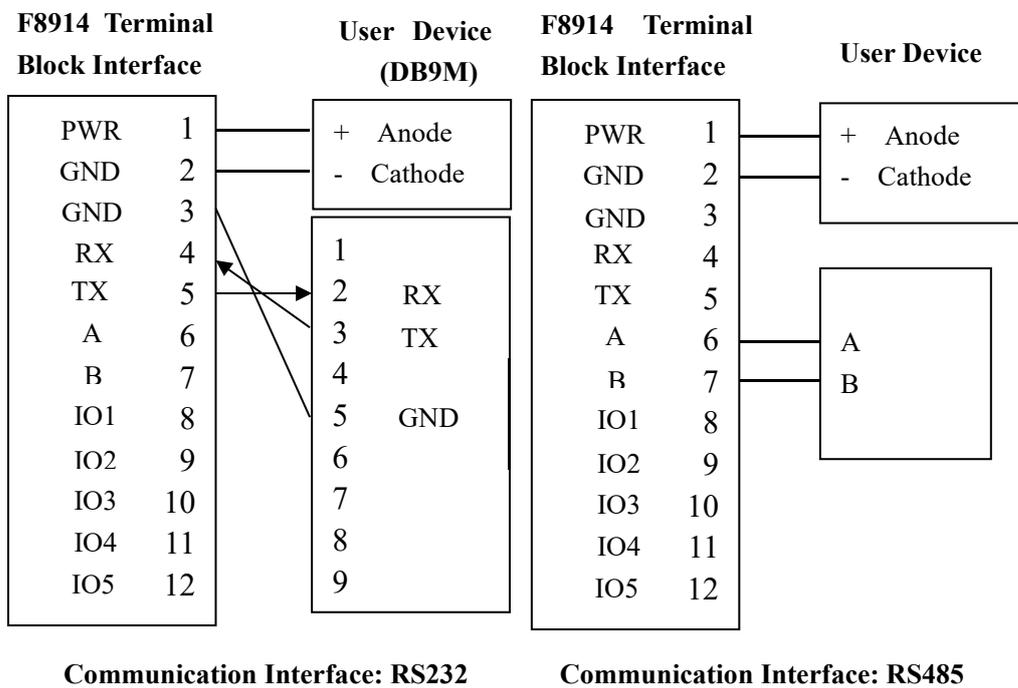
RS232 Cable:

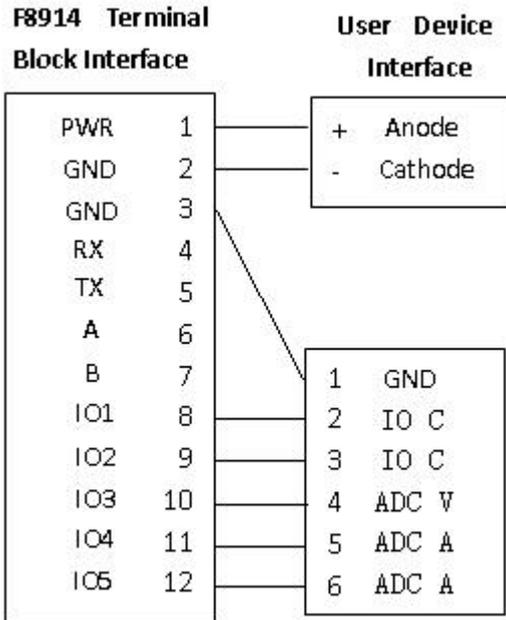
| Cable Color | Corresponding DB9-M Pin Number |
|-------------|--------------------------------|
| Brown | Pin 2 |
| Blue | Pin 3 |
| Black | Pin 5 |

RS485 Cable:

| Cable Color | Signal definition |
|-------------|-------------------|
| Red | RS485(A) |
| Black | RS485(B) |

Power adapter and communication cable connection chart as following:





Communication Interface: IO/ADC

2.4 Power

The power range of the IP MODEM is DC 5~35V

Warning: When we use other power, we should make sure that the power can supply power above 4W.

We recommend user to use the standard DC 12V/0.5A power adapter.

2.5 Indicator Lights Introduction

The F8914 provides three indicator lights: “Power”, “ACT”, “Online”.

| Indicator Light | State | Introduction |
|-----------------|-------|-----------------------------------|
| Power | ON | F8914 is powered on |
| | OFF | F8914 is powered off |
| ACT | BLINK | Serial Data is communicating |
| | OFF | No data |
| Online | ON | F8914 has logged on network |
| | OFF | F8914 hasn't logged on network |
| | FLASH | Joining or establishing a network |

Chapter 3 Zigbee Description

3.1 Device Type Description

ZigBee device has three types: coordinator,router and end device.They all can transmit and receive data.

3.1.2 Coordinator

This is the device that “starts” a ZigBee network. It is the first device on the network. The coordinator node scans the RF environment for existing networks, chooses a channel and a network identifier (also called PAN ID) and then starts the network.

Note that the role of the Coordinator is mainly related to starting up and configuring the network. Once that is accomplished, the Coordinator behaves like a Router node (or may even go away). The continued operation of the network does not depend on the presence of the Coordinator due to the distributed nature of the ZigBee network.

3.1.2 Router

A Router performs functions for allowing other devices to join the network multi-hop routing assisting in communication for its child battery-powered end devices.

In general, Routers are expected to be active all the time and thus have to be mains-powered.

3.1.3 End Device

An end-device has no specific responsibility for maintaining the network infrastructure, so it can sleep and wake up as it chooses. Thus it can be a battery-powered node.

3.2 ZigBee Network Description

3.2.1 Form a ZigBee Network Procedure

(1) The coordinator node scans the RF environment for existing networks, chooses a channel and a network identifier (also called PAN ID) and then starts the network.

(2) Router or end device also scans the RF environment for existing networks, chooses a channel and a network identifier (also called PAN ID) and then join the network.

(3) The coordinator's node address fixed to 0x0000, router's or end device's node address can be assigned randomly or configured previously.

(4) The nodes in the network can use node address transmit or receive data.

NOTE : In a Zigbee network , just only using one coordinator

3.2.2 Physical Channel

ZigBee is based on IEEE 802.15.4 that has defined the MAC layer and physical layer. IEEE 802.15.4 also defined 3 work band 2.5GHz(global),868MHz(Europe) and 915MHz(USA),they respectively has highest 250kbit/s, 40kbit/s, 20kbit/s transmission rate. On the three band has 27 work channels in total. 2.4GHz has 16 channels, 915MHz has 10 channels, 868MHz has only one channel.

Four-Faith ZigBee product works on 2.4GHz band, and has 16 physical channel. In AT command mode ,we send “AT+CHA=N”,(N=11~26) to configure the channel. We recommend 15 ,20 ,25 ,26 channel .

3.2.3 PAN ID

ZigBee network also calls personal area network, every personal area network has unique Pan ID.This Pan ID is used on every device in a same ZigBee network.

Four-Faith ZigBee product can pre-configure a Pan ID and randomly select a Pan ID. In AT command mode ,we send “AT+PID=N”,(N=0-65531),if PID=65535 ,it will randomly select a Pan ID.

3.2.4 Node address

ZigBee device has two address types: 64 bit MAC address and 16 bit node address. 64 bit MAC address is unique in the world, and used in the product life. 16 bit node address usually assigned when the device joined in the network. It's unique in a same Pan ID network. We use node address to send and receive data.

Four-Faith ZigBee product can pre-configure a node address and randomly assigned a node address. In AT command mode, if received “AT+NID=65535”, it will randomly assigned a node address.

Chapter 4 Configuration

4.1 Configuration Connection

Before configuration, It's necessary to connect the device with the configure PC by the shipped RS232 or RS232-485 conversion cable.As showing in the figure 4-1.



Figure 4-1 F8914 connect with PC

4.2 Configuration Introduction

There are two ways to configure the device:

- ◆ Configuration software tool: All the settings are configured through the shipped software tool. It's necessary to have one PC to run this tool.
- ◆ Extended AT command: All the settings are configured through AT command, so any device with serial port can configure it. Before configuration with AT command, you should make device enter configure state.

The following describes how to configure device with AT command .At the same time, it gives out the corresponding the configure software tool of each configuration item.

Note: When device powers on, after three seconds, it is in configuration time(during 3 seconds, Please reference to Appendix in detail).During this time, the network not works,and the serial's baud rate is 115200,no parity, 1 stop bit. Send the 3-character command sequence“+++”twice through serial port.Then it goes into AT command configuration.

4.3 Run the configure tool: ZigbeeConfigure.exe

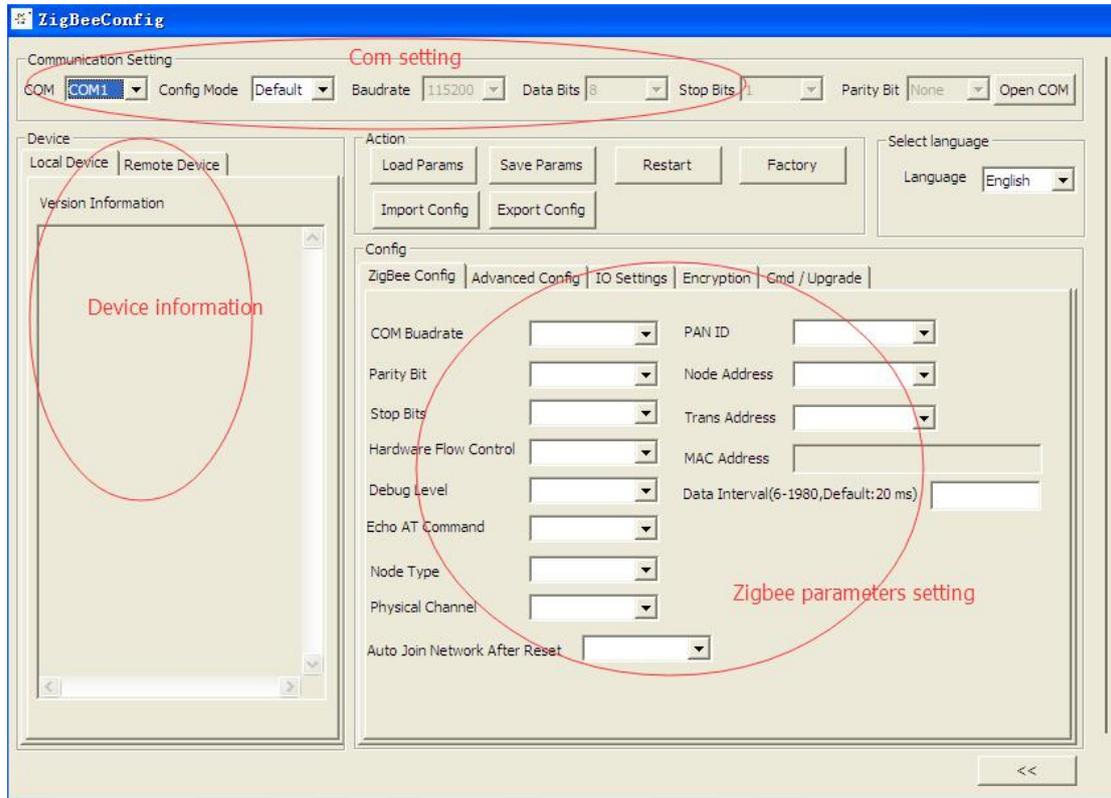


Figure 4-2 ZigbeeConfig tool

The “Communication Setting” column shows the current serial port settings. To configure ZigBee modules, please choose the correct serial port parameters ,then open the serial port. If the button text is“Close”, it shows the serial port now has been opened. If the text is “Open”, you should open the port first.

When you had configure the correct serial port, the device will enter configure state after power on.

The configure tool window contains “Com setting”, “Device information” and “Zigbee parameters setting”.

Press  button can show or hide the log information.

4.4 Modes of Operation

F8914 supports three modes of Operation: Transparent Mode, AT Command Mode and API Mode.

4.4.1 Transparent mode

When operation in transparent mode the modules act as a serial line replacement. All UART data received through the DIN pin is queued up for RF transmission. When data is received, the data is sent out through the DOUT pin.

Re-power module enter the transparent mode by default.

To enter transparent mode:

- In the AT command mode, send “AT+ESC<CR><LF>” through serial port.
- In the API mode, send “FE 01 21 2A 00 0A” through serial port.

4.4.2 AT command mode

AT command mode is a multiple function operation. This mode can configure the modules parameters, send data and receive data.

To enter AT command mode:

- In the transparent mode, send the 3-character command sequence “+++” twice through serial port.
- In the API mode, send “FE 01 21 2A 00 0A” through serial port.

CHECK the AT command mode, send “AT<CR><LF>” through serial port, it will return “OK”.

All AT command line should begin with “AT” or “at” and end with “<CR><LF>”. In general, the AT command includes three forms, as shown in table 3-1.

Table 3-1 AT command forms

| Form | Description | Instance |
|---------|------------------------------------|----------------|
| Set | Set the custom parameters | AT+XXX=<.....> |
| Query | Query the current parameters value | AT+XXX? |
| Execute | Execute the command | AT+XXX |

Note: every configure item is set, it should send save command. Network param (PAN ID, Physical Channel, node address or device type changed), sleep param and serial param change should re-power device.

4.4.3 API mode

API operation requires that communication with the module be done through a structured interface (data is communicated in frames in a defined order). The API specifies how commands, command responses and module status messages are sent and received from the module using a UART Data Frame.

To enter API mode :

- In the transparent mode, send the 3-character command sequence“= = =”twice through serial port.
- In the AT command mode, send “AT+API<CR><LF>” through serial port.

The UART data frame structure is defined as follows:

| SOF | Length | Command | Frame data | Frame check sequence |
|--------|--------|---------|------------------|----------------------|
| 1 Byte | 1 Byte | 2 Bytes | xx Bytes (xx<82) | 1 Byte |

SOF (Start of Frame): This is a one byte field with value equal to 0xFE that defines the start of each general serial packet.

Length : 1 byte length of the actual data.

Command : 2 byte command Id.

Frame data : the data ranging from 0-82 bytes.

FCS (Frame Check Sequence):

This is a one byte field that is used to ensure packet integrity. This field is computed as an XOR of all the bytes in the message starting with LEN field and through the last byte of data. The following is a sample code FCS calculation:

```

unsigned char calcFCS(unsigned char *pMsg, unsigned char len)
{
    unsigned char result = 0;
    while (len--)
    {
        result ^= *pMsg++;
    }
    return result;
}

```

Note:1.Frame data some place need little-endian (node address,IO value and other set commands)

2.Every configure item is set, it should send save command.Network param(PAN ID,Physical Channel ,node address or device type changed),sleep param and serial param change should re-power device.

4.5 Device sleep mode configuration description

F8914 support router and end device configure Timer sleep and Deep sleep.

Note: 1. When device is not working on sleep mode, IO1\IO2 are used as GPIO input or output.

2. When device is working on sleep mode, IO1 is reused as external interrupt, IO2 is reused to indicate on-line or off-line.

4.5.1 Timer sleep

Function description :

Timer sleep can set the sleep interval, when it wakes up, the device will wake up a certain time then it goes to sleep again.

After device waking up, if device successfully joined in the network IO2 will output low level to indicate online. If device unsuccessfully joined in the network or went into sleep IO2 will output high level to indicate off-line.

Configuration conditions

(1) Hardware: IO1 must connect to high level (3V ~3.3V).

(2) Software: Device should be configured as end device or router and Timer Sleep. The sleep interval must be greater than 0.

4.5.2 Deep sleep

Function description :

Deep sleep is waked up by external interrupt. When IO1 is low level, device not goes to sleep. When IO1 is high level (3V ~3.3V), device goes to deep sleep.

After device waking up, if device successfully joined in the network IO2 will output low level to indicate online. If device unsuccessfully joined in the network or went into sleep IO2 will output high level to indicate off-line.

Configuration conditions

(1) Hardware: Operate on IO1's level.

(2) Software: Device should be configured as end device or router and Deep Sleep.

Appendix

A1 Notes

A1.1 Serial port's frame interval

Say serial port's baud rate 115200.

The serial port's frame interval is 20 ms. To ensure one packet in a frame, the interval must be smaller than 20 ms.

When the application received serial's data, the frame interval should be greater than 20 ms.

Please modify the frame interval value in other baud rate, corresponding to the case of the baud rate with 115200.

A1.2 About the factory setting

Make sure to do factory setting, before modifying Pan ID, Physical channel and Node address!

A1.3 About the network parameters

In a ZigBee network, it has only one pan id and only one node address. Unpredictable errors occurred in a ZigBee network with two same pans ids or node addresses.

A1.4 Sleep mode

Sleep mode contains timer sleep and deep sleep. The power consume in timer sleep is greater in deep sleep. So in actual application, we suggested that the zigbee device work on deep sleep mode.

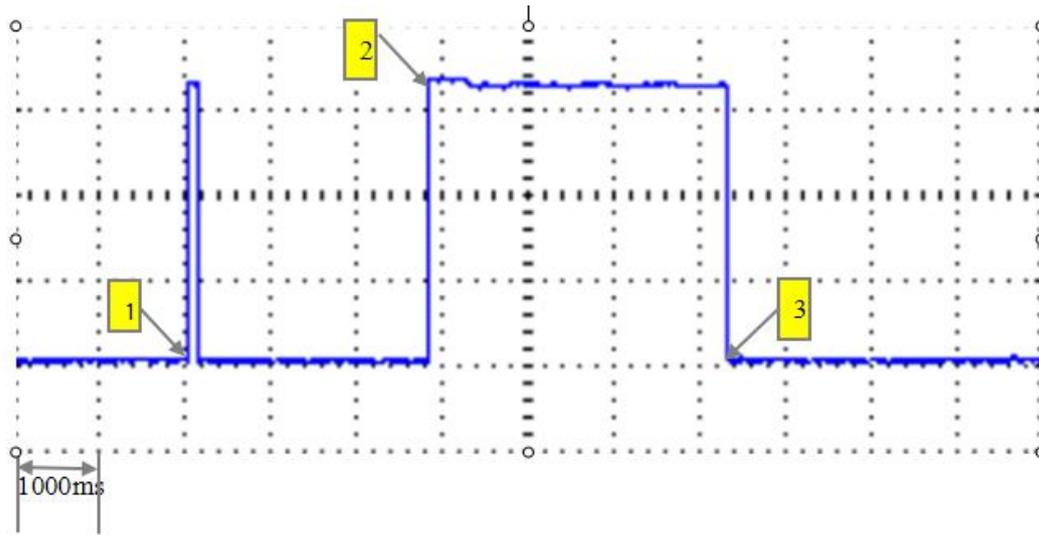
However, we suggest the route device should not work on deep sleep mode. Because in deep sleep work mode, it need more time to send data after device awake.

A1.5 Work mode

On API work mode, the serial data should be avoid of 0xFE data.

On transparent work mode, the serial data should be avoid “+++” and “===” string.

A1.6 Power on timing



FigureA1-1 Module's power on timing

As Figure A1-1, point 1 to 2 is system start up time, 2.9 second. During this period, the ZigBee module did not respond to any commands.

Point 2 to Point 3 is configure time, 3.2 second. During this period, the Zigbee module's serial port's baud rate is 115200 bps and work mode is transparent mode. After receiving “+++” string twice, responding to the peer with “OK”, the module will change to AT work mode. The interval between two ”+++” string, should in 50ms~200ms.100ms is recommended.

After Point 3, the module work on the pre-setting work mode. It can change the work mode to AT mode by sending twice “+++” string any time in normal work state. It will back to the original work mode, if it did not received any commands within one minute.

A1.7 Transmit Power

Keep more than 20cm distance between two ZigBee device, when tested or in practical application

A2 FAQ

FAQ1 : Configure parameters fail

Solution: Please check the serial port number and the property of the serial ports, such as baud rate, parity.

FAQ2 : With right parameters , but add network fail

Solution : First Check that the antenna installation was OK. Then check the network parameters were correct,such as pan id, node address, physical channel. If everything is all right, try to factory the device,then add network and send data.

FAQ3 : In network , but send data fail

Solution : Please check the distance of the two device, make sure the distance is greater then 20 cm. Then confirm that the way of send data is right in the current work mode(eg. AT+TXA or AT+TXH on AT work mode). Please refer to the chapter 4.4.21 and 4.4.2.22

FAQ4 : Can not enter sleep

Solution : 1. On timer sleep mode, if the sleep time and awake time is 0, then the device will not enter sleep.

2. On deep sleep mode. Please check the sleep control(SLEP_REQ) pin's wire splice is OK and the control level is OK(high level make device sleep, otherwise awake)