F8913 User Manual

Xiamen Four-Faith Communication Technology Co., Ltd.

Add：J1-J3,3rd Floor,No.44,GuanRi Road,SoftWare Park,XiaMen,China Zip Code:361008
Tel：+86 592-6300326 ，6300325，6300324
Fax:+86 592-5912735
http://www.fourfaith.com

Copyright Notice

Trademark Notice


ZB-MOD V1.0
2011-11-11


2011-11-11
ZB-MOD V1.0

Contents

Chapter 1 Brief Introduction of Product

1.1 Overview

F8913 ZigBee data transmission module is based on the IEEE 802.15.4/ZigBee technology,embedded wireless data transmission module, use the 2.4GHz IEEE 802.15.4 standard RF transceivers for ZigBee networks to provide users with wireless data transmission capabilities.

The product uses high-performance industrial grade ZigBee program can work on the toll-free worldwide 2.4GHz ISM(Industrial,Scientific and Medical)band, and is divided into 16 channels in the band, the data transfer rate of 250kb/s.In addition to the IEEE standards-based RF and PHY/MAC layer protocol stack embedded F8913 supports a variety of network functions. From simple lighting networks to complex multi-layer Ad-Hoc private network,F8913 network to support design can cover the entire range of needs.

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.

1.2 Specifications

1.2.1、F8913-N and F8913-E Specifications

Specifications of the F8914-N/F8914-E ZB SMT RF Module

Specification	F8913-N	F8913-E
Outdoor RF line-of-sight Range	200 米	800 米
Indoor/Urban Range	60 米	90 米
Transmit Power Output	1.26mw(1dBm), Normal mode 2.82mw (+4.5dBm), Boost mode	100 mw (+20dBm)
RF Data Rate	250kbps	
Receiver Sensitivity	－50 dBm（Normal mode） －95dBm（Boost mode）	-104dBm
Supply Voltage	2.0～3.6V	
Operating Current (Transmit))	29mA（+1dBm, Normal mode） 34mA（+4.5dBm, Boost mode）	128mA@+3.0V,+20dBm
Operating Current (Receive)	20.5mA（Normal mode） 24.3mA（Boost mode）	25mA
Power-down Current	<1uA@25°C	
Operating Frequency Band	ISM2.4～2.5GHz	
ZigBee Standard	IEEE 802.15.4	
Dimensions	0.875” x 1.475” x 0.149” (2.223cm x 3.747cm x 0.378cm)	

Weight	38g	40g
Operating Temperature	-40～125 ºC	-40～85 ºC
Antenna Options	Standard SMA female interface、U.FL Connector	
Pin Interface	SMT2.0 Patch、line-double 8 spacing of 2.0	
Supported Network Topologies	Point-to-point, Point-to-multipoint, Peer-to-peer, and Mesh	
Number of Channels	16 Direct Sequence Channels	
Channels	11～26	
Max packge size	512Bytes	
Node Type	Coordinator、Route、Endpoints (optional)	
UART	9600、19200、38400、57600、115200 bps	
SPI	4 Mbps maximum (burst)	
Protocol Standards	ZigBee Pro	

1.2.2 Serial Communications Specifications

F8913 RF modules support both UART (Universal Asynchronous Receiver / Transmitter) and SPI (Serial Peripheral Interface) serial connections.

1.2.2.1 UART

The SC1 (Serial Communication Port 1) of the CC2530 is connected to the UART port.

UART Pin Assignments

UART Pins	Module Pin Number
TX	25(SMT)、41（DIP）
RX	26(SMT)、40（DIP）
CT/ADC/GPIO	24(SMT)、19（DIP）
RT/ADC/GPIO	23(SMT)、18（DIP）

More information on UART operation is found in the UART section in Chapter 2.

1.2.2.2 SPI

The SC2 (Serial Communication Port 2) of the CC2530 is connected to the SPI port.

SPI Pin Assignments

SPI Pins	Module Pin Number
MI/GPIO	9(SMT)、14（DIP）
MO/GPIO	10(SMT)、15（DIP）

C/GPIO	11(SMT)、16（DIP）
SS/GPIO	12(SMT)、17（DIP）

For more information on SPI operation, see the SPI section in Chapter 2.

1.2.3 GPIO Specifications

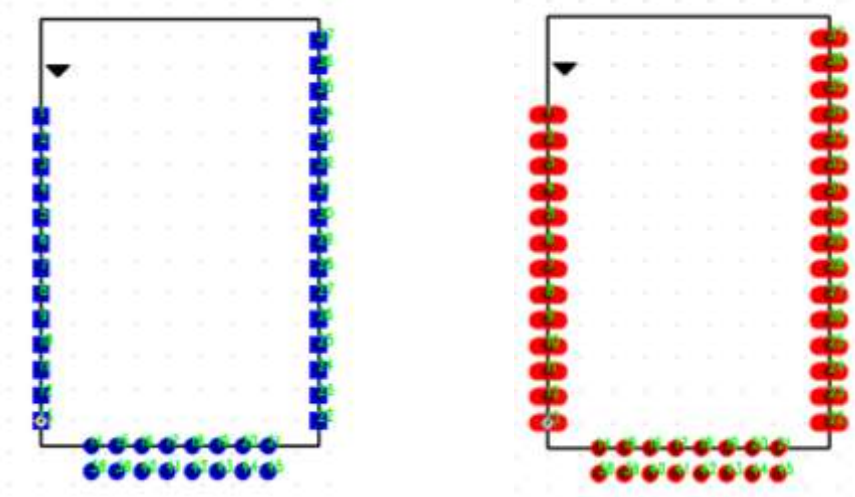
F8913 RF modules have 21 GPIO (General Purpose Input / Output) ports available. The exact list will depend on the module configuration, as some GPIO pads are used for purposes such as serial communication. See GPIO section for more information on configuring and using GPIO ports.

Electrical Specifications for GPIO Pads

GPIO Electrical Specification	MIN	TYP	MAX
Voltage – Supply(V)	-0.3	VDD	+0.3
Logic-0 input voltage(V)			0.5
Logic-1 input voltage(V)	2.5		
Logic-0 input current(A)	-50		50
Logic-1 input current(A)	-50		50
Input pull-up and pull-down resistor value(kΩ)		20	
Logic-0 output voltage, 4-mA pins(V)			0.5
Logic-1 output voltage, 4-mA pins(V)	2.4		
Logic-0 output voltage, 20-mA pins(V)			0.5
Logic-1 output voltage, 20-mA pins(V)	2.4		

Note: The output drive strength is 4 mA on all outputs, except for the two high-drive outputs, P1.0 and P1.1,which each have 20-mA output drive strength.

1.3 Module Pin Definition



Top View Botton View

Pin No	Symbol	Direction	Default Function	Description
SMT				
1	GND	-	-	Ground
2	VCC	-	-	Power Supply
3	GND	-	-	Ground
4	P2.4	Input	Q1	XOSC32K_Q1
5	P2.3	Output	Q2	XOSC32K_Q2
6	P2.2	Input	DC	DC/GPIO
7	P2.1	Both	DD	DD/GPIO
8	P2.0	Both	GPIO	GPIO
9	P1.7	Output	MI	MI/GPIO
10	P1.6	Input	MO	MO/GPIO
11	P1.5	Input	C	C/GPIO
12	P1.4	Input	SS	SS/GPIO
13	P1.3	Both	GPIO	GPIO
22	P0.6	Input	ADC	ADC/GPIO
23	P0.5	Input	RT	RT/ADC/GPIO
24	P0.4	Output	CT	CT/ADC/GPIO
25	P0.3	Output	TX	TX
26	P0.2	Input	RX	RX
27	P0.1	Input	ADC	ADC/GPIO
28	P0.0	Input	ADC	ADC/GPIO
29	RST	Input	Reset	Module Reset
30	P1.1	Both	-	GPIO
31	P1.2	Both	-	GPIO
32	P0.7	Both	-	GPIO

33	P1.0	Both	GPIO	GPIO
34	GND	-	-	Ground
35	VCC	-	-	Power Supply
36	GND	-	-	Ground
37	GND	-	-	Ground
DIP				
14	P1.7	Output	MI	MI/GPIO
15	P1.6	Input	MO	MO/GPIO
16	P1.5	Input	C	C/GPIO
17	P1.4	Input	SS	SS/GPIO
18	P0.5	Input	RT	RT/ADC/GPIO
19	P0.4	Output	CT	CT/ADC/GPIO
20	P0.1	Input	ADC	ADC/GPIO
21	P0.0	Input	ADC	ADC/GPIO
38	P2.2	Input	DC	DC/GPIO
39	P2.1	Both	DD	DD/GPIO
40	P0.2	Both	RX	RX
41	P0.3	Both	TX	TX
42	RST	Input	Reset	Module Reset
43	GND	-	-	Ground
44	VCC	-	-	Power Supply
45	P0.6	Input	ADC	ADC/GPIO

Note: Red F8913-N have.

Signal direction relative to the specified module.

1.4 Firmware Performance Specifications

Serial	Baud	115200（Default）
	Configuration	8/N/1
	Max packge size	512Bytes
	XOR	1-byte XOR
	Command Mode	AT Mode HEX Mode
Network	Network Max	65000（0～65000）
	Node Range	0～65000 0：Coordinator Add 65535：Broad
	Routing Table	180-way
	RREQ Table	4-way
Sleep	External Wake-Up	RTC Wake-up

1.5 Absolute Maximum Ratings

		MIN		MAX	UNIT
Supply voltage	All supply pins must have the same voltage	-0.3		3.9	V
Voltage on any digital pin		-0.3	VDD	+0.3 ≤3.9	V
Input RF level				10	dBm
Storage temperature range		－40		125	° C
ESD(2)	All pads, according to human-body model, JEDEC STD 22, method A114			2	KV
	According to charged-device model, JEDEC STD 22, method C101			500	V

NOTE:

(1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions* is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

(2) CAUTION: ESD sensitive device. Precaution should be used when handling the device in order to prevent ermanent damage.

Chapter 2 Module Operation

2.1 Serial communication

Signal Description

Default UART Transport

UART default configuration :

- Baud rate: 115200
- 8N-1 byte format

The following standard UART signals are used:

- TX: Transmit data.
- RX: Receive data.
- CT: Clear to send.
- RT: Ready to send.

Figure 5 shows the RTS/CTS flow control connections to the host processor. On the CC2530, RT and CT are active-low signals. The RT output is driven low when the receive register is empty and reception is enabled. Transmission of a byte does not occur before the CT input goes low.

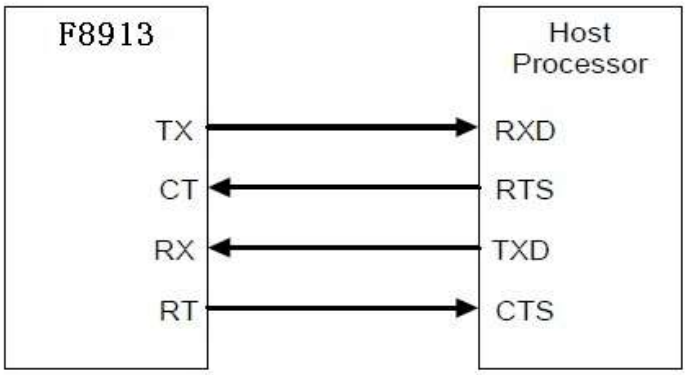
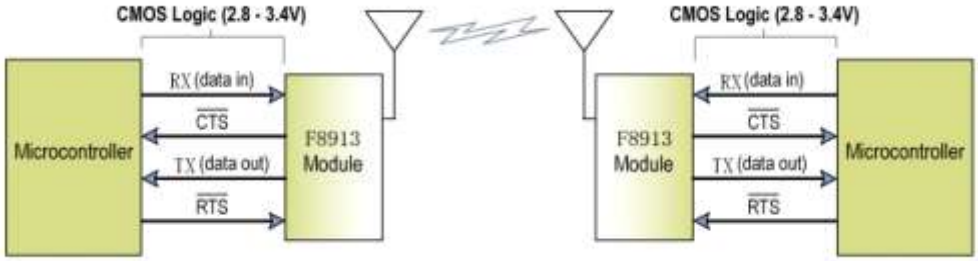


Figure 5 RTS/CTS Flow Control Connections

Signal Operation

UART transport sends and receives data asynchronously. Data can be sent and received
simultaneously and the transfer of a frame can be initiated at any time by either the application
processor



2.2 ADC and GPIO

F8913 support ADC and GPIO, The exact list will depend on the module configuration.

Pins	name	AT cmd
SMT		
6	P2.2/DC	
7	P2.1/DD	
8	P2.0	
13	P1.3	
22	P0.6/ADC	
23	P0.5/RT/ADC	
24	P0.4/CT/ADC	
27	P0.1/ADC	
28	P0.0/ADC	
33	P1.0	
DIP		

18	P0.5/RT/ADC	
19	P0.4/CT/ADC	
20	P0.1/ADC	
21	P0.0/ADC	
38	P2.2/DC	
39	P2.1/DD	
45	P0.6/ADC	

I/O Configuration

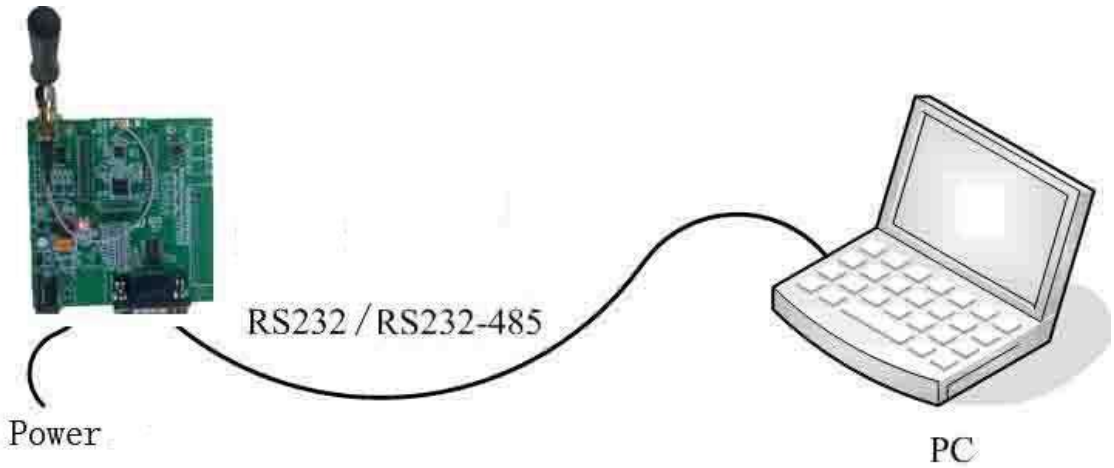
See AT command “AT+DMn” section in charpter 3

Setting value	Description
0	Disabled
1	Analog
2	Data in monitored
3	Data out low
4	Data out high

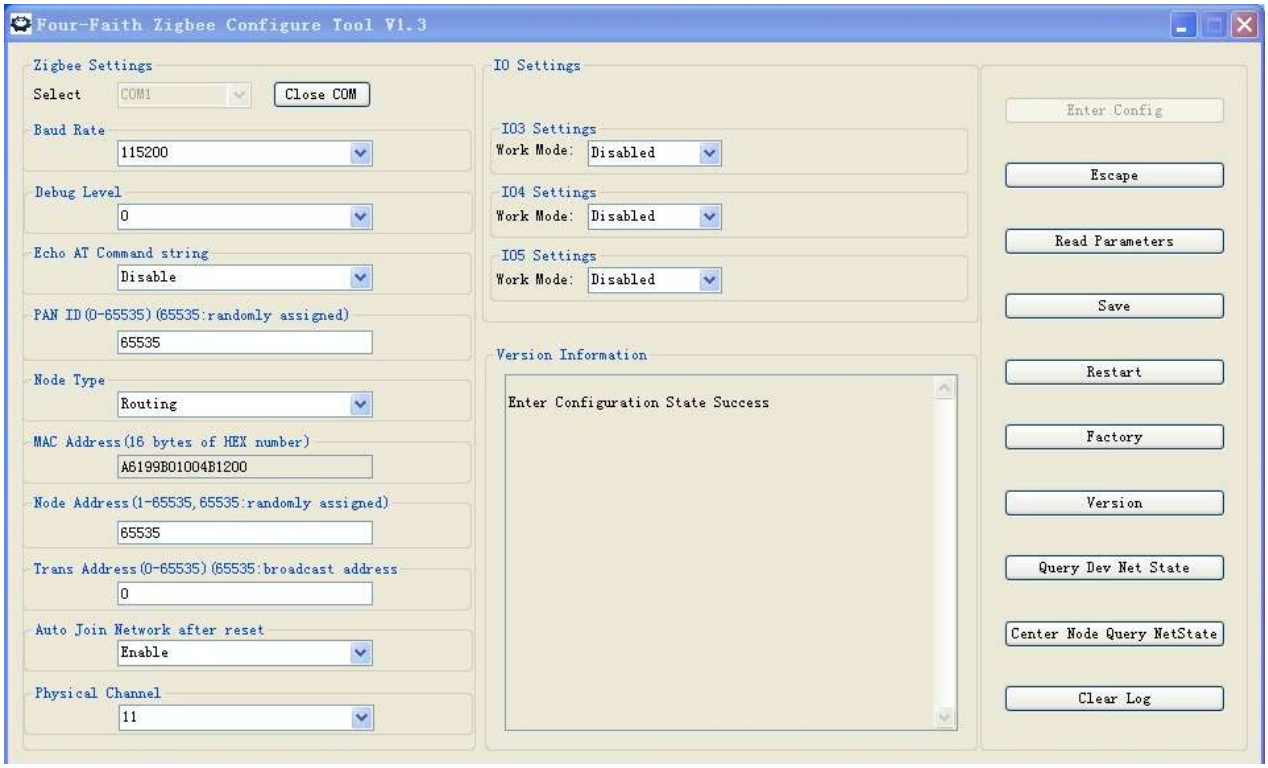
Chapter 3 Configuration

3.1 Configuration Connection

Before configuration, It’s necessary to connect the device with the configure PC by the shipped RS232 or RS232-485 conversion cable.



3.2 Configuration Introduction



There are two ways to configure the F8913:

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 F8913 enter configure state.

The following describes how to configure F8913 with the configure software tool. At the same time, it gives out the corresponding AT command of each configuration item.

3.3 Run the configure Tool: ZigbeeConfigure.exe

The "Serial Parameters" column shows the current serial port settings. To configure IP MODEM, please choose the correct serial port which connects to F8913, and the baud-rate is 115200 with no parity, 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 the port opened, the "Output Info" column will display

"Port(COM1) Has Opened，Please Re-Power the F8913,

Waiting F8913 enter configure state..."

3.4 Re-power F8913

After Re-power F8913, The configure tool will make it enter configure state. At the same time, the software will load current settings from and displays on the right configure columns. It's now ready to configure.

3.5 Configuration

Acronyms :

SREQ : Asynchronous Request
SREQ : Synchronous request
SRSP : Synchronous response

1 Transparent mode.

In transparent mode, F8913 received data from serial interface, then send data to other zigbee device by RF according to the address of the transparent transmit address. See AT command AT+TID

2 AT command mode

When In transparent mode,Enter 3 equal mark "+++" twice in 100 mSecondsto place the F8913 in API mode.

AT+<command>?<CR LF> Query value
AT+<command>=<value><CR LF> Setting value
Success response : OK<CR LF>
Failure response : ERROR<CR LF>
CR: 0x0D carriage return
LF: 0x0A line feed
Example:
Query:AT+PID?<CR LF>
rsp:+PID:0<CR LF>
OK<CR LF>
Setting:AT+PID=198<CR LF>
rsp:OK<CR LF>

ATcommand:
AT+PID PAN ID setting PAN ID digital string 0-65535
0-16383: Set a PAN ID.
65535 : System will assign a stochastic PAN ID. (default)
Query rsp:
+PID:65535

OK

Note: This command setting the PID that saving in non-valatile flash.
In contrast ,“AT+PCD” command query the PANID which is used actually

AT+PCD
Query the current used PANID
example:
AT+PCD?
Query rsp:
+PCD:65535
OK

AT+MID MAC Address 16 HEX characters
example:0x0123456789ABCDEF.
[read only]
Query rsp:
+MID:EF357F01004B1200
OK

AT+TYP=<0,1,2> Node Type
(0 -- Coordinator,
1 -- Router (defalut)
2 -- End Device)
+TYP:0
OK

AT+NID Node Address (0-65535)
NOTE: when Coordinator establish a network,its net address will be 0,only a coordinator in the network.
Router and End device shold not set network address to 0
65535 System will assign a stochastic net address
Query rsp:
+NID:65535
OK

Note: This command setting the PID that saving in non-valatile flash.
In contrast ,“AT+NCD” command query the net address which is used actually

AT+NCD
example:
AT+NCD?
Query rsp:

+NCD:65535
OK

AT+TID Transparent Address **0**-65535 (0 dafault)
65535 is broadcast address. It will send to all other nodes.

Query rsp:
+TID:0
OK

AT+IPR Baud Rate (0-4)
0 -- 9600
1 -- 19200
2 -- 38400
3 – 57600
4 — 115200 (dafault)

AT+ECH character echo.
0 -- no character echo
1 -- character echo

AT+ACK=<0,1> data acknowledgement.
0-- NO
1-- YES (dafault)

AT+VER Version
Query rsp:
Four-Faith F8913 Standard
Ver: V1.00
Time: Nov 28 2011 16:02:38
OK

AT+DBL=<0,1,2> log level.
0 -- disable (dafault)
1 -- print significant message.
2 -- print all message.

AT+AST=<0,1> auto go into network when power on
0 -- no
1 -- yes. (dafault)

AT+STA Start network.
Success : OK

failure :ERROR

note: when AT+AST=0,use this command to start network.

AT+CHA=<11-26> Set Working Channel

AT+SAV Save all setting parameters to System.

AT+ESC Escape, exit AT command mode, and enter the transparent mode.

AT+API API switch to API mode

AT+FAC Factory load factory setting

AT+SRS System Reset

AT+SNS Query network state or itself.

RSP:+SNS:01

OK

net state table:

00	Initialized - not started automatically
01	Initialized - not connected to anything
02	Discovering PAN's to join
03	Joining a PAN
04	ReJoining a PAN, only for end devices
05	Joined but not yet authenticated by trust center
06	Started as device after authentication
07	Device joined, authenticated and is a router
08	Zigbee Coordinator starting network
09	Started as Zigbee Coordinator
10	Device has lost information about its parent

AT+NWS For coordinator to query the whole network state.

SRSP:

rsp:

OK

then receive other node's response.

+NWS:<state>,<net address>,<IEEE address >,<node type>

Example:

+NWS:0,1,1122334455667788,0

+NWS:0,2,1122334455667799,1

+NWS:0,8,1122334455667732,2

NOTE: For avoid network busy traffic,other nodes receiving this OTA command will delay a random time, and then sent response to coordinator.Random time range: 0--66 seconds

AT+QNA=<MAC address> query net addrss by MAC address.

SRSP:

Success rsp:

OK
Failure rsp:
ERROR
AREQ:
+NWS:<state>,<net address>,<IEEE address >,<node type>

AT+QMA=<Net address> Query MAC address by net address.
SRSP:
Success rsp:
OK
Failure rsp:
ERROR
AREQ:
+NWS:<state>,<net address>,<IEEE address >,<node type>

AT data send and receive

HEX mode: AT+TXH=< destination address(little endidan)><data content>
send data:
AT+TXH=0123383838383838
destination net address: 0x2301
data content: "888888"
SRSP:
OK

ASCII mode:
Send data:
AT+TXA=12245,1235567789
destination address: 12245
data content: "1235567789"

Receive data
AREQ:
:+RCV:12245,1235567789
Source net address: 12245
data content: "1235567789"

OTA IO Sample and control

AT+DMn=<0-5> IO work mode setting
0 = Disabled
1 = ADC
2 = DI GPIO input
3 = DO low GPIO ouput High
4 = DO high GPIO ouput High
example:AT+DM1=4

AT+DTn=<0-65535 seconds>
auto report time interval setting.
0 -- diable
others -- F8913 will report IO value to coordinator per interval time

AT+DVn? get IO value
Example:
AT+DV3?
rsp:
+DV3:1
OK

AT+NVn=<net address> OTA query
SRSP:
Sucess rsp:OK
Failure rsp:ERROR
AREQ:
Sucess rsp:
+NVn:<state>,<destination net address>,<value>
Failure rsp:
+NVn:<state>,< destination net address >,<value>

状态信息表:

0	Success
1	no in the newwork
2	no exist
3	no ack
4	IO no used
5	invalid value

OTA IO Set.
AT+NSn=<net address>,<mode 3 or 4>
Description: Set IO output only when IO mode is Hight or Low

3 API work mode:

Enter API mode:
When In transparent mode,Enter 3 equal mark "===" twice to place the F8913 in API mode.
When In AT command mode,send AT+API command to place the F8913 in API

mode:

AT+API<CR><LF>

Exit API mode:

refer to API command Set work mode

General Frame Format. The general frame format is shown in the following figure. The left-most field is transmitted first
over the wire. For multi-byte fields, the lowest order byte is transmitted first:

SOF 1 Byte	Length 1 Byte	Command 2 Bytes	Data xx Bytes (xx<250)	FCS 1 Byte

SOF: Start of frame indicator. This is always set to 0xFE
Length: The length of the data field of the frame.
Command: The command of the frame.
Data: The frame data. This depends on the command field and is described for each command.
FCS: Frame-check sequence. This field is computed as an XOR of all the bytes in the length,command and data fields.
Shown below is a C example for the FCS calculation:

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

Data send.

SREQ:

Fields	**Sub Fields**	**Offset**	**Example**	**Description**
SOF		1	FE	
Length		1	06	
Command	Data send	2	24 5F	
Data	Address	2	00 00	Destination address
	Content	4	41 41 41 41	
FCS		1		

SRSP:

Fields	**Sub Fields**	**Offset**	**Example**	**Description**
SOF		1	FE	
Length		1	03	

Command		2	64 5F	
Data	state	1	00	00
FCS		1		

AREQ:

Fields	Sub Fields	Offset	Example	Description
SOF		1	FE	
Length		1	03	
Command		2	44 80	
Data	state	1	00	00 -- success others -- error
			0B 00	
FCS		1		

Receive data

AREQ:

Fields	Sub Fields	Offset	Example	Description
SOF		1	FE	
Length		1	06	
Command		2	44 5F	
Data	source address	2	00 00	Source net address
	content	<80	42 42 42 42	content
FCS		1		

Set work mode

SREQ:

Fields	Sub Fields	Offset	Example	Description
SOF		1	FE	
Length		1	01	
Command	mode set	2	21 2A	
Data	mode value	1	00	work mode 0 – transparent mode 1 – AT command mode 2 – API mode
FCS		1		

SRSP:

Fields	Sub Fields	Offset	Example	Description
SOF		1	FE	
Length		1	01	

Command	mode set ack	2	61 2A	
Data	state	1	00	0 -- success 1-- error
FCS		1		

OTA IO Sample

SREQ(24 5E):

Fields	Sub Fields	Offset	Example	Description
SOF		1	FE	
Length		1	04	
Command		2	24 5E	
Data	Des address	2	00 00	Destination address
	read action	1	00	
	IO address	1	02	IO address (00 - 02)
FCS		1		

SRSP(64 5E):

Fields	Sub Fields	Offset	Example	Description
SOF		1	FE	
Length		1	06	
Command		2	64 5E	
Data	state	1		state
FCS		1		

ARSP(44 5E):

Fields	Sub Fields	Offset	Example	Description
SOF		1	FE	
Length		1	06	
Command		2	44 5E	
Data	state	1	00	state
	Des address	2	00 00	Destination address
	IO address	1	2	Destination IO address
	IO value	n	12 34	value is 0x3412
FCS		1		

OTA Pin Set(Only in GPIO output mode)

SREQ:

Fields	Sub Fields	Offset	Example	Description
SOF		1	FE	
Length		1	03	
Command		2	24 60	
Data	Des address	2	00 01	Destination address
	write action	1	01	

	IO address	1	02	Destination IO address
	IO value	1	01 00	0x0001(little endian)
FCS		1		

SRSP:

Fields	Sub Fields	Offset	Example	Description
SOF		1	FE	
Length		1	06	
Command		2	64 60	
Data	state	1		
FCS		1		

ARSP:

Fields	Sub Fields	Offset	Example	Description
SOF		1	FE	
Length		1	05	
Command		2	44 60	
Data	state	1	00	state
	Des address	2	00 00	Destination address
	IO address	1	2	Destination IO address
	state	1	00	00 -- success othters -- error
FCS		1		

OTA IEEE address query

SREQ:

Fields	Sub Fields	Offset	Example	Description
SOF		1	FE	
Length		1	02	
Command		2	24 5D	
Data	Des address	2	12 34	Destination address
	action	1	02	IEEE address query
FCS		1		

SRSP

Fields	Sub Fields	Offset	Example	Description
SOF		1	FE	
Length		1	01	
Command		2	64 5D	
Data	state	1	00	state
FCS		1		

AREQ:

Fields	Sub Fields	Offset	Example	Description
SOF		1	FE	
Length		1	0C	
Command		2	44 5D	
Data	state	1	0	state
	Source address	2	00 00	Source netaddress
	IEEE address	8	12 34 56 78 AA BB CC DD	0xDDCCBBAA78563412
	node type	1		0 -- Cordinator 1 -- Router 2 – End device
FCS		1		

OTA net address query

SREQ:

Fields	Sub Fields	Offset	Example	Description
SOF		1	FE	
Length		1	09	
Command		2	24 5C	(Its is a broadcast cmd)
Data	action	1	03	qurey net address
	IEEE address	8	12 34 56 78 AA BB CC DD	0xDDCCBBAA78563412
FCS		1		

SRSP:

Fields	Sub Fields	Offset	Example	Description
SOF		1	FE	
Length		1	01	
Command		2	64 5C	
Data	state	1	00	state
FCS		1		

AREQ:

Same as the AREQ of OTA IEEE netaddres query

OTA query the whole network

SREQ:

Fields	Sub Fields	Offset	Example	Description
SOF		1	FE	
Length		1	01	
Command		2	24 5B	
Data	--	1	01	
FCS		1		

SRSP:

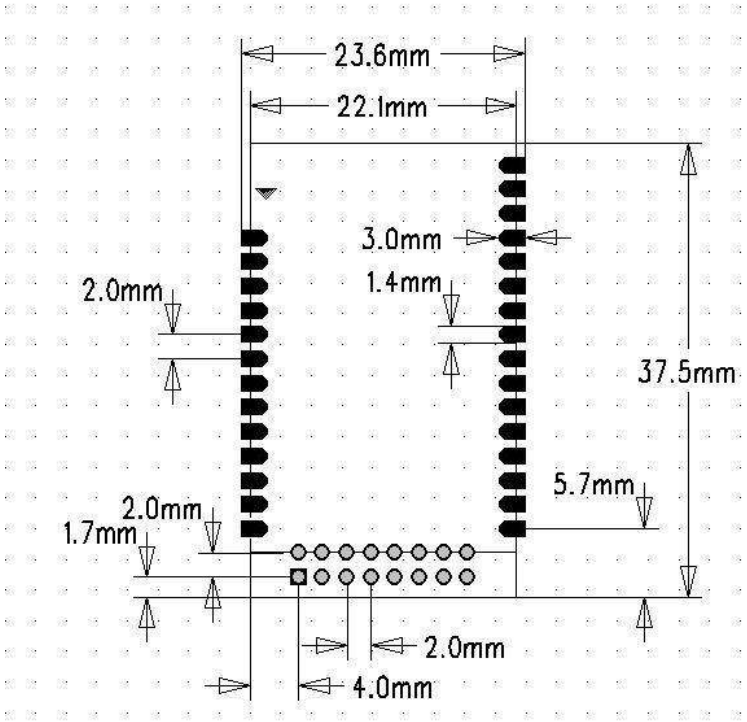
Fields	Sub Fields	Offset	Example	Description
SOF		1	FE	
Length		1	03	
Command		2	64 5B	
Data	state	1	00	state
FCS		1		

AREQ:
Same as the AREQ of OTA IEEE netaddres query

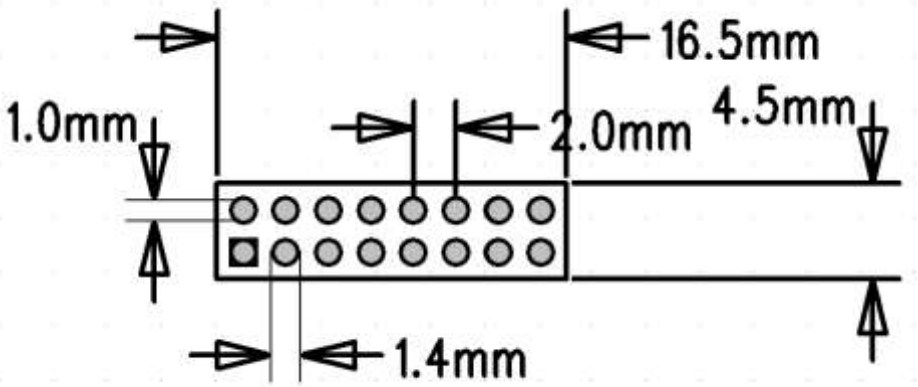
Chapter 4 Hardware Specifications

4.1 F8913 Module Mechanical Dimensions

We recommend that you use as shown below for the surface-mount PCB packaging. Dimensions are in millimeters.



You can also use the DIP PCB package as shown below. Dimensions are in millimeters.



4.2 Re-flow Temperature Specification

Recommendations according to IPC / JEDEC J-STD-020B standard welding.

	Ideal (ºC)	Maximum (ºC)
Maximum Re-flow Temperature	215	230

4.3 Solder Recommended

Recommendations according to IPC / JEDEC J-STD-020B standard welding.

	Alloy Composition	Solidus (ºC)	Liquidus (ºC)	Shear MPa
Johnson Alloy #806	In/48Sn (e)	118	118	

Chapter 5 Ordering Information

You can contact Xiamen Four-Faith Communication Technology Co., Ltd. and our sales to buy modules or development kit to expand your network. Please specify date you need the product model.