E180-2G4Z20SX Product Specification

2.4 GHz ZigBee Multifunctional SoC Wireless Module



Chengdu Ebyte Electronic Technology Co.,Ltd.

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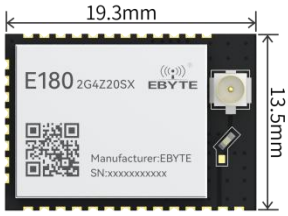
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1、Overview

1.1 Product Profile

E180-2G4Z20SX is a ZigBee module designed and produced by Chengdu Ebyte that can quickly realize wireless connection, easy to add, small size, low power consumption, high reliability, and work in the 2.4GHz frequency band. up to 20dBm.

E180-2G4Z20SXS integrates fast and easy-to-use ad-hoc network function, which simplifies the complexity and greatly simplifies the complicated development process of wireless products, so that your products can be quickly put into the market at a lower cost.



1.2 Functional characteristics

- Compatible with XBEE 3 ZigBee 3.0 Series Modules.
- Rapid realization of wireless connection: through the upper computer or instructions to quickly build a communication network, shorten the user development cycle.
- Super-large network capacity: The coordinator uses the way of not storing node network access information, which can form a super-large network with unlimited number of network nodes.
- Centralized network management: ZigBee 3.0 security standard centralized network access mechanism, data security and reliability;
- Interoperability: compliant with ZigBee 3.0 standard network mechanism;
- Convenient parameter configuration: view and configure module parameters through upper computer or HEX and AT instructions;
- Role switching: The user can make the device switch arbitrarily in the three types of coordinator, router and dormant terminal through serial port instructions;
- Support a variety of network topologies: point-to-point, star network, MESH network;
- Network self-healing: when the intermediate nodes of the network are lost, a new Mesh topology is automatically formed, and the lost nodes are automatically recovered after restarting;
- Automatic routing: The module supports network routing function;
- Automatic channel and PANID: The coordinator automatically creates the network on the optimal channel and automatically assigns PANID to avoid duplication with other coordinators.
- Support native ZigBee underlying instructions to obtain the maximum control authority of the network.
- Automatic acquisition of MAC address: The coordinator can obtain the node MAC address and short address at the moment of node screening, without further processing at the device end.
- Address search: Users can find out the corresponding short address according to the MAC address (unique and fixed) of the nodes that have joined the network, and can also find the corresponding long address of each node in the network according to the short address of the nodes;
- Data security: Integrate ZigBee 3.0 secure communication standard, and the network contains multi-level security keys;
- GPIO wake-up: support GPIO wake-up function, and wake up the module by pulling PD4 pin low level (default high level);
- Module reset: the user can reset the module through serial port command;
- Restore factory settings: users can restore factory settings of modules through serial port commands;

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- Multiple command formats: Users can use hexadecimal format commands and AT commands to configure and control modules, and realize networking, setting transparent transmission and other operations.
- Have the national invention patent certificate, and the invention name: a kind of invention based on ZigBee 3.0 Patent number of interconnection method of wireless transparent transmission module based on:ZL 2019 1 1122430. X



1.3 Introduction to Equipment Types

There are three types of logical devices in a ZigBee network: a Coordinator, a Router, and a Sleep-End-Device. The ZigBee network consists of a Coordinator along with multiple Router and multiple Sleep-End-Devices.

1.3. 1 Coordinator

It has the function of establishing and managing the network, controls whether other nodes are allowed to join the network, and has all the functions of routing equipment. Its main task is to manage the network, upload the information of child nodes to the upper computer and forward messages. At the same time, the coordinator needs to identify the authority of the terminal requesting to enter the network. After the coordinator is powered off, the network will not crash, and the router and dormant terminal will work normally in the current network.

1.3. 2 Router

Other nodes are allowed to connect with routing equipment to expand the coverage of the network. Its main task is to forward messages, play the role of relay routing, and have all the functions of terminal equipment. If there are multiple paths from one node to another node, when one of the paths fails, the network will automatically adjust to the other optimal path for transmission to ensure the arrival of data. The router can set up its own network or join someone else's network. The router is always active, so it must be powered by the main power supply. E180-2G4Z20SX factory default role is router.

1.3. 3 Dormant terminal

When no data is sent or received, the dormant terminal enters a dormant state (data can be received), and the dormant current is as low as about 2uA.

When the dormant terminal needs to send wireless data or perform instruction operation,The module needs to wake up by pulling down the PA0 pin level,The dormant terminal will not become a coordinator or router after waking up

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1.4 Application Scenarios

- Smart home and industrial sensors;
- Security system, positioning system;
- Wireless remote control, drones;
- Wireless game remote control;
- Medical care products;
- Wireless voice, wireless headphones;
- Advanced Meter Reading Architecture (AMI);
- Application in automobile industry;
- Building automation solutions;
- Automation application of agricultural greenhouse.

2、 Specifications and Parameters

2.1 Limit parameters

Main parameters	Performance		Remarks
	Minimum value	Maximum value	
Power supply voltage (V)	0	3.8	More than 3.8 V permanently burned modules
Blocking power (dbm)	-	10	The probability of burning is small when used at close range
Operating temperature (℃)	-40	+85	Industrial grade
Working humidity (%)	10	90	%
Storage temperature (℃)	-40	+125	℃

2.2 Operating parameters

Main parameters		Performance			Remarks
		Minimum value	Typical value	Maximum value	
Operating voltage (V)		1.9	3.3	3.8	The output power can be guaranteed by ≥ 3.3 V, and the module will be damaged if it exceeds 3.8 V
Communication level (V)		-	3.3	-	Risk of burning when using 5V TTL
Operating temperature (℃)		-40	-	+85	Industrial grade design
Operating frequency band (MHz)		2400	-	2480	Support ISM band
Power	Emission	-	160	-	Instantaneous power consumption

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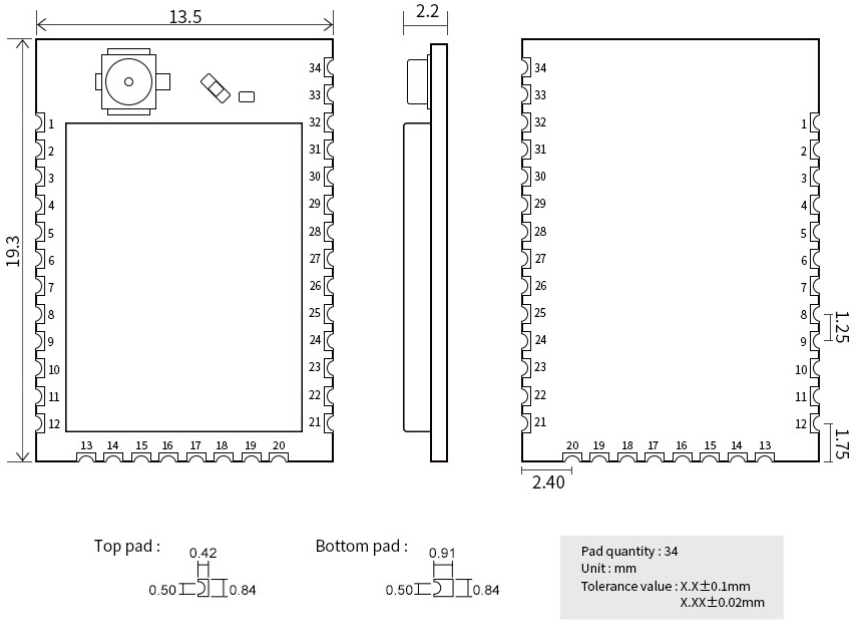
consumption	current (mA)				
	Received current (mA)	-	10	-	-
	Dormancy current (μ A)	1.8	1.98	2.0	Power supply 3.3 V, 10s periodic wake-up sleep current
Transmit power (dBm)		19.5	20	20.5	-
Air rate (bps)		-	250kbps	-	-
FIFO (byte)		-	1024	-	Automatic packet over 66 bytes, with a single packet size not exceeding 1024 bytes

Main parameters	**Describe**	**Remarks**
Communication distance	1.3Km	In clear and open environment, the antenna gain is 5 dBi, the antenna height is 2 meters, and the air speed is 250kbps
Crystal frequency	38.4 MHz	-
Support protocol	ZigBee 3.0	-
Packaging mode	Patch type	-
Interface mode	1.25 mm Stamp Holes	-
Overall dimensions	13.5*19.3*2.2 mm	± 0.1 mm
Antenna interface	IPEX/Stamp Hole	The equivalent impedance is about 50 Ω
Product weight	1.1 g	± 0.1 g

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3、Mechanical dimensions and pin definitions



Pin serial number	Pin definition	Pin direction	Pin use
1	GND	Power source ground	Power source ground
2	VCC	Input	Support 1.9-3.8 V power supply, and ≥ 3.3 V can guarantee output power
3	PB1	Output	Serial output pin, TXD
4	PB0	Input	Serial receiving pin, RXD
5	PA1	Input/output	General GPIO port
6	RESET	Input	Reset pin, active low
7	PA0	Input/output	General GPIO port
8	PD3	Input/output	General GPIO port
9	PD4	Input	Wake-up pin, pull up internally, pull low to wake up dormant terminal
10	GND	Power source ground	Power source ground
11	PD2	Input/output	General GPIO port
12	GND	Power source ground	Power source ground
13	PA6	Input/output	General GPIO port
14	PA5	Input/output	General GPIO port
15	PA4	Input/output	General GPIO port
16	PA3	Input/output	General GPIO port
17	NC	NC	-
18	NC	NC	-
19	NC	NC	-

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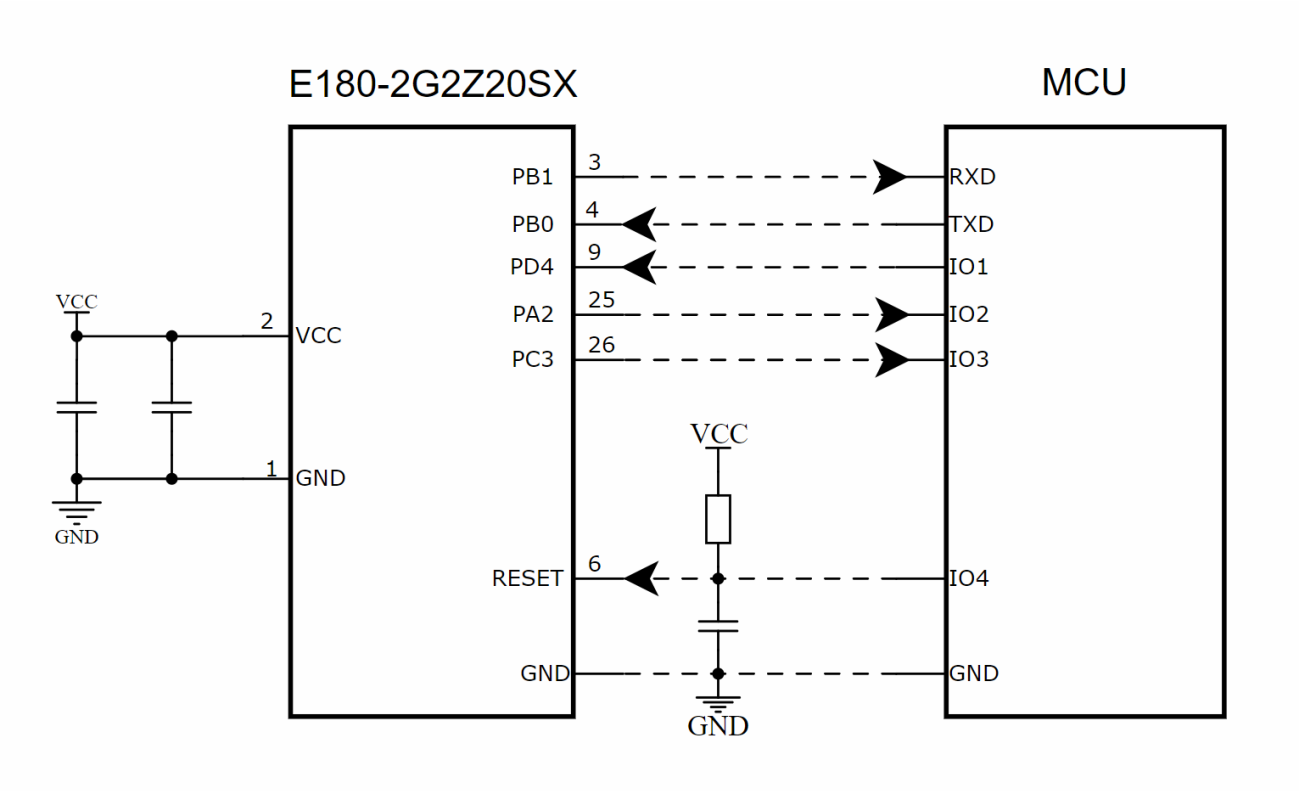
20	NC	NC	-
21	GND	Power source ground	Power source ground
22	NC	NC	-
23	PC0	Input/output	General GPIO port
24	PC1	Input/output	General GPIO port
25	PA2	Output	Device status indicator pin, high level means that the module is in wake state, and low level means sleep state.
26	PC3	Output	Network access indication pin, and the output high level indicates that the module is not connected to the network; Outputting high level at 2Hz frequency means that the module has been connected to the network (router); Outputting high level at 1Hz frequency means that the module has been connected to the network (coordinator); Output low indicates that the module is in sleep state.
27	PC2	Input/output	General GPIO port
28	NC	NC	-
29	NC	NC	-
30	PC4	Input/output	General GPIO port
31	PC5	Input/output	General GPIO port
32	GND	Power source ground	Power source ground
33	RF	-	Antenna interface
34	GND	Power source ground	Power source ground

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4、Application and Operation

4.1 Recommended Circuit Diagram

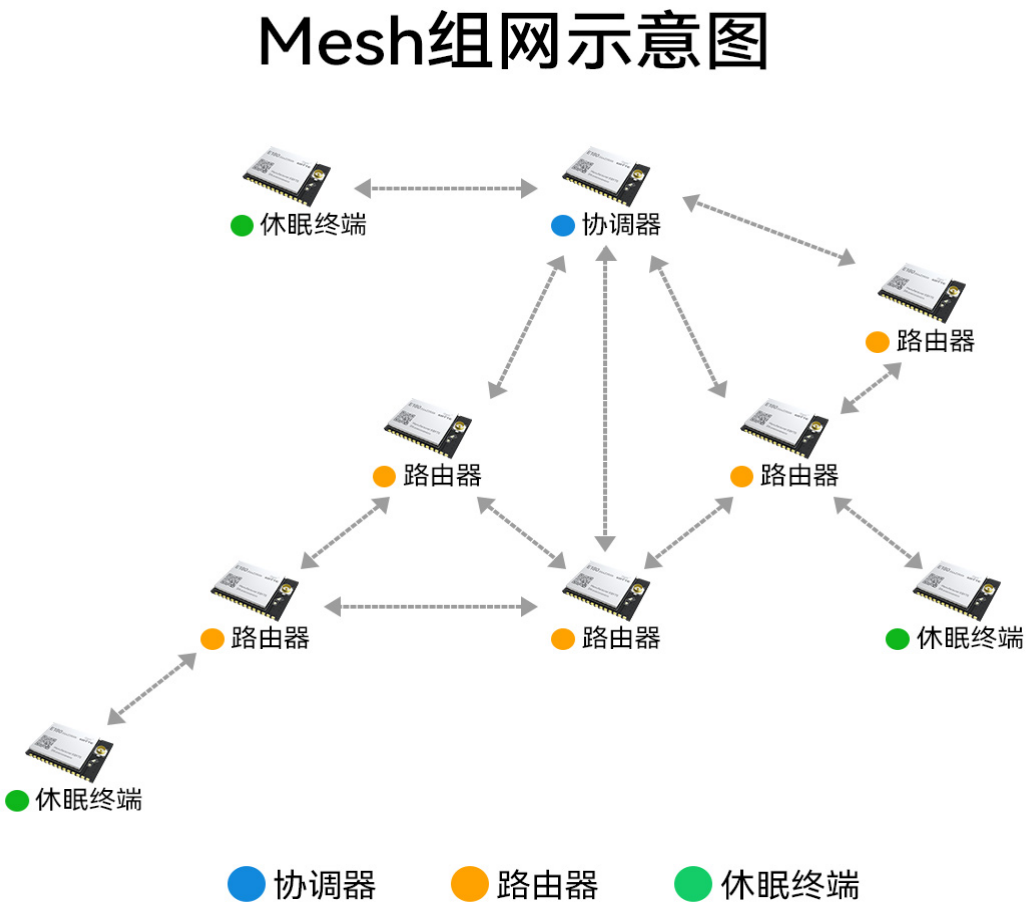


4.2 Network Topology

E180-2G4Z20SX module can be used as coordinator, router and dormant terminal equipment. The module supports ZigBee 3.0 standard specification, and has strong networking capability and interconnection capability. At the same time,The coordinator adopts the way of not storing the network access information of nodes, and can form a super-large network with unlimited number of network nodes.

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5、Introduction of working mode

5.1 Operating Mode

E180-2G4Z20SX module has two working modes, namely API instruction mode and data transmission mode.

API instruction mode: Input instructions conforming to API instruction format into serial port of module in API instruction mode, and the module executes instructions, which can realize module setting, module distribution network, module clearing network, data transmission and other operations.

Data transmission mode: In the transmission mode, any data input to the serial port of the module will be sent out through the RF interface. In transport mode, AT instruction mode can be temporarily turned on, and the module can be configured with AT instruction. Receiving object, sending method It is determined by the configuration parameters inside the module, which can be set by instructions.

Data transmission method:

Broadcast: To the coordinator and all routers, the router can forward broadcast messages and form broadcast storms, so the broadcast data frame cannot exceed 66 bytes, and the data transmitter (RF transmitting unit) must be cooled for 0.33 seconds after sending a packet of data.

On Demand: The data packet is sent to the specified target node according to the short address or MAC address of the target

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node.

Mode switching:

Enter "+ + +" in transmission mode to open AT instruction, and enter the string "ATAP1\ r" to switch to API mode. All the parameters of AT command need to be entered in string format and end with the newline character "\ r" (hexadecimal 0x0D).

In API mode, enter the API command "7E 00 05 08 01 41 50 00 65" of AT command type to switch to transport mode.

5.2 AT Command

E180-2G4Z20SX can be set by AT command in API mode and transport mode. API mode input AT command type API instructions, AT command input can be achieved. In transport mode, you need to enter the "+ + +" symbol to activate the AT command. Note that in transfer mode, if no valid AT command is entered within 6 seconds after the AT command is activated, the module automatically jumps back to transfer mode.

API mode input AT command, AT command parameter format is hexadecimal input format. The AT command is turned on in transmission mode, and the AT command parameters need to be entered in string format. In transport mode, AT commands need to end with a newline character "\ r" (hexadecimal 0x0D), while in API mode, no ending symbol is needed, just enter the correct API instruction checksum.

5.3 Serial port Parameter

Serial port parameters		
Type	Parameter	Remarks
Serial port baud rate (bps)	9600 (default)	Configurable as 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400, 460800, 921600
Stop bit (bit)	One (default)	Configurable as One (1), Two (2)
Data bit (bit)	8	Not configurable
Parity bit	None (default)	It can be configured as None, Odd, Even
RTS	None	-
DTR	None	-

6、API instruction

6.1 API instruction format

Field	Start field	Length Field		Frame data field		Verification field
				Type	Data	
Byte	1	2	3	4	5 ~ n	n+1
Describe	0x7E	High	lower	Instruction type	Instruction data	Single byte

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- Starting field: Fixed 0x7E
- Length field: 2 bytes, high before low after, length Does not contain Verify the field.
- Frame data field: It consists of two parts, which are composed of type and data. Type 1 bytes, and the data becomes longer.
- Verification fields: adopt and verify.

Verification algorithm:

Add all the contents in the frame data field, and take the lower 8 bits of the obtained data (divided by 256 to take the remainder), and then subtract the value with 0xFF.

For example: 7E 00 08 08 01 4E 49 58 42 45 45 3B is a valid instruction

Field	Start field	Length Field		Frame data field		Verification field
				Type	Data	
Byte	1	2	3	4	5 ~ n	n+1
Data	7E	00	08	08	01 4E 49 58 42 45 45	3B

Type directory:

Type of frame entered into the module	
Type	value
AT command	0x08
Send request frame	0x10
Send ZigBee data frames	0x11

Frame type of module output	
Type	value
AT command return	0x88
Network state	0x8A
Sending status	0x8B
Receive ZigBee data frames	0x91

6.2 Interpretation of API Instruction Classification

6.2. 1 Send AT command, type = 0x08, direction input

Field	Start field	Length Field		Frame data field					Verification field
				Type	Frame ID	AT command		Instruction parameter	
Byte	1	2	3	4	5	6	7	8 ~ n	n+1
Describe	0x7E	High	lower	0x08	Used to compare AT command returns	AT The first	AT The second	AT instruction parameters	Single byte

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Frame ID: Enter any value from 0x00 to 0xFF, and return after receiving AT command (type = 0x88), which AT command can correspond to.

6.2. 2 Send request frame, type = 0x10, direction input

Field	Start field	Length Field		Frame data field					
				Type	Frame ID	Target MAC	Destination short address	Broadcast radius	Transmission mode
Byte	1	2	3	4	5	6~13	14~15	16	17
Describe	0x7E	High	lower	0x10	Used for comparison Sending status	MAC address Big end mode	Segment address Big end mode	Reserved field	Reserved field

Frame data field	Verification field
Valid data sent to the target device	
18 ~ n	n+1
Transparent data	Single byte

6.2. 3 Send ZigBee data frame, type = 0x11, direction input

Field	Start field	Length Field		Frame data field					
				Type	Frame ID	Target MAC	Destination short address	Source port	Destination port
Byte	1	2	3	4	5	6~13	14~15	16	17
Describe	0x7E	High	lower	0x11	Used for comparison Sending status	MAC address Big end mode	Segment address Big end mode	0xE8	0xE8

Frame data field					Verification field
cluster ID	profile ID	Routing radius	Transmission mode	ZigBee AF message	
18~19	20~21	22	23	24 ~ n	n+1
0x0011	0xC105	Reserved field	Reserved field	Transparent data	Single byte

6.2. 4 AT command returns, type = 0x88, direction output from module

Field	Start field	Length Field	Frame data field					Verification field
			Type	Frame ID	AT command	Instruction state	Instruction parameter	

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Byte	1	2	3	4	5	6	7	8	9 ~ n	n+1
Describe	0x7E	High	lower	0x88	Used to compare AT command returns	AT The first	AT The second	AT command Return status	AT command Parameter	Single byte

6.2. 5 Network Status, Type 0x8A, Direction Output from Module

Field	Start field	Length Field		Frame data field		Verification field
				Type	Instruction state	
Byte	1	2	3	4	5	6
Describe	0x7E	High	lower	0x8A	Status byte	Single byte

6.2. 6 Send status, type 0x8B, direction output from module

This command is the return of 0x10 and 0x11

Field	Start field	Length Field		Frame data field						Verification field
				Type	Frame ID	Short address	Number of re-transmissions	Sending status	Routing mode	
Byte	1	2	3	4	5	6~7	8	9	10	n+1
Describe	0x7E	High	lower	0x8B	Compare 0x10 and 0x11 command returns	Short address of sending destination	Reserved bit	Send result status	Reserved bit	Single byte

6.2. 7 Receive request frame, type 0x90, direction output from module.

The AT command "AO" is output when an AF data frame with Profile ID 0xC105, cluster ID 0x0011 and destination port 0xE6 or 0xE8 is received when it is set to 0.

Field	Start field	Length Field		Frame data field					Verification field
				Type	Opposite MAC	Short address of opposite party	Receiving mode	Data message	
Byte	1	2	3	4	5~12	13~14	15	16 ~ n	n+1
Describe	0x7E	High	lower	0x90	MAC address Big end mode	Short address Big end mode	Reserved field	Transparent data	Single byte

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6.2. 8 ZigBee data frame received, type 0x91, direction output from module

This command is the output of the module when the remote module sends 0x10 and 0x11 to this module.

Field	Start field	Length Field		Frame data field				
				Type	Opposite MAC	Short address of opposite party	Source port	Destination port
Byte	1	2	3	4	5~12	13~14	15	16
Describe	0x7E	High	lower	0x91	MAC address Big end mode	Short address Big end mode	0xE8	0xE8

Frame data field				Verification field
cluster ID	profile ID	Receiving mode	ZigBee AF message	
17~18	19~20	21	22 ~ n	n+1
0x0011	0xC105	Reserved field	zigbee message	Single byte

6.2. 9 Remote AT Command, Type 0x17, Direction Input

Field	Start field	Length Field		Frame data field								Verification field
				Type	Frame ID	Target MAC	Destination short address	Transmission mode	AT command		Instruction parameter	
Byte	1	2	3	4	5	6	14	16	17	18	19 ~ n	n+1
Describe	0x7E	High	lower	0x17	Used to compare command returns	MAC address Big end mode	Segment address Big end mode	Reserved field	AT The first	AT The second	AT instruction parameters	Single byte

Frame ID: Enter any value from 0x00 to 0xFF, and return (type = 0x97) after receiving the remote AT command, which remote AT command can correspond to.

6.2. 10 Remote AT Command Status Return, Type 0x97, Direction Output

This command is the status return of the remote AT command

Field	Start field	Length Field	Frame data field							Calibration Field
			Type	Frame ID	Opposite MAC	Short address of opposite	AT command	Instruction state	Instruction parameter	

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							party					
Byte	1	2	3	4	5	6~13	14~15	16	17	18	19 ~ n	n+1
Describe	0x7E	High	lower	0x97	Used to compare AT command returns	MAC address Big end mode	Short address Big end mode	AT The first	AT The second	AT command Return status	AT command Parameter	Single byte

6.2. 11 Node Identification Indication, Type 0x95, Direction Output

Field	Start field	Length Field		Frame data field					
				Type	Opposite MAC	Short address of opposite party	Receiving mode	Node short address	Node MAC address
Byte	1	2	3	4	5~12	13~14	15	16~17	18~25
Describe	0x7E	High	lower	0x97	MAC address Big end mode	Short address Big end mode	Reservation	Big end mode	Big end mode

Frame data field						Calibration Field
NI identification	Parent node address	Node type	Network access mode	Profile	Manufacturer code	
26~27	28~29	30	31	32~33	34~35	n+1
0x20, 0x00	Short address Big end mode	1=Routing 2 = Terminal	2 = Network access for the first time 3 = Restart	0x00, 0x00	0x00, 0x00	Single byte

7、AT instruction parsing

7.1 Interpretation of AT Instruction Classification

- All AT commands need to be added with carriage return (\ r), which will not be explained later.
- All AT instructions are case sensitive

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- The return result of the AT instruction ends with\ r, which will not be explained later.
- The last bit of the sent and returned API instruction is the check bit.

7.1. 1 CN Command: Switch to Transparent Mode

In string mode:

Send	Return
ATCN	OK

In API mode:

Send	Return
7E 00 04 08 01 43 4E 65	7E 00 05 88 01 43 4E 01 E3

7.1. 2 AP Command: Switch API Mode

In string mode:

Send	Return
ATAP1	OK

In API mode:

Send	Return
7E 00 05 08 01 41 50 00 65	7E 00 05 88 01 41 50 00 E5

7.1. 3 CE Command: Read, Set Device Roles

- Read the current role

In string mode:

Send	Return
ATCE	0
	1
Description: 0 is the router or dormant terminal, and 1 is the coordinator	

In API mode:

Send	Return
7E 00 04 08 01 43 45 6E	7E 00 06 88 01 43 45 00 01 ED
	7E 00 06 88 01 43 45 00 00 EE
Description:00Is a router or a dormant terminal,01Is the coordinator	

- Set the device role: 0 is Router or dormant terminal1 is the coordinator.

In string mode:

Send	Return	Description
ATCE0	OK	Configure the device as a router or a dormant terminal
ATCE1		Configure a device as a coordinator
Description:0Is a router or a dormant terminal,1Is the coordinator		

In API mode:

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Send	Return	Description
7E 00 05 08 01 43 45 00 6E	7E 00 05 88 01 43 45 00 EE	Configure the device as a router or a dormant terminal
7E 00 05 08 01 43 45 01 6D		Configure a device as a coordinator
Description:00Is a router or a dormant terminal,01Is the coordinator		

7.1. 4 SH Command: Read module MAC address 4 bytes high

In string mode:

Send	Return
ATSH	xxxxxxxx
Explanation: "xxxxxxxx"Is 4 bytes higher than the MAC address of the module	

In API mode:

Send	Return
7E 00 04 08 01 53 48 5B	7E 00 09 88 01 53 48 00 xx xx xx xx RR
Explanation: "xx xx xx xx"Is 4 bytes higher than the MAC address of the module,"RR"Is the check code.	

7.1. 5 SL Command: Read module MAC address 4 bytes lower

In string mode:

Send	Return
ATSL	xxxxxxxx
Explanation: "xxxxxxxx"Is 4 bytes higher than the MAC address of the module	

In API mode:

Send	Return
7E 00 04 08 01 53 4C 57	7E 00 09 88 01 53 4C 00 xx xx xx xx RR
Explanation: "xx xx xx xx"4 bytes lower than the MAC address of the module;"RR"Is the check code.	

7.1. 6 DH Command: Read, Configure Transparent transmission The MAC address of the destination is 4 bytes high

Note: The target MAC address is set to 0x00000000000000000, which is directly on demand to the coordinator. Set to 0x00000000000000FFFF for broadcast transmission.

- Read the transparent transfer destination MAC address 4 bytes high

In string mode:

Send	Return
ATDH	xxxxxxxx
Explanation: "xxxxxxxx"4 bytes higher than the transparent destination MAC address of the module	

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In API mode:

Send	Return
7E 00 04 08 01 44 48 6A	7E 00 09 88 01 44 48 00 xx xx xx xx RR
Explanation: "xx xx xx xx"4 bytes higher than the MAC address of the transparent destination of the module,"RR"Is the check code.	

- Configure the transparent transfer destination MAC address to be 4 bytes higher

In string mode:

Send	Return
ATDHxxxxxxxx	OK
Explanation: "xxxxxxxx"MAC address 4 bytes higher for transparent destination	

In API mode:

Send	Return
7E 00 04 08 01 44 48 xx xx xx xx RR	7E 00 05 88 01 44 48 00 EA
Explanation: "xx xx xx xx"Is 4 bytes higher than the MAC address of the transparent destination,"RR"Is the check code.	

7.1. 7 DL Command: Read, set the MAC address of the transparent destination 4 bytes lower

Note: The target MAC address is set to 0x00000000000000000, which is directly on demand to the coordinator. Set to 0x000000000000000FFFF for broadcast transmission.

- Read the transparent transfer destination MAC address 4 bytes lower

In string mode:

Send	Return
ATDL	xxxxxxxx
Explanation: "xxxxxxxx"MAC address 4 bytes lower for transparent destination	

In API mode:

Send	Return
7E 00 04 08 01 44 4C 66	7E 00 09 88 01 44 4C 00 xx xx xx xx RR
Explanation: "xxxxxxxx"Is 4 bytes lower than the MAC address of the transparent destination,"RR"Is the check code.	

- Set the transparent transfer target MAC address 4 bytes lower

In string mode:

Send	Return
ATDLxxxxxxxx	OK
Explanation: "xxxxxxxx"MAC address 4 bytes lower for transparent destination	

In API mode:

Send	Return
7E 00 04 08 01 44 4C xx xx xx xx RR	7E 00 05 88 01 44 4C 00 E6

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Explanation: "xx xx xx xx"Is 4 bytes lower than the MAC address of the transparent destination,"RR"Is the check code.

7.1. 8 MY Command: Read the current short address of the device

Note: The current short address is equal to 0xFFFE or 0xFFFF, indicating that the node is not networked.

In string mode:

Send	Return
ATMY	FEEA
Description: Current short address =0xFEEA	

In API mode:

Send	Return
7E 00 04 08 01 4D 59 50	7E 00 07 88 01 4D 59 00 FE EA E8
Description: Current short address = 0xFEEA	

7.1. 9 OP Command: Read the current actual extension PANID of the device

String Mode:

Send	Return
ATOP	AEADF13599A8E0A1
Description: Current actual extension PANID=0xAEADF13599A8E0A1	

In API mode:

Send	Return
7E 00 04 08 01 4F 50 57	7E 00 0D 88 01 4F 50 00 AE AD F1 35 99 A8 E0 A1 94
Description: Current actual extension PANID=0xAEADF13599A8E0A1	

7.1. 10 OI Command: Read current PANID

Note: The current PANID equals 0xFFFE or 0xFFFF, indicating that the node is not networked.

In string mode:

Send	Return
ATOI	E4F6
Description: Current PANID=0xE4F6	

In API mode:7E 00 04 08 01 4F 49 5E

Send	Return
7E 00 04 08 01 4F 49 5E	7E 00 07 88 01 4F 49 00 E4 F6 04
Description: Current PANID=0xE4F6	

7.1. 11 CH Command: Read device current channel

Note: Zigbee's 11-channel to 26-channel frequencies are 2405MHz to 2480MHz.

In string mode:

Send	Return
ATCH	12

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Explanation: The current channel is0x12= 18 channels (2440MHz); Operating frequency formula: Operating frequency = 2405 + (current channel-11) * 5, unit MHz.

In API mode:

Send	Return
7E 00 04 08 01 43 48 6B	7E 00 06 88 01 43 48 00 12 D9
Explanation: The current channel is0x12= 18 channels (2440MHz); Operating frequency formula: Operating frequency = 2405 + (current channel-11) * 5, unit MHz.	

7.1. 12 ID command: Read, set device expected extension PANID.

- Read the device currently Expectation Extended PANID

Note: The coordinator sets the Expectation If the PANID is extended, the network is established by using the extended PANID. The router or hibernate terminal is set Expectation Extended PANID can only be added to the Expectation Extend the coordinator of PANID. If you do not set Expectation Extend PANID, and the coordinator establishes random Expectation PANID is extended, and routing and dormant terminals are randomly added with any coordinator.

String Mode:

Send	Return
ATID	0
Explanation: The current extension PANID is0The default is 0.	

In API mode:

Send	Return
7E 00 04 08 01 49 44 69	7E 00 0D 88 01 49 44 00 00, 00, 00, 00, 00, 00 E9
Explanation: The current extension PANID is00, 00, 00, 00, 00, 00	

- Set the desired extension PANID

Note: Expected Extended PANID Range is 8 arbitrary bytes, All 0 or All FF is invalid, Expected Extended PANID function is disabled.

In string mode:

Send	Return
ATID1234567890ABCDEF	OK
Description: Set the expected extension PANID to 0x1234567890ABCDEF	

In API mode:

Send	Return
7E 00 0C 08 01 49 44 12 34 56 78 90 AB CD EF 5E	7E 00 05 88 01 49 44 00 E9
Description:Set the expected extension PANID to 0x1234567890ABCDEF	

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7.1. 13 NR Command: Exit Network

String Mode:

Send	Return
ATNR	OK

In API mode:

Send	Return
7E 00 04 08 01 4E 52 56	7E 00 05 88 01 4E 52 00 D6

7.1. 14 FR Command: Module Reset

In string mode:

Send	Return
ATFR	OK

API Mode:

Send	Return
7E 00 04 08 01 46 52 5E	7E 00 05 88 01 46 52 00 DE

7.1. 15 RE Command: Module Resumed from Factory

In string mode:

Send	Return
ATRE	OK

In API mode:

Send	Return
7E 00 04 08 01 52 45 12	7E 00 05 88 01 52 45 00 DF

7.1. 16 NJ Command: Allow Network Access Time

Note: The value range of allowed access time is 0x00-0xFF, 0 is closed and allowed access time, and the default is 0xFE.

- Read the current allowed network access time of the device

In string mode:

Send	Return
ATNJ	FE
Note: The current default allowable network access time is 0xFE=254 seconds, the allowable network access time ranges from 0x00 to 0xFF, and 0x00 is allowed to close the network access.	

In API mode:

Send	Return
7E 00 04 08 87 4E 4A D8	7E 00 06 88 87 4E 4A 00 FE 5A
Note: The current default allowable network access time is 0xFE=254 seconds, the allowable network access time ranges from 0x00 to 0xFF, and 0x00 is allowed to close the network access.	

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- Set the open allowed network access time

Precautions:

When a node needs to access the network, the coordinator must send Open the allowed access time, otherwise the node cannot access the network. The allowable network access time ranges from 0x00 to 0xFF.

In string mode:

Send	Return
ATNJFE	OK
Description: The time to open the network is0xFESeconds	

In API mode:

Send	Return
7E 00 05 08 01 4E 4A FE 60	7E 00 05 88 01 4E 4A 00 DE
Description: The time to open the network is0xFESeconds	

7.1. 17 AO Command: Print format for receiving transparent data

Note: A0 mode = 0x00, and the transparent transmission data received is adopted "Receive request frame"(API command 0x90) format output, AO mode = 0x01 received transparent data in" receive Zigbee data frame "(API command 0x91) format output

- Read the print format of transparent data currently received by the device

In string mode:

Send	Return
ATAO	0
Description: The current AO mode is0That is to say, the received transparent transmission data is output in the format of "receive request frame"	

In API mode:

Send	Return
7E 00 06 88 01 41 4F 00 00 E6	7E 00 06 88 01 41 4F 00 00 E6
Description: The current AO mode is0,That is to say, the received transparent transmission data is output in the format of "receiving request frame"	

- Setting Transparent Data Print Format

In string mode:

Send	Return
ATAO1	OK
Description: Set AO mode to1That is to say, the received transparent transmission data is output in the format of "received Zigbee data frame"	

In API mode:

Send	Return
7E 00 05 08 01 41 4F 01 65	7E 00 05 88 01 41 4F 00 E6

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Description: Set AO mode to1.That is to say, the received transparent transmission data is output in the format of "received Zigbee data frame"

7.1. 18 SM Command: Set up hibernate terminal

Value range: 0 refers to coordinator or router, and other values refer to dormant terminal. Pin wake-up is currently only open in mode 5 (timed wake-up + pin wake-up), and single pin wake-up (mode 1) or single timed wake-up (mode 4) can be customized.

- Inquire whether the module is a dormant terminal

In string mode:

Send	Return
ATSM	0
Description: Currently in non-dormant node mode	

In API mode:

Send	Return
7E 00 04 08 01 53 4D 56	7E 00 06 88 01 53 4D 00 00 D6
Description: Currently in non-dormant node mode	

- Set the module to sleep terminal mode (only router can set it)

In string mode:

Send	Return
ATSM1	OK
Description: The module is set to sleep terminal, which only supports sleep mode 5 at present.	

In API mode:

Send	Return
7E 00 05 08 01 53 4D 01 55	7E 00 05 88 01 53 4D 00 D6
Description: The module is set to sleep terminal, which only supports sleep mode 5 at present.	

7.1. 19 SP Command: Set hibernation wake-up cycle

Note: The range of sleep wake-up is 0X20-0XAF0, and the unit is 10ms. If Zigbee terminal nodes are required to receive messages from parent nodes, it is recommended that the sleep wake-up period should not exceed 7 seconds for stable operation.

- Query the current wake-up period of the module

In string mode:

Send	Return
ATSP	64
Description:0x64= 100, the current wake-up period is 100 * 10ms = 1000ms	

In API mode:

Send	Return
7E 00 04 08 01 53 50 53	7E 00 07 88 01 53 50 000 00 64 6F
Description:0x64= 100, the current wake-up period is 100*10ms	

- Set the current wake-up period of the module

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In string mode:

Send	Return
ATSP1F4	OK
Description:0x1F4= 500, set the sleep wake-up period to 500*10ms	

In API mode:

Send	Return
7E 00 06 08 01 53 50 01 F4 5E	7E 00 05 88 01 53 50 00 D3
Description:0x1F4= 500, set the sleep wake-up period to 500*10ms	

7.1. 20 PO Command: Set node polling cycle

Note: The value range of polling period is 0X0-0X3E8, and the unit is 100ms. The polling period is the period during which the module polls the parent node when the pin is awake, which can be used interchangeably with the sleep awakening period. It is recommended that the polling period be shorter than the wake-up period (for example, the polling period is 500ms, and the wake-up period is 5s). The module that the pin wakes up is in the "active" state, polling the parent node every 500ms and receiving data. The module with non-wake-up pin is in "standby" state, polling the parent node every 5s and receiving data, and the serial port cannot input any commands at this time.

- Current polling cycle of query module

In string mode:

Send	Return
ATPO	5
Description:0x05The current polling period is 5*100 ms	

In API mode:

Send	Return
7E 00 04 08 B4 50 4F A4	7E 00 07 88 B8 50 4F 00 00 05 1B
Description:0x05= 5, the current wake-up period is 5*100ms	

- Set the current polling period of the module

In string mode:

Send	Return
ATPO5	OK
Description:0x05= 5, set the sleep wake-up period to 5*100ms	

In API mode:

Send	Return
7E 00 05 08 01 50 4F 05 52	7E 00 05 88 01 50 4F 00 D7
Description:0x5= 5, set the sleep wake-up period to 5*100ms	

7.1. 21 BD Command: Serial port baud rate

Serial port baud rate parameter table:

Serial port baud rate parameter table

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Value	Serial port baud rate (bps)
0	1200
1	2400
2	4800
3	9600
4	19200
5	38400
6	57600
7	115200
8	230400
9	460800
A	921600

- Query the current serial port baud rate

In string mode:

Send	Return
ATBD	3
Note: Current baud rate03= 9600bps, please see the serial port baud rate parameter table for details	

In API mode:

Send	Return
7E 00 04 08 01 42 44 70	7E 00 06 88 01 42 44 00 03 ED
Note: Current baud rate03= 9600bps, please see the serial port baud rate parameter table for details	

- Set the current baud rate

In string mode:

Send	Return
ATBD7	OK
Description: Set the baud rate value to7That is, 115200bps, please see the serial port baud rate parameter table for details	

In API mode:

Send	Return
7E 00 05 08 01 42 44 07 69	7E 00 05 88 01 42 44 00 F0
Description: Set the baud rate value to7That is, 115200bps,Please see the serial port baud rate parameter table for details	

7.1. 22 NB Command: Serial Verification Mode

Verification mode parameter value: 0 = no verification

1=odd check

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2 = even check

- Query the current verification mode

In string mode:

Send	Return
ATNB	0
Description: Verification Mode 0 = No Verification	

In API mode:

Send	Return
7E 00 04 08 01 4E 42 66	7E 00 06 88 01 4E 42 00 00 E6
Description: Verification Mode 0 = No Verification	

- Set the current verification mode

In string mode:

Send	Return
ATNB2	OK
Description: Set to even check	

In API mode:

Send	Return
7E 00 05 08 01 4E 42 02 64	7E 00 05 88 01 4E 42 00 E6
Description: Set to even check	

7.1. 23 SB Command: Stop bit

Stop bit value: 0 = 1bit stop bit, 1 = 2bit stop bit

- Query the current stop bit

In string mode:

Send	Return
ATSB	0
Description: Stop bit value 0, 1 bit stop bit	

In API mode:

Send	Return
7E 00 04 08 01 53 42 61	7E 00 06 88 01 53 42 00 00 E1
Description: Stop bit value 0, 1 bit stop bit	

- Set the stop bit

In string mode:

Send	Return
ATSB1	OK
Description: Set to 2bit stop bit	

In API mode:

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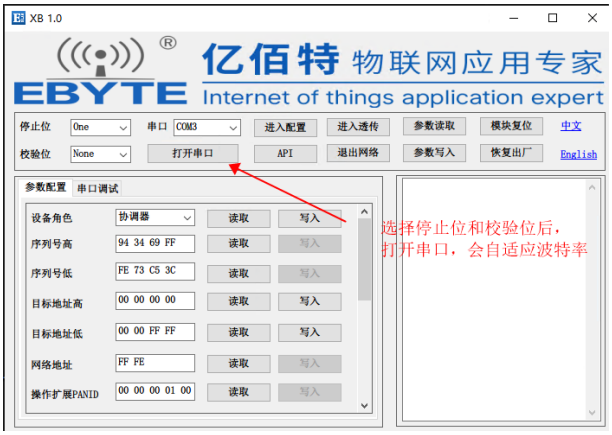
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Send	Return
7E 00 05 08 01 53 42 01 60	7E 00 05 08 01 53 42 01 60
Description: Set to 2bit stop bit	

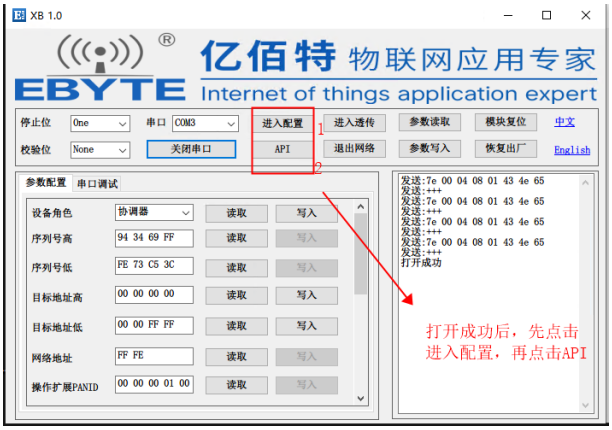
8、Quick Start

8.1 Quick Use

1. Open the upper computer, select the serial port parameters, and then open the serial port.



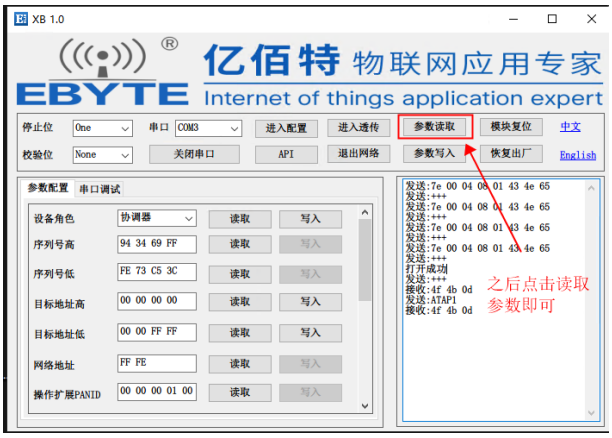
2. After opening the serial port successfully, click to enter the configuration and click API.



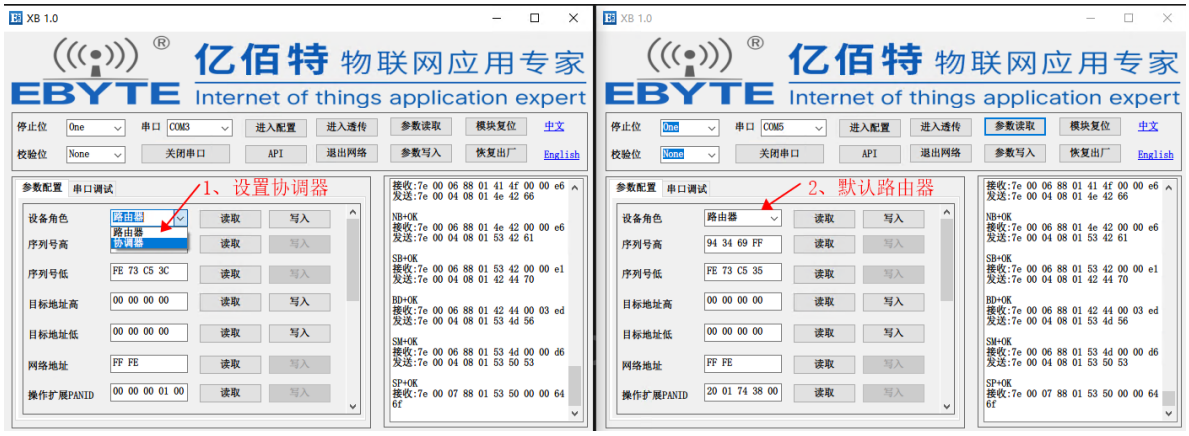
3. Click Parameter Read and wait for the upper computer to obtain module parameters.

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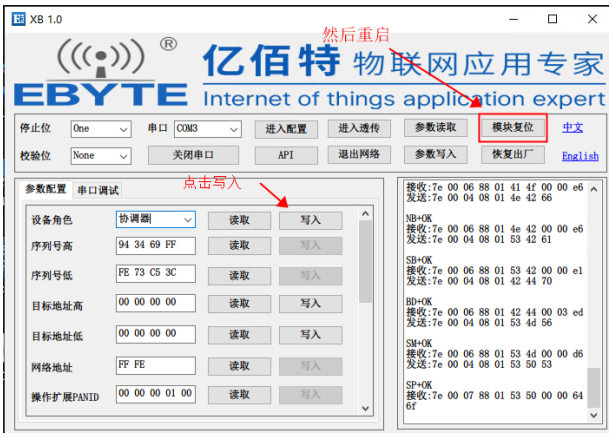
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4. The role of communication module is configured in the device role configuration, that is, the left side is set as coordinator and the right side is set as router.



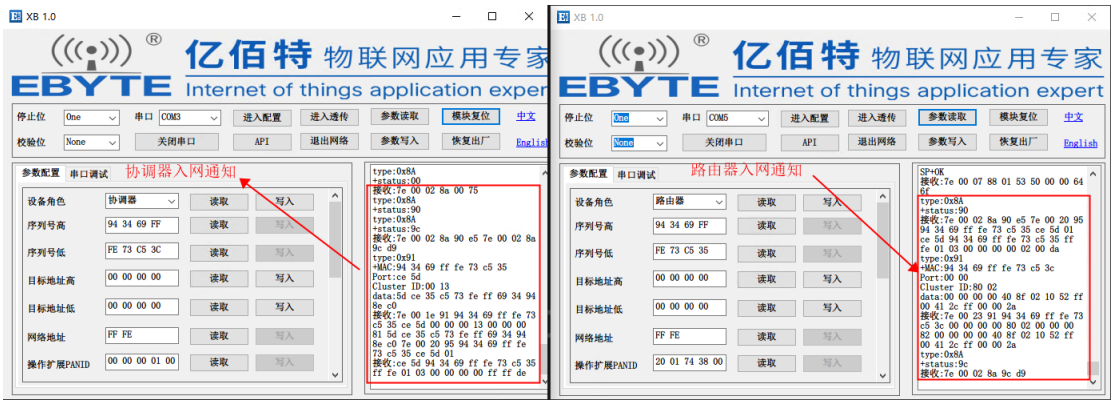
5. Click Write. After the parameters are written successfully, click Module Reset.



6. After reset, wait for the serial port to receive the network access notification, and then access the network successfully.

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7. After setting the high and low parameters of the target address, click Write.



8. Click to enter transparent transmission to enter transparent transmission mode.



9. Click serial debugging, in the serial debugging interface, select the frame type as transparent transmission, then enter hexadecimal data in the sending box, and click send to realize transparent transmission communication.

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8.2 Command Networking and Transparent Transmission

- The following is an example of instruction networking and transparent transmission. In actual use, attention should be paid to the changes of MAC address and parity bit. See the parity algorithm description in Section 6.1 for details of parity bit algorithm.

8.2. 1 Fast networking

1. Determine the module instruction mode

The default baud rate of the module is 9600, and the default mode is API instruction mode.

Send HEX format data to the module: 2B 2B 2B (or character format: "+ + +")

The module returns HEX format data: 4F 4B 0D (or character format "OK\ r") indicating that the module is in transparent (AT command) mode.

If no information is returned, the module may currently be in API instruction mode, sending HEX format data: 7E 00 04 08 01 41 50 65

Received: 7E 00 06 88 01 41 50 00 01 E4 means that the module is in API command mode, and if no information is received, it may be that the baud rate and serial port mode are incorrect.

Try to modify the baud rate, parity check and stop bit of serial port control terminal (upper computer software or serial port control software). The baud rate can be tried one by one from 2400 to 921600. If "+ + +" and "7E 00 04 08 01 41 50 65" are sent without returning, it may be poor contact or damage of the module.

2. Configure the coordinator

If the module is in transparent mode:

First, send the string "+ + +" (HEX: 2B 2B 2B) and start the AT command of the module.

Then send the AT instruction in string format: "ATAP1\ r" (HEX: 41 54 41 50 31 0D), returning the string "OK\ r" (HEX: 4F 4B 0D).

If the module is in API instruction mode:

Send: 7E 00 05 08 01 41 40 01 6D, receive: 7E 00 05 88 01 41 40 01 6D.

3. Configure the network access node

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The other module is set as a routing node. If the module is in transparent mode:

First, send the string "+ + +" (HEX: 2B 2B 2B) and start the AT command of the module.

Then send the AT instruction in string format: "ATAP0\ r" (HEX: 41 54 41 50 30 0D), returning the string "OK\ r" (HEX: 4F 4B 0D).

If the module is in API instruction mode:

Send: 7E 00 05 08 01 43 45 00 6E, Receive: 7E 00 05 08 01 43 45 01 6D.

4. The coordinator opens the network:

First, send the string "+ + +" (HEX: 2B 2B 2B) and start the AT command of the module.

Then send the AT instruction in string format: "ATNJFE\ r" (HEX: 41 54 4E 4A 46 45 0D), returning the string "OK\ r" (HEX: 4F 4B 0D).

If the module is in API instruction mode:

Send: 7E 00 05 08 01 4E 4A FE 60, receive: 7E 00 05 88 01 4E 4A 00 DE.

5. Routing into the network:

First, send the string "+ + +" (HEX: 2B 2B 2B) and start the AT command of the module.

Then send the AT instruction in string format: "ATNR\ r" (HEX: 41 54 4E 52 0D), returning the string "OK\ r" (HEX: 4F 4B 0D).

If the module is in API instruction mode:

Send: 94 34 69 FF FE 73 C5 34, Received: 7E 00 05 88 01 4E 52 00 D6

8.2. 2 Setting up transparent transmission

It is known that the MAC address of the coordinator is 943469FFFE73C534, the MAC of the routing node is 0013A200421A591C, the coordinator is in API instruction mode, and the routing node is in transparent transmission mode.

The transparent content is the string "Hello World"

1. The routing node sets the transparent transmission target as the coordinator

First, send the string "+ + +" (HEX: 2B 2B 2B) and start the AT command of the module.

Send the AT instruction "ATDH943469FF\ r" and return the string "OK\ r", setting the destination MAC address 4 bytes higher.

Send the AT instruction "ATDLFE73C534\ r" and return the string "OK\ r", setting the target MAC address 4 bytes lower.

Then send the AT command "ATCN\ r" back to the transparent transmission mode, or you can send nothing to the serial port and wait for 6 seconds to automatically return to the AT mode.

2. Send "Hello World" to the routing node using the serial port tool

Received by coordinator: 7E 00 17 90 00 13 A2 00 42 1A 59 1C D3 1D 00 48 65 6C 6C 6F 20 57 6F 72 6C 64 DD, of which00 13 A2 00 42 1A 59 1CIt is the MAC address of the sender, and 48 65 6C 6C 6F 20 57 6F 72 6C 64 is the hexadecimal format data of "Hello World".

Note: The actual MAC address is subject to the currently used module.

3. Send "Hello World" to the routing node using the coordinator

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Send by coordinator: 7E 00 1A 10 01 00 13 A2 00 42 1A 59 1CFF FE 00 00 48 65 6C 6C 6F 77 20 57 6F 72 6C 64 D8, received back: 7E 00 07 8B 01 D3 1D 00 00 00 83.

The send frame contains00 13 A2 00 42 1A 59 1CIs the routing node MAC address, 48 65 6C 6C 6F 77 20 57 6F 72 6C 64 is the transmit string HEX, but the ninth byte 00 returned indicates that the transmit is valid.

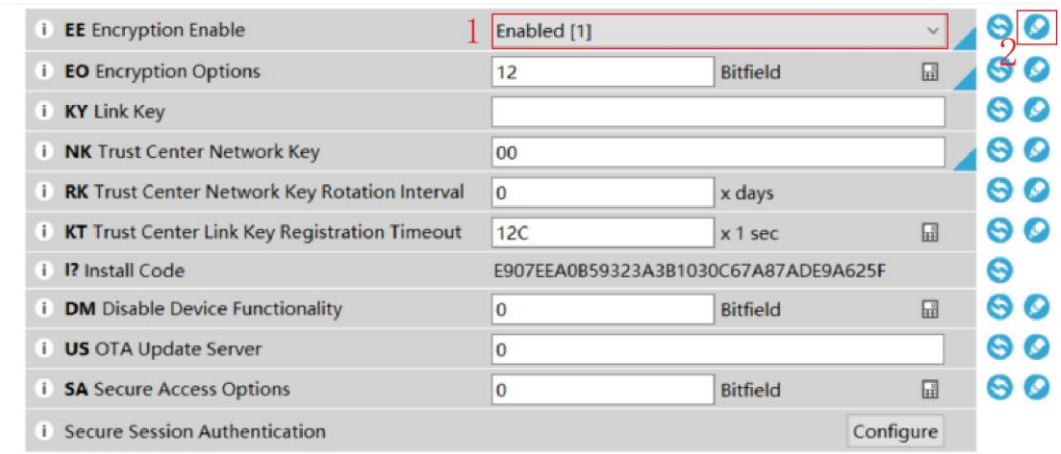
The routing node side receives the string "Hello World"

8.3 XBee3 Module Compatibility Instructions

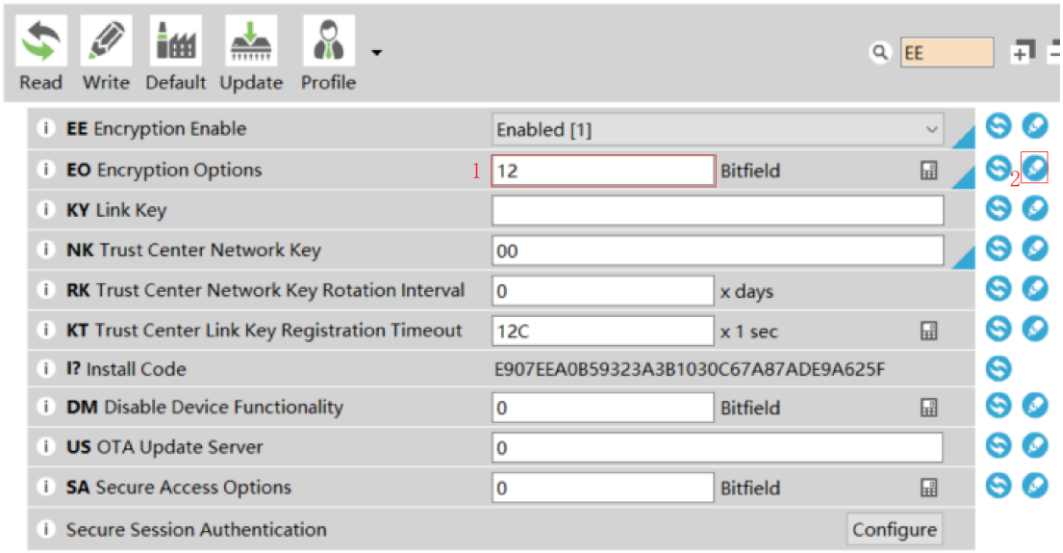
EE and EO parameters of DIGI XBee 3 ZigBee 3.0 module need to be modified before E180-2G4Z20SX is mixed with DIGI XBee 3 ZigBee 3.0 series module. Our company does not recommend customers to mix E180-2G4Z20SX module with DIGI XBee3 ZigBee3.0 series module, and our company does not assume any responsibility for all adverse consequences caused by mixed use.

Configure the DIGI XBee 3 ZigBee 3.0 module:

1. Click the drop-down box, select Enabled [1], and click the write button on the right.



2. Click the input box, enter 12, and click the write button on the right.



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9、Hardware design reference

9.1 Hardware Design Matters needing attention

- It is recommended to use DC regulated power supply to supply power to the module, the ripple coefficient of the power supply is as small as possible, and the module needs reliable grounding;
- Please pay attention to the correct connection of the positive and negative poles of the power supply, such as reverse connection may lead to permanent damage to the module;
- Please check the power supply to ensure that between the recommended supply voltage, if it exceeds the maximum value, the module will be permanently damaged;
- Please check the stability of the power supply, and the voltage cannot fluctuate greatly and frequently;
- When designing the power supply circuit for the module, it is often recommended to keep more than 30% margin, and the whole machine is conducive to long-term stable work;
- Modules should be as far away from power supply, transformer, high-frequency wiring and other parts with large electromagnetic interference;
- High-frequency digital wiring, high-frequency analog wiring and power wiring must avoid the lower part of the module. If it is really necessary to pass through the lower part of the module, assuming that the module is welded on the Top Layer, copper is laid on the Top Layer of the module contact part (all copper is laid and well grounded), and it must be close to the digital part of the module and wiring on the Bottom Layer;;
- Assuming that the module is welded or placed in Top Layer, it is wrong to route randomly in Bottom Layer or other layers, which will affect the spurious and receiving sensitivity of the module to varying degrees;
- It is assumed that there are devices with large electromagnetic interference around the module, which will greatly affect the performance of the module. According to the intensity of interference, it is recommended to stay away from the module appropriately, and if the situation permits, appropriate isolation and shielding can be done;
- Assuming that there are traces with large electromagnetic interference around the module (high frequency digital, high frequency analog and power supply traces), it will greatly affect the performance of the module. According to the intensity of interference, it is recommended to stay away from the module appropriately, and if the situation permits, appropriate isolation and shielding can be done;
- If the communication line uses 5V level, 1k-5.1 k resistors must be connected in series (not recommended, there is still a risk of damage);
- Try to stay away from some TTL protocols whose physical layer is also 2.4 GHz, such as USB3.0;;
- The antenna installation structure has a great influence on the module performance, so it is necessary to ensure that the antenna is exposed, preferably vertically upward. When the module is installed inside the casing, high-quality antenna extension wires can be used to extend the antenna to the outside of the casing;
- The antenna must not be installed in the metal shell, which will greatly weaken the transmission distance.

9.2 Precautions for Antenna Use

The module adopts IPEX antenna mode by default. If the customer needs to connect the antenna through the stamp hole, the capacitance at the antenna should be removed from position 1 and then welded to position 2. As shown in the following figure:

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10、Frequently Asked Questions

10.1 The transmission distance is not ideal

- When there is a linear communication barrier, the communication distance will be attenuated accordingly;
- Temperature, humidity and co-frequency interference will lead to an increase in communication packet loss rate;
- The ground absorbs and reflects radio waves, and the test effect near the ground is poor;
- Seawater has a strong ability to absorb radio waves, so the seaside test effect is poor;
- If there is a metal object near the antenna or placed in a metal shell, the signal attenuation will be very serious;
- The power register is set incorrectly, and the air rate is set too high (the higher the air rate, the closer the distance);
- At room temperature, the low voltage of power supply is lower than the recommended value, and the lower the voltage, the smaller the generator power;
- Poor matching degree between the used antenna and the module or the quality problem of the antenna itself.

10.2 Modules are vulnerable to damage

- Please check the power supply to ensure that between the recommended supply voltage, if it exceeds the maximum value, the module will be permanently damaged;
- Please check the stability of the power supply, and the voltage cannot fluctuate greatly and frequently;
- Please ensure anti-static operation and electrostatic sensitivity of high-frequency devices during installation and use;
- Please ensure that the humidity should not be too high during installation and use, and some components are humidity sensitive devices;
- If there is no special demand, it is not recommended to use it at too high or too low temperature.

10.3 The bit error rate is too high

- There is interference of the same frequency signal nearby, stay away from the interference source or modify the frequency and channel to avoid interference;
- Unsatisfactory power supply may also cause garbled codes, so it is necessary to ensure the reliability of power supply;
- Poor or too long quality of extension lines and feeders will also cause high bit error rate.

11、Welding operation instruction

11.1 Reflow soldering temperature

During reflow soldering, all temperatures refer to the center temperature of the package, which is measured on the upward surface of the package (the lead is placed downward, that is, the live worm is oriented). If the reflow soldering does not measure the temperature of the module in the live insect direction (the lead is placed upward, that is, the dead insect direction), the measured Tp temperature is within 2 ℃ of the measured Tp temperature in the live insect direction, which still meets the requirements of Tc.

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Otherwise, the temperature curve should be adjusted to meet the requirements of Tc. In order to accurately measure the actual peak temperature of the package body, it is recommended to use the method recommended by JEP140 for furnace temperature test.

In order to obtain better welding effect, it is recommended to control the constant temperature at 25 ℃ in the production workshop.

When the welded parts need to reset the temperature curve, they should be re-flowed with the same construction of load-bearing fixture, or have been verified to have equivalent thermal load.

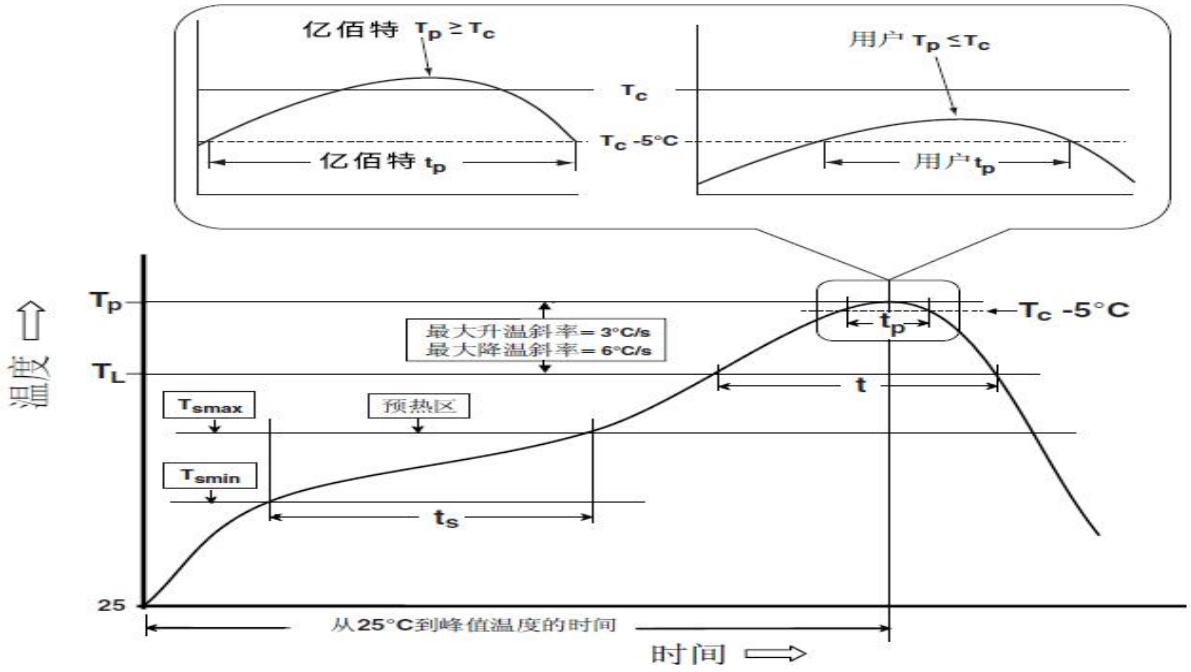
The reflow curves in this document are specific recommendations for soldering only Billion Baxter modules and cannot be used to confirm the user's actual assembly curves. In the actual production process, the user should develop the actual production assembly curve according to the specific production process, needs and circuit board design, and should not exceed the following parameters.

Characteristics of reflow soldering curve	Assembly with lead process	Lead-free process assembly
Preheating/heat preservation Minimum temperature (Tsmin) Maximum temperature (Tsmax) Time (Tsmin ~ Tsmin)	 100℃ 150℃ 60-120 seconds	 150℃ 200℃ 60-120 seconds
Heating slope (TL ~ Tp)	3 ℃/sec, max	3 ℃/sec, max
Liquid phase temperature (TL) Hold time above TL	183℃ 60 ~ 90 seconds	217℃ 60 ~ 90 seconds
Package peak temperature Tp	Users should not exceed the temperature indicated on the "humidity sensitivity" label of the product.	Users should not exceed the temperature indicated on the "humidity sensitivity" label of the product.
The time (Tp) within 5 ℃ of the specified grading temperature (Tc) is shown in Figure 6-3-2	20 seconds	30 seconds
Cooling slope (Tp ~ TL)	6 ℃/sec, max	6 ℃/sec, max
Time from room temperature to peak temperature	6 minutes, longest	8 minutes, longest
The peak temperature (Tp) tolerance of the temperature curve is defined as the upper limit of the user		

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11.2 Reflow soldering graph



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1.0	2023-08-17	First edition	Bin
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