EWM528-2G4NW20SX/27SX User Manual

2.4GHz ISM 100mW/500mW TTL LoRa MESH Wireless Networking Module



Chengdu Ebyte Electronic Technology Co.,Ltd.

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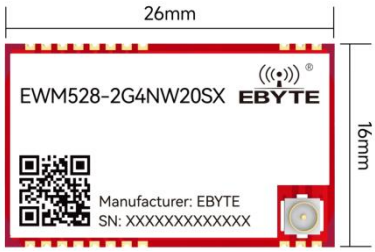
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1 Product Overview

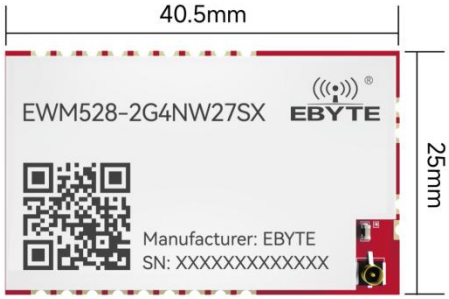
1.1 Product Introduction

EWM528-2G4NW20SX/27SX is a wireless serial port LoRa MESH networking module based on LoRa spread spectrum technology , with a maximum output power of + 27 dBm, a maximum air rate of 253Kbps, and a maximum supported baud rate of 2000000bps. The module operates in a frequency range of 2400 to 2500 MHz (default 2400 MHz).

EWM528-2G4NW20SX/27SX adopts the new LoRa MESH networking technology, which has the features of decentralization, self-routing, network self-healing, multi-level routing, etc. It is suitable for smart home and industrial sensors, wireless alarm security systems, building automation solutions, smart agriculture and other application scenarios.



EWM528-2G4NW20SX



EWM528-2G4NW27SX

1.2 Functional Description

The LoRa MESH network adopts a decentralized structure. The entire network consists of only two types of nodes : terminal nodes and routing nodes. There is no need for a central node or coordinator to participate in network management; users can also use only routing nodes to build a MESH network. Routing nodes are similar to terminal nodes, but terminal nodes do not have routing functions. Terminal nodes are generally deployed at the edge of the network and are generally used to design low-power nodes , but low-power functions are not currently supported . Routing nodes need to continuously receive data from the network for routing updates and data forwarding, so routing nodes cannot be used as low-power nodes.

CSMA avoidance technology is used in the MESH network. The CSMA avoidance mechanism can avoid nodes sending wireless data at the same time as much as possible, reducing the probability of data collision errors. Routing nodes will automatically collect information from surrounding nodes to form a multi-hop communication network; when a link fails or is abnormal, the routing node will re-establish a new path after several consecutive communication failures .

The network supports four communication modes: Unicast, Multicast, Broadcast, and Anycast. Users can choose different communication modes according to different application scenarios. Unicast and Broadcast are the simplest and most basic communication modes. In Unicast, routes and return request responses will be automatically established to determine the data transmission path; in Broadcast mode, all routing nodes will start a data relay after receiving the data. The multicast mechanism is relatively complex and can achieve one-to-many communication. Users need to configure the multicast group address first, which is similar to the public address. Anycast is usually used for data interaction between different networks. Data will not be forwarded in Anycast. In Anycast, two communication methods, Unicast and Broadcast, can be implemented according to different target addresses. Users can transmit any data to any module within the communication range.

During network transmission, data will be encrypted by default using a special algorithm to ensure data privacy and security. In addition, in order to avoid data errors caused by interference from other nodes , multiple checks are performed on the data at the

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network layer to ensure the reliability and accuracy of the transmitted data.

1. 3 Features

- LoRa MESH: It adopts the advanced LoRa modulation method, which has the advantages of long-distance anti-interference and greatly improves the coverage of the entire MESH network ;
- Ultra-large network capacity: The theoretical number of LoRa MESH networks is as high as 65,535, and the recommended network size is around 200.
- Decentralization : The entire network consists of only two types of nodes : terminal nodes and routing nodes. No central node or coordinator is required to participate in network management.
- Automatic routing: When a data request is initiated, each routing node can automatically initiate a connection with surrounding nodes to determine the data transmission path, without the need for a coordinator to participate in path planning;
- Network self-healing: When a link fails, the routing node reestablishes a new path after several failed attempts to communicate;
- Multi-level routing: Routing nodes can automatically transfer data to lower-level routers, and the automatically generated routing table controls the data transmission direction;
- Path optimization: Routing information will be automatically updated and optimized as data is transmitted in the network to ensure the stability of the entire network;
- Avoidance mechanism: The CSMA avoidance mechanism can greatly reduce the possibility of air signal collision;
- Communication mode: Supports four communication modes: Unicast, Multicast, Broadcast and Anycast;
- Frequency range: Works in the 2400~2500 MHz frequency band , supports up to 200 channels ;
- Multiple verifications: ensure the reliability and accuracy of data transmission;
- Encrypted transmission: A special encryption algorithm is used during data transmission to ensure data security and privacy;
- High throughput: The entire network is combined in time and space to achieve high concurrency performance ;
- Remote configuration: supports remote modification of basic communication parameters of the entire network .

1. 4 Network topology

LoRa MESH network supports two types of devices : routing nodes and terminal nodes .

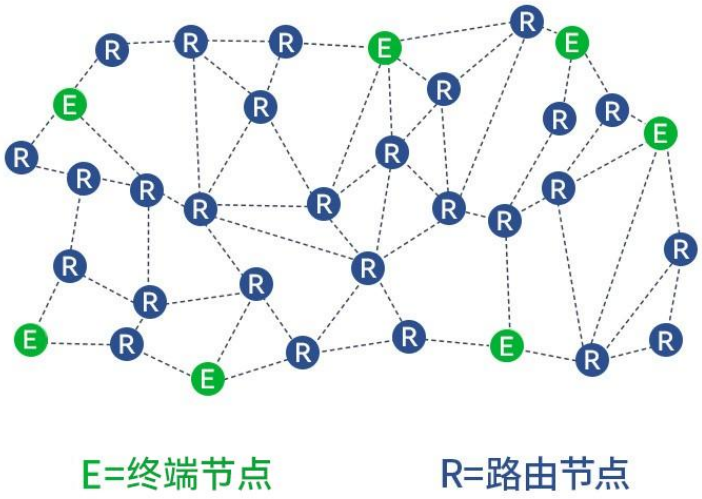
Routing node: Routing nodes receive data in the network to perform routing updates and data forwarding .

Terminal nodes: Terminal nodes do not have routing functions and are generally deployed at the edge of the network.

topology of routing nodes and terminal nodes is shown in the figure :

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1.5 Application scenarios

- Smart home and industrial sensors, etc.
- Wireless alarm security system;
- Building automation solutions ;
- Smart agriculture;
- Smart logistics and warehousing.

2 Specifications

2.1 Limit parameters

Main parameters	Performance		Remark
	Minimum	Maximum	
Supply voltage	0 V	5.5 V	≥ 5 V can guarantee the output power , exceeding 5.5 V may burn the module
Operating temperature	-40 ℃	+ 85 ℃	Industrial-grade design
Operating humidity	10%	90%	-
Storage temperature	-40 ℃	+ 125 ℃	-

2.2 Working parameters

Main parameters	Performance			Remark
	Minimu	Typical	Maximu	

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		m	Value	m	
EWM528-2G4NW20SX Operating voltage (V)		2.1	5.0	5.5	≥ 5 V can guarantee the output power , exceeding 5.5 V may burn the module
EWM528-2G4NW2 7 SX Operating voltage (V)		2.6	5.0	5.5	≥ 5 V can guarantee the output power , exceeding 5.5 V may burn the module
Communication level (V)			3.3		When using 5.0 V TTL, it is recommended to add a level shifter
Operating temperature (°C)		-40	-	+85	Industrial-grade design
Operating frequency band (MHz)		2400	2400	2500	Support ISM band
EWM528-2G4N W20SX Power consumption	Emission current (mA)	-	150	-	DC 5.0V, instantaneous power consumption
	Receive current (mA)	-	twenty two	-	-
EWM528-2G4N W2 7 SX Power consumption	Emission current (mA)	-	34 0	-	DC 5.0V, instantaneous power consumption
	Receive current (mA)	-	26	-	-
EWM528-2G4NW20SX Transmit power (dBm)		-	20	20	User configurable
EWM528-2G4NW2 7 SX Transmit power (dBm)		-	27	27	User configurable
Air rate (bps)		11K	11K	253K	8 air speed levels available

Main parameters	Describe	Remark
EWM528-2G4NW20SX reference distance	2.0km	Clear and open environment, antenna gain 5dBi, antenna height 2.5 meters, airspeed 11Kbps
EWM528-2G4NW2 7 SX reference distance	4.0km	Clear and open environment, antenna gain 5dBi, antenna height 2.5 meters, airspeed 11Kbps
Subcontracting	200 Byte	Maximum capacity of a single package. It is forbidden to exceed the maximum capacity.
Modulation	LoRa	-
Communication interface	UART Serial Port	3.3V TTL level
Packaging	SMD	-
EWM528-2G4NW20SX Dimensions	26*16mm	±0.2mm
EWM528-2G4NW2 7 SX	40.5*25mm	±0.2mm

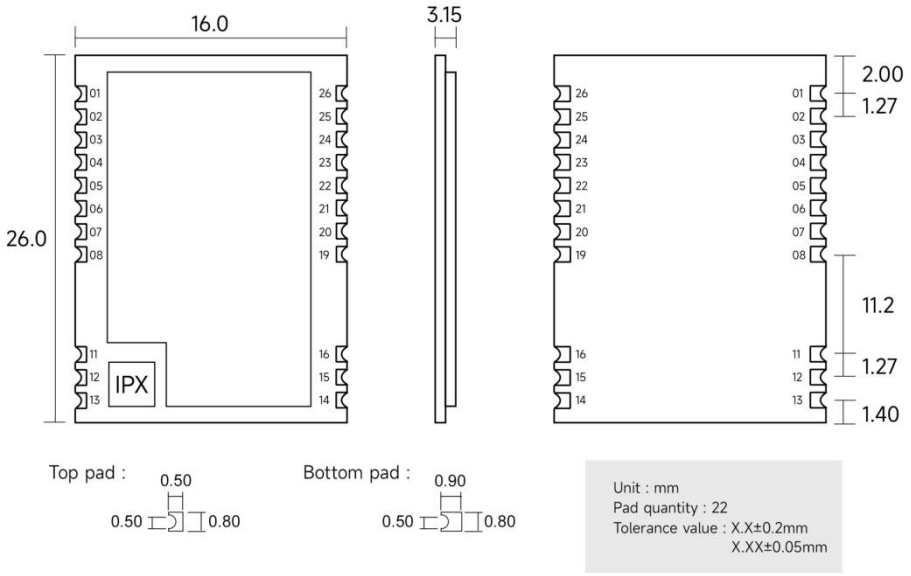
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dimensions		
Antenna interface	IPEX /Stamp Holes	Characteristic impedance about 50 Ω
EWM528-2G4NW20SX Weight	2.1g	±0.1g
EWM528-2G4NW27SX Weight	4.8g	±0.1g

3 Mechanical dimensions and pin definition

EWM528-2G4NW20SX :



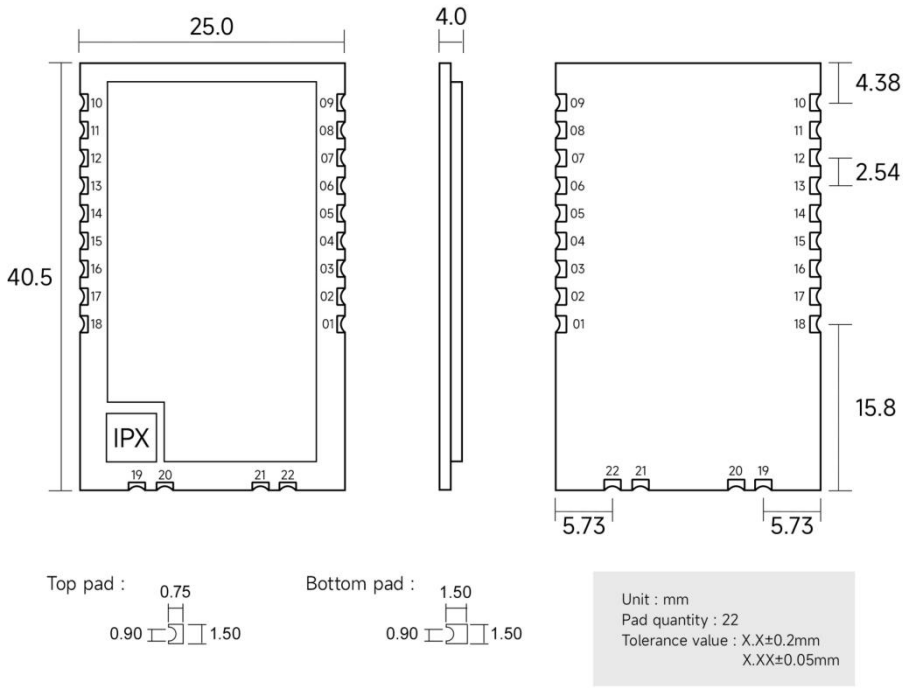
Pin number	Pin Name	Pin Direction	Pin Purpose
1	NRST	Input	Module reset pin, low level reset
2	GND	-	Module ground wire
3	NC	-	Not used yet, NC is recommended
4	NC	-	Not used yet, NC is recommended
5	NC	-	Not used yet, NC is recommended
6	NC	-	Not used yet, NC is recommended
7	NC	-	Not used yet, NC is recommended
8	GND	-	Module ground wire
11	GND	-	Module ground wire
12	ANT	-	antenna
13	GND	-	Module ground wire
14	GND	-	Module ground wire
15	GND	-	Module ground wire
16	GND	-	Module ground wire
19	GND	-	Module ground wire

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20	NC	-	Not used yet, NC is recommended
21	DATA	Output	RF transmission indication pin, high level by default, low level is effective
22	RxD	Input	TTL serial port input, connected to external TXD output pin;
23	TXD	Output	TTL serial port output, connected to external RXD input pin;
24	BOOT	Input	The default high level, power on and pull the level low to enter the Bootloader
25	VCC	-	Module power positive reference, voltage range: 2.3～5.5V DC
26	GND	-	Module ground wire

EWM528-2G4NW27SX :



Pin number	Pin Name	Pin Direction	Pin Purpose
1	GND	-	Module ground wire
2	NC	-	Not used yet, NC is recommended
3	NC	-	Not used yet, NC is recommended
4	NC	-	Not used yet, NC is recommended
5	NC	-	Not used yet, NC is recommended
6	NC	-	Not used yet, NC is recommended
7	NRST	Input	Module reset pin , low level reset
8	GND	-	Module ground wire
9	NC	-	Not used yet, NC is recommended
10	GND	-	Module ground wire
11	VCC	Input/Output	Module power supply, voltage range: 2.3～5.5V DC
12	BOOT	Input	The default is high level, and the power is pulled low to enter the Bootloader
13	TXD	Output	UART_TXD, serial port sending pin
14	RxD	Input	UART_RXD, serial port receiving pin
15	DATA	Output	RF transmission indication pin , high level by default, low level is effective
16	NC	Input/Output	Not used yet, NC is recommended
17	NC	Input/Output	Not used yet, NC is recommended
18	GND	-	Module ground wire

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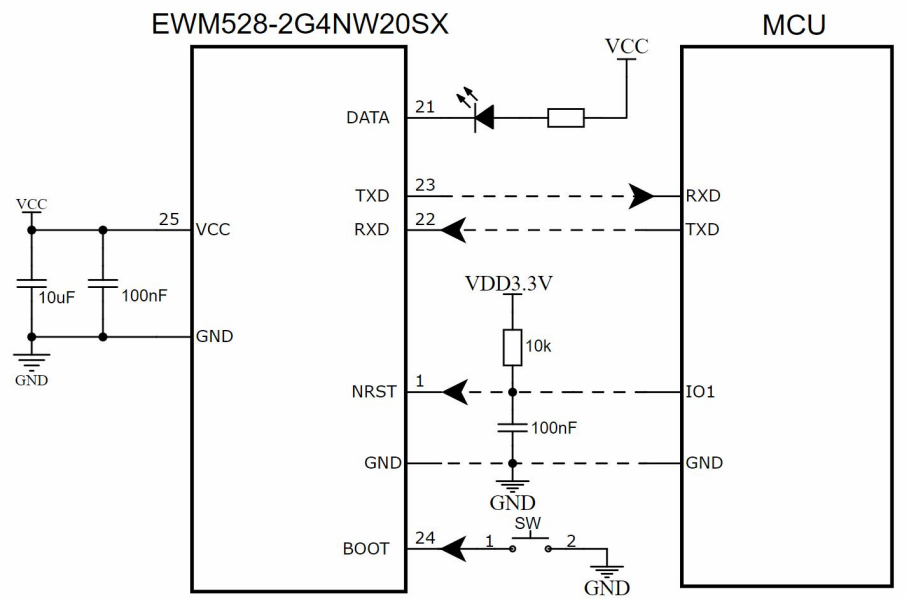
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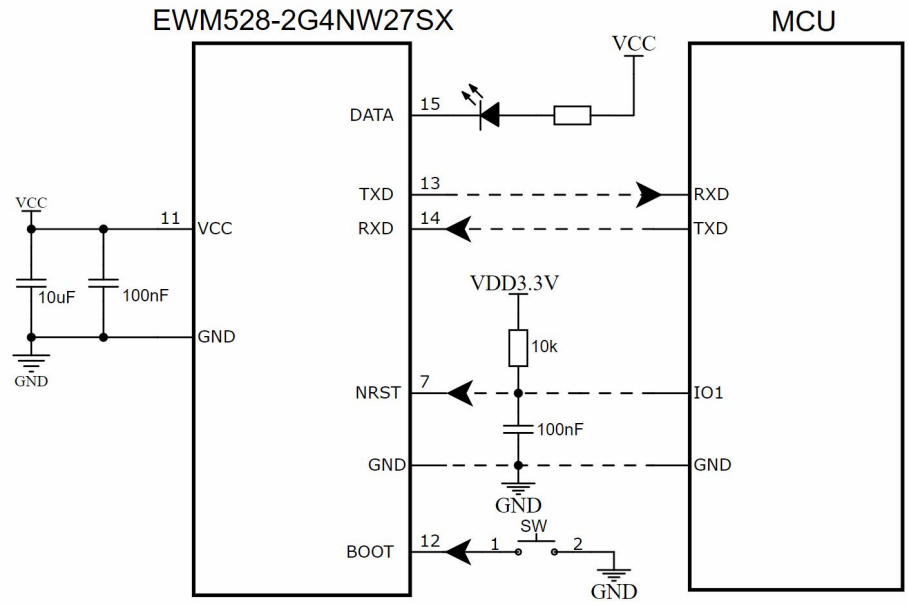
19	ANT	Input/Output	Antenna interface, 50Ω characteristic impedance (connected to the SMA interface of the test kit)
20	GND	-	Module ground wire
21	GND	-	Module ground wire
22	GND	-	Module ground wire

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4 Recommended Connection Diagram





Serial number	Brief connection instructions between the module and the MCU (the above figure takes the STM8L MCU as an example)
1	The wireless serial port module is TTL level, please connect it to 3.3V TTL level MCU.
2	When using a 5V microcontroller, please perform UART level conversion.
3	TVS protection and capacitors need to be added outside the power supply .
4	The RF module is sensitive to pulse static electricity. Do not hot-swap the module.

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5 Command Introduction

5.1 AT command introduction

- AT commands are divided into three categories: command commands, setting commands and query commands;
- By default, AT commands use a baud rate of 115200 bps and do not send new lines;
- Different AT commands require different numbers of parameters to be entered. Different parameters need to be separated by "," and all input parameters are in decimal. You need to read the instruction set carefully for details. If the number of input parameters of an AT command is incorrect, the serial port will return data similar to " AT+DST_ADDR=CMD_ERR " .
- Some AT command parameters are restricted. If the value entered in the AT command is incorrect, the serial port will return data similar to " AT+DST_ADDR=CMD_VALUE_ERR " ;
- If the parameters are set successfully, the serial port will return data similar to " AT+DST_ADDR=OK " ;
- Data not in the AT command set will be considered as transparent data, and the module will initiate a data request, so you should try to avoid sending data starting with "AT+";
- After using the saved command , all parameters in the current module will be saved. Most setting commands will be saved directly to Flash, and only some commonly used setting commands can choose whether to save to Flash according to the parameters.

5.2 Command instruction set

- The command instruction has no suffix, only "AT+RESET" is needed to restart the module .

Command Instructions	Function	describe
AT+IAP	Enter IAP upgrade mode	After returning AT+IAP=OK, the module will restart immediately and enter IAP upgrade mode Keep the power on for about 30 seconds to automatically exit the IAP upgrade mode
AT+RESET	Module restart	After returning AT+RESET=OK, the module will restart immediately
AT+DEFAULT	Restore the module to factory settings	After returning AT+DAFAULT=OK, the parameters will be restored to factory values and then restart immediately

5.3 Query instruction set

- The query command suffix is "=?", for example, the command to query module related information is "AT+INFO=?", the module will return the main parameters of the module.

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Query command	Function	describe
AT+INFO=?	Query module main parameters	Important instructions , return the main parameters of the module (displayed by the serial port assistant)
AT+DEVTYPE=?	Query module model	Returns the device model number such as EWM528-2G4NW20SX
AT+FWCODE=?	Query module firmware code	Return firmware code such as 7517-0-10
AT+POWER=?	Query module transmission power	Returns the RF output power
AT+CHANNEL=?	Query module working channel	Returns the RF operating channel
AT+UART=?	Query module serial port parameters	Returns the serial port baud rate and parity bit
AT+RATE=?	Query module air speed	Returns the air speed of the module
AT+OPTION=?	Query module communication mode	Important instructions , return module communication mode
AT+PANID=?	Query network identification code	Return network identification code
AT+ TYPE =?	Query module node type	Returns the module type (routing node/terminal node)
AT+SRC_ADDR=?	Query the address of the current module	Important instruction , returns the address of the current module
AT+DST_ADDR=?	Query the address of the target module	Important instruction , returns the address of the target module
AT+SRC_PORT=?	Query the port of the current module	Returns the port of the current module
AT+DST_PORT=?	Query the port of the target module	Returns the port of the target module
AT+MEMBER_RAD=?	Query multicast member radius	Returns the propagation radius of the multicast member. The larger the radius, the greater the coverage.
AT+NONMEMBER_RAD=?	Query multicast non-member radius	Returns the multicast non-member propagation radius. The larger the radius, the greater the coverage.
AT+CSMA_RNG=?	Query CSMA random avoidance time	Returns the maximum random avoidance time
AT+ROUTER_SCORE=?	Maximum number of consecutive failures in querying routes	Returns the maximum number of consecutive failures. If this number is exceeded, the routing information will be removed.
AT+HEAD=?	Check whether the extra frame header function is enabled	Returns whether the extra frame header function is enabled

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AT+BACK=?	Check whether the function of sending return information is enabled	Returns whether the send return message function is enabled
AT+SECURITY=?	Check whether the data encryption function is enabled	Returns whether the data encryption function is enabled
AT+RESET_AUX=?	whether LED2 changes during automatic reset	whether LED2 is turned on when the RF is restarted
AT+RESET_TIME=?	Query the automatic reset time	Returns the RF automatic restart time, in minutes
AT+FILTER_TIME=?	Query broadcast filtering timeout	Returns the broadcast filter timeout
AT+ACK_TIME=?	Query request response timeout	Returns the request response timeout
AT+ROUTER_TIME=?	Query routing request timeout	Returns the routing request timeout
AT+GROUP_ADD=?	Query GROUP information	Returns the multicast group address table
AT+GROUP_DEL=?		
AT+GROUP_CLR=?		
AT+ROUTER_CLR=?	Query routing table information	Return routing table information
AT+ROUTER_SAVE=?		
AT+ROUTER_READ=?		
AT+MAC=?	Query the unique MAC address	Returns the unique 32-bit MAC address of the MCU
AT+KEY=?	Querying the encryption key	Unable to read, avoiding key leakage

5.4 Setting the instruction set

- Set the command suffix to "=%d,%d,%d". For example, set the module target address command "AT+DST_ADDR=25640,0". The first parameter is the target address, and the second parameter is whether to save it to Flash. The two need to be separated by ",".
- If there is no <save> parameter in the setting command, the data will be saved in Flash.

Setting Instructions	Function	describe
AT+INFO=0	Query module advanced parameters	for more advanced settings (Serial port assistant displays the usage)
AT+POWER=<power>,<save>	Set the module transmit power	<power>: RF output power (0 ~ 3) <save>: whether to save to Flash

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AT+CHANNEL=<channel>,<save>	Set the module working channel	<channel>: Frequency band: RF working channel (0 ~ 200)
AT+UART=<baud>,<parity>	Set the module serial port parameters	Restart to take effect <baud>: serial port baud rate (1200 ~ 2000000) <parity>: check digit (8N1 8E1 8O1)
AT+RATE= <rate>	Set the module air rate	<rate>：0:11K 1:19K 2:38K 3:63K 4:76K 5:126K 6:152K 7:253K
AT+OPTION=<option>,<save>	Set the module communication mode	Commonly used instructions, generally using broadcast and unicast <option>: Communication method (1 ~ 4) <save>: whether to save to Flash
AT+PANID=<panid>,<save>	Set network ID	Commonly used instructions, it is not recommended to use the default value <panid>: Network identification code (0 ~ 65535) <save>: whether to save to Flash
AT+ TYPE = <type>	Set the node type of the module	<type>: 0: routing node 1: terminal node
AT+SRC_ADDR=<addr>,<save>	Set the address of the current module (guaranteed uniqueness)	Common commands, the default is the last 15 digits of the MAC address <addr>: current address (0 ~ 65535) <save>: whether to save to Flash
AT+DST_ADDR=<addr>,<save>	Set the address of the target module	Common instructions, set the target address <addr>: target address (0 ~ 65535) <save>: whether to save to Flash
AT+SRC_PORT=<port>,<save>	Set the port of the current module	<port> : default current port 1 <save>: whether to save to Flash
AT+DST_PORT=<port>,<save>	Set the port of the current module	<port> : Default destination port 1 <save>: whether to save to Flash
AT+MEMBER_RAD=<rad>,<save>	Set module multicast member radius	For multicast use , it is recommended to keep the default <rad> : Multicast member radius (0 ~ 15) <save>: whether to save to Flash
AT+NONMEMBER_RAD=<rad>,<save>	Set module multicast non-member radius	For multicast use , it is recommended to keep the default value <rad>: Multicast non-member radius (0 ~ 15) <save>: whether to save to Flash
AT+CSMA_RNG=<rng>	Set the CSMA random backoff time	It is recommended to keep the default Random avoidance time range (20 ~ 65535) ms
AT+ROUTER_SCORE=<score>	Set the maximum number of consecutive routing failures	<score>: Maximum number of consecutive routing failures . exceeding the limit , the route needs to be re-established

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AT+HEAD=< enable >	Set the extra frame header function enable switch	<enable>: Whether the additional frame header function is enabled
AT+BACK= < enable >	Set the send return information enable switch	<enable>: Whether to enable sending return information
AT+SECURITY=< enable >	Set the data encryption function to enable or disable	<enable>: Whether the data encryption function is enabled
AT+RESET_AUX=< enable >	Set automatic reset LED2 change switch	<enable>: Automatic reset LED2 change enable
AT+RESET_TIME=<reset_time>	Set the automatic reset time	< reset_time >: automatic reset interval (min)
AT+FILTER_TIME=<time>	Set broadcast filter timeout	It is recommended to keep the default <time>: broadcast filtering timeout (3000 ~ 65535 ms)
AT+ACK_TIME=<time>	Set the request response timeout	It is recommended to keep the default <time>: request response timeout (1 000 ~ 65535 ms)
AT+ROUTER_TIME=<time>	Set the routing request timeout	It is recommended to keep the default <time>: routing request timeout (1 000 ~ 65535 ms)
AT+GROUP_ADD=< group >	Add GROUP information	<group>: Add multicast group address, up to 8 can be added
AT+GROUP_DEL=< group >	Delete GROUP information	<group>: delete multicast group address
AT+GROUP_CLR=<enable>	Delete the GROUP information table	<enable>: 1: Delete the entire GROUP information table
AT+ROUTER_CLR=<enable>	Clear routing table information	<enable>: 1: Delete the entire routing information table
AT+ROUTER_SAVE=<enable>	Flash Operations on Routing Tables	<enable>: 1: Save the routing information table to Flash <enable>: 0: Delete the routing information in Flash
AT+ROUTER_READ=<enable>	Read routing information from Flash	<enable>: 1: Load the routing information table in Flash
AT+KEY=<key>	Setting Data Encryption Keys	If the keys are different, communication is impossible <key>: data encryption key [0~0x7FFF FFFF]

5.5 Parameter value table

Parameter name	Value range	Function	describe

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<table>
<tr><td><save></td><td>[0~1]</td><td>Whether to save the parameters to Flash</td><td>[1: Save, 0: Do not save]</td></tr>
<tr><td><power></td><td>[0~3]</td><td>Set the module transmit power</td><td>The default value of <power> is 0 , and the corresponding RF output power parameters are as follows:
<table>
<tr><th colspan="3">Power correspondence table</th></tr>
<tr><td><power></td><td>EWM528-2G4NW20SX</td><td>EWM528-2G4NW27 SX</td></tr>
<tr><td>0</td><td>20dBm</td><td>27dBm</td></tr>
<tr><td>1</td><td>18dBm</td><td>24dBm</td></tr>
<tr><td>2</td><td>15dBm</td><td>21dBm</td></tr>
<tr><td>3</td><td>12dBm</td><td>18dBm</td></tr>
</table></td></tr>
<tr><td><channel></td><td>[0~200]</td><td>Set the module working channel</td><td>Working channel [0~200], under different airspeed settings, the maximum baud rate supported and the working frequency calculation method are different . For details, see the "Airspeed and Working Frequency Correspondence Table" below .</td></tr>
<tr><td><baud></td><td>See description</td><td>Setting the baud rate</td><td>Restart to take effect , support the following baud rates: 1200,2400,4800,9600,19200,38400, 57600,115200,230400,460800,921600,1000000,2000000 bps</td></tr>
<tr><td><parity></td><td>[0~2]</td><td>Setting the check digit</td><td>Serial port check digit
[0:8N0 1:8E1 2:8O1]</td></tr>
<tr><td><rate></td><td>[0~3]</td><td>Set the air rate</td><td>[0:11K 1:19K 2:38K
3:63K 4:76K 5:126K
6:152K 7:253K]</td></tr>
<tr><td><option></td><td>[1~4]</td><td>Set up communication method</td><td>Communication
[1: Unicast 2: Multicast 3: Broadcast 4: Anycast]</td></tr>
<tr><td><panid></td><td>[0~65534]</td><td>Set network ID</td><td>Network identification code [0x0000~0xFFF E]</td></tr>
<tr><td><type></td><td>[0~1]</td><td>Set the node type of the module</td><td>Set the node type of the module
[0: routing node 1: terminal node]</td></tr>
<tr><td><addr></td><td>[0~65534]</td><td>Set the module address</td><td>Address range [0x0000~0xFFF E]
Routing node: 0x0000~0x7FFF
Terminal node: 0x8000~0xFFF E</td></tr>
<tr><td><group></td><td>[0~65534]</td><td>Set the multicast group address</td><td>Group address range [0x0000~0xFFF E]</td></tr>
<tr><td><port></td><td>[1, 14]</td><td>Port Settings</td><td>Different ports correspond to different functions, and the remaining ports have no functions yet.
Port 1: Output data directly through UART
Port 14: Parse data as AT commands</td></tr>
<tr><td><rad></td><td>[0~15]</td><td>radius in multicast</td><td>Multicast transmission radius [0~15]
The larger the radius, the more propagation levels there</td></tr>
</table>

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			are.
<rng>	[20~65535]	Set the CSMA random backoff time	Random avoidance time [20~65535] ms
<score>	[1~15]	Set the maximum number of consecutive failures . Exceeding this limit will require re-routing requests.	Maximum number of consecutive failures [1~15]
<enable>	[0~1]	Various function switches	[1 : Function Enable 0 : Function disabled]
<reset_time>	[0~255]	Automatically reset RF time	Automatic reset time [1 ~255] min [0: Disable automatic reset]
<time>	See description	Network timeout	Broadcast filter timeout [3 000~65535] ms Request response timeout [1 000~65535] ms Routing request timeout [1 000~65535] ms
<key>	[0~0x7FFF FFFF]	Network encryption key	Encryption key [0~0x7FFF FFFF]

Airspeed and operating frequency correspondence table:

Airspeed (Kbps)	AT+RATE setting value	Maximum Channel	Channel Spacing(KHz)	Calculation method (MHz)
11	0	200	500	FREQ = 2400 + channel * 0.5
19	1	200	500	FREQ = 2400 + channel * 0.5
38	2	200	500	FREQ = 2400 + channel * 0.5
63	3	200	500	FREQ = 2400 + channel * 0.5
76	4	100	1000	FREQ = 2400 + channel * 1
126	5	100	1000	FREQ = 2400 + channel * 1
152	6	50	2000	FREQ = 2400 + channel * 2
253	7	50	2000	FREQ = 2400 + channel * 2

5.6 Parameter considerations

- save option parameter, the setting command will be saved to Flash.
- Baud rate < baud > and Parity After the setting is completed, a restart is required to take effect . You can use "AT+RESET" to reset.
- the address <addr> and network identification code <panid> to 0xFFFF. 0xFFFF is used as the broadcast address and broadcast network.
- The node type <type> will change the highest bit of the local address. Generally, you need to set the node type <type> after setting the local address <addr> .
- Port <port> Generally, the default port is kept as port 1. Only in remote configuration, the target port needs to be changed to port 14. The other ports have no function yet.
- Multicast radius <rad> Generally keep the default level 2. The larger the multicast radius <rad> , the larger the coverage area.

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- CSMA random backoff time <rng> Generally, keep the default value (the default random avoidance time is different at different airspeeds). The longer the random avoidance time, the slower the network response speed, but the lower the possibility of conflict. If you want to modify this time, you need to pay attention to the response time and conflict probability of the entire network . Generally, it is not recommended to shorten this time .
- Maximum number of consecutive failures <score> Generally, the default value is kept as 3 times. The maximum number of consecutive failures <score> will affect the probability of re-establishing the route.

the maximum consecutive failure times <score> , the shorter the time it takes to re-establish the route when the link fails or the communication is abnormal. However, it takes a certain amount of time to re-establish the route, so it is generally acceptable to keep the default value. When the communication is successful, the current failure times will be reset.

- RF automatic reset time < reset_time > Generally, the default setting is 5 minutes . When data is received, the RF automatic reset time will be reset, which will not affect normal data transmission. This time can be shortened in places with severe environmental interference. If it is set to 0 minutes, the automatic restart function will be turned off.
- the broadcast filter timeout <time> is different at different airspeeds . When duplicate data frames are received within the broadcast filter timeout <time> , they will be filtered. It is not recommended to shorten this time .
- the request response timeout <time> are different at different airspeeds.

In unicast mode, the target device needs to return an ACK. If the target address receives an ACK, SUCCESS is returned immediately. Otherwise, NO ACK is returned only after the request response timeout <time> expires.

The more levels of routing devices a request passes through , the longer the request response timeout <time> should be. Under the default parameters, about 5 levels of routing devices can be supported.

- the route request timeout <time> is different at different airspeeds.

In unicast mode, a routing request needs to be initiated first, and the routing information of each device is collected within the routing request timeout period <time>. After the timeout period <time>, a data request is initiated again.

The routing request timeout <time> needs to cover the entire process from the initiation of the routing request to the complete completion of the network. If the route is not successfully established, NO ROUTER will be returned.

The more devices there are, the longer the routing request timeout <time> should be. Under the default parameters, it can support about 50 devices to establish routing. If there are more than 50 devices, this time needs to be extended through instructions.

- When "OUT OF CACHE" is returned, it means that the send buffer is full. The send buffer can cache 5 items. Under normal circumstances, the buffer will not be full. It will only appear when the continuous sending interval is too fast. The module will forcefully clear all the send data cache.
- The network protocol layer uses data RSSI to optimize the entire network link. The routing node will automatically select the best routing node for routing, and users no longer need to worry about signal strength issues.

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6 Basic Function Introduction

6.1 Obtaining the main parameters of the module

- The main parameters of the module can be obtained through the "AT+INFO=?" AT command, which is mainly used for serial port display, as shown in Figure 8.1.1 .
- If it is difficult to parse it using MCU, the correct operation of MCU should be obtained using separate AT commands, as shown in Figure 8.1.2 .



Figure 8.1.1 AT+INFO=? command

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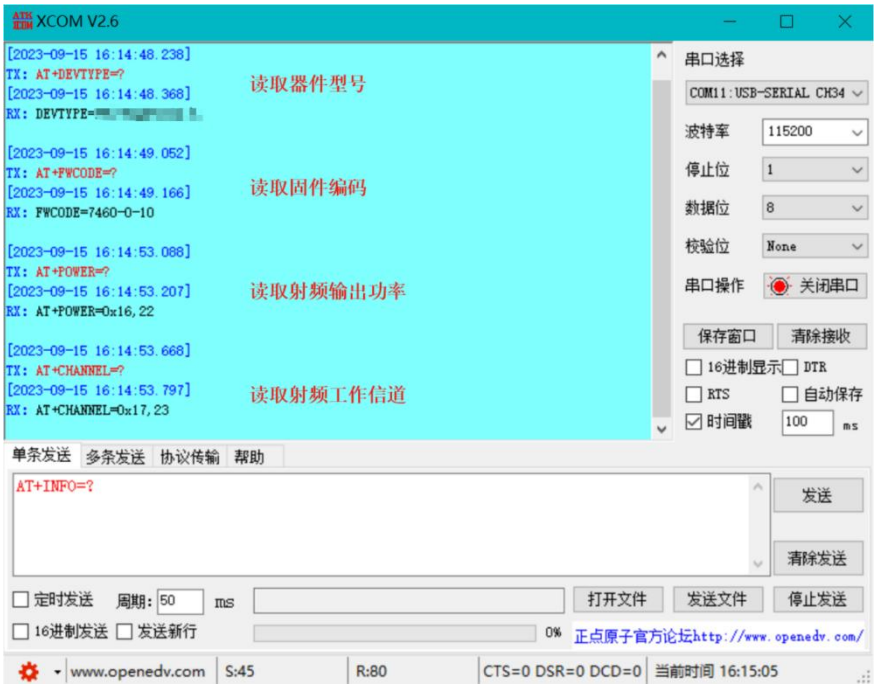


Figure 8.1.2 MCU obtains parameters

6.2 Unicast

- The unicast communication method requires the address of the target module (the address of module B) to be known in advance. For specific steps to obtain basic parameters, please refer to Chapter 8.1.
- The first unicast request needs to wait for the route to be established (the waiting time varies at different airspeeds). After the route is established, the module will automatically send user data again. 1234567890. After the route is established, you do not need to wait for the route to be re- established when you access it again , until the number of consecutive communication failures with a certain node exceeds 3 times .
- The routing table can be queried through the "AT+ROUTER_CLR=?" command .
- The data frame header can be closed using the "AT+HEAD=0" command .
- User data cannot be the module's internal AT commands, otherwise they will be recognized as AT commands by the module, resulting in failure to send user data.
- The basic steps of unicast operation are as follows:

Step 1: Module A uses the "AT+DST_ADDR=2 6034 ,0" command to configure the target address to the address of module B ;

Step 2: Module A uses the "AT+OPTION=1,0" command to change the communication mode to unicast mode;

Step 3: Module A sends user data 1234567890 If the transmission is successful , SUCCESS will be returned ; if the transmission fails , NO ROUTE or NO ACK will be returned . NO ROUTE means that the route establishment failed; NO ACK means that the route establishment was successful but no response was received. If NO ACK appears 3 times, the routing table needs to be re-established.

Step 4: Module B receives the (ASCII code) 1234567890 sent from module A The converted HEX format is 31 32 33 34 35 36 37 38 39 30 (showing different encoding), and an additional data frame header is added .

- The time for initiating the first unicast request is different at different airspeeds. The timeout times corresponding to different airspeeds are as follows:

Airspeed (Kbps)	Time (s)

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11	17
19	10
38	5
63	3
76	3
126	2
152	2
253	1

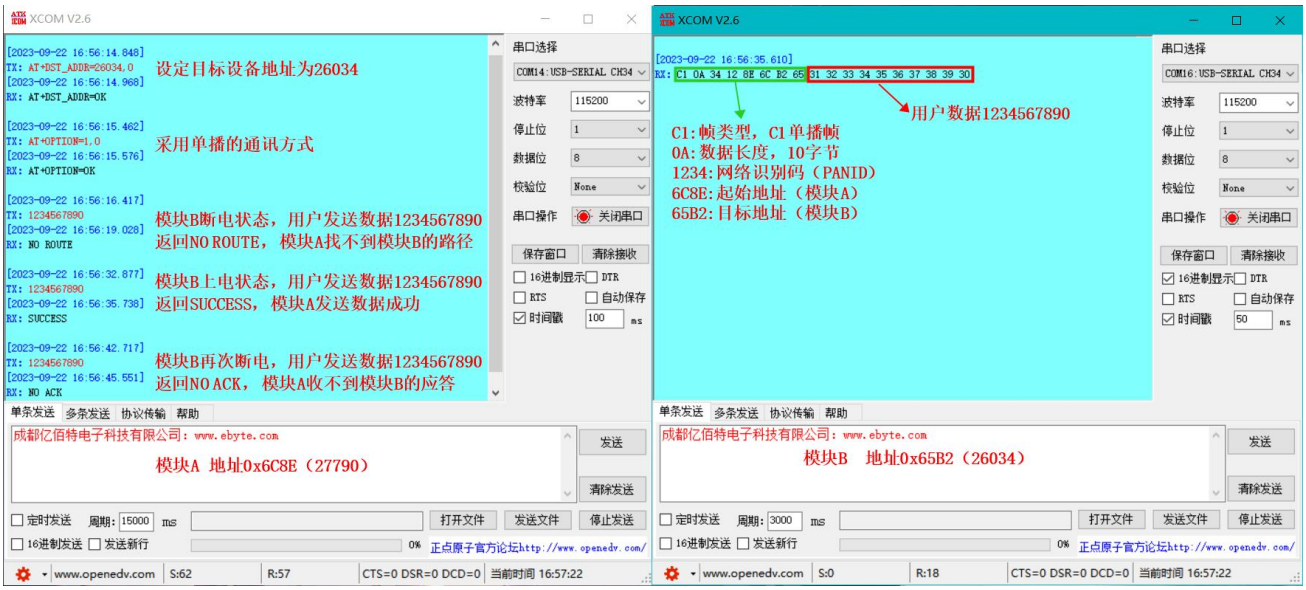


Figure 8.2.1 Unicast communication

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6.3 Multicast

- The multicast communication method requires grouping management of the target modules in advance. All target modules need to be grouped in advance using "AT+GROUP _ADD = <group> " .
- < group > can be understood as a public address. Each module can set up to 8 group addresses.
- In multicast mode, the route needs to be re-established each time , and the recommended interval for launching multicast continuously is about 5 seconds .
- “AT+GROUP_DEL=< group >” can delete the group address with the public address group , and save the new group information to Flash .
- “AT+GROUP_CLR=1” can clear all group addresses and the group information in Flash .
- The routing table can be queried through the "AT+ROUTER_CLR=?" command .
- The data frame header can be closed using the "AT+HEAD=0" command .
- User data cannot be the module's internal AT commands, otherwise they will be recognized as AT commands by the module, resulting in failure to send user data.

- The basic operation steps of multicast are as follows:

Step 1: Use “AT+GROUP _ADD = 123 ” to group module B in advance;

Step 2: Module A uses the "AT+OPTION= 2 , 0" command to change the communication mode to multicast mode (Multicast) ;

3 : Module A uses the "AT+DST_ADDR= 123 ,0" command to change the communication mode to multicast mode and set the target group address;

4 : Module A sends user data 1234567890. If the data is sent successfully , SUCCESS will be returned ; if the data fails to be sent, NO ROUTE or NO ACK will be returned. NO ROUTE means that the route establishment failed; NO ACK means that the route establishment was successful but no response was received. If NO ACK appears 3 times, the routing table needs to be re-established.

Step 5: Module B receives the (ASCII code) 1234567890 sent by module A and converts it into HEX format 31 32 33 34 35 36 37 38 39 30 (displaying different encodings), and adds an additional data frame header .

- The time for initiating the first unicast request is different at different airspeeds. The timeout times corresponding to different airspeeds are as follows:

Airspeed (Kbps)	Time (s)
11	17
19	10
38	5
63	3
76	3
126	2
152	2
253	1

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Figure 7.3.1 Multicast communication

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6.4 Broadcast

- Broadcast communication does not require knowing the address of the target module .
- In the broadcast module, there will be no sending timeout and no need to establish a route, but all receiving modules will forward the data again after receiving it . The module's built-in CSMA avoidance mechanism and broadcast filtering mechanism can effectively prevent data collision and secondary forwarding.
- User data cannot be the module's internal AT commands, otherwise they will be recognized as AT commands by the module, resulting in failure to send user data.

- The basic steps of broadcasting are as follows:

Step 1 : Module A uses the "AT+OPTION= 3 ,0" command to change the communication mode to broadcast mode (Broadcast);

Step 2: Module A sends user data 1234567890. Send successfully It will return SUCCESS , and the user can wait for SUCCESS to determine whether the data has been sent ;

Step 3: Module B receives the (ASCII code) 1234567890 sent by module A and converts it into HEX format 31 32 33 34 35 36 37 38 39 30 (display encoding is different), and adds an additional data frame header .

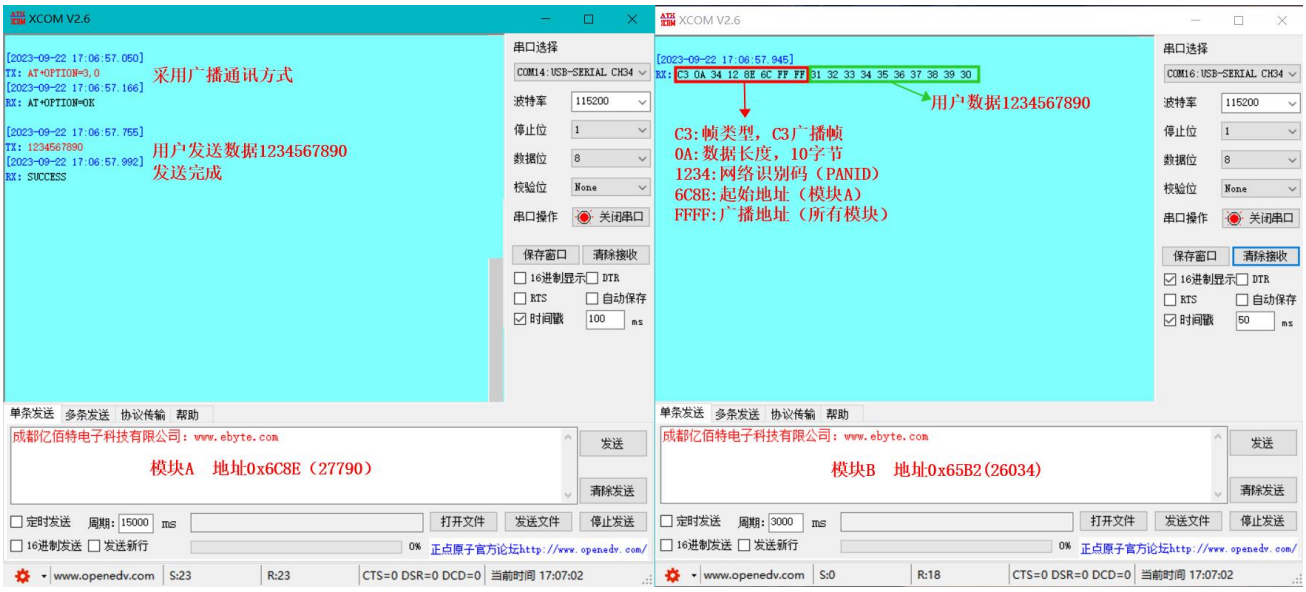


Figure 7.4.1 Broadcast communication

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6.5 Anycast

- Anycast communication is generally used for communication between different networks. Different networks have different network identification codes. Unicast, multicast, and broadcast communication methods cannot directly exchange data between networks . In this case, anycast can be used to exchange data between different networks .
- Anycast communication can send data to a single node or all nodes within the single-hop coverage range according to the set target address.
- In the broadcast mode, data cannot be relayed or responded to.
- Flooding cannot guarantee the reliability of data transmission, which is similar to simple data transparent transmission.
- User data cannot be the module's internal AT commands, otherwise they will be recognized as AT commands by the module, resulting in failure to send user data.

- The basic steps of anycast operation are as follows:

Step 1: Module A uses the "AT+DST_ADDR=2 6034 ,0" command to configure the target address to the address of module B ;

Step 2 : Module A or use the "AT+DST_ADDR= 65535 ,0" command to configure the target address to all modules ;

3 : Module A uses the "AT+OPTION= 4 ,0" command to change the communication mode to Any cast mode ;

4 : Module A sends user data 1234567890. Sent successfully It will return SUCESS , and the user can wait for SUCCESS to determine whether the data has been sent ;

Step 5: Module B receives the (ASCII code) 1234567890 sent by module A and converts it into HEX format 31 32 33 34 35 36 37 38 39 30 (displaying different encodings), and adds an additional data frame header .

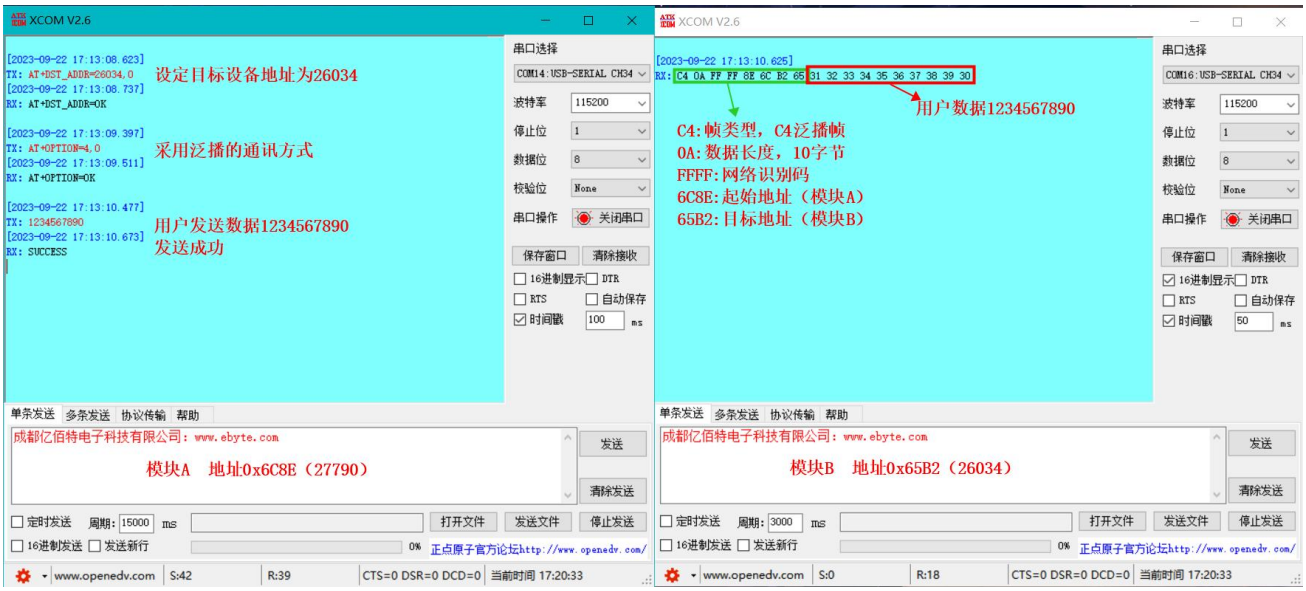


Figure 7.5.1 Flood communication

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6.6 Routing table introduction

- The routing table is automatically created by the routing request, cannot be modified manually, and is stored in RAM. If the module is restarted, it will be lost. The routing table is only for viewing the path, and the user does not need to pay attention to it. There is no need to parse the routing table by AT commands.
- The routing table can be saved to Flash via the "AT+ROUTER_SAVE=1" command , and can be loaded via the "AT+ROUTER_READ=1" command when the power is turned on again.
- If you want to clear the routing information saved in Flash , you can use the "AT+ROUTER_SAVE=0" command to clear it.
- If you only want to clear the routing information in RAM, you can use the "AT+ROUTER_CLR=1" command to clear it.
- The routing table can be read through the three instructions "AT+ROUTER_CLR=?", "AT+ROUTER_SAVE=?", and "AT+ROUTER_READ=?".
- The routing table contains parameters such as target address , subordinate address , score, signal strength , etc.
- HOP in the routing table are different, it means that the module needs to go through the routing node to reach the target module .
- 3 and NO.0 4 in the figure below together form a path to the destination address 59020 :

NO.0 4 tells the module that if it wants to send data to the module of 59020 , the next level should send the data through the routing node of 26017 .

NO.0 3 tells the module that if it wants to send data to the module of 26111 , the next level can directly transmit the data to the routing node of 26111 .



Figure 7.6.1 Routing table

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6.7 Additional frame header information

- When the module receives data from other modules , additional frame header information will be added to the serial port output data .
- Frame header meaning:

Frame Type	Data length	Network ID	Starting address	Target Address	User Data
C1	03	34 12	8E 6C	28 64	01 02 03
C3	01	34 12	AA 71	28 64	AA

  - Frame type: C1 represents unicast frame , C2 represents multicast frame, C3 represents broadcast frame, and C4 represents anycast frame;
  - Data length: user data length, maximum value is 200 bytes;
  - Network identification code: Different networks have different network identification codes. This information can tell which network the source is.
  - Address: specifies the source and destination of the data;
  - User data: User data area, maximum 200 bytes.

- In the data frame header, the low bits of the address and network identification are in the front, such as network identification 34 12, which should actually be 0x1234 , so that it can be parsed using the structure.
- The data frame header can be closed through the "AT+HEAD=0" command.

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7 Remote Configuration

7.1 Introduction to remote configuration

- In addition to basic communication, the module also supports remote configuration. Since remote configuration can change the basic communication parameters of the entire network, it needs to be used with caution to avoid important parameters of some nodes being changed and unable to communicate normally with the previous network.

- Remote configuration can be divided into single-point configuration and broadcast configuration. In both configuration modes, the command will be executed after a certain delay in order to maintain the current parameters and continue to forward data to the next level module to ensure that the data can be transmitted to the entire network range before taking effect.

- In single-point configuration, you also need to establish a route in advance. When the target receiving module receives the correct AT command, it will return "+OK" or "+FAIL" through radio frequency to indicate the module execution result. In broadcast configuration, it is still the same as basic broadcast communication. All modules that receive data will forward data once to ensure that all modules in the entire network can receive this command, but there will be no radio frequency data response in broadcast configuration.

- The default target port for normal basic communication is port 1, and the corresponding function is to output the data sent by the user directly through the serial port and add an additional information frame header. The target port used by remote configuration is port 14, and the corresponding function is to parse the remote configuration instructions sent by the user and execute or respond after a delay. The remote configuration instructions need to be added with "++" to distinguish them from local configurations. After the remote configuration is completed, the target port should be restored to port 1 in time to avoid affecting the next basic communication .

- The delay time is different at different airspeeds. The specific delay time is as follows (a route establishment timeout):

Airspeed (Kbps)	Time (s)
11	11
19	6.6
38	3.4
63	2.5
76	1.7
126	1
152	1
253	0.8

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7.2 Remote single point configuration introduction

- The basic steps of remote single-point configuration are as follows:

Step 1: Module A uses the "AT+DST_ADDR= 26034 , 0" command to configure the target address to the address of module B ;

Step 2: Module A uses the "AT+OPTION=1,0" command to change the communication mode to unicast mode (Unicast);

Step 3: Module A uses the "AT+DST_PORT=14,0" command to change the target port to the remote parsing AT command function;

4 : Module A sends the AT command "++AT+PANID=4660,0". If the command is sent successfully , it will return SUCCESS;

Step 5: After receiving the command, module B will wait for a timeout period before outputting the execution result of the corresponding command through the serial port, and respond with "+OK:" or "+FAIL:" through the radio frequency. It will also send the current module parameters through the radio frequency, and return SUCCESS if the transmission is successful .

Step 6: Module A receives the module information from module B and outputs it through the serial port.



Figure 8.2.1 Remote single point configuration steps

7.3 Remote broadcast configuration introduction

- The basic steps for remote broadcast configuration are as follows:

Step 1 : Module A uses the "AT+OPTION= 3 ,0" command to change the communication mode to broadcast mode (Broadcast);

Step 2: Module A uses the "AT+DST_PORT=14,0" command to change the target port to the remote parsing AT command function;

3 : Module A sends the AT command "++AT+PANID=4660,0" . If the command is sent successfully , it will return SUCCESS;

Step 4: After receiving the command, module B will wait for a routing establishment timeout period and then output the execution result of the corresponding command through the serial port.

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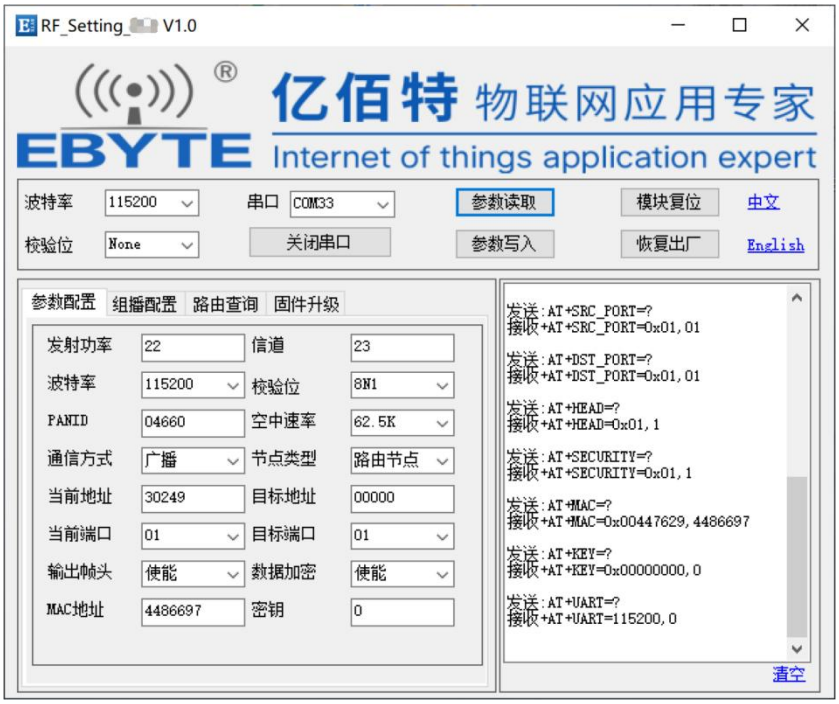
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Figure 8.3.1 Remote broadcast configuration steps

8 Introduction to Host Computer

- Users can use the host computer provided by the official website to configure the module . When using it, the user needs to virtualize the module serial port into a COM port. The host computer interface is shown below . The top is the basic function button. Set the COM port, baud rate, and check bit. You can read and write parameters, restore defaults, and restart the module. The left side below is the parameter area, and the right side below is the log area. The corresponding AT commands executed will be printed and displayed. Users can operate the module according to the log.

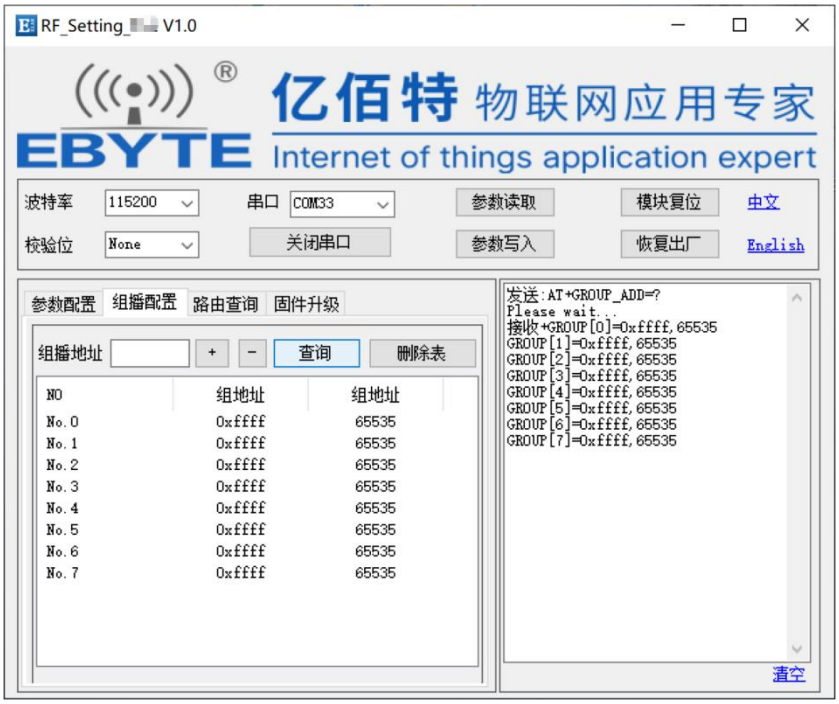


- The second page is for multicast related group address settings. Users can add, delete and query multicast group

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addresses. Multicast group addresses support up to 8 different addresses.



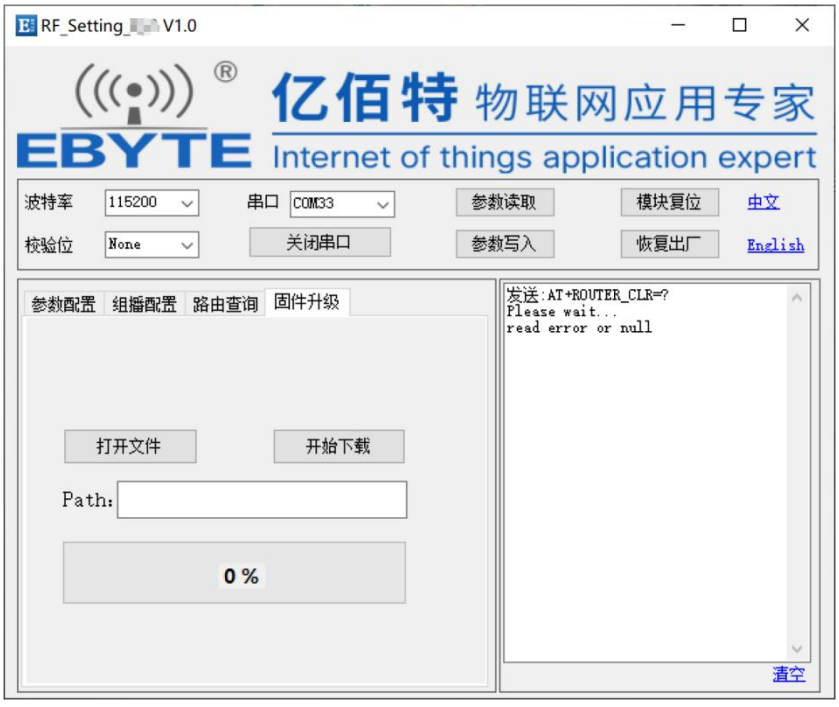
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- The third page is for routing table related functions. Users can read and clear the routing table, and can also perform Flash related read and write operations. Due to the large amount of data, it takes about 4 seconds to read the routing table. If there is no routing table information, the error "read error or null" will be returned.
- The routing table will continuously update the path according to the data transmitted in the network to optimize network transmission efficiency.
- It is not recommended to read the routing table at low baud rates such as 1200, 2400, 4800, as it will take a long time.



- The fourth page is the online upgrade (IAP) function, users can upgrade the firmware, generally no upgrade is required . If you accidentally enter the IAP upgrade mode, keep the power on for about 30 seconds, the module will automatically exit the IAP upgrade, even if it is restarted, it will not exit the IAP upgrade mode.



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9 Hardware Design

- It is recommended to use a DC regulated power supply to power the module. The power supply ripple coefficient should be as small as possible and the module should be reliably grounded.
- Please pay attention to the correct connection of the positive and negative poles of the power supply. Reverse connection may cause permanent damage to the module.
- Please check the power supply to ensure that it is within the recommended power supply voltage. If it exceeds the maximum value, the module will be permanently damaged.
- Please check the stability of the power supply. The voltage should not fluctuate greatly or frequently.
- When designing the power supply circuit for the module, it is often recommended to retain more than 30% margin, which is conducive to long-term stable operation of the whole machine;
- The module should be kept as far away as possible from power supplies, transformers, high-frequency wiring and other parts with large electromagnetic interference;
- High-frequency digital routing, high-frequency analog routing, and power routing must avoid the bottom of the module. If it is necessary to pass under the module, assuming that the module is soldered on the Top Layer, ground 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 routed on the Bottom Layer;
- Assuming the module is soldered or placed on the Top Layer, it is also wrong to randomly route the wires on the Bottom Layer or other layers, which will affect the module's spurious signal and receiving sensitivity to varying degrees;
- If there are devices with large electromagnetic interference around the module, it will also greatly affect the performance of the module. It is recommended to keep them away from the module according to the intensity of the interference. If possible, appropriate isolation and shielding can be performed.
- If there are traces with large electromagnetic interference around the module (high-frequency digital, high-frequency analog, power traces), it will also greatly affect the performance of the module. It is recommended to keep them away from the module according to the intensity of the interference. If possible, appropriate isolation and shielding can be performed.
- If the communication line uses 5V level, a 1k-5.1k resistor 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 2.4GHz, such as USB3.0;
- The antenna installation structure has a great impact on the module performance. Make sure the antenna is exposed and preferably vertically upward;
- When the module is installed inside the case, you can use a high-quality antenna extension cable to extend the antenna to the outside of the case;
- The antenna must not be installed inside a metal shell, as this will greatly reduce the transmission distance.

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10 FAQ

10.1 The transmission distance is not ideal

- When there is a straight-line communication obstacle, the communication distance will be attenuated accordingly;
- Temperature, humidity, and co-channel interference can increase the communication packet loss rate;
- The ground absorbs and reflects radio waves, so the test results are poor when close to the ground;
- Seawater has a strong ability to absorb radio waves, so the test effect at the seaside is poor;
- If there are metal objects near the antenna, or the antenna is placed in a metal shell, the signal attenuation will be very serious;
- The power register is set incorrectly, or the air rate is set too high (the higher the air rate, the closer the distance);
- The power supply voltage is lower than the recommended value at room temperature. The lower the voltage, the lower the transmission power.
- The antenna used does not match the module well or the antenna itself has quality issues.

10.2 Modules are vulnerable to damage

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

10.3 Bit Error Rate Too High

- There is interference from the same frequency signal nearby. Stay away from the interference source or change the frequency or channel to avoid interference.
- An unsatisfactory power supply may also cause garbled characters, so the reliability of the power supply must be ensured;
- Extension cables or feeder cables that are of poor quality or are too long can also cause a high bit error rate.

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11 Welding Operation Instructions

11.1 Reflow Temperature

During reflow soldering, all temperatures refer to the center temperature of the package, measured on the upward package surface (leads facing down, i.e. live worm direction). If the reflow soldering does not use the live worm direction (leads facing up, i.e. dead worm direction) to measure the module temperature, the measured Tp temperature is within ±2°C of the Tp temperature measured in the live worm direction, and still meets the Tc requirement. Otherwise, the temperature curve should be adjusted to meet the Tc requirement. In order to accurately measure the actual peak temperature of the package body, it is recommended to use the method recommended by JEP140 to perform furnace temperature testing.

In order to obtain better welding results, the production workshop recommends controlling the temperature at 25°C. When the temperature curve of the welded parts needs to be reset, the same structure of the load fixture should be used for reflow soldering, or it should be verified to have an equivalent heat load.

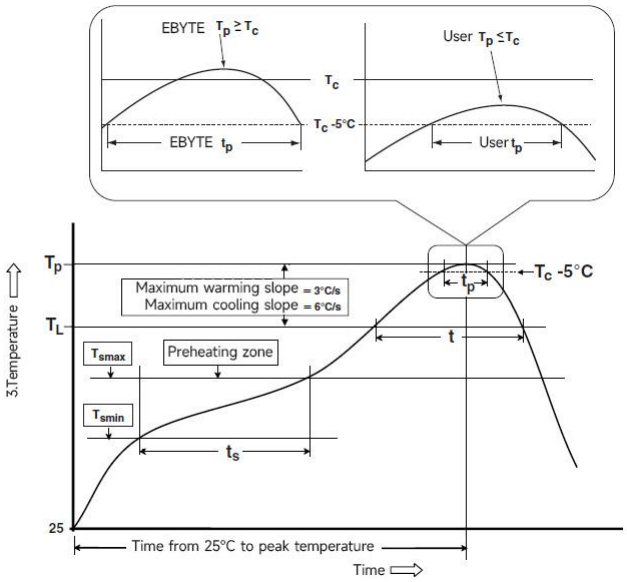
The reflow soldering curves in this document are some suggestions specifically for soldering Ebyte modules and cannot be used to confirm the user's actual assembly curve. The user's actual production process should be based on the specific production process, needs and circuit board design to develop the actual production assembly curve, and should not exceed the following table:

Reflow profile characteristics		Leaded process assembly	Lead-free assembly
Preheating/keeping	Minimum temperature (Tsmin)	100℃	150℃
	Maximum temperature (Tsmax)	150℃	200℃
	Time (Tsmin~Tsmin)	60-120 seconds	60-120 seconds
Heating slope (TL~Tp)		3℃/sec, max.	3℃/sec, max.
Liquidus temperature (TL)		183℃	217℃
Keep time above TL		60~ 90 seconds	60~ 90 seconds
Package peak temperature Tp		Users must not exceed the temperature stated on the product's "Moisture Sensitivity" label.	Users must not exceed the temperature stated on the product's "Moisture Sensitivity" label.
The time (Tp) within 5°C of the specified classification temperature (Tc) is shown in the figure below.		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 Oven Curve



Revision History

Version	Revision Date	Revision Notes	Maintained by
1.0	2025-03-11	Initial version	Bin

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