EWD95M-xxxNW22(xxx) User Manual

400/900MHz 22dBm

RS485/RS232 LoRa MESH Wireless Networking DTU



成都亿佰特电子科技有限公司
Chengdu Ebyte Electronic Technology Co.,Ltd.

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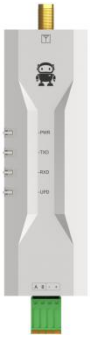
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1 Product Overview

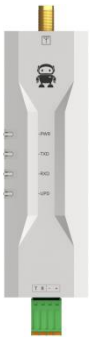
1.1 Product Introduction

EWD95M-xxxNW22(xxx) is a wireless serial port LoRa MESH networking module based on LoRa spread spectrum technology , with a maximum output power of 22dBm, the highest air rate can reach 62.5K, and the maximum supported baud rate is 460800bps. The operating frequency range of EWD95M-400NW22 (xxx) module is 410.125 ~ 509.125 MHz (default 433.125 MHz) , and EWD95M- 900 NW22 (xxx) module operating frequency range 850.125 ~ 929.125 MHz (default 868.125 MHz) .

EWD95M-xxxNW22(xxx) adopts the new LoRa MESH networking technology, with 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.



EWD95M-xxxNW22(485)



EWD95M-xxxNW22(232)

1.2 Functional Description

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

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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 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;
- EWD95M-400NW22(xxx) Frequency range: operates in the 410.125 ~ 509.125 MHz frequency band , supports 100 channels, and the channel spacing is 1 MHz;
- EWD95M-900NW22(xxx)Frequency range: operates in the 850.125 ~ 929.125 MHz frequency band , supports 80 channels and the channel spacing is 1 MHz;
- 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 .
- Compatible with our company's E52 series modules;
- Adopt flame-retardant plastic shell and guide rail installation structure, which is convenient and efficient to install;
- Multiple protection functions such as power reverse connection protection and antenna surge protection greatly increase the reliability of the radio;
- The communication port and power interface adopt isolation and high protection;
- Working temperature range: -40℃～+85℃, adaptable to various harsh working environments, a true industrial-grade product;

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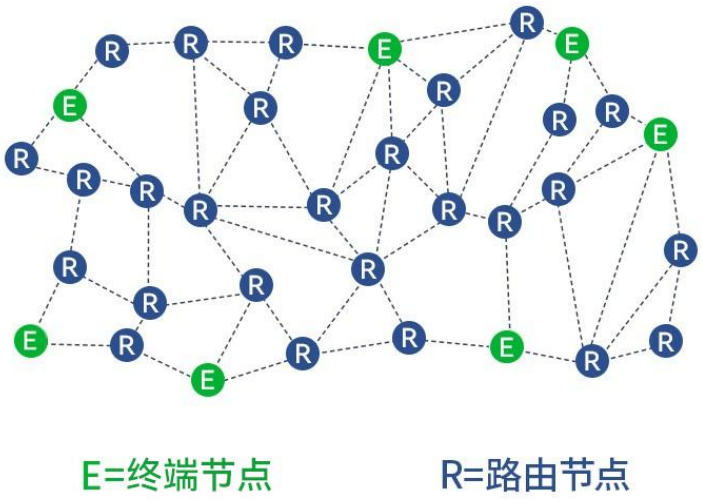
1. 4 Network topology

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

Routing node: Routing nodes receive data from 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 :



1.5 Application scenarios

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

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2 Specifications

2.1 Limit parameters

Main parameters	performance		Remark
	Minimum	Maximum	
Supply voltage	0V	28V	Exceeding 28V 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
		Minimum	Typical Value	Maximum	
Operating voltage (V)		5	12	28	Exceeding 28 V may burn the module
Operating temperature (°C)		-40	-	+85	Industrial-grade design
Operating frequency band (MHz)		410.125	433.125	509.125	EWD95M-400NW22(xxx) operating frequency band , supports ISM band
		850.125	868.125	929.125	EWD95M-900NW22(xxx) operating frequency band , supports ISM band
EWD95M-400NW22(xxx) power consumption	TX current (mA)	-	57	-	DC 12V power supply, instantaneous power consumption
	TX current (mA)	-	8.2	-	-
EWD95M-900NW22(xxx) power consumption	TX current (mA)	-	69	-	DC 12V power supply, instantaneous power consumption
	RX current (mA)	-	7.3	-	-
Transmit power (dBm)		-9	22	22	User configurable
Air rate (bps)		7K	62.5K	62.5K	Three air speed options (62.5K, 21.875K, 7K)
Receiving sensitivity (dBm)		-121	-116	-111	The sensitivity corresponding to the three air speeds

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Main parameters	Describe	Remark
Reference distance	2.5 Km	Clear and open environment, antenna gain 3.5dBi, antenna is put in a height of 2.5 meters, air rate 7Kbps
	2.0 Km	Clear and open environment, antenna gain 3.5dBi, antenna is put in a height of 2.5 meters, air rate 21.875Kbps
	1.6 Km	Clear and open environment, antenna gain 3.5dBi, antenna is put in a height of 2.5 meters, air rate 62.5Kbps
Subcontracting	200 Btye	Maximum capacity of a single package. It is forbidden to exceed the maximum capacity.
Modulation	LoRa	-
EWD95M-xxxNW22(485) communication interface	RS485	-
EWD95M-xxxNW22(232) communication interface	RS232	-
Hardware Interface	Spring-loaded terminal blocks	4Pin 3.81mm
Dimensions	102*28*28.5mm	±0.2mm
Antenna interface	SMA-K	External thread inner hole, characteristic impedance about 50 Ω
Weight	32g	±2g

2.3 Current parameters

Model	TX current			Waiting current		
	5V	12V	24V	5V	12V	24V
EWD95M-400NW22(xxx)	122 mA	57 mA	34 mA	12.8 mA	8.2 mA	4.1 mA
EWD95M-900NW22(xxx)	140 mA	69 mA	36 mA	12 mA	7.3 mA	3.8 mA

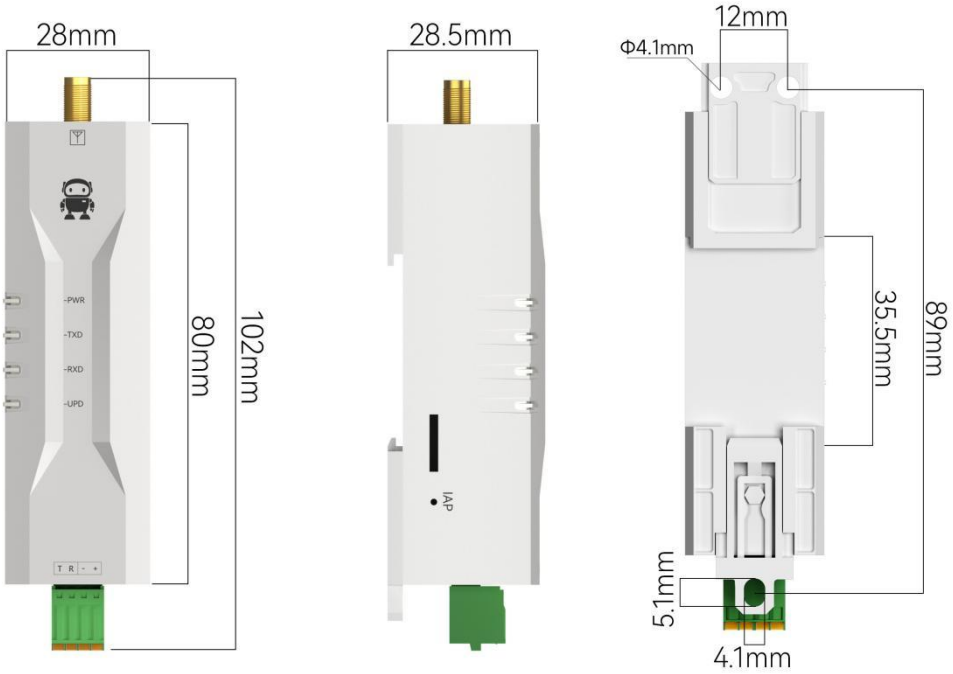
Note: It is recommended to retain more than 50% current margin when selecting the power supply, which is conducive to the long-term and stable operation of the radio.

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3 Mechanical dimensions and pin definition

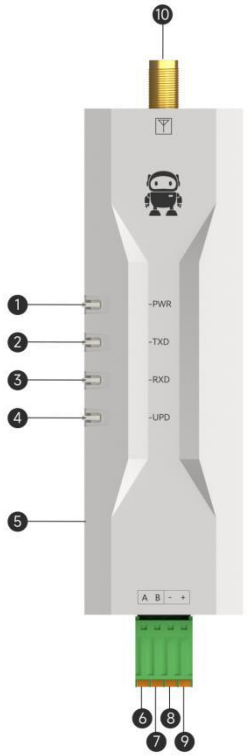
Size:



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EWD95M-xxxNW22(485) pin definition:

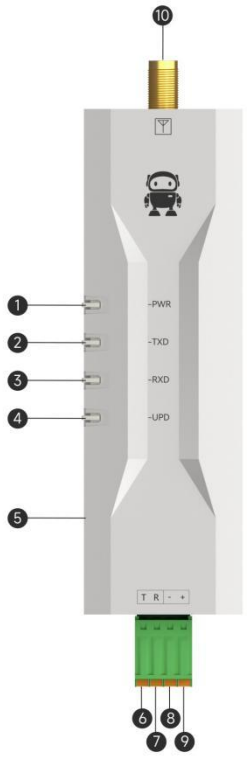


Serial number	Name	Function	Remark
1	PWR	Power indicator	Blue, always on after power on
2	TXD	RF transmit indicator	Red, RF data sending indicator
3	RXD	RF receiving indicator	Yellow, RF data receiving indicator
4	UPD	Upgrade status indicator	Green, upgrade status indicator, always on after entering upgrade mode , and off after upgrade is completed
5	IAP	Upgrade mode button	When the power is on, press the button, the UPD light will turn on, and you can use the host computer to upgrade. After the upgrade is completed, it will automatically exit the upgrade mode
6	A	RS485_A	RS485 Signal A
7	B	RS485_B	RS485 signal B
8	-	GND	Negative pole of power supply
9	+	VCC	Power positive pole, supports DC 5~28V power supply
10	ANT	RF Interface	SMA-K, external threaded inner hole.

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EWD95M-xxxNW22(232) pin definition:



Serial number	Name	Function	Remark
1	PWR	Power indicator	Blue, always on after power on
2	TXD	RF transmit indicator	Red, RF data sending indicator
3	RXD	RF receiving indicator	Yellow, RF data receiving indicator
4	UPD	Upgrade status indicator	Green, upgrade status indicator, always on after entering upgrade mode , and off after upgrade is completed
5	IAP	Upgrade mode button	When the power is on, press the button, the UPD light will turn on, and you can use the host computer to upgrade. After the upgrade is completed, it will automatically exit the upgrade mode
6	T	TXD	RS232 Output
7	R	RxD	RS232 Input
8	-	GND	Negative pole of power supply
9	+	VCC	Power positive pole, supports DC 5~28V power supply
10	ANT	RF Interface	SMA-K, external threaded inner hole.

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4 Wiring Diagram



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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 command , return the main parameters of the module (displayed by the serial port assistant)
AT+DEVTYPE=?	Query module model	Return the device model number such as E 52 -400NW22S
AT+FWCODE=?	Query module firmware code	Return firmware code such as 7 460 -0-10
AT+POWER=?	Query module transmission power	Return the RF output power
AT+CHANNEL=?	Query module working channel	Return the RF operating channel
AT+UART=?	Query module serial port parameters	Return the serial port baud rate and parity bit
AT+RATE=?	Query module air speed	Return module air rate [0:62.5K 1:21.825K 2:7K]
AT+OPTION=?	Query module communication mode	Important command , return module communication mode
AT+PANID=?	Query network identification code	Return network identification code
AT+ TYPE =?	Query module node type	Return the module type (routing node/terminal node)
AT+SRC_ADDR=?	Query the address of the current module	Important command , returns the address of the current module
AT+DST_ADDR=?	Query the address of the target module	Important command , returns the address of the target module
AT+SRC_PORT=?	Query the port of the current module	Return the port of the current module
AT+DST_PORT=?	Query the port of the target module	Return the port of the target module
AT+MEMBER_RAD=?	Query multicast member radius	Return the propagation radius of the multicast member. The larger the radius, the greater the coverage.
AT+NONMEMBER_RAD=?	Query multicast non-member radius	Return the multicast non-member propagation radius. The larger the radius, the greater the coverage.
AT+CSMA_RNG=?	Query CSMA random avoidance time	Return the maximum random avoidance time
AT+ROUTER_SCORE=?	Query maxium numbers of consecutive failure of routers	Return 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	Return whether the extra frame header function is enabled

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AT+BACK=?	Check whether the function of sending return information is enabled	Return whether the send return message function is enabled
AT+SECURITY=?	Check whether the data encryption function is enabled	Return whether the data encryption function is enabled
AT+RESET_AUX=?	Query whether LED2 changes during automatic reset	whether LED2 is turned on when the RF is restarted
AT+RESET_TIME=?	Query the automatic reset time	Return the RF automatic restart time, in minutes
AT+FILTER_TIME=?	Query broadcast filtering timeout	Return the broadcast filter timeout
AT+ACK_TIME=?	Query request response timeout	Return the request response timeout
AT+ROUTER_TIME=?	Query routing request timeout	Return the routing request timeout
AT+GROUP_ADD=?	Query GROUP information	Return 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	Return 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.

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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	E52-400 /900 NW22 S <power>: RF output power (-9 ~ +22 dBm) E52-400/900NW 30 S<power>: RF output power (+15 ~ + 30 dBm) <save>: whether to save to Flash
AT+CHANNEL=<channel>,<save>	Set the module working channel	<channel>: E52-400NW22/30S frequency band: RF working channel (0 ~ 99) E52-900NW22/30S frequency band: RF working channel (0 ~ 79) <save>: whether to save to Flash
AT+UART=<baud>,<parity>	Set the module serial port parameters	Restart to take effect <baud>: serial port baud rate (1200 ~ 460800) <parity>: check digit (8N1 8E1 8O1)
AT+RATE= <rate>	Set the module air rate	<rate> : 0:62.5K 1:21.825K 2: 7K
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

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AT+MEMBER_RAD=<rad>,<save>	Set module multicast member radius	For multicast use , it is recommended to keep the default value <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
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

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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
<save>	[0~1]	Whether the parameters are saved to Flash	[1: Save, 0: Do not save]
<power>	[-9~22]	Set the module transmit power	RF output power [-9~+22] dBm
<channel>	[0~99]	Set the working channel of E52-400NW22S module	Working channel [0~ 99] , Corresponding frequency 410.125 ~ 509.125 MHz Operating frequency = 410.125 + channel * 1 MHz
	[0~79]	Set the working channel of the E52-900NW22S module	Working channel [0~ 79] , Corresponding frequency 850.125 ~ 929.125 MHz Operating frequency = 850.125 + channel * 1 MHz
<baud>	See description	Setting the baud rate	Restart to take effect , support the following baud rates: 1200,2400,4800,9600,19200,38400, 57600,115200,230400,460800 bps
<parity>	[0~2]	Setting the check digit	Serial port check digit [0:8N0 1:8E1 2:8O1]
<rate>	[0~3]	Set the air rate	[0:62.5K 1:21.825K 2:7K]
<option>	[1~4]	Set up communication method	Communication [1: Unicast 2: Multicast 3: Broadcast 4: Anycast]
<panid>	[0~65534]	Set network ID	Network identification code [0x0000~0xFFFE]
<type>	[0~1]	Set the node type of the module	Set the node type of the module [0: routing node 1: terminal node]
<addr>	[0~65534]	Set the module address	Address range [0x0000~0xFFF E] Routing node: 0x0000~0x7FFF Terminal node: 0x8000~0xFFFE
<group>	[0~65534]	Set the multicast group address	Group address range [0x0000~0xFFFE]

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<port>	[1, 14]	Port Settings	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
<rad>	[0~15]	radius in multicast	Multicast transmission radius [0~15] The larger the radius, the more propagation levels there 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 [3000~65535] ms Request response timeout [1000~65535] ms Routing request timeout [1000~65535] ms
<key>	[0~0x7FFF FFFF]	Network encryption key	Encryption key [0~0x7FFF FFFF]

5.6 Parameter considerations

- When there is no <save> parameter in the setting command, all settings will be saved in Flash.
- After the setting of Baud rate<baud> and Parity<parity> is completed, a restart is required to take effect . You can use "AT+RESET" to reset.
- the address <addr> and network identification code <panid> is not recommended to be set as 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.
- CSMA random avoidance time <rng> Generally, the default value is 127 (the random avoidance time is 0~127ms). The longer the random avoidance time is, the slower the network response speed is, but the lower the possibility of conflict is. 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.

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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 filtering timeout <time> at different airspeeds are 15s, 30s, and 60s . When duplicate data frames are received within the broadcast filtering timeout <time> , filtering will be performed. It is not recommended to shorten this time .
- the request response timeout <time> the default value at different air rates are 2.5s, 5s, and 15s respectively.

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> at different airspeeds are 2.5s, 5s, and 15s respectively.

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 interval between consecutive sends is too fast. The module will forcefully clear all send data caches.
- 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 DTU

- 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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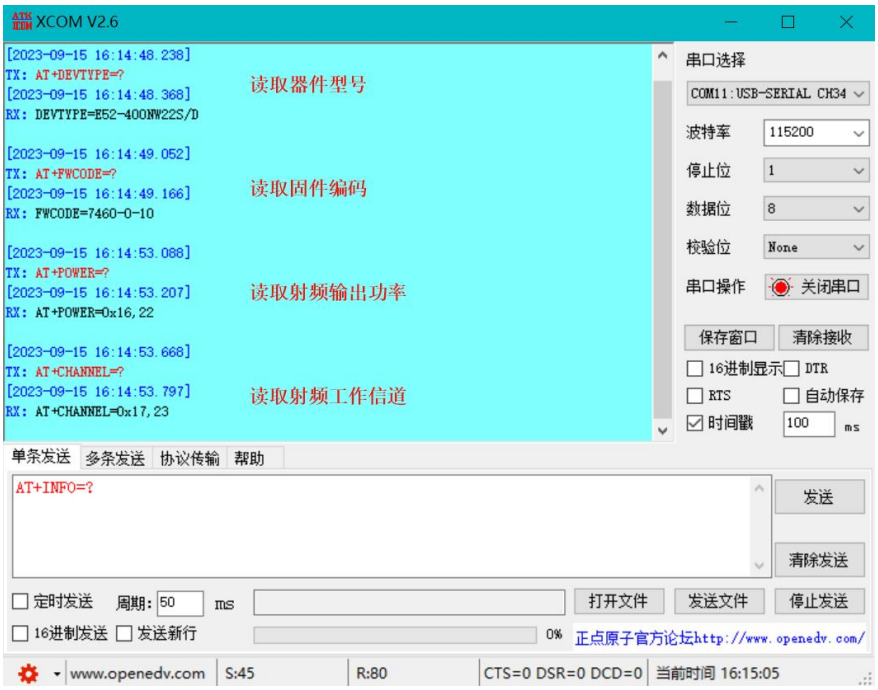


Figure 8.1.2 MCU obtains parameters

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 (Unicast);

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 Converted to HEX format is 31 32 33 34 35 36 37 38 39 30 (display encoding is different), and an additional data frame header is added .

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- The time to initiate the first unicast request is different at different airspeeds and is at least 1.5 times the routing request timeout period:
  seconds to initiate a unicast request for the first time .
  seconds to initiate a unicast request for the first time .
  seconds to initiate the first unicast request at 7K airspeed .

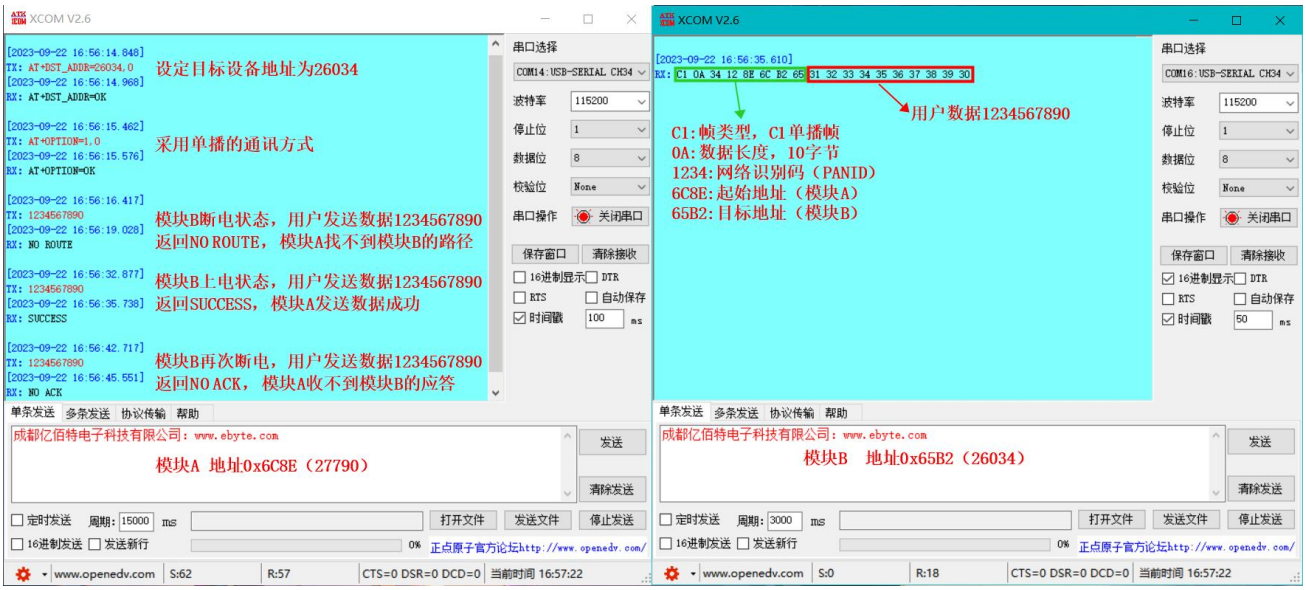


Figure 8.2.1 Unicast communication

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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 to initiate the first unicast request is different at different airspeeds, and is at least 1.5 routing request timeouts:

  seconds to initiate a unicast request for the first time .

  seconds to initiate a unicast request for the first time .

  seconds to initiate the first unicast request at 7K airspeed .

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Figure 7.3.1 Multicast communication

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 .

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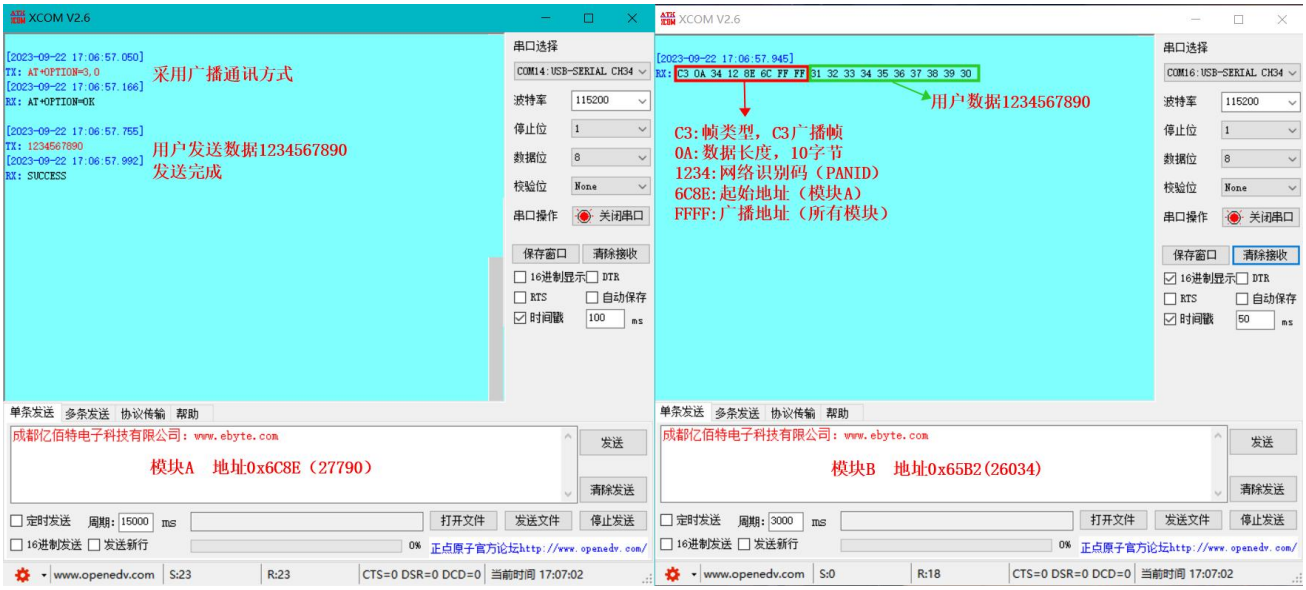


Figure 7.4.1 Broadcast communication

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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=26034,0" 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 ;

Step 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 .

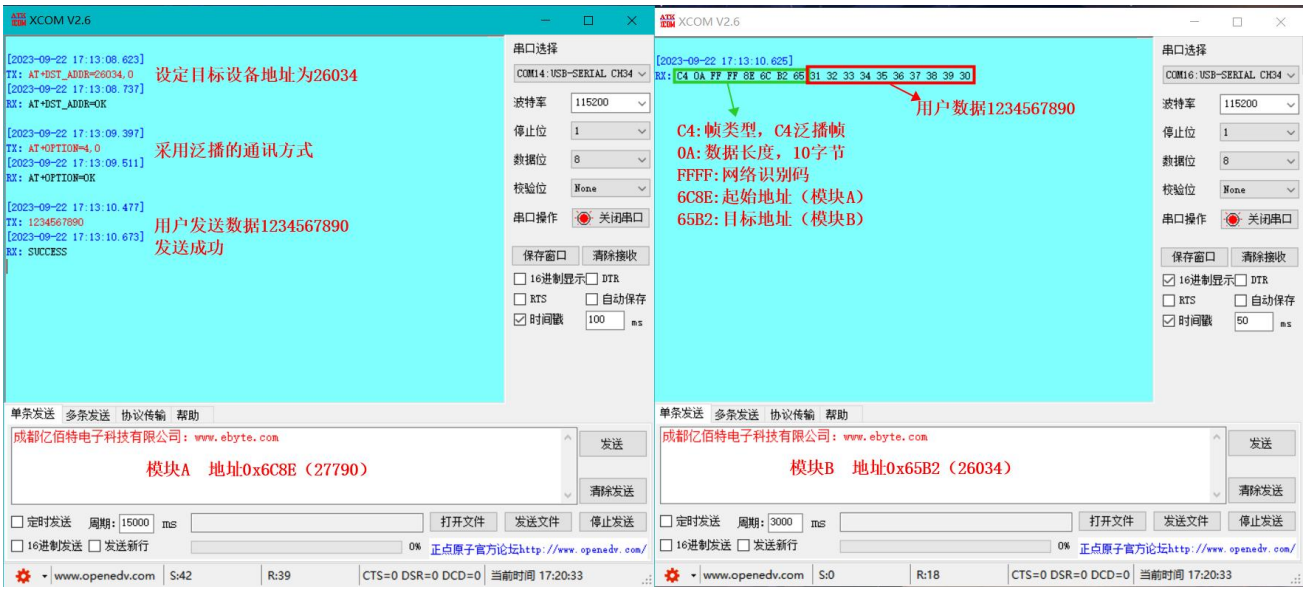


Figure 7.5.1 Flood communication

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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 .
- NO.03 and NO.04 in the figure below together form a path to the destination address 59020 :

NO.04 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.03 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):
  The command execution delay time at 62.5K airspeed is about 2.5 seconds .
  The command execution delay time is about 5 seconds at an airspeed of 21.875K .
  seconds at 7K airspeed .

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);

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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

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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;

Step 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.



Figure 8.3.1 Remote broadcast configuration steps

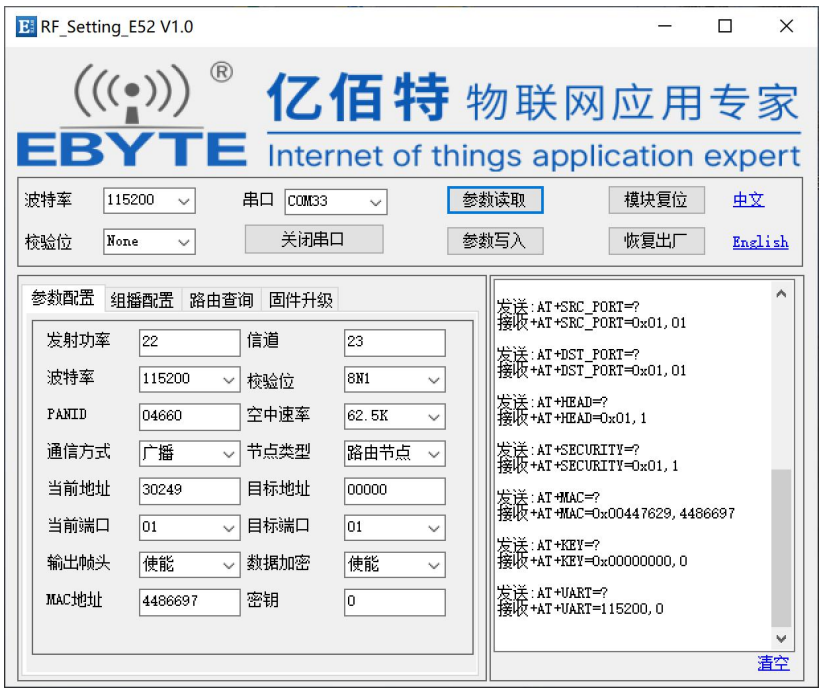
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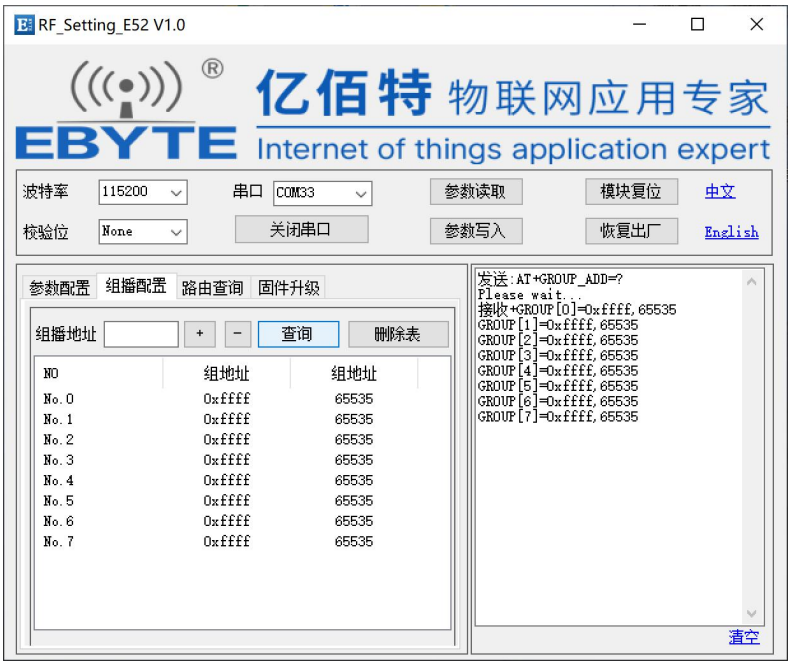
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8 Introduction to Host Computer

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



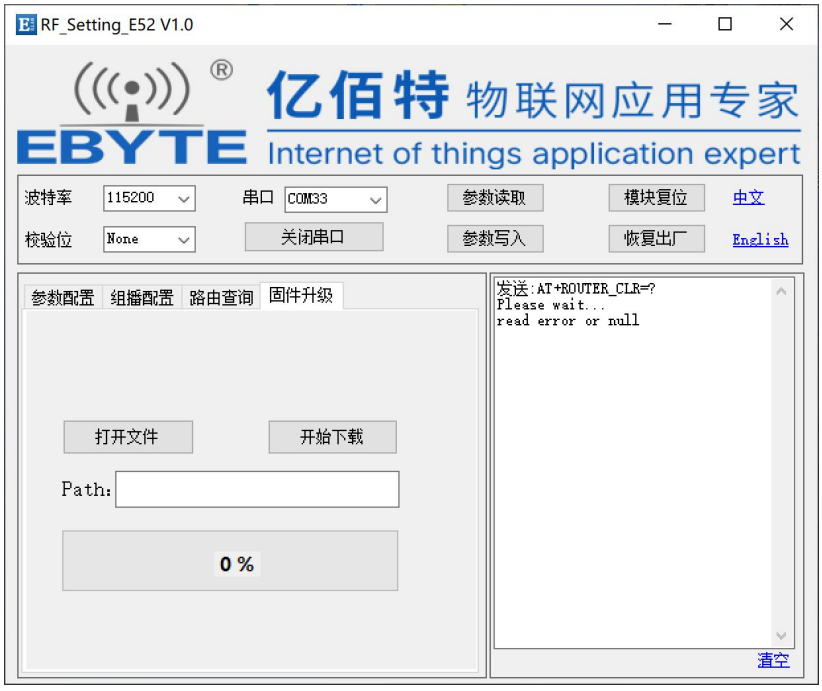
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- The third page is for routing table related functions. Users can read and clear the routing table, and can also perform Flash related read and write operations. Due to the large amount of data, it takes about 4 seconds to read the routing table. 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 50 % margin, so that the whole machine can work stably for a long time;
- The module should be kept as far away as possible from power supplies, transformers, high-frequency wiring and other parts with large electromagnetic interference;
- 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.
- 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 Frequently Asked Questions

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 at room temperature is lower than the recommended value. 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 Related Models

Product Model	Carrier frequency Hz	Transmit power dBm	Test distance km	Air speed bps	Package	Product size mm	Antenna type
E32-170T30D	170M	30	8	0.3k～9.6k	Direct Plug	24*43	SMA-K
E32-433T20DC	433M	20	3	0.3k～19.2k	Direct Plug	21*36	SMA-K
E32-433T20S1	433M	20	3	0.3k～19.2k	SMD	17*25.5	Stamp Holes
E32-433T20S2T	433M	20	3	0.3k～19.2k	SMD	17*30	IPEX/Stamp Hole
E32-400T20S	433/470M	20	3	0.3k～19.2k	SMD	16*26	IPEX/Stamp Hole
E32-433T30D	433M	30	8	0.3k～19.2k	Direct Plug	24*43	SMA-K
E32-433T30S	433M	30	8	0.3k～19.2k	SMD	25*40.3	IPEX/Stamp Hole
E32-868T20D	868M	20	3	0.3k～19.2k	Direct Plug	21*36	SMA-K
E32-868T20S	868M	20	3	0.3k～19.2k	SMD	16*26	IPEX/Stamp Hole
E32-868T30D	868M	30	8	0.3k～19.2k	Direct Plug	24*43	SMA-K
E32-868T30S	868M	30	8	0.3k～19.2k	SMD	25*40.3	IPEX/Stamp Hole
E32-915T20D	915M	20	3	0.3k～19.2k	Direct Plug	21*36	SMA-K
E32-915T20S	915M	20	3	0.3k～19.2k	SMD	16*26	IPEX/Stamp Hole
E32-915T30D	915M	30	8	0.3k～19.2k	Direct Plug	24*43	SMA-K
E32-915T30S	915M	30	8	0.3k～19.2k	SMD	25*40.3	IPEX/Stamp Hole

12 Antenna Guide

Antennas play an important role in the communication process. Often, poor-quality antennas will have a great impact on the communication system. Therefore, our company recommends some antennas as supporting antennas for our wireless modules with excellent performance and reasonable prices.

Product Model	type	Frequency band	Gain	Size	Feeder	interface	Features
		Hz	dBi	mm	cm		
TX433-JZ-5	Rubber antenna	433M	2.0	52	-	SMA-J	Ultra-short straight, omnidirectional antenna
TX433-JZG-6	Rubber antenna	433M	2.5	62	-	SMA-J	Ultra-short straight, omnidirectional antenna
TX433-JW-5	Rubber antenna	433M	2.0	50	-	SMA-J	Fixed bending, omnidirectional antenna
TX433-JWG-7	Rubber antenna	433M	2.5	70	-	SMA-J	Fixed bending, omnidirectional antenna
TX433-JK-11	Rubber antenna	433M	2.5	110	-	SMA-J	Bendable Rubber, omnidirectional antenna
TX433-JK-20	Rubber	433M	3.0	200	-	SMA-J	Bendable Rubber,

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	antenna						omnidirectional antenna
TX433-XPL-100	Sucker antenna	433M	3.5	185	100	SMA-J	Small Sucker antenna, cost-effective
TX433-XP-200	Sucker antenna	433M	4.0	190	200	SMA-J	Small Sucker antenna, low loss
TX433-XPH-300	Sucker antenna	433M	6.0	965	300	SMA-J	Small Sucker antenna, high gain

Revision History

Version	Revision Date	Revision Notes	Maintainer
1.0	2025-01-20	Initial release	Bin
1.1	2025-02-06	Content revision	Bin

About Us

Hot line:4000-330-990

Technical support: support@cdebyte.com

Documents and RF Setting download link: https://www.cdebyte.com

Thank you for using Ebyte products! Please contact us with any questions or suggestions: info@cdebyte.com

Address: B2 Mould Industrial Park, 199# Xiqu Ave, High tech Zone, Chengdu, Sichuan

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