E22-xxxT22S User Manual

AT command 22dBm LoRa wireless module

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Contents

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1. Product Overview

1.1 Product introduction

The E22-xxxT22S is a new generation of LoRa wireless data transmission modules, the series (UART) modules based on SEMTECH high-performance RF chips developed. Its transmit power is: 22dBm and has a variety of transmission methods. The working frequency bands are respectively 230MHz, 400MHz and 900MHz. LoRa spread spectrum technology, TTL level output, compatible with 3.3V IO port voltage.

E22-xxxT22S adopts a new generation of LoRa spread spectrum technology., faster speed, lower power consumption and smaller size; supporting air wake-up, wireless Configuration, carrier monitoring, automatic relay, communication key and other functions; supporting sub-packet length setting and customized development service is available. The three modules in the picture below have the same power but different frequency bands.

Figure 1 : E22-230T22S

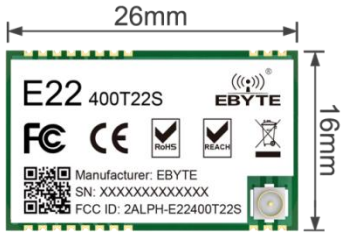


Figure 2 : E22-400T22S

Figure 3 : E22-900T22S

1.2 Features

- Adopting a new generation of LoRa spread spectrum modulation technology, it brings longer communication distance and stronger anti-interference ability;
- Supporting serial port upgrade of firmware, making it more convenient to update firmware;
- Supporting AT commands, making it more convenient to use;
- Supporting automatic relay networking, multi-level relays are suitable for ultra-long-distance communications, and multiple networks can run simultaneously in the same area;
- Supporting users to set their own communication keys, which cannot be read, greatly improving the confidentiality of user data;
- Supporting LBT function, which monitors the channel environment noise before sending, which can greatly improve the communication success rate of the module in harsh environments;
- Supporting RSSI signal strength indication function for evaluating signal quality, improving communication networks, and ranging;
- Supporting wireless parameter configuration, send command data packets wirelessly, and remotely configure or read wireless module parameters;
- Supporting air wake-up, an ultra-low power consumption function, suitable for battery-powered applications;
- Supporting fixed-point transmission, broadcast transmission, and channel monitoring;
- Supporting deep sleep. In this mode, the power consumption of the whole machine is about 3 uA;
- Under ideal conditions, the communication distance can reach 5 km;
- The parameters are saved when power is turned off, and the module will work according to the set parameters after powering on again;

- Efficient watchdog design, once an exception occurs, the module will automatically restart and continue to work according to the previous parameter settings;
- E22-400T22S and E22-900T22S support data transmission rates of 2.4K~62.5K bps ;
- E22-230T22S supports data transmission rate of 2.4K～15.6Kbps ;
- Supports 2. 7 ~ 5.5V power supply, and any power supply greater than 5 V can ensure the best performance;
- Industrial grade standard design, supports long-term use at -40~+85℃;
- The maximum module power can reach 160mW (22dBm), and the transmission is farther and more stable.

1.3 Application scenarios

- Home security alarm and remote keyless entry;
- Smart home and industrial sensors, etc.;
- Wireless alarm security system ;
- Building automation solutions;
- Wireless industrial grade remote control;
- healthcare products;
- Advanced Meter Infrastructure (AMI) .

2. Specifications

2.1 RF parameters

RF parameters	unit	model			Remark
		E22-230T22SV2.2	E22-400T22SV2.2	E22-900T22SV2.2	
Maximum transmit power	dBm	22.0±1	22.0±1	22.0±1	-
Receive sensitivity	dBm	-138	-147	-147	Air data rate is 2.4 kbps
reference distance	M	5K	5K	5K	Test condition：clear and open area, antenna gain: 5dBi，antenna placement height: 2.5m，air data rate: 2.4kbps
Working frequency	MHz	220.125～236.125MHz	410.125～493.125MHz	850.125～930.125MHz	Support ISM frequency band
Air speed	bps	2.4K～15.6K	2.4K～62.5K	2.4K～62.5K	Controlled by programming
blocking power	dBm	10	10	10	Less chance of burning when used at close range
TX packet length	Btye	240	240	240	Subpackage 32/64/128/240 bytes can be set to be sent through commands

2.2 Electrical parameters

Electrical parameters		unit	model			Remark
			E22-230T22 SV2.2	E22-400T22 SV2.2	E22-900T22 SV2.2	
Operating Voltage		V	2.7～5.5	2.7～5.5	2.7～5.5	≥ 5 V can guarantee the output power , exceeding 5.5 V will permanently burn the module .
Communication level		V	3.3V	3.3V	3.3V	There is risk of burning out by using 5V TTL
Power consumption	Transmitting current	mA	110	110	150	Instantaneous power consumption@22dBm
	Receiving current	mA	15	15	17	
	Sleep current	uA	3	3	3	Software shutdown
temperature	Operating temperature	℃	-40～+85			Industrial grade design
	Storage temperature	℃	-40～+85			Industrial grade design

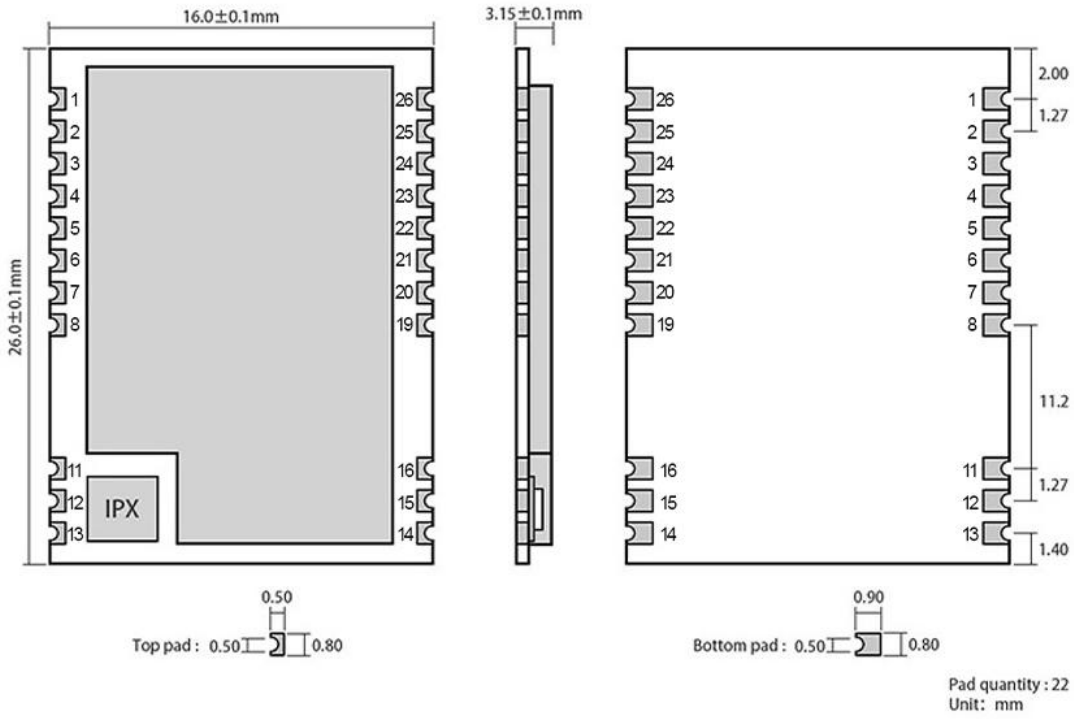
2.3 Hardware parameters

Hardware parameters	model			Remark
	E22-230T22SV2.2	E22-400T22SV2.2	E22-900T22SV2.2	
Crystal frequency	32MHz			Industrial grade high-precision crystal oscillator
Modulation	LoRa			New generation LoRa modulation technology
Interface	1.27mm stamp hole			
Communication Interface	UART serial port			TTL level
TX packet length	240Byte			Subpackage 32/64/128/240 bytes can be set to be sent through commands
Packaging method	SMD type			-
Cache capacity	1000Byte			-
Antenna interface	IPEX/stamp hole			Equivalent impedance is about 50 Ω
Size	26 * 16 mm			±0.1mm

Product Weight	1.95g	±0.05g

3. Mechanical dimensions and pin definitions

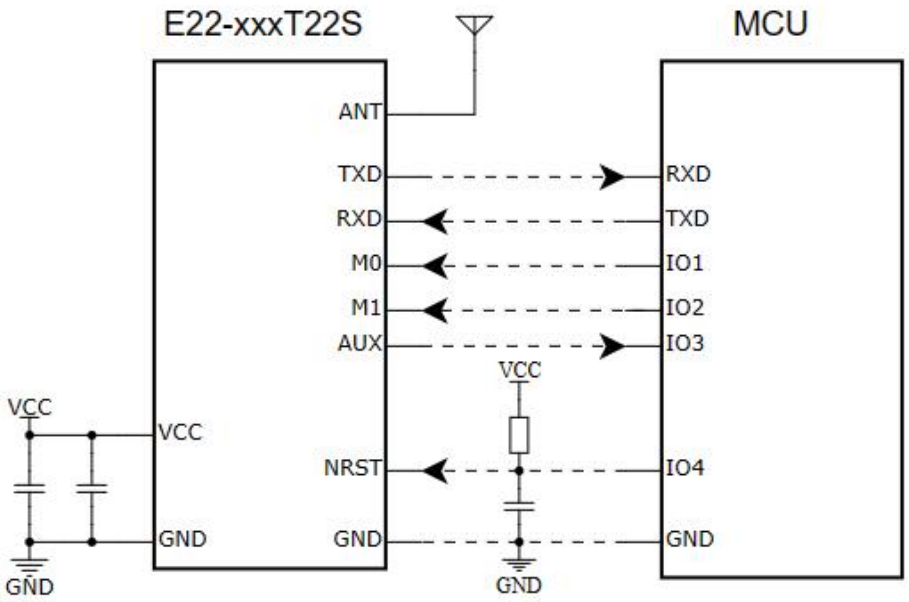
3.1 E22-230/400/900T22S mechanical dimensions and pin definitions



Pin number	Pin name	Pin direction	Pin usage
1	NRST	Input	Module reset pin, 3.3V.
2	GND	-	Module ground wire
3	NC	-	Empty pin
4	NC	-	Empty pin
5	NC	-	Empty pin
6	NC	-	Empty pin
7	NC	-	Empty pin
8	GND	-	Module ground wire
11	GND	-	Module ground wire
12	ANT	Output	Antenna interface (high frequency signal output, 50ohm characteristic impedance)

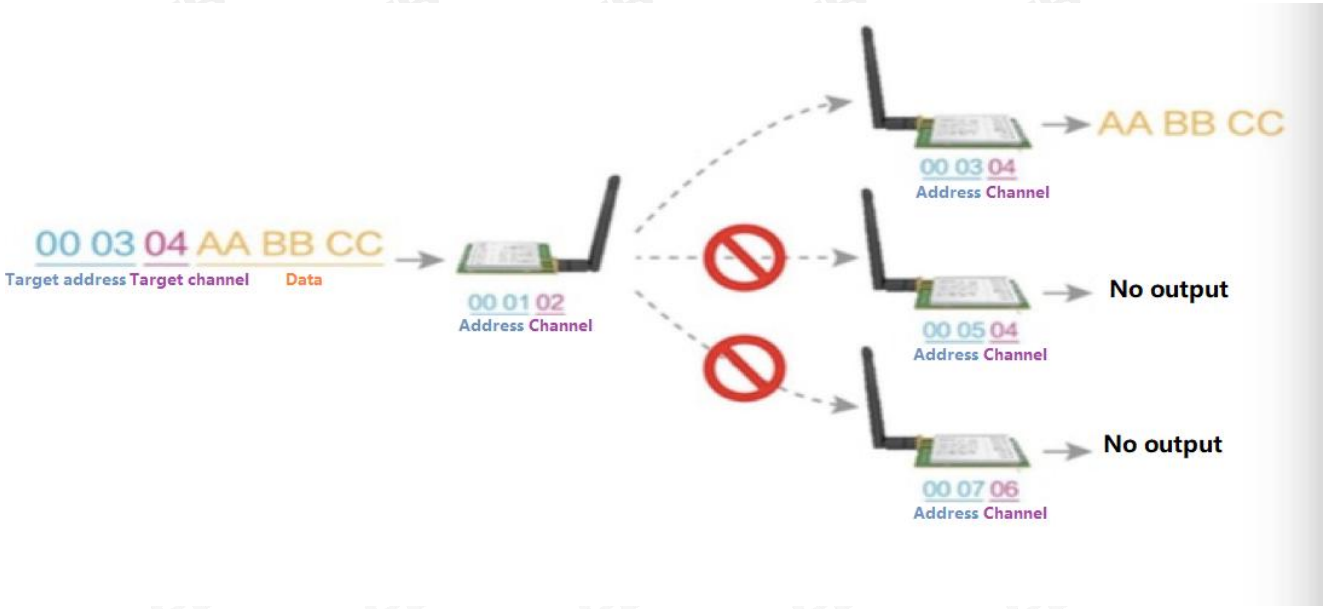
13	GND	-	Module ground wire
14	GND	-	Module ground wire
15	GND	-	Module ground wire
16	GND	-	Module ground wire
19	GND	-	Module ground wire
20	M0	Input (very weak pull-up)	Work with M1 to decide 4 working modes of the module (cannot be left floating; can be grounded if not used).
21	M1	Input (very weak pull-up)	Work with M0 to decide 4 working modes of the module (cannot be left floating; can be grounded if not used).
22	RXD	Input	TTL serial port input, connected to the external TXD output pin;
23	TXD	Output	TTL serial port output , connected to the external RXD input pin;
24	AUX	Output	Used to indicate the working status of the module; For user to wakes up the external MCU and it outputs low level during power-on self-check initialization; (can be left floating)
25	VCC	-	Module power supply positive reference, voltage range: 2.7 ~ 5.5VDC
26	GND	-	Module ground wire

4. Recommended Connection Diagram



5. Function Description

5.1 Fixed point Transmission



5.2 Broadcast Transmission

5.3 Broadcasting Address

- For Example: Set the address of module A to 0xFFFF and the channel to 0x04.
- When module A is used as a transmitter (same mode, transparent transmission mode), all receiving modules under the 0x04 channel can receive data to achieve the purpose of broadcasting.

5.4 Listening Address

- For example: Set the address of module A as 0xFFFF, and the channel as 0x04;
- When module A is the receiver, it can receive the data sent from all modules under channel 0x04, the purpose of listening is realized.

5.5 Module Reset

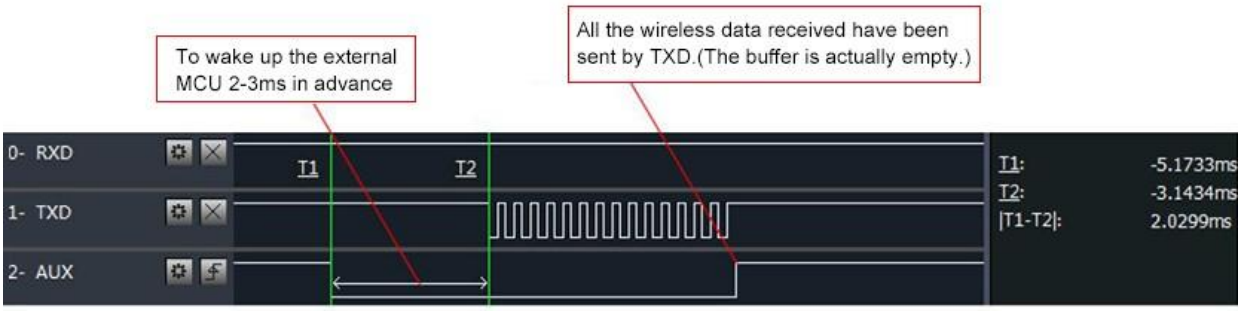
- After the module is powered on, AUX will immediately output low level, perform hardware self-check, and set the working mode according to user parameters;
- During this process, AUX keeps low level, and AUX outputs high level after completion, and starts to work normally according to the working mode formed by M1 and M0; Therefore, the user needs to wait for the rising edge of AUX as the starting point for the module to work normally.

5.6 Detailed explanation of AUX

- AUX Pin can be used as indication for wireless TX &RX buffer and self-check.
- It can indicate whether there is data not transmitted via wireless way, or whether the received data has not been sent through UART, or whether the module is still in the process of self-check initialization.

5.6.1 Indication of Serial port data output

- Used to wake up the external MCU from sleep;

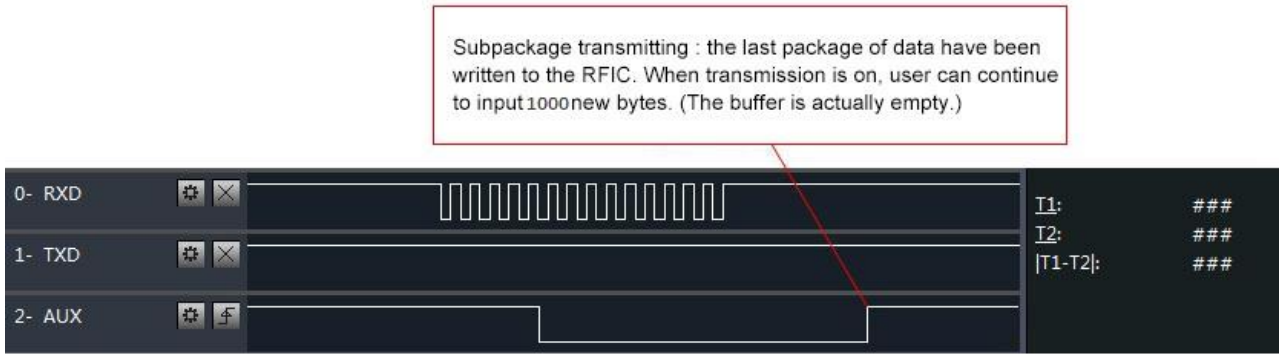


Timing Sequence Diagram of AUX when TXD pin transmits

5.6.2 Indication of Wireless transmission

- Buffer empty: the data in the 1000-byte buffer in the module is written to the wireless chip (automatically sub-packaging);
  When AUX=1, if user continuously sends data less than 1000 bytes, it won't overflow;
  When AUX=0, the buffer is not empty: It means data in the module's internal 1000-byte buffer has not been written to the wireless chip and has not been transmitted. At this time, the module may be waiting for the end of user input data (subject to timeout), or the module is going on with wireless sub-packet transmission.

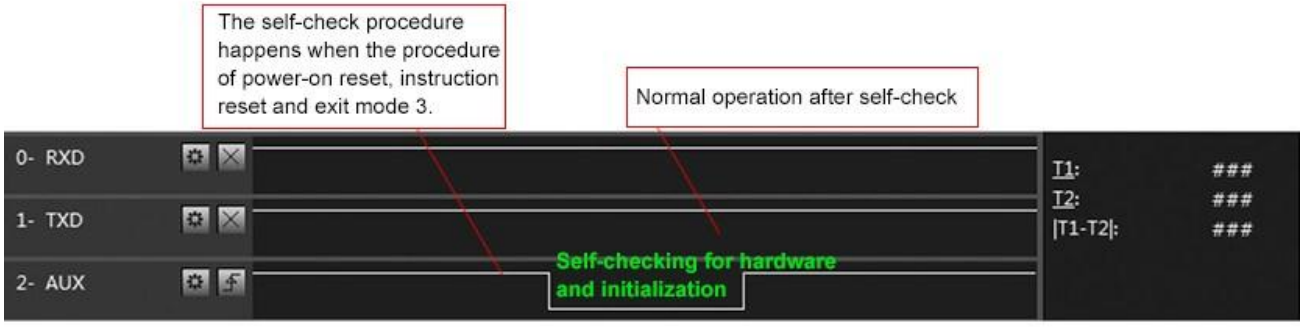
[Note]: When AUX=1, it does not mean that all serial port data of the module has been transmitted through wireless; It may be the case that the last data packet is being transmitted.



Timing Sequence Diagram of AUX when RXD pin receives

5.6.3 The module is being configured

- Only when resetting and exiting sleep mode;



Timing Sequence Diagram of AUX when self-check

5.6.4 Notes for AUX

No.	Notes for AUX
1	For function 1 (5.6.1) & function 2 ((5.6.2) mentioned above, the priority should be given to the one with low level output, which means as long as any output low level condition is met, AUX will output low level; Only when none of the output low level condition is met, AUX will outputs high level.
2	When AUX outputs low level, it means the module is busy & it won't conduct working mode checking. Within 1ms since AUX outputs high level, the module working mode switch will be completed.
3	After switching to new working mode, module will not work in the new mode immediately until AUX rising edge lasts for 2ms. If AUX is always at high level, then the mode switch will take effect immediately;
4	When the user switches to other working modes from mode 3 (sleep mode) or it is still in reset process, the module will reset user parameters, during which AUX outputs low level.
5	Due to the characteristics of the LoRa modulation method, the information transmission delay is much longer than FSK. To avoid communication abnormalities caused by data accumulation and data loss, customer is suggested not to transmit large amounts of data at low air data rate.

6. Working Mode

The module has four working modes, which are set by pins M1 and M0; details are shown in the following table:

Mode (0-3)	M1	M0	Mode introduction	Remark
0 Transmission Mode	0	0	UART and wireless channel are open, transparent transmission is on	Support over-the-air configuration via special command
1 WOR Mode	0	1	Can be set as WOR Transmitter or WOR Receiver	Support wake up over the air
2 Configuration Mode	1	0	Users can access the registers through the serial port to control the working status of the module	
3 Deep Sleep Mode	1	1	Module goes to sleep	

6.1 Precautions for mode switching

No.	Remark
1	● Users can combine high and low levels with M1 and M0 to determine the module's working mode. Two GPIOs of the MCU can be used to control mode switching; ● After changing M1 and M0: If the module is idle, after 1ms, it can start working according to the new mode; ● If there is serial port data of the module not been transmitted through the wireless, the new working mode can be switched after the transmission is completed; ● If the module receives the wireless data and transmits the data through the serial port, it needs to finish transmission before switching to the new working mode; ● Therefore, mode switching can only be valid when AUX output is 1, otherwise it will delay switching
2	● For example, users continuously inputs a large amount of data and simultaneously performs mode switching. At this time, the switching mode operation is invalid; the module will process all the user data before performing the new mode detection; ● Therefore, the general recommendation is to detect the output state of the AUX pin and switch mode after 2ms when AUX outputs high level.
3	● When the module is switched to sleep mode from other modes, if there is data not been processed yet, the module will process these data (including receiving and sending) before entering sleep mode. This feature can be used for fast sleep to save power; ● For example, the transmitter module works in mode 0, the user transmits the serial port data "12345". At the time, user does need to wait for the AUX pin to be idle (high level), user can directly switch the module to sleep mode and make user's main MCU immediately sleep, then the module will automatically transmit the user data through the wireless, and will enters sleep mode within 1ms automatically; This will saves MCU's working time and reduces its power consumption.
4	● Similarly, any mode switching can use this feature. After the module processes the event in the current mode, it will automatically enter the new mode within 1ms; This saves the user's work of querying AUX and it achieves the purpose of fast switching; ● For example, switching from the transmit mode to the receive mode; the user MCU can also enter sleep before the mode switch, and use the external interrupt function to acquire the AUX change, thereby performing mode switching.
5	● This operation mode is very flexible and efficient. It is designed according to the user's MCU's operation convenience, and it can reduce the workload of the entire system as much as possible, improving system efficiency, and reducing power consumption as well..

6.2 Normal mode（Mode 0）

Type	When M0 = 0，M1 = 0，module works in Mode 0
Transmitting	Users can input data through the serial port and the module will start wireless transmission.
Receiving	The module wireless receiving function is turned on, and after receiving the wireless data, it will be output through the serial port TXD pin.

6.3 WOR mode（Mode 1）

Type	When M0 = 1，M1 = 0，module works in Mode 1
Transmitting	When defined as the transmitter, the wake-up code for a certain period of time will be automatically added before transmitting
Receiving	Data can be received normally, and the receiving function is equivalent to that in mode 0

6.4 Configuration mode（Mode 2）

type	When M0 = 0, M1 = 1, the module works in mode 2
Transmitting	Wireless transmission is turned off and it will be automatically turned on during wireless configuration.
Receiving	Wireless reception is turned off and it will be automatically turned on during wireless configuration.
Configuration	Users can access registers to configure module’s working status

6.5 Deep sleep mode（Mode 3）

Type	When M0 = 1，M1 = 1，module works in Mode 3
Transmitting	Unable to transmit wireless data.
Receiving	Unable to receive wireless data.
Note	When entering other modes from sleep mode, the module will reconfigure parameters. During the configuration process, AUX stays in low level; After completion of configuration, AUX will output a high level, so user is recommended to detect the rising edge of AUX.

7. Register Read and Write Control

7.1 Command format

In configuration mode (mode 2: M0 = 0, M1 = 1), the list of supported commands are as follows (**when setting, only 9600, 8N1 format is supported**):

No.	Command format	Detailed description
1	Set register	Command: C0+starting address+length+parameters Response: C1+starting address+length+parameters E.g 1: Configure Channel to be 0x09 command starting address length parameter Send: C0 05 01 09 Return: C1 05 01 09 E.g 2: Configure module address (0x1234), network address (0x00), serial port (9600 8N1) and air data rate (2.4K). Send: C0 00 04 12 34 00 62 Return: C1 00 04 12 34 00 62
2	Read register	Command: C1+starting address+ length Response: C1+starting address+length+parameters E.g 1: Read channel command starting address length parameter Send: C1 05 01 Returen: C1 05 01 09 E.g 2: Read module address, network address, serial port and air data rate. Send: C1 00 04 Return: C1 00 04 12 34 00 62
3	Set temporary register	Command: C2+starting address+length+parameters Response: C1+starting address+length+parameters E.g 1: Configure Channel to be 0x09 command starting address length parameter Send: C2 05 01 09 Return: C1 05 01 09 E.g 2: Configure module address (0x1234), network address (0x00), serial port (9600 8N1) and air data rate (2.4K). Send: C2 00 04 12 34 00 62 Return: C1 00 04 12 34 00 62
4	Wireless configuration	Command: CF CF + normal command Respond: CF CF + normal respond E.g 1: Configure Channel to be 0x09 by wireless configuration Command head command starting address length parameter Send: CF CF C0 05 01 09 Returen: CF CF C1 05 01 09 E.g 2: Configure module address (0x1234), network address (0x00), serial port (9600 8N1) and air data rate (2.4K) by wireless configuration. Send: CF CF C0 00 04 12 34 00 62 Return: CF CF C1 00 04 12 34 00 62

5	Wrong format	Format error response FF FF FF

7.2 E22-400/900T22S register description

No.	Read or Write	Name	Description				Remark
00H	Read/ Write	ADDH	ADDH (default 0)				High byte and low byte in the module address; Note: When the module address is FFFF, it can be used as the broadcast and listening address, that is: the module will not perform address filtering.
01H	Read/ Write	ADDL	ADDL (default 0)				
02H	Read/ Write	NETID	NETID (default 0)				Network address, used to distinguish the network. When two or more modules need to communicate with each other, their network address should be the same.
03H	Read/ Write	REG0	7	6	5	UART Serial port rate（bps）	For the two modules communicating with each other, their serial port baud rate can be different, and their serial parity bit can also be different. When transmitting large packets continuously, users need to consider the data blocking and possible data loss caused by the same baud rate. It is generally recommended that both communication parties have the same baud rate.
			0	0	0	Serial port baud rate 1200	
			0	0	1	Serial port baud rate 2400	
			0	1	0	Serial port baud rate 4800	
			0	1	1	Serial port baud rate 9600（default）	
			1	0	0	Serial port baud rate 19200	
			1	0	1	Serial port baud rate 38400	
			1	1	0	Serial port baud rate 57600	
			1	1	1	Serial port baud rate 115200	
			4	3	Serial port parity bit		The communication parties can have different serial parity bit.
			0	0	8N1（default）		
			0	1	8O1		
			1	0	8E1		
			1	1	8N1（equal to 00）		
			2	1	0	Wireless air data rate（bps）	The communication parties must have the same air data rate. The higher the air data rate is, the smaller the delay in response, and the shorter the transmission distance is.
			0	0	0	Air data rate 2.4K	
			0	0	1	Air data rate 2.4K	
			0	1	0	Air data rate 2.4k（default）	
			0	1	1	Air data rate 4.8k	
			1	0	0	Air data rate 9.6k	
			1	0	1	Air data rate 19.2k	
			1	1	0	Air data rate 38.4k	
			1	1	1	Air data rate 62.5k	
0 4H	Read/ Write	REG1	7	6	Sub packet setting		When the data sent is smaller than the sub packet length, the serial output of the receiving end is an uninterrupted continuous output.
			0	0	240 bytes（default）		

<table>
<tr><td></td><td></td><td></td><td>0</td><td>1</td><td>128 bytes</td><td rowspan="3">When the data sent is larger than the sub packet length, the serial port in receiving end willsub packet the data and then output them.</td></tr>
<tr><td></td><td></td><td></td><td>1</td><td>0</td><td>64 bytes</td></tr>
<tr><td></td><td></td><td></td><td>1</td><td>1</td><td>32 bytes</td></tr>
<tr><td></td><td></td><td></td><td>5</td><td colspan="2">RSSI environmental noise enable</td><td rowspan="3">RSSI enable command (Sub packet setting, transmit power as default parameters, configuration mode): C0 04 01 20;

After enabling, the command C0 C1 C2 C3 can be sent in the normal mode(mode 0) or WOR transmission mode (transmitter in mode 1) to read the register;
Register 0x00: current environmental noise RSSI;
Register 0x01: RSSI at Last Data Received (Current channel noise is: dBm = -(256 - RSSI));
Command format: C0 C1 C2 C3+start address+read length;
Return: C1 + address + read length + read valid value;
For example:
Send: C0 C1 C2 C3 00 01
Return: C1 00 01 RSSI (the address can only start from 00)</td></tr>
<tr><td></td><td></td><td></td><td>0</td><td colspan="2">Disable（default）</td></tr>
<tr><td></td><td></td><td></td><td>1</td><td colspan="2">Enable</td></tr>
<tr><td></td><td></td><td></td><td>4</td><td colspan="2">Software mode switching</td><td rowspan="3">If you use Ebyte's host computer configuration software, this bit will be turned off automatically. If you don’t want to use the M0 M1 pins to switch working modes, you can enable this function, and use specific serial port commands to switch modes.
Format: C0 C1 C2 C3 02 + working mode
Send C0 C1 C2 C3 02 00 to switch to transparent transmission mode
Send C0 C1 C2 C3 02 01 to switch to WOR mode
Send C0 C1 C2 C3 02 02 to switch to configuration mode
Send C0 C1 C2 C3 02 03 to switch to sleep mode
Return: C1 C2 C3 02 + working mode
Note: After enabling this function, WOR mode and sleep mode only support 9600 baud rate.</td></tr>
<tr><td></td><td></td><td></td><td>0</td><td colspan="2">Disabled (default)</td></tr>
<tr><td></td><td></td><td></td><td>1</td><td colspan="2">Enable</td></tr>
<tr><td></td><td></td><td></td><td>3</td><td>2</td><td>Reserve</td><td></td></tr>
<tr><td></td><td></td><td></td><td>1</td><td>0</td><td>Transmitting power</td><td rowspan="5">There is a non-linear relationship between power and current. At the maximum power, the power supply efficiency is the highest ;

Current does not decrease in proportion to the decrease in power.</td></tr>
<tr><td></td><td></td><td></td><td>0</td><td>0</td><td>22dBm (default)</td></tr>
<tr><td></td><td></td><td></td><td>0</td><td>1</td><td>17dBm</td></tr>
<tr><td></td><td></td><td></td><td>1</td><td>0</td><td>13dBm</td></tr>
<tr><td></td><td></td><td></td><td>1</td><td>1</td><td>10dBm</td></tr>
<tr><td>05H</td><td>Read/ Write</td><td>REG2</td><td colspan="3">Channel Control (CH)
0-83 respectively represent a total of 84 channels (applicable to the 400Mhz frequency band)
0-80 respectively represent a total of 81 channels (applicable to the 900Mhz frequency band)</td><td>Actual frequency = 410.125MHz + CH * 1MHz
Actual frequency = 850.125MHz + CH * 1MHz</td></tr>
<tr><td>06H</td><td>Read/</td><td>REG3</td><td>7</td><td colspan="2">Enable RSSI bytes</td><td>After enabled, when the module receives the</td></tr>
</table>

	Write		0	Disabled (default)			wireless data, it will follow an RSSI strength byte after output via the serial port TXD
			1	Enable			
			6	Transfer method			During fixed-point transmission, the module will identify the first three bytes of serial port data as: address high + address low + channel, and use them as wireless transmission targets.
			0	Transparent transmission (default)			
			1	Fixed point transmission			
			5	Repeater function			After the repeater function is enabled, if the target address is not the module itself, the module will start a forwarding ; In order to prevent data from being transmitted back, it is recommended to use it in conjunction with fixed-point mode ; that is, the destination address and source address are different.
			0	Disable repeater functionality (default)			
			1	Enable repeater function			
			4	LBT Enable			When enabled, wireless data will be monitored before transmission, which can avoid interference to a certain extent, but may cause data delays; The maximum dwell time of LBT is 2 seconds. The wireless data will be transmitted forcibly after 2 seconds.
			0	Disabled (default)			
			1	Enable			
			3	WOR mode transmission control			Below operation is valid for Mode 1 only； In WOR receiving mode (as WOR receiver), the delay time after wake-up can be modified. The default time is 0; 1. To modify the delay time after wake-up, WOR receiver needs to send the command C0 09 02 03 E8 in the configuration mode (C0 is writing command, 09 is the starting address of the register, 02 is the length, 03 E8 is the set delay, the maximum delay FFFF is 65535ms, if the delay is set to 0, the wake-up delay is turn off.) 2. Data can be sent within the delay.
			0	WOR receiver（default） Working in WOR listening mode, the listening period is shown below (WOR period), which can save a lot of power consumption.			
			1	WOR transmitter The module receiving and transmitting functions are turned on, and a wake-up code of a period of time is added when transmitting data.			
			2	1	0	WOR cycle time	Below description is valid for Mode 1 only； Cycle time T = (1 + WOR) * 500ms, max.4000ms, min.500ms; The longer the cycle time T (WOR listening interval period), the lower the average power consumption, but the greater the data delay. Both the transmitter and the receiver must be set as the same cycle time T (very important).
			0	0	0	500ms	
			0	0	1	1000ms	
			0	1	0	1500ms	
			0	1	1	2000ms	
			1	0	0	2500ms	
			1	0	1	3000ms	
			1	1	0	3500ms	
			1	1	1	4000ms	
07H	Write	CRYPT_H	High byte of Key（default 0）				Write only, read returns 0; Used for encryption to avoid interception of wireless data in the air by similar modules; The module will internally use these two bytes as a calculation factor to do a transform encryption processing for the wireless signal over the air.
08H	Write	CRYPT_L	Low byte of Key（default 0）				
80H～86H	Read	PID	Product information 7 bytes				Product information 7 bytes

7.3 E22-230T22S register description

<table>
<tr><th>No.</th><th>Read or Write</th><th>Name</th><th colspan="4">Description</th><th>Remark</th></tr>
<tr><td>00H</td><td>Read/ Write</td><td>ADDH</td><td colspan="4">ADDH (default 0)</td><td rowspan="2">High byte and low byte in the module address;
Note: When the module address is FFFF, it can be used as the broadcast and listening address, that is: the module will not perform address filtering.</td></tr>
<tr><td>01H</td><td>Read/ Write</td><td>ADDL</td><td colspan="4">ADDL (default 0)</td></tr>
<tr><td>02H</td><td>Read/ Write</td><td>NETID</td><td colspan="4">NETID (default 0)</td><td>Network address, used to distinguish the network. When two or more modules need to communicate with each other, their network address should be the same.</td></tr>
<tr><td rowspan="29">03H</td><td rowspan="29">Read/ Write</td><td rowspan="29">REG0</td><td>7</td><td>6</td><td>5</td><td>UART Serial port rate（bps）</td><td rowspan="11">For the two modules communicating with each other, their serial port baud rate can be different, and their serial parity bit can also be different.
When transmitting large packets continuously, users need to consider the data blocking and possible data loss caused by the same baud rate.
It is generally recommended that both communication parties have the same baud rate.</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>Serial port baud rate 1200</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>Serial port baud rate 2400</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>Serial port baud rate 4800</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>Serial port baud rate 9600（default）</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>Serial port baud rate 19200</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>Serial port baud rate 38400</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>Serial port baud rate 57600</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>Serial port baud rate 115200</td></tr>
<tr><td>4</td><td>3</td><td colspan="2">Serial port parity bit</td><td rowspan="5">The communication parties can have different serial parity bit.</td></tr>
<tr><td>0</td><td>0</td><td colspan="2">8N1（default）</td></tr>
<tr><td>0</td><td>1</td><td colspan="2">8O1</td></tr>
<tr><td>1</td><td>0</td><td colspan="2">8E1</td></tr>
<tr><td>1</td><td>1</td><td colspan="2">8N1（equal to 00）</td></tr>
<tr><td>2</td><td>1</td><td>0</td><td>Wireless air data rate（bps）</td><td rowspan="10">The communication parties must have the same air data rate.
The higher the air data rate is, the smaller the delay in response, and the shorter the transmission distance is.</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>Air data rate 2.4k</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>Air data rate 2.4k</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>Air data rate 2.4k</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>Air data rate 2.4k (default)</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>Air data rate 4.8k</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>Air data rate 9.6k</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>Air data rate 15.6k</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>Air data rate 15.6k</td></tr>
<tr><td rowspan="5">04H</td><td rowspan="5">Read/ Write</td><td rowspan="5">REG1</td><td>7</td><td>6</td><td colspan="2">Sub packet setting</td><td rowspan="5">When the data sent is smaller than the sub packet length, the serial output of the receiving end is an uninterrupted continuous output.
When the data sent is larger than the sub packet length, the serial port in receiving end will sub packet the data and then output them.</td></tr>
<tr><td>0</td><td>0</td><td colspan="2">240 bytes（default）</td></tr>
<tr><td>0</td><td>1</td><td colspan="2">128 bytes</td></tr>
<tr><td>1</td><td>0</td><td colspan="2">64 bytes</td></tr>
<tr><td>1</td><td>1</td><td colspan="2">32 bytes</td></tr>
</table>

<table>
<tr><td></td><td></td><td></td><td colspan="3">5 RSSI environmental noise enable</td><td rowspan="4">RSSI enable command (Sub packet setting, transmit power as default parameters, configuration mode): C0 04 01 20;

After enabling, the command C0 C1 C2 C3 can be sent in the normal mode(mode 0) or WOR transmission mode (trasmitter in mode 1) to read the register;
Register 0x00: current environmental noise RSSI;
Register 0X01: RSSI at Last Data Received (Current channel noise is: dBm = -(256 - RSSI));
Command format: C0 C1 C2 C3+start address+read length;
Return: C1 + address + read length + read valid value;
For example:
Send: C0 C1 C2 C3 00 01
Return: C1 00 01 RSSI (the address can only start from 00)</td></tr>
<tr><td></td><td></td><td></td><td colspan="3">0 Disabled (default)</td></tr>
<tr><td></td><td></td><td></td><td colspan="3">1 Enable</td></tr>
<tr><td></td><td></td><td></td><td colspan="3">4 Software mode switching</td></tr>
<tr><td></td><td></td><td></td><td colspan="3">0 Disabled (default)</td><td rowspan="2">If you use Ebyte's host computer configuration software, this bit will be turned off automatically. If you don't want to use the M0 M1 pins to switch working modes, you can enable this function, and use specific serial port commands to switch modes.
Format: C0 C1 C2 C3 02 + working mode
Send C0 C1 C2 C3 02 00 to switch to transparent transmission mode
Send C0 C1 C2 C3 02 01 to switch to WOR mode
Send C0 C1 C2 C3 02 02 to switch to configuration mode
Send C0 C1 C2 C3 02 03 to switch to sleep mode
Return: C1 C2 C3 02 + working mode
Note: After enabling this function, WOR mode and sleep mode only support 9600 baud rate.</td></tr>
<tr><td></td><td></td><td></td><td colspan="3">1 Enable</td></tr>
<tr><td></td><td></td><td></td><td>3</td><td>2</td><td>Reserve</td><td></td></tr>
<tr><td></td><td></td><td></td><td>1</td><td>0</td><td>Transmitting power</td><td rowspan="6">There is a non-linear relationship between power and current. At the maximum power, the power supply efficiency is the highest ;

Current does not decrease in proportion to the decrease in power.</td></tr>
<tr><td></td><td></td><td></td><td>0</td><td>0</td><td>22dBm (default)</td></tr>
<tr><td></td><td></td><td></td><td>0</td><td>1</td><td>17dBm</td></tr>
<tr><td></td><td></td><td></td><td>1</td><td>0</td><td>13dBm</td></tr>
<tr><td></td><td></td><td></td><td>1</td><td>1</td><td>10dBm</td></tr>
<tr><td>05H</td><td>Read/ Write</td><td>REG2</td><td colspan="3">Channel Control (CH)
0-64 respectively represent a total of 65 channels</td><td>Actual frequency = 220.125MHz + CH *0.25MHz</td></tr>
<tr><td rowspan="8">06H</td><td rowspan="8">Read/ Write</td><td rowspan="8">REG3</td><td colspan="3">7 Enable RSSI bytes</td><td rowspan="3">After enabled, when the module receives the wireless data, it will follow an RSSI strength byte after output via the serial port TXD</td></tr>
<tr><td colspan="3">0 Disable（default）</td></tr>
<tr><td colspan="3">1 Enable</td></tr>
<tr><td colspan="3">6 Transmission mode</td><td rowspan="3">During fixed-point transmission, the module will identify the first three bytes of serial port data as: address high + address low + channel, and use them as wireless transmission targets.</td></tr>
<tr><td colspan="3">0 Transparent transmission mode（default）</td></tr>
<tr><td colspan="3">1 Fixed point transmission mode</td></tr>
<tr><td colspan="3">5 Repeater function</td><td>After the repeater function is enabled, if the target</td></tr>
</table>

			0	Disable relay functionality (default)			address is not the module itself, the module will start a forwarding ; In order to prevent data from being transmitted back, it is recommended to use it in conjunction with fixed-point mode ; that is, the destination address and source address are different.
			1	Enable relay function			
			4	LBT enable			When enabled, wireless data will be monitored before transmission, which can avoid interference to a certain extent, but may cause data delays; The maximum dwell time of LBT is 2 seconds. The wireless data will be transmitted forcibly after 2 seconds.
			0	Disabled (default)			
			1	Enable			
			3	WOR mode transmission control			Below operation is valid for Mode 1 only; In WOR receiving mode (as WOR receiver), the delay time after wake-up can be modified. The default time is 0; 1. To modify the delay time after wake-up, WOR receiver needs to send the command C0 09 02 03 E8 in the configuration mode (C0 is writing command, 09 is the starting address of the register, 02 is the length, 03 E8 is the set delay, the maximum delay FFFF is 65535ms, if the delay is set to 0, the wake-up delay is turn off.) 2. Data can be sent within the delay.
			0	WOR receiver（default） Working in WOR listening mode, the listening period is shown below (WOR period), which can save a lot of power consumption.			
			1	WOR transmitter The module receiving and transmitting functions are turned on, and a wake-up code of a period of time is added when transmitting data.			
			2	1	0	WOR cycle time	Below description is valid for Mode 1 only; Cycle time T = (1 + WOR) * 500ms, max.4000ms, min.500ms; The longer the cycle time T (WOR listening interval period), the lower the average power consumption, but the greater the data delay. Both the transmitter and the receiver must be set as the same cycle time T (very important).
			0	0	0	500ms	
			0	0	1	1000ms	
			0	1	0	1500ms	
			0	1	1	2000ms	
			1	0	0	2500ms	
			1	0	1	3000ms	
			1	1	0	3500ms	
			1	1	1	4000ms	
07H	Write	CRYPT_H	High byte of Key（default 0）				Write only, read returns 0; Used for encryption to avoid interception of wireless data in the air by similar modules; The module will internally use these two bytes as a calculation factor to do a transform encryption processing for the wireless signal over the air.
08H	Write	CRYPT_L	Low byte of Key（default 0）				
80H~86H	Read	PID	Product information 7 bytes				Product information 7 bytes

7.4 Factory default parameters

model	E22-230T22S factory default parameter values: C0 00 09 00 00 00 63 00 28 03 00 00 E22-400T22S factory default parameter value: C0 00 09 00 00 00 62 00 17 03 00 00 E22-900T22S factory default parameter value: C0 00 09 00 00 00 62 00 12 03 00 00						
Model No	Frequency	Address	Channel	Air data rate	Baud rate	Parity format	Transmit Power
E22-230T22S	230.125MHz	0x0000	0x28	2.4kbps	9600	8N1	22dbm
E22-400T22S	433.125MHz	0x0000	0x17	2.4kbps	9600	8N1	22dbm
E22-900T22S	868.125MHz	0x0000	0x12	2.4kbps	9600	8N1	22dbm

8. AT command

- Parameter configuration or query using AT commands needs to be done in configuration mode;
- AT commands are used in configuration mode. AT commands are divided into three categories: command commands, setting commands and query commands;
- Users can query the AT command set supported by the module through "AT+HELP=?". The baud rate used by the AT command is 9600 8N0;
- When the input parameters exceed the range, they will be restricted. Please do not let the parameters exceed the range to avoid unknown situations.

8.1 AT command list

Command Commands	Description	Example	Example description
AT+IAP (use with caution, please see 8.3 Precautions for Serial Port Firmware Upgrade in this article for details)	Enter IAP upgrade mode	AT+IAP	Enter IAP upgrade mode
AT+RESET	Device restart	AT+RESET	Device restart
AT+DEFAULT	Restore configuration parameters to default and the device restarts	AT+DEFAULT	Restore configuration parameters to default and the device restarts

Setting Commands	Description	Example	Example description
AT+UART=baud,parity	Set baud rate and parity	AT+UART=3,0	Set the baud rate to 9600, 8N0
AT+RATE=rate	Set air data rate	AT+RATE=7	Set air data rate to 62.5K/15.6K
AT+PACKET=packet	Set packet length	AT+PACKET=0	Set the packet size to 240 bytes

AT+WOR=role	Set WOR role	AT+WOR=0	Set to WOR reception
AT+POWER=power	Set transmit power	AT+POWER=0	Set the transmit power to 22dBm
AT+TRANS=mode	Set transmission mode	AT+TRANS=1	Set to fixed point transmission mode
AT+ROUTER=router	Set repeater mode	AT+ROUTER=1	Set to repeater mode
AT+LBT=lbt	Set Listen Before Talk function switch	AT+LBT=1	Setting is enabled, please refer to Section 7.2 LBT Enable for details.
AT+ERSSI=erssi	Set the environmental noise RSSI switch	AT+ERSSI=1	The setting is enabled. For details, please refer to Section 7.2 RSSI environmental Noise Function.
AT+DRSSI=data_rssi	Set the receive data RSSI switch	AT+DRSSI=1	Receive data RSSI function is turned on
AT+ADDR=addr	Set module address	AT+ADDR=1234	Set the module address to 1234
AT+CHANNEL=channel	Set module working channel	AT+CHANNEL=23	Set frequency to 433.125M
AT+NETID=netid	Set network ID	AT+NETID=2	Set network ID to 2
AT+KEY=key	Set module key	AT+KEY=1234	Set the module key to 1234
AT+DELAY=delay	Set WOR delay sleep time	AT+DELAY=1000	Set the WOR delay sleep time to 1000ms
AT+SWITCH=switch	Setting software mode switch	AT+SWITCH=1	Enable settings in configuration mode to allow software switching
AT+MODE=mode	Switch working mode	AT+MODE=0	Switch to transparent transmission mode

Query Commands	Description	Return example	Example description
AT+HELP=?	Query AT command table		Return to AT command list
AT+DEVTYPE=?	Query module model	DEVTYPE=E22 -400T22S/D	Return module model
AT+FWCODE=?	Query firmware code	FWCODE=7432-0-10	Return firmware version
AT+UART=?	Query baud rate and checksum	AT+UART=3,0	Return baud rate 9600, 8N1
AT+RATE=?	Query air speed	AT+RATE=7	Return air rate is 62.5K/ 15.6K
AT+PACKET=?	Query packet length	AT+PACKET=0	The returned packet is 240 bytes
AT+WOR=?	Query WOR roles and cycles	AT+WOR=0	Return as WOR receiver
AT+POWER=?	Query transmit power	AT+POWER=0	The return transmit power is 22dBm

AT+TRANS=?	Query sending mode	AT+TRANS=1	Return to fixed point mode
AT+ROUTER=?	Query relay mode	AT+ROUTER=1	Return to relay mode
AT+LBT=?	Query the Listen Before Talk function switch	AT+LBT=1	Return LBT switch status
AT+ERSSI=?	Query the environmental noise RSSI switch	AT+ERSSI=1	Return to environmental noise switch status
AT+DRSSI=?	Query RSSI output	AT+DRSSI=1	Return channel RSSI function is enabled
AT+ADDR=?	Query module address	AT+ADDR=1234	The return module address is 1234
AT+CHANNEL=?	Query module working channel	AT+CHANNEL=23	The return frequency is 433.125M
AT+NETID=?	Query network ID	AT+NETID=2	Return network ID is 2
AT+KEY=?	Query module key	Reading is not supported (security considerations)	Return ERR
AT+DELAY=?	Query WOR delayed sleep time	AT+DELAY=1000	Return to WOR delayed sleep time is 1000ms
AT+SWITCH=?	Query software switching mode switch	AT+SWITCH=0	Software switching mode is off
AT+MODE=?	Query the current working mode (can be queried in all modes)	AT+MODE=0	Returns the current transparent transmission mode

8.2 AT parameter analysis

When the serial port receives the correct command, the serial port will return "command=OK", otherwise it will return "=ERR"

Command parameters	Parameter meaning
Baud (serial port baud rate)	0:1200 1:2400 2:4800 3:9600 4:19200 5:38400 6 : 57600 7:115200
Parity (serial port parity bit)	0:8N1 1:8O1 2:8E1 3:8N1
Rate (over-the-air data rate) Applicable to 400MHz frequency band and 900MHz frequency band	0:2.4K 1:2.4K 2:2.4K 3:4.8K 4:9.6K 5:19.2K 6:38.4K 7:62.5K
Rate (over-the-air data rate) Applicable to 230MHz frequency band	0:2.4K 1:2.4K 2:2.4K 3:2.4K 4:4.8K 5: 9.6K 6:15.6K 7:15.6K
Packet (packet length)	0: 240 1: 128 2:64 3:32
Role (WOR role)	0: Receiving 1: Transmitting
Period (WOR period)	0:500ms 1:1000ms 2:1500ms 3:2000ms 4:2500ms 5:3000ms 6:3500ms 7:4000ms
Power (transmission power) Note 1	0:22dBm 1:20dBm 2:17dBm 3:14dBm
Mode (transmission mode)	0: transparent 1: fixed point
Router (repeater mode)	0: Close 1: Open

LBT(listen before talk)	0: Close 1: Open
Erssi (environment RSSI)	0: Close 1: Open
Data_rssi (data RSSI)	0: Close 1: Open
Addr (module address)	Module address 0~65535 (decimal)
Channel (module channel)	Module channel 0~83 (decimal)
Netid (Network ID)	Module network 0~255 (decimal)
Key _	Module key 0~65535 (decimal)
Delay (WOR delayed sleep)	Delayed sleep 0~65535 (decimal)

Note 1: Modules with different powers have different settings. You can check the transmission power in Section 7.2 of the manual.

8.3 Notes for upgrading firmware via serial port

If the customer needs to upgrade the firmware, they need to find the corresponding BIN file provided by the official, and then use the officially provided host computer to upgrade the firmware. Generally, when users do not need to upgrade the firmware, please do not use the "AT+IAP" command.

The pins necessary for the upgrade must be lead out (M1, M0, AUX, TXD, RXD, VCC, GND), and then send the "AT+IAP" command in the configuration mode to enter the upgrade mode. If you need to exit the IAP upgrade mode, you need to keep Power on and wait 60 seconds, the program will automatically exit, otherwise it will enter the upgrade mode indefinitely even if it is restarted.

After entering the upgrade mode, the baud rate will automatically switch to 115200 until it automatically exits, during which there will be log output.

9. Repeater networking mode

No.	Repeater mode description
1	User need to set the repeater function in configuration mode. After setting, switch module to the normal mode. Then the repeater starts working.
2	In the repeater mode, ADDH/ADDL is no longer used as the module address, it is used as a NETID to pair and forwarding. If the reperater receive the data from a network, then it will forward the data to the other network. The network ID of the repeater itself is invalid in this case. (See below examples)
3	The repeater module cannot transmit and receive data, and cannot perform low-power operation.
4	When module enters the other modes from mode 3 (sleep mode) or during the reset process, it will reset the user parameters. During this period, AUX outputs low level.

Repeater networking rules:

1. Forwarding rules: the repeater can forward data in both directions between two NETIDs.
2. In repeater mode, ADDH\ADDL is no longer used as the module address. It is used as a NETID to pair and forwarding.

As shown in the figure：

① Primary repeater

“Node 1” NETID is 08.

“Node 2” NETID is 33.

ADDH\ADDL of Repeater 1 are 08，33 respectively.

So the data sent by node 1 (08) can be forwarded to node 2 (33)

Meanwhile,node 1 and node 2 have the same address, so the data transmitted by node 1 can be received by node 2.

② Secondary repeater

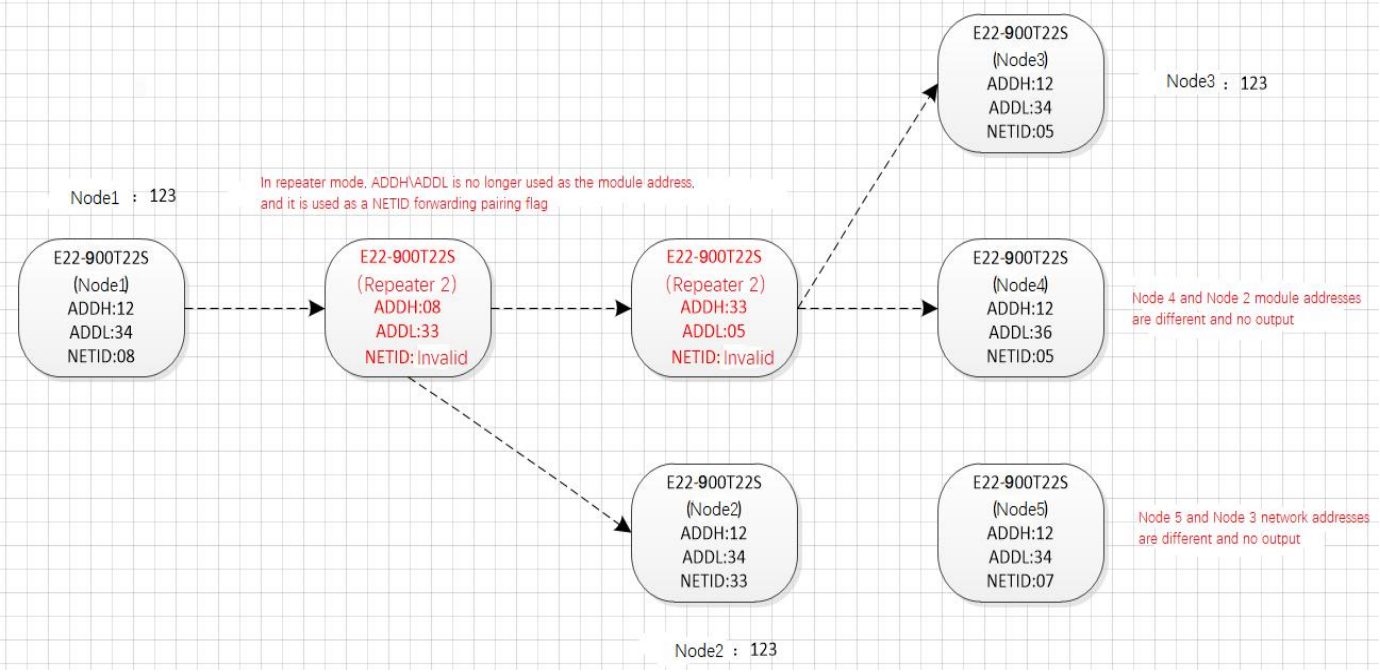
ADDH\ADDL of Repeater 2 are 33，05 respectively.

Therefore, Repeater 2 can forward the data of Repeater 1 to the network NETID: 05.

Thus node 3 and node 4 can receive the data from node . Node 4 outputs data normally, but no ourput from Node3 because Node 3 has a different address from Node 1.

③ Two-way repeater

As shown in below：
The data sent by Node 1 can be received by Node 2 and Node 4;
The data sent by by Node 2 and Node 4 can also be received by Node 1.



10. Configuration instructions on computer

- The following figure is the display interface of E22-900T30D configuration on computer. User can switch to the command mode through M0, M1, and quickly configure and read the parameters on computer.

- In the configuration software on computer, the module address, frequency channel, network ID, and key are all in decimal display mode; The range of values of each parameter is:

  Network address: 0～65535

  Frequency channel: 0～80

  Network ID: 0～255

  Key: 0～65535

- When user configures the repeater mode using the host computer, one point much be paid attention to: In the configuration software, each parameter is in decimal, so the module address and network ID need to be converted when set it.
- For example, in the configure software, if the network ID of Transmitter A is input 02, and the network ID of Receiver B is input 10, then the module address of Repeater R should be set as 522. (The address of Repeater R is 0X020A in hex, and it need to be converted to decimal.)

11. 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 must 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, it will cause permanent damage to the module;
- Please check the stability of the power supply. The voltage cannot fluctuate greatly and frequently;
- When designing the power supply circuit for the module, it is often recommended to reserve more than 30% 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 high electromagnetic interference;
- High-frequency digital wiring, high-frequency analog wiring, and power wiring must avoid the bottom of the module. If it is

really necessary to pass under the module, assume that the module is welded on the Top Layer, and ground copper is laid on the Top Layer of the module contact part (all copper is laid and Good grounding), must be close to the digital part of the module and routed on the Bottom Layer ;

- Assuming that the module is welded or placed on the Top Layer, it is also wrong to route traces randomly on the Bottom Layer or other layers, which will affect the module's spurious and receiving sensitivity to varying degrees ;
- Assuming that there are devices with large electromagnetic interference around the module, which will also greatly affect the performance of the module, it is recommended to stay away from the module according to the intensity of the interference. If the situation allows, appropriate isolation and shielding can be done;
- Assuming that there are traces with large electromagnetic interference around the module (high-frequency digital, high-frequency analog, power traces), it will also greatly affect the performance of the module. It is recommended to stay away from the module according to the intensity of the interference. If the situation allows, you can make appropriate adjustments. isolation and shielding;
- 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 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.

12. Frequently Asked Questions

12.1 Transmission distance is short

- When there are straight-line communication obstacles, the communication distance will be correspondingly attenuated ;
- Temperature, humidity, and co-channel interference will cause the communication packet loss rate to increase ;
- The ground absorbs and reflects radio waves, and the test effect is poor when close to the ground ;
- Seawater has a strong ability to absorb radio waves, so the seaside test results are poor ;
- If there are metal objects near the antenna, or if it is placed in a metal case, the signal attenuation will be very serious ;
- The power register setting is wrong and the air rate is set too high (the higher the air rate, the closer the distance) ;
- The low voltage of the power supply at room temperature is lower than the recommended value. The lower the voltage, the smaller the power generated ;
- There is a poor match between the antenna and the module or there is a problem with the quality of the antenna itself.

12.2 Modules are easily damaged

- Please check the power supply to ensure that it is within the recommended power supply voltage. If it exceeds the maximum value, it will cause permanent damage to the module ;

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

12.3 BER(Bit Error Rate) is high

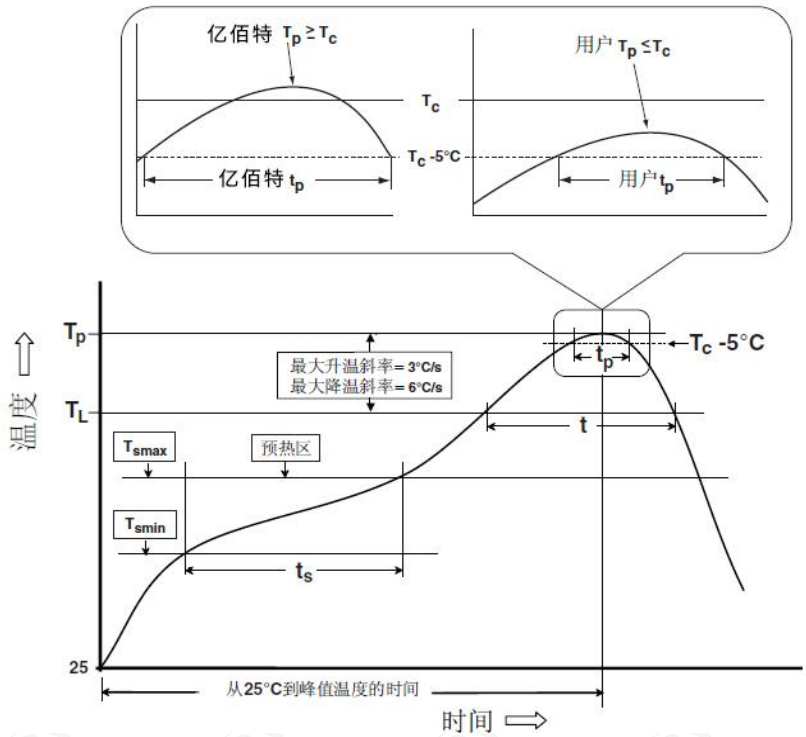
- If there is co-channel signal interference nearby, stay away from the interference source or modify the frequency or channel to avoid interference;
- Unsatisfactory power supply may also cause garbled code, so be sure to ensure the reliability of the power supply;
- Poor quality or too long extension cords and feeders can also cause a high bit error rate.

13. Welding Operation Guidance

13.1 Reflow soldering temperature

Reflow soldering curve characteristics		Lead process assembly	Lead-free process assembly
Preheat /keep warm	Minimum temperature (Tsmin)	100℃	150℃
	Maximum temperature (Tsmax)	150℃	200℃
	Time (Tsmin ~Tsmin)	60-120 seconds	60-120 seconds
Temperature rise slope (T_L ~Tp)		3℃/second, maximum	3℃/second, maximum
Liquidus temperature (T_L)		183℃	217℃
Holding time above T_L		60~ 90 seconds	60~ 90 seconds
Package peak temperature Tp		Users should not exceed the temperature indicated on the product's "Moisture Sensitivity" label.	Users should not exceed the temperature indicated on the product's "Moisture Sensitivity" label.
The time (Tp) within 5°C of the specified classification temperature (Tc), see the figure below		20 seconds	30 seconds
Cooling slope (Tp ~TL)		6℃/second, maximum	6℃/second, maximum
Time from room temperature to peak temperature		6 minutes, maximum	8 minutes, maximum
※The peak temperature (Tp) tolerance definition of the temperature curve is the upper limit of the user			

13.2 Reflow soldering curve



14. Related Models

Product number	carrier frequency Hz	Transmit power dBm	Tested distance km	Package form	Product Size mm	Communication Interface
E22-230T22S	230M	22	5	SMD	16*26	TTL
E22-230T30S	230M	30	10	SMD	20*40.5	TTL
E22-400T22S	433/470M	22	5	SMD	16*26	TTL
E22-400T30S	433/470M	30	10	SMD	20*40.5	TTL
E22-900T22S	868/915M	22	5	SMD	16*26	TTL
E22-900T30S	868/915M	30	10	SMD	20*40.5	TTL
E22-400M22S	433/470M	22	7	SMD	14*20	SPI
E22-400M30S	433/470M	30	12	SMD	24*38.5	SPI
E22-900M22S	868/915M	22	7	SMD	14*20	SPI
E22-900M30S	868/915M	30	12	SMD	24*38.5	SPI

15. Antenna Guide

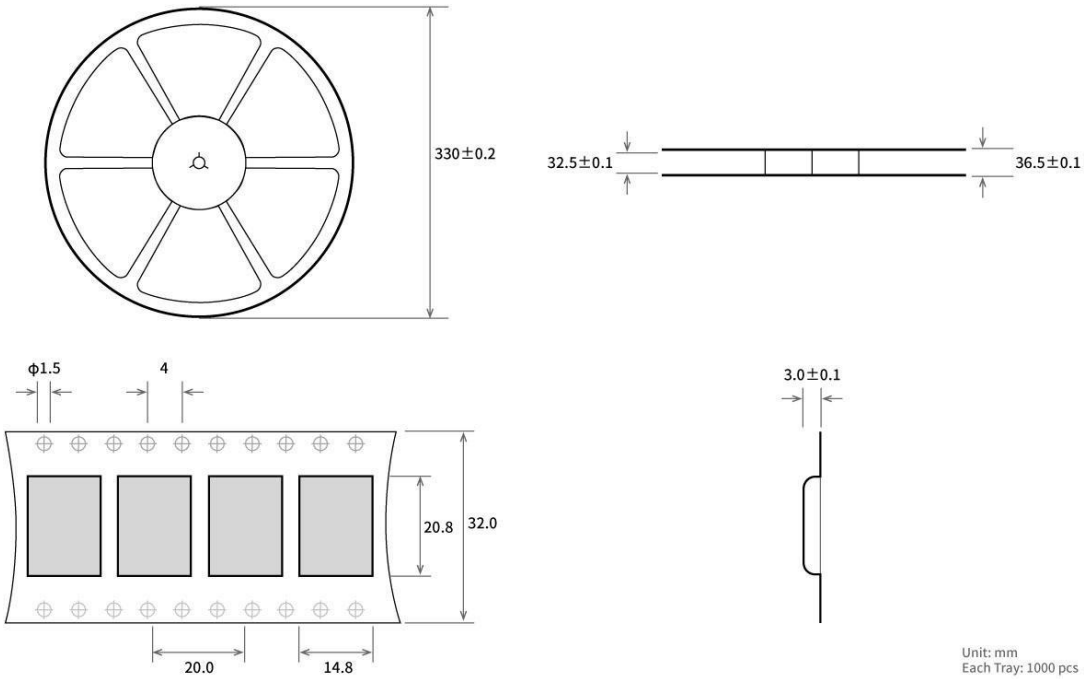
15.1 Antenna recommendations

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 antennas that support our wireless modules and have excellent performance and reasonable prices.

Product number	type	frequency band Hz	interface	Gain dBi	high mm	feeder cm	Features
TX433-NP-4310	FPC antenna	433M	welding	2.0	43.8*9.5	-	Embedded FPC antenna
TX433-JZ-5	Rubber antenna	433M	SMA-J	2.0	52	-	Short straight &omnidirectional
TX433-JZG-6	Rubber antenna	433M	SMA-J	2.5	62	-	Short straight &omnidirectional
TX433-JW-5	Rubber antenna	433M	SMA-J	2.0	50	-	Flexible &omnidirectional
TX433-JWG-7	Rubber antenna	433M	SMA-J	2.5	75	-	Flexible &omnidirectional
TX433-JK-11	Rubber antenna	433M	SMA-J	2.5	110	-	Flexible &omnidirectional
TX433-JK-20	Rubber antenna	433M	SMA-J	3.0	210	-	Flexible &omnidirectional
TX433-XPL-100	Sucker antenna	433M	SMA-J	3.5	185	100	Small sucker antenna, cost-effictive
TX433-XP-200	Sucker antenna	433M	SMA-J	4.0	190	200	Medium sucker antenna,low power comsumption
TX433-XPH-300	Sucker antenna	433M	SMA-J	6.0	965	300	Large sucker antenna, high gain
TX490-JZ-5	Rubber antenna	470/490M	SMA-J	2.0	50	-	Short straight &omnidirectional
TX490-XPL-100	Sucker antenna	470/490M	SMA-J	3.5	120	100	Small sucker antenna, cost-effictive

16. Bulk packaging method

16.1 E22-230/400/900T22S batch packaging method



Revise history

Version	Revision date	Revision Notes	Maintenance man
1.0	2023-6-15	initial version	Hao
1.1	2024-3-20	Content correction	Hao

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