E32-T Series Product Specifications

AT Command 433/868/915MHz LoRa Wireless Module



Chengdu Ebyte Electronic Technology Co.,Ltd.

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1 Product Overview

1.1 Brief Introduction

The E32-T Series (UART) module, developed by Chengdu Yibait Electronics Technology Co., Ltd. based on SEMTECH's classic RF chip, features a transmit power of 20/30dBm. It supports multiple transmission modes and operates in the 433MHz/868MHz/915MHz frequency bands. Utilizing LoRa spread spectrum technology, it provides TTL-level output and is compatible with 3.3V IO port voltage.

The E32-T series employs the latest generation of LoRa spread spectrum technology. LoRa™ direct sequence spread spectrum technology offers extended communication range, superior interference resistance, and robust confidentiality. With a maximum transmit power of 30dBm, it incorporates a PA power amplifier and LNA low-noise amplifier to enhance communication stability and extend transmission distance. Industrial-grade standards ensure reliability and consistency. Currently in stable mass production, it is widely deployed in utility metering, IoT retrofits, smart home applications, and other fields.

The eight modules shown below vary in power, packaging, and frequency bands. Detailed specifications are provided in Section 2.1: E32-T Series Product Selection Comparison.



E32-433T20D



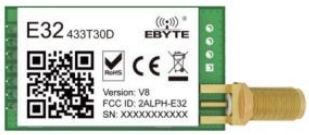
E32-433T20S



E32-900T20D



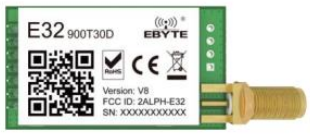
E32-900T20S



E32-433T30D



E32-433T30S



E32-900T30D



E32-900T30S

1.2 Features

- Features next-generation LoRa spread-spectrum modulation technology for extended communication range and enhanced interference resistance;
- Supports multiple frequency bands including 433/868/915MHz (customizable);
- Enables serial port firmware upgrades for simplified maintenance;
- Supports dual HEX and AT command systems for flexible user selection;
- Supports Forward Error Correction (FEC) for enhanced communication stability;
- Supports Wake-on-Air (WoA) functionality, enabling ultra-low power consumption ideal for battery-powered applications;
- Supports point-to-point transmission and broadcast transmission;
- Supports deep sleep mode;
- Multi-level adjustable air transmission rates;
- Parameters are preserved during power loss; the module resumes operation with preset parameters upon power-up;
- Built-in watchdog automatically resets and restores operation in case of unexpected events.

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1.3 Application

- Home security alarms and remote keyless entry;
- Smart home and industrial sensors;
- Wireless alarm security systems;
- Building automation solutions;
- Wireless industrial-grade remote controllers;
- Healthcare products;
- Advanced Metering Infrastructure (AMI).

2 Specification and parameter

2.1 E32-T Series Product Selection Comparison

Type	Model	Frequency① Hz	Transmit Power②dBm	Test Distance③km	Package Type	Size mm	Antenna Type④
433MHz Band Module	E32-433T20S	410～441M	20	5	SMD	16*26	IPEX-1/Stamp Hole
	E32-433T20D	410～441M	20	5	DIP	21*36	SMA-K
	E32-433T30S	410～441M	30	8	SMD	40.5*25	IPEX-1/Stamp Hole
	E32-433T30D	410～441M	30	8	DIP	43*24	SMA-K
868/915 MHz Band Module	E32-900T20S	862～930M	20	5	SMD	16*26	IPEX-1/Stamp Hole
	E32-900T20D	862～930M	20	5	DIP	21*36	SMA-K
	E32-900T30S	862～930M	30	8	SMD	40.5*25	IPEX-1/Stamp Hole
	E32-900T30D	862～930M	30	8	DIP	43*24	SMA-K

Note:

(1) Carrier Frequency ①: Frequency band range supports user customization;

(2) Transmit Power ②: 20dBm = 100mW / 30dBm = 1000mW, tolerance range ±1dBm. Multi-level power adjustment available. Refer to Sections 6 and 7 for detailed power levels;

(3) Test Distance③: Clear open space, airspeed 2.4kbps, antenna height 2 meters (for reference only; field testing recommended);

(4) Antenna Configuration④: Equivalent impedance approximately 50Ω;

(5) Modules within the same frequency band can communicate with each other.

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2.2 Basic Parameters

- E32-T Series 20dBm Low-Power Module Models: E32-433T20D, E32-433T20S, E32-900T20D, E32-900T20S;
- E32-T Series 30dBm high-power module models are: E32-433T30D, E32-433T30S, E32-900T30D, E32-900T30S;

2.2.1 Basic Parameters

Conditions: Tc=25°C, VCC=5.0V, 433MHz/868MHz/915MHz

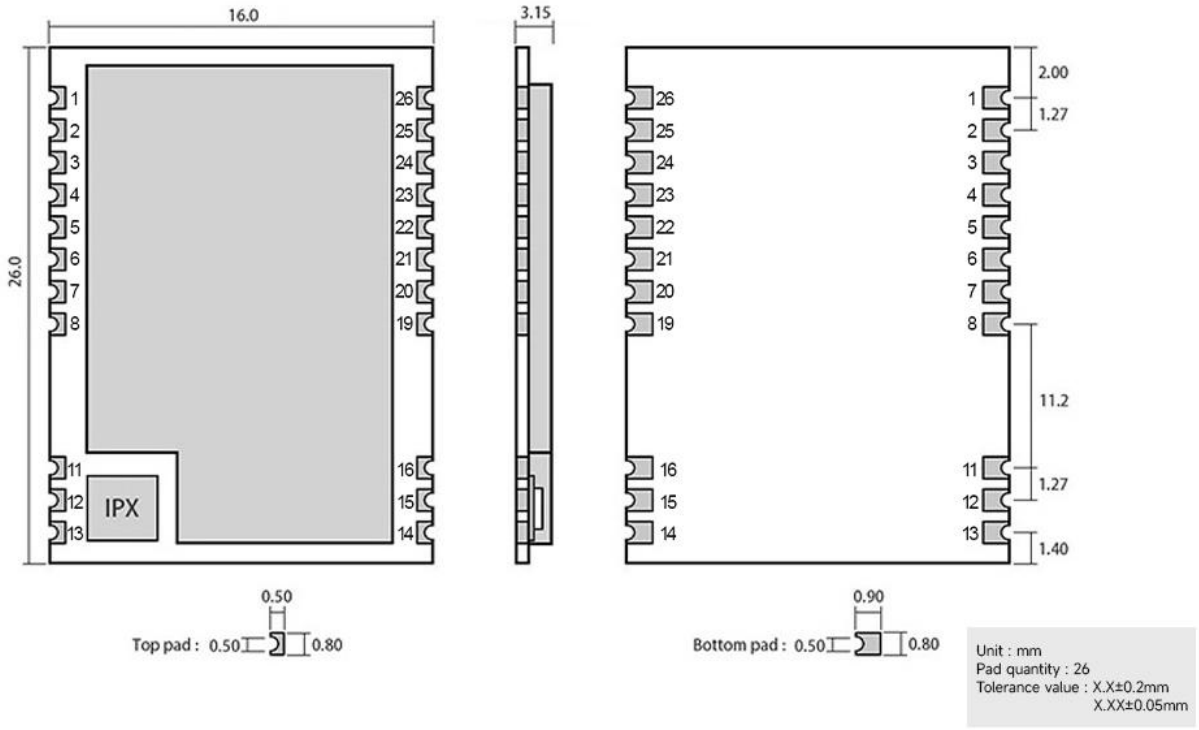
Parameters	Description
Modulation method	LoRa Modulation Technology
Interface	1.27mm pin pitch / 2.54mm pin header connectors; the pin pitch connectors are surface-mount modules, while the pin headers are through-hole modules.
Communication Interface	UART Serial Port (3.3V)
Launch length	58 Bytes, maximum capacity per package; automatically splits into multiple packages when exceeded.
Packaging method	SMD/DIP
Cache capacity	512Byte
Work Environment	
Operating Temperature	-40℃～+85℃，Industrial-grade standards
Operating Humidity	10～90%RH
Storage temperature	-40℃～+125℃
RF parameters	
Transmit Power	20dBm = 100mW, with multi-level power adjustment. For details, refer to Sections 6 and 7 of this document.
	30dBm = 1000mW, with multi-level power adjustment. For details, refer to Sections 6 and 7 of this document.
Operating frequency band	410 MHz to 441 MHz, supports custom frequency bands
	862 MHz to 930 MHz, supports customized frequency bands
Receiver sensitivity	-126dBm, data rate 2.4kbps@SF11, suitable for E32-T series 20dBm low-power modules
	-134dBm, data rate 2.4kbps@SF11, suitable for E32-T series 30dBm high-power modules
Air Speed	2.4 to 19.2 Kbps, with multi-level adjustable air interface rates. For details, refer to Sections 6 and 7 of this document.
Blocking power	10dBm
Electrical Parameters	
Supply Voltage	2.6–5.5V, 30dBm output module ≥5V, 20dBm output module ≥3.3V to ensure output power. Exceeding 5.5V will permanently burn out the module.
Communication Level	3.3V
Launch current	90–120mA, instantaneous power consumption @ 20dBm, suitable for E32-T series 20dBm low-

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Parameters	Description
	power modules
	500–600mA, instantaneous power consumption @ 30dBm, suitable for E32-T series 30dBm high-power modules
Receive current	≈7mA, suitable for E32-T series 20dBm low-power modules
	≈14mA, suitable for E32-T series 30dBm high-power modules
Sleep current	≈2uA

3 Mechanical Dimensions and Pin Definitions

3.1 E32-433T20S & 900T20S Mechanical Dimensions and Pin Definitions



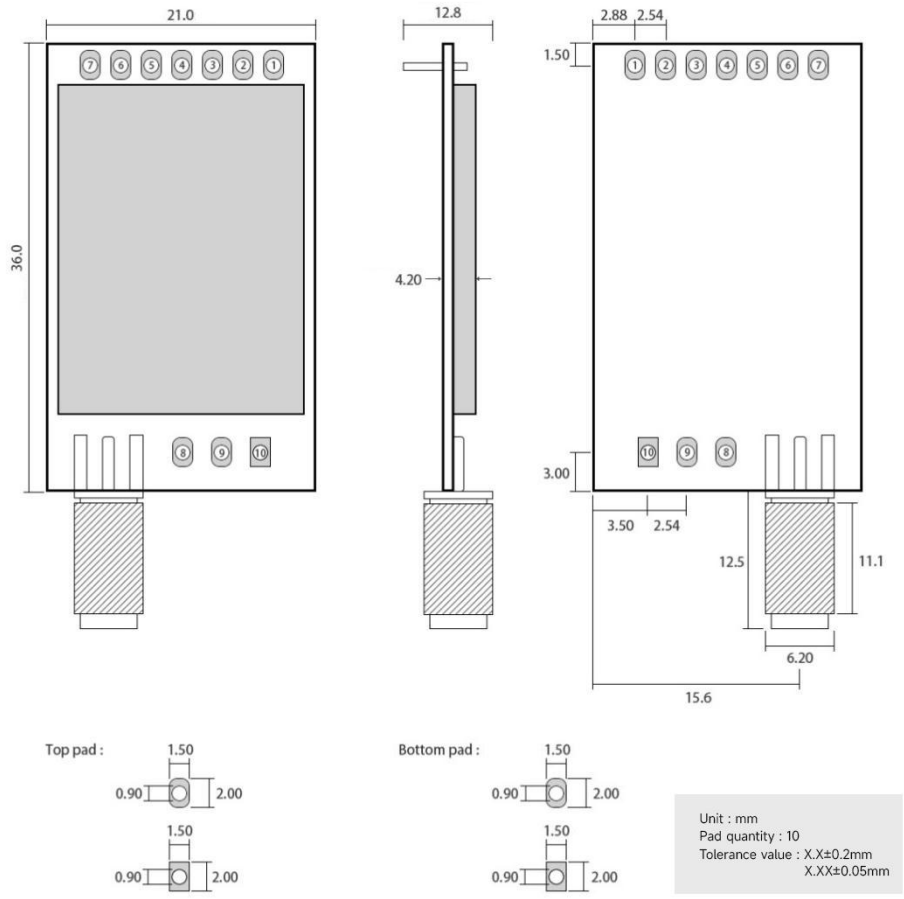
Pin Number	Pin Name	Pin Orientation	Pin Function
1	RESET	Input	1. Module reset pin. Low-level trigger for reset, requiring a pull-down time exceeding 100μs; 2. Users are strongly advised to connect to a microcontroller for reset and recovery in unexpected situations.
2	GND	-	Module Grounding
3	NC	-	Empty Foot (Please leave this space blank)
4	NC	-	Empty Foot (Please leave this blank)

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5	NC	-	Empty Foot (Please leave this blank)
6	NC	-	Empty pins (programming pins; if possible, bring them out for easier maintenance or firmware customization later)
7	NC	-	Empty pins (programming pins; if possible, bring them out for easier maintenance or firmware customization later)
8	GND	-	Module Grounding
11	GND	-	Module Grounding
12	ANT	Outpu	Antenna Interface (High-Frequency Signal Output, 50-Ohm Characteristic Impedance)
13	GND	-	Module Grounding
14	GND	-	Module Grounding
15	GND	-	Module Grounding
16	GND	-	Module Grounding
19	GND	-	Module Grounding
20	M0	Input (Very weak pull-up)	In conjunction with M1, determines the module's four operating modes (cannot be left floating).
21	M1	Input (Very weak pull-up)	In conjunction with M0, determines the module's four operating modes (cannot be left floating).
22	RXD	Input	3.3V serial input connected to external TXD output pin;
23	TXD	Output	3.3V serial port output connected to the external RXD output pin;
24	AUX	Output	1. Indicates module operational status (may be left floating); 2. During normal operation, a low level on this pin indicates busy status, while a high level indicates idle status; 3. It is not recommended to use this pin to drive external devices or pull it low. Otherwise, if the AUX pin is continuously pulled low by an external source during module power-up, the module may forcibly enter upgrade mode and fail to operate normally. For detailed information, please refer to Section 5.
25	VCC	-	Module Power Supply (Please refer to the Electrical Parameters section)
26	GND	-	Module Grounding

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3.2 E32-433T20D&900T20D Mechanical Dimensions and Pin Definitions

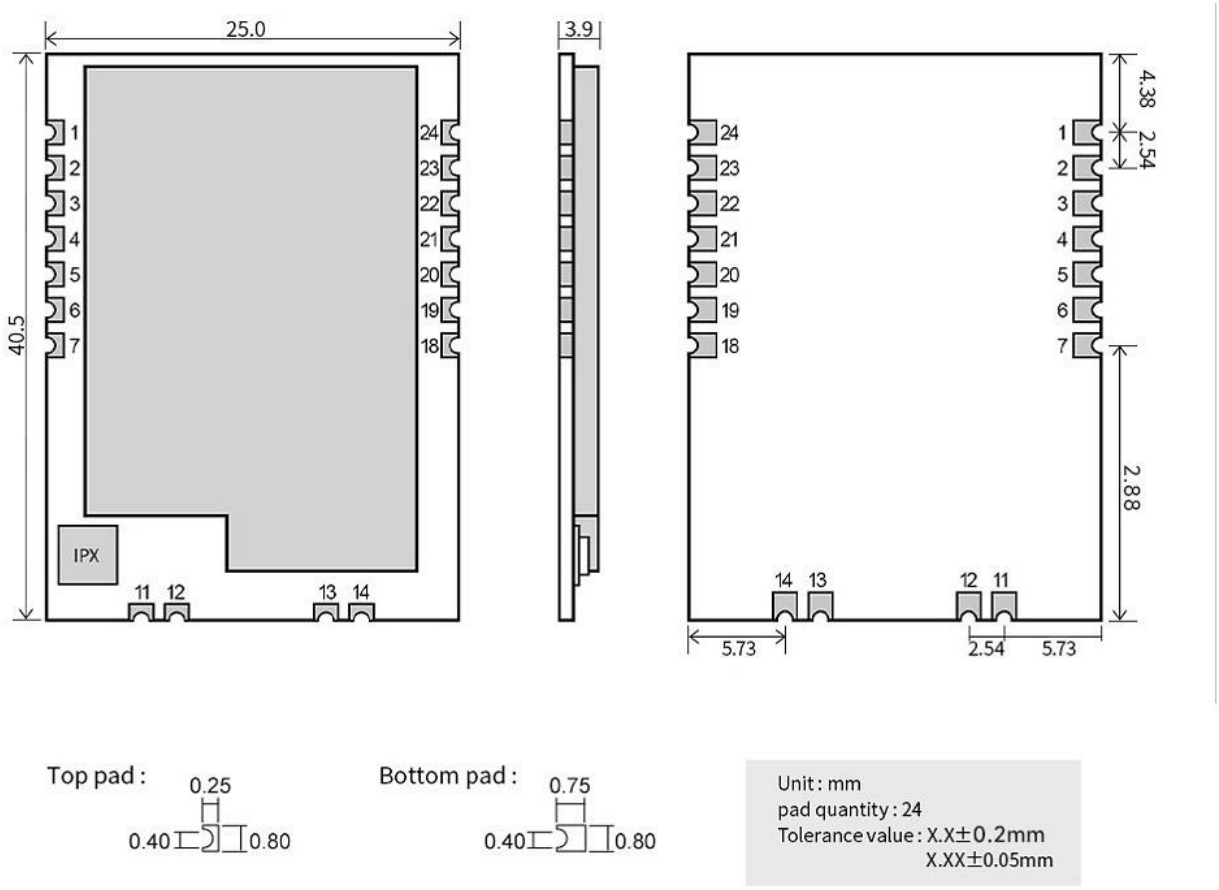


Pin Number	Pin Name	Pin Orientation	Pin Function
1	M0	Input (Very weak pull-up)	When paired with M1, determines the module's four operating modes (cannot be left floating).
2	M1	Input (Very weak pull-up)	When paired with M0, determines the module's four operating modes (cannot be left floating).
3	RXD	Input	TTL serial input, connected to the external TXD output pin;
4	TXD	Output	TTL serial output connected to the external RXD input pin
5	AUX	Output	1. Indicates module operational status (may be left floating); 2. During normal operation, a low level on this pin indicates busy status, while a high level indicates idle status; 3. It is not recommended to use this pin to drive external devices or pull it low. Otherwise, if the AUX pin is continuously pulled low by an external source during module power-up, the module may forcibly enter upgrade mode and fail to operate normally. For detailed information, please refer to Section 5.
6	VCC	Input	Module Power Supply (Please refer to the Electrical Parameters

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			section)
7	GND	Input	Module Grounding
8	Fixed hole		Fixed hole
9	Fixed hole		Fixed hole
10	Fixed hole		Fixed hole

3.3 E32-433T30S&900T30S Mechanical Dimensions and Pin Definitions



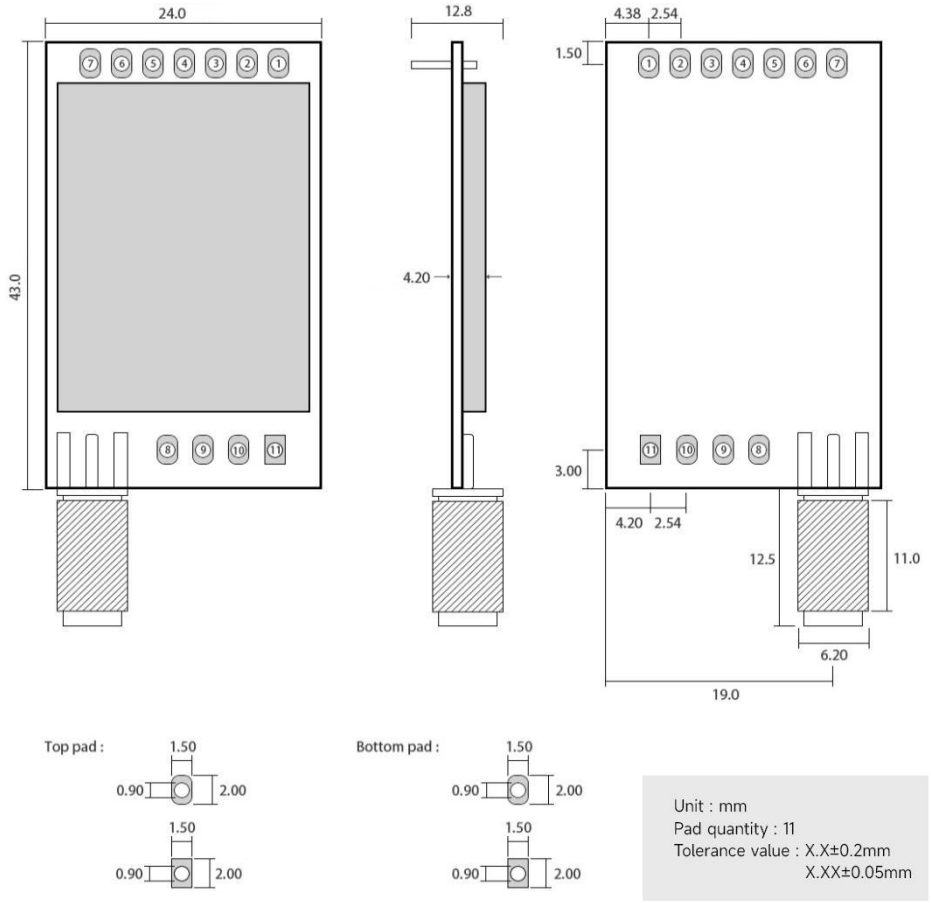
Pin Number	Pin Name	Pin Orientation	Pin Function
1	GND	Input	Module Grounding
2	VCC	Input	Module Power Supply (Please refer to the Electrical Parameters section)
3	AUX	Output	1. Indicates module operational status (may be left floating) 2. During normal operation, a low level on this pin indicates busy status, while a high level indicates idle status;

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			3. It is not recommended to use this pin to drive external devices or pull it low. Otherwise, if the AUX pin is continuously pulled low by an external source during module power-up, the module may forcibly enter upgrade mode and fail to operate normally. For detailed information, please refer to Section 5.
4	TXD	Output	3.3V serial port output, connected to the external RXD input pin;
5	RXD	Input	3.3V serial input connected to external TXD output pin;
6	M1	Input (Very weak pull-up)	In conjunction with M0, determines the module's four operating modes (cannot be left floating).
7	M0	Input (Very weak pull-up)	In conjunction with M1, determines the module's four operating modes (cannot be left floating).
11	ANT	Output	Antenna Interface (High-Frequency Signal Output, 50-Ohm Characteristic Impedance)
12	GND	-	Grounded pin
13	GND	-	Grounded pin
14	GND	-	Grounded pin
18	NC	_	Empty pins (programming pins; if possible, bring them out for easier maintenance or firmware customization later)
19	NC	_	Empty pins (programming pins; if possible, bring them out for easier maintenance or firmware customization later)
20	NC	_	Empty Foot (Please leave this space blank)
21	NC	_	Empty Foot (Please leave this space blank)
22	RESET	Input	1. Module reset pin. Low-level trigger initiates reset, requiring a hold time exceeding 100μs. 2. Users are strongly advised to connect to a microcontroller for reset and recovery in unexpected situations.
23	GND	-	Grounded pin
24	NC	_	Empty Foot (Please leave this blank)

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3.4 E32-433T30D&900T30D Mechanical Dimensions and Pin Definitions

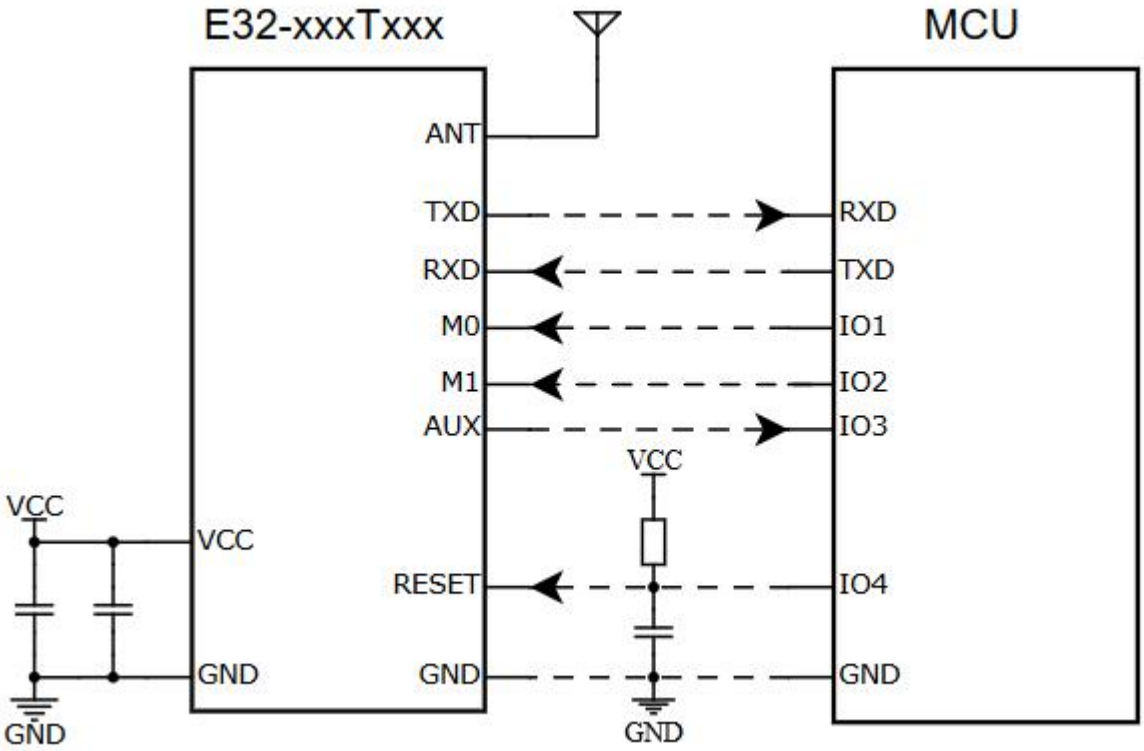


Pin Number	Pin Name	Pin Orientation	Pin Function
1	M0	Input (Very weak pull-up)	When paired with M1, determines the module's four operating modes (cannot be left floating).
2	M1	Input (Very weak pull-up)	When paired with M0, determines the module's four operating modes (cannot be left floating).
3	RXD	Input	3.3V serial input connected to the external TXD output pin;
4	TXD	Output	3.3V serial port output, connected to the external RXD input pin;
5	AUX	Output	1. Indicates module operational status (may be left floating); 2. During normal operation, a low level on this pin indicates busy status, while a high level indicates idle status; 3. It is not recommended to use this pin to drive external devices or pull it low. Otherwise, if the AUX pin is continuously pulled low by an external source during module power-up, the module may forcibly enter upgrade mode and fail to operate normally. For detailed information, please refer to Section 5.
6	VCC	Input	Module Power Supply (Please refer to the Electrical Parameters section)
7	GND	Input	Module Grounding

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8	Fixed hole	-	Fixed hole
9	Fixed hole	-	Fixed hole
10	Fixed hole	-	Fixed hole
11	Fixed hole	-	Fixed hole

4 Recommended Connection Diagram



Serial Number	Notes
1	The module features a 3.3V serial port and I/O pins. Users with 5V microcontrollers should consider level conversion.
2	It is strongly recommended to connect the RESET pin to prevent unexpected malfunctions or other abnormal conditions.
3	If you plan to add an external switch to the module's VCC, consider the leakage current of the external microcontroller's serial port. Otherwise, the module cannot be turned off.
4	It is not recommended to use the AUX pin to drive external components, such as powering LEDs or controlling relays. If continuously pulled low by an external source during power-up, it will not function properly.
5	(Optional) Surface-mount modules may consider exposing the module's programming pins to facilitate future maintenance or firmware customization.

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Serial Number	Notes
6	(Optional) The module serial port may be extended with additional interfaces for easier maintenance (supporting online upgrades via PC tools).

5 Detailed Functionality

- In this section, pin 0 of M1/M0 represents a low level, while 1 represents a high level.
- If using software switching mode, refer to Chapter 7 for the AT+MODE command.

5.1 Operating Mode

The module has four operating modes, set via pins M1 and M0. Details are shown in the table below:

Mode（0-3）	M1	M0	Model Introduction	Note
0 General Mode	0	0	Serial port enabled, wireless enabled, transparent transmission	The receiving party must be Mode 0 or Mode 1.
1 Wake Mode	0	1	Serial port enabled, wireless enabled; The only difference from Mode 0: Before transmitting data packets, it automatically appends a wake-up code to wake up the receiver operating in Mode 2.	The receiver can be Mode 0 The receiver can be Mode 1 The receiver can be Mode 2
2 Power Saving Mode	1	0	Serial port reception is disabled. Wireless is in air wake mode. Upon receiving wireless data, enable the serial port to transmit data.	Transmitter must be in Mode 1 Transmission is not permitted in this mode
3 Sleep Mode	1	1	The module enters sleep mode and can receive parameter configuration commands.	For detailed specifications, please refer to the detailed explanation of working parameters.

5.1.1 Transmission mode in use: Mode 0 (M1 and M0 pins set to 0,0)

Type	When M0 = 0 and M1 = 0, the module operates in Mode 0.
Transmit	The module receives user data from the serial port and transmits wireless data packets with a length of 58 bytes. When the user input data reaches 58 bytes, the module initiates wireless transmission. At this point, the user may continue inputting data for transmission. If the user needs to transmit less than 58 bytes, the module waits for 3 bytes. If no further user data is input, it assumes data termination and transmits all accumulated data packets wirelessly. Upon receiving the first user data byte, the module outputs a low level on the AUX pin. After loading all data into the RF chip and initiating transmission, the AUX pin outputs a

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	high level. This indicates the final wireless data packet has begun transmission, allowing the user to continue inputting data up to 512 bytes. Data packets transmitted in Mode 0 can only be received by receiver modules operating in either Mode 0 or Mode 1.
Receive	The module continuously maintains its wireless reception capability, enabling it to receive data packets transmitted from Mode 0 and Mode 1 devices. Upon receiving a data packet, the module outputs a low level on the AUX pin. After a 5ms delay, it begins transmitting the wireless data via the serial port's TXD pin. Once all wireless data has been output through the serial port, the module outputs a high level on the AUX pin.

5.1.1.1 Quick Start Guide for Transparent Transfer

What you see is what you get. Simply use Serial Port Assistant for mutual communication (all factory default parameters are identical, and the transmission mode is transparent). An example scenario is as follows:

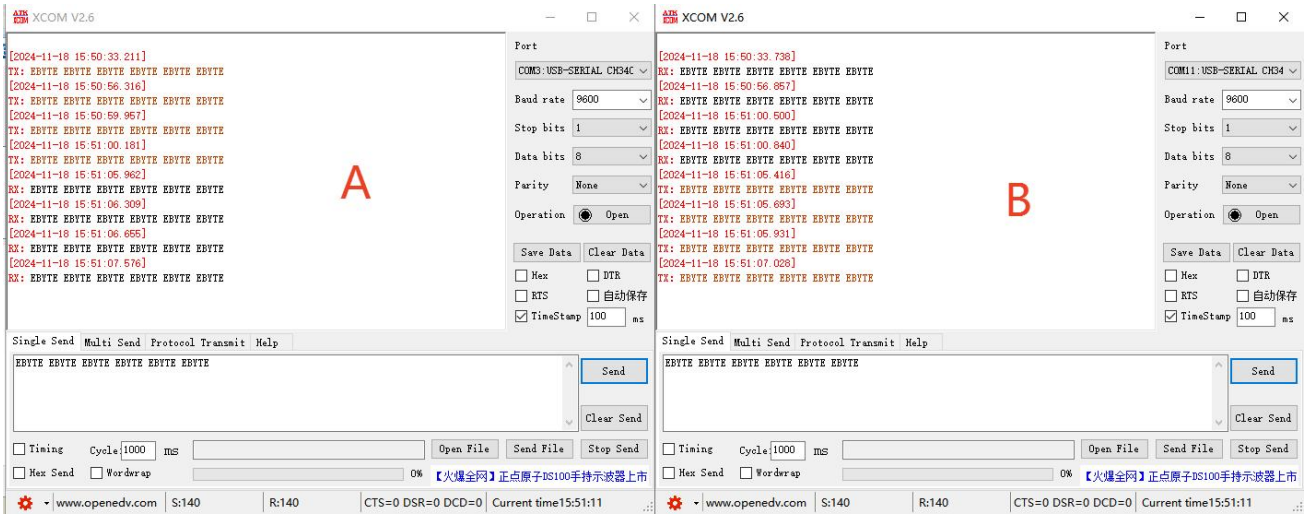


Figure 1: Schematic of Bidirectional Transmission and Reception

5.1.1.2 Quick Point-to-Point Transmission (Specify Destination Address and Channel)

Data transmission and reception follow a fixed format: destination address + destination channel + data. This effectively minimizes interference. Detailed operational steps are as follows:

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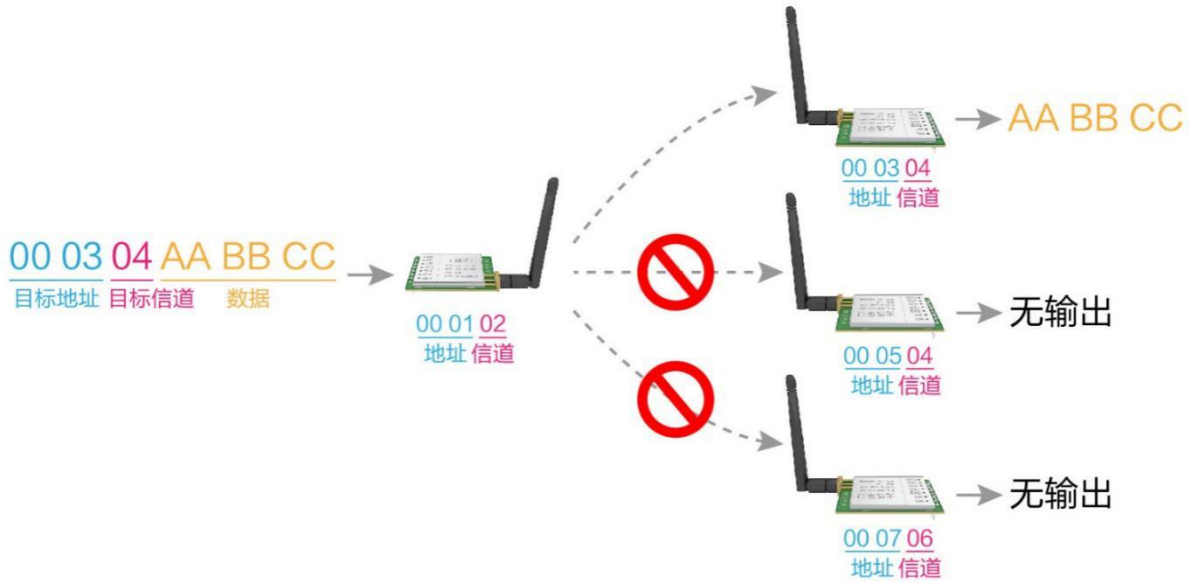


Figure 2 Point-to-Point Transmission Schematic

Operating Procedure:

Step 1: Modify module parameters via the host computer:

Under configuration mode (set M1 and M0 pins to 1,1), modify the module address and channel. Change the transmission mode from transparent to fixed-point transmission. Finally, write the parameters to complete the modification.



Figure 3: Host Computer Interface

Step 2: Switch the module operating mode to normal mode: Edit Module A parameters to 000304AABBCC and send to Module B. Similarly, Module B sends data as 000102AABBCC. (Data transmission format in fixed-point mode: Destination address + Destination channel + Data).

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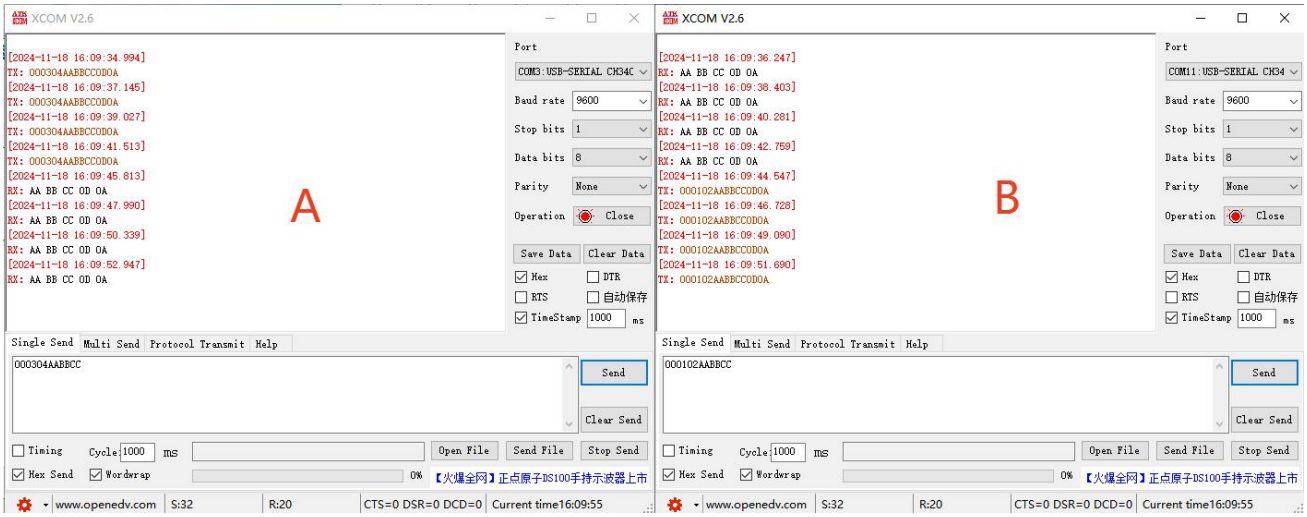


Figure 4 Data Transmission Diagram

5.1.1.3 Quick Guide to Broadcasting

- Set Module A's address to 0xFFFF and channel to 0x04. When Module A transmits (in the same mode, transparent transmission or fixed-point transmission), all receiving modules on channel 0x04 can receive the data, achieving a broadcast effect.
- Set Module A's address to 0xFFFF and channel to 0x04. When Module A operates as a receiver, it can receive all data on channel 0x04, achieving monitoring functionality.

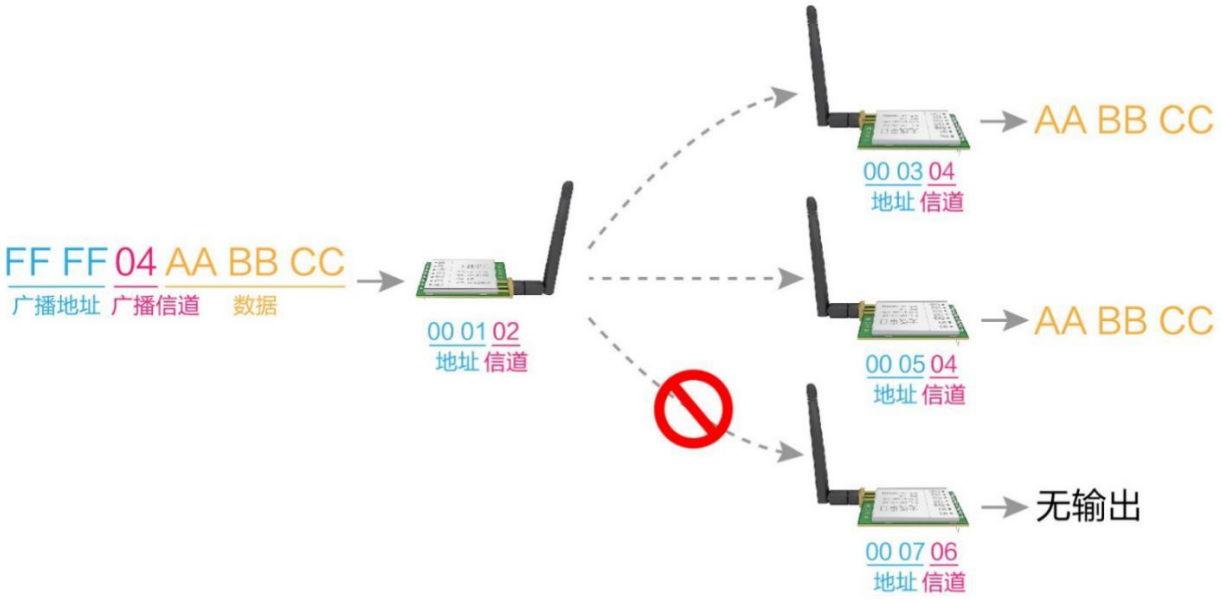


Figure 5 Point-to-Point Broadcast Transmission Diagram

Operating Procedure:

Step 1: Modify module parameters via the host computer:

In configuration mode (with M1 and M0 pins set to 1,1), modify the module address and channel. Change the transmission mode from transparent to fixed-point transmission. Finally, write the parameters to complete the modification.

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Figure 6: Host Computer Interface Diagram

Step 2: Switch the module operating mode to normal mode: Edit Module A parameters to FFFF04AABBCC and transmit to Module B. Similarly, Module B transmits data as FFFF02AABBCC. (Data transmission format in point-to-point broadcast mode: Broadcast address + Target channel + Data).

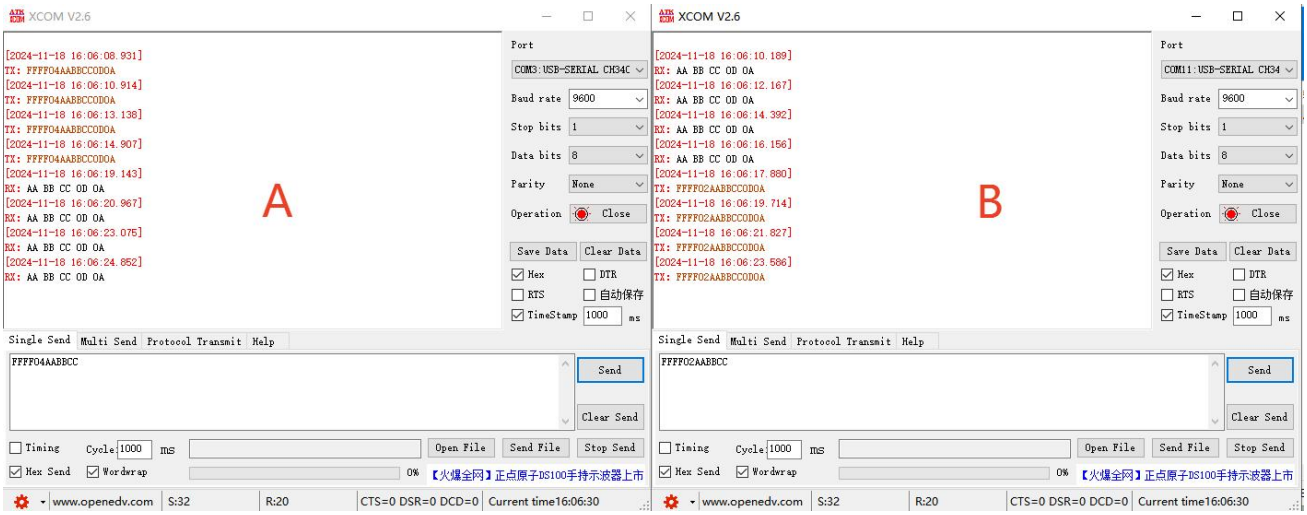


Figure 7 Data Transmission Diagram

5.1.2 Wake-up Mode, Mode 1 (M1, M0 pins set to 0,1)

Type	When M0 = 1 and M1 = 0, the module operates in Mode 1.
Transmit	The conditions for module startup packet transmission and AUX functions are identical to Mode 0. The only difference is that the module automatically appends a wake-up code before each packet. The length of the wake-up code depends on the wake-up time set in the user parameters. The purpose of the wake-up code is to wake up receiver modules operating in Mode 2. Therefore, data transmitted in Mode 1 can be received by Modes 0, 1, and 2.
Receive	Equivalent to Mode 0.

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5.1.3 Power-saving mode, Mode 2 (M1 and M0 pins set to 1 and 0)

Type	When M0 = 0 and M1 = 1, the module operates in Mode 2.
Transmit	The module is in sleep mode, and the serial port is disabled, preventing reception of serial data from an external MCU. Therefore, this mode does not support wireless transmission functionality.
Receive	In Mode 2, the transmitter must operate in Mode 1; it periodically monitors for wake-up codes. Upon receiving a valid wake-up code, the module remains in continuous receive mode until the entire valid data packet is acquired. Subsequently, the AUX pin outputs a low level. After a 5ms delay, the serial port is activated to transmit the received wireless data via TXD. Upon completion, the AUX pin outputs a high level. The wireless module then returns to its “Sleep - Listening” operational state (polling). By configuring different wake-up times, the module exhibits varying reception response delays (maximum 2s) and average power consumption (minimum 30μA). Users must strike a balance between communication latency and average power consumption.

5.1.3.1 Quick Start Guide for Transparent Transfer

Based on the content in Sections 5.1.2 and 5.1.3, the detailed steps for module wake-up are as follows:

Step 1: Modify the operating mode via the M1 and M0 pins of the module. Set the A module pin to 0,1 for wake-up mode, and set the B module pin to 1,0 for power-saving mode.

Step 2: After switching the module's operating mode: The transmitting module sends data to the receiving module, but the receiving module cannot send data back to the transmitting module.

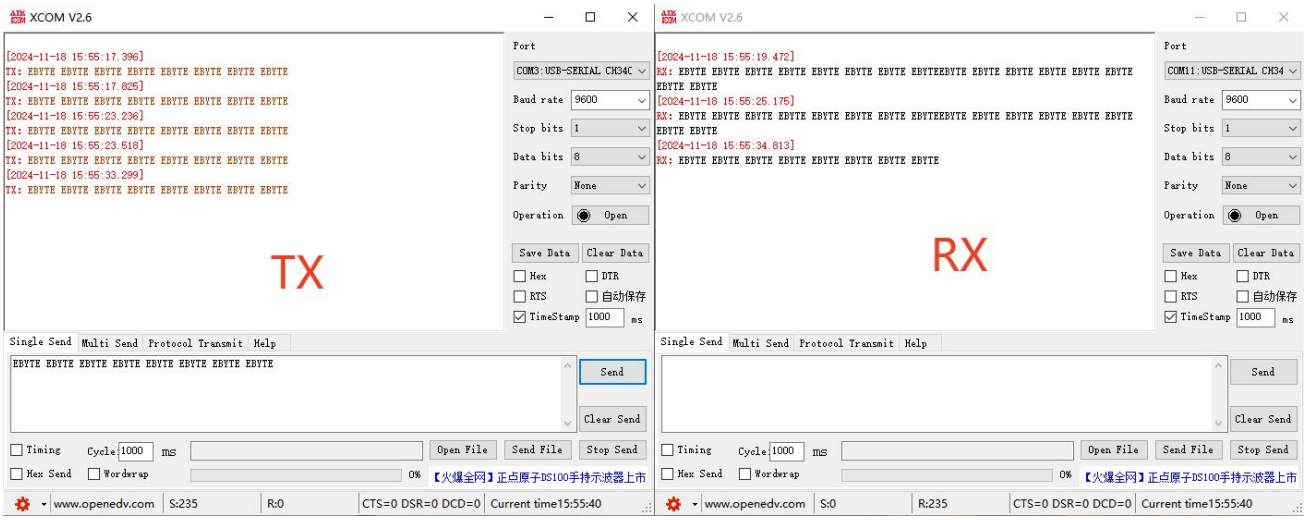


Figure 8 Data Transmission Diagram

5.1.4 Sleep configuration mode in use, Mode 3 (M1, M0 pins set to 1,1)

Type	When M0 = 1 and M1 = 1, the module operates in Mode 3.
Transmit	Unable to transmit wireless data.
Receive	Unable to receive wireless data.
Configuration	Sleep mode can be used for module parameter configuration. Utilize the serial port at 9600 baud, 8 data bits, and 1 stop bit to set the module's operational parameters via specific command formats.
Notice	When transitioning from sleep mode to other modes, the module reconfigures its parameters. During this process, AUX remains low; upon completion, it outputs a high level. Therefore, users are advised to detect the rising edge of AUX.

5.1.4.1 Quick Start Guide for Configuration Tools

- The figure below shows the configuration host display interface. Users can switch to configuration mode via M0 or M1 to quickly configure and read parameters on the host computer.
- Within the configuration host, module addresses and frequency channels are displayed in decimal mode. For the valid parameter ranges, refer to the specific parameters for different product models within the registers in Section 6.3.

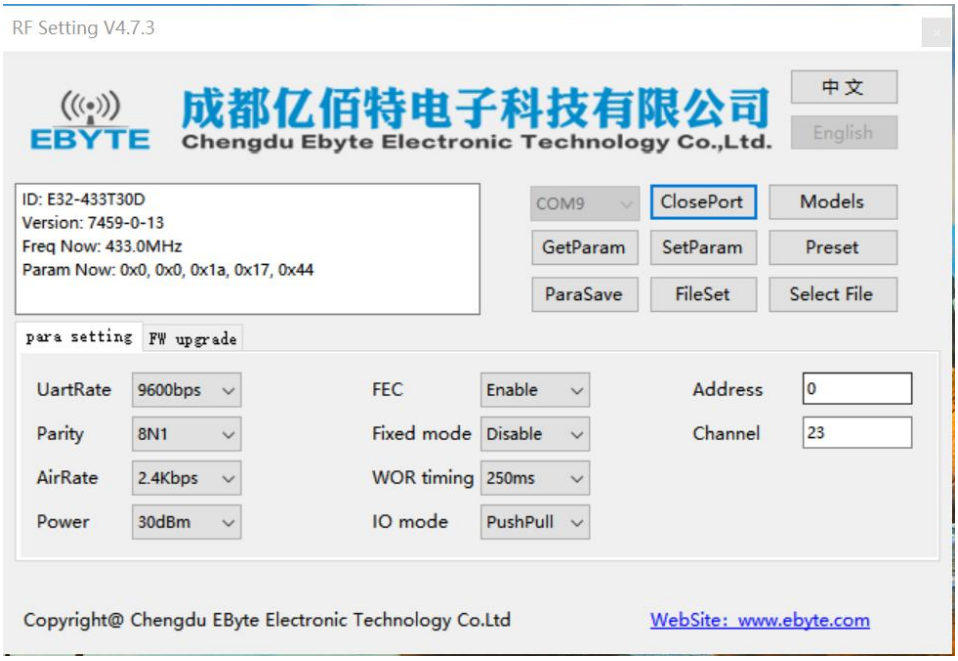


Figure 9: Host Computer Interface

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5.1.5 Precautions for Using Work Modes

Serial Number	Notes
1	●Users can combine M1 and M0 into high or low levels to determine the module's operating mode. Two GPIO pins on the MCU can be used to control mode switching; ●If the module has serial data that has not yet been fully transmitted wirelessly, it can only enter a new operating mode after transmission is complete; ●If the module receives wireless data and then transmits data externally via the serial port, it must finish transmitting before entering a new operating mode; ●Mode switching is only effective when AUX is outputting 1; otherwise, the switch will be delayed.
2	●When a user continuously inputs large amounts of data while simultaneously switching modes, the mode-switching operation is ineffective. The module will process all user data before performing a new mode detection.
3	●When the module transitions from other modes to sleep mode, if any data remains unprocessed, the module will complete processing of this data (including both received and transmitted data) before entering sleep mode. This feature enables rapid sleep mode transition to conserve power. For example: When the transmit module operates in Mode 0, if the user initiates serial data “12345”, it can immediately switch to sleep mode without waiting for the AUX pin to become idle (high level). The user's main MCU can then enter sleep mode immediately. The module will automatically transmit all user data wirelessly and enter sleep mode within 1ms.

5.2 AUX Timing

5.2.1 Power-On Start Indicator

Conditions: Tc = 25°C, VCC = 5 V

Parameters	Description	Typical value	Unit
T1	The entire startup process after powering on the module's VCC takes time (entering operational mode, user-accessible state).	16	ms
T2	After the module's VCC power supply is applied, the initial delay period begins when AUX first pulls low. It does not immediately indicate a busy state (low level) because the internal microcontroller also requires a certain amount of startup time. Note: During the initial phase of T2, the AUX pin operates as an internally pulled-up input. If it detects an externally pulled-low signal lasting over 1 second (e.g., via an external pull-down resistor or shorting to GND), the device will forcibly enter upgrade mode. This prevents normal wireless data transmission, reception, and configuration command processing. For further details, refer to the firmware upgrade section.	5	ms

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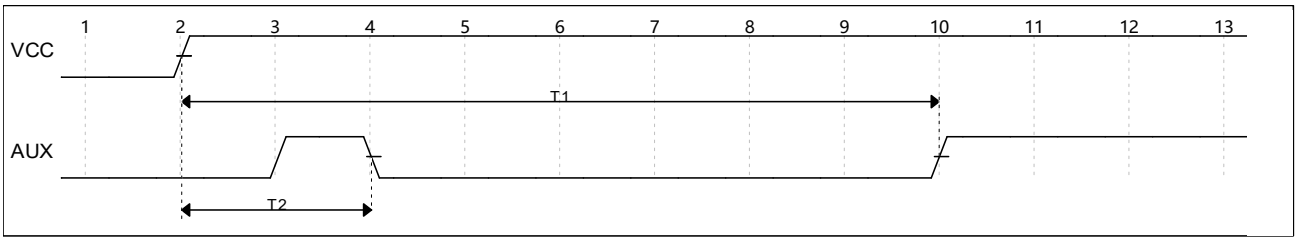


Figure 10 Power-Up Sequence Diagram

5.2.2 Serial Port Data Output Indicator

Conditions: Tc = 25° C, VCC = 5 V

Parameters	Description	Typical value	Unit
T1	After the module completes reception of the air data packet, the AUX pin pulls low to indicate to external users that the microcontroller is ready. It can also serve as a wake-up signal, suitable for certain low-power battery applications.	3	ms
T2	The module outputs the time interval between two consecutive packets of air data. Scenario 1: When the transmitter is transmitting data in an oversized packet loop and the air data rate significantly exceeds the receiver's serial port rate, the serial output data from the receiver module will exhibit packet sticking (T2=0). The length of a single serial output may exceed the user-defined packet size. This is suitable for applications where Modbus reads multiple registers from a slave device and acknowledges responses. Scenario 2: The transmitter is transmitting oversized packets in a loop, but both the air interface rate and serial baud rate are slow (e.g., default air interface 2.4 Mbps, serial 9600 baud). In this case, air transmission is time-consuming, so the receiver outputs packets at the packet interval.	0 or Tx (single packet airtime)	ms

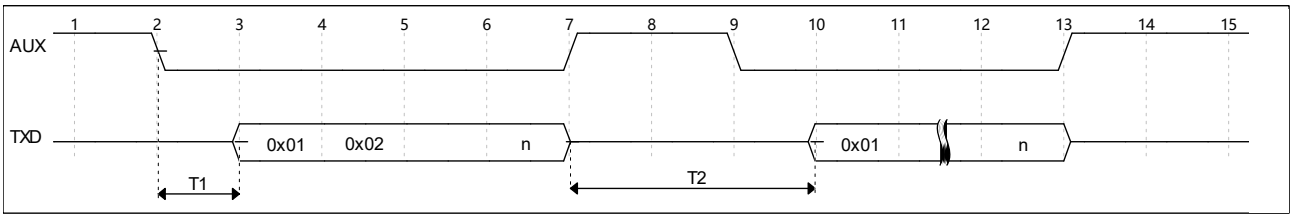


Figure 11 Serial Port Data Output Timing Diagram

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5.2.3 Wireless Transmission Indicator

Tc = 25° C, VCC = 5 V

Parameters	Description	Typical value	Unit
n	Internal buffer capacity of the module serial port (maximum single-transmission data length). When the buffer contains data exceeding the user-defined packet size (default 58 bytes), it will automatically segment the data for wireless transmission.	512	Byte
T1	AUX indicator delay time when the module receives serial data. The busy state (pulled low) is only indicated after the module identifies and receives the first byte of the serial data packet. Therefore, the delay time is related to the serial baud rate (default 9600 bps).	1	ms
T2	Module Cache Idle State AUX Indicator Delay (Pull-High) Time Scenario 1: When the data length transmitted to the module is shorter than the packet length (default 58 bytes), At this point, T2 represents the serial port reception frame break delay, with a default frame break time of 3 bytes (dependent on the serial port baud rate, default 9600). Once the frame break countdown ends, the AUX pin is immediately pulled high to indicate cache idle, simultaneously triggering the air transmission process (under default conditions, AUX does not indicate wireless transmission busy; refer to the AT+UAUX command for additional settings). Scenario 2: When the data length transmitted to the module exceeds the packet size, T2 represents the total airtime consumption (dependent on air interface rate). During serial reception, once the packet size is reached, the air transmission process is triggered immediately (LoRa air transmission is relatively time-consuming). Subsequent cycles involve multiple packet transmissions (based on the incoming data length) until all data in the receive buffer is fully transmitted. Only then is the AUX pin pulled high to indicate buffer availability.	3 or Tx (Transmission time)	ms

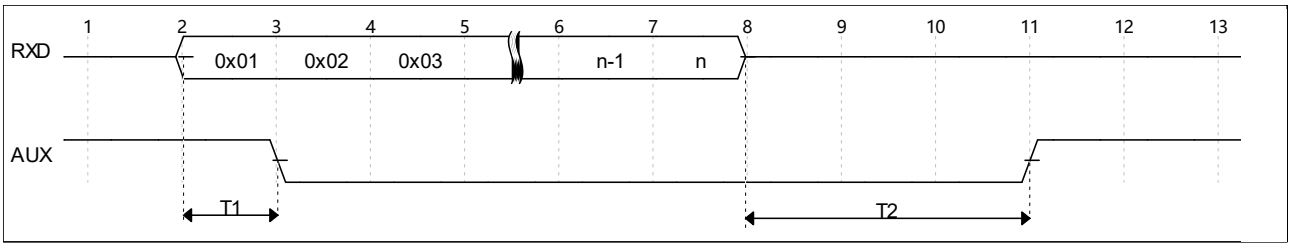


Figure 12 Wireless Transmission Timing Diagram

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5.2.4 Switch Mode

When switching between all modes, the AUX will indicate a busy state for the durations specified in the table below:

Original working mode	Switch Mode	T1 Switching Time (ms)
Sleep Mode	Transparent Mode	9～11
	Power Saving Mode	9～11
	Wake Mode	9～11
Transparent Mode	Sleep Mode	9～11
	Power Saving Mode	9～11
	Wake Mode	9～11
Power Saving Mode	Sleep Mode	9～11
	Transparent Mode	9～11
	Wake Mode	9～11
Wake Mode	Sleep Mode	9～11
	Transparent Mode	9～11
	Power Saving Mode	9～11

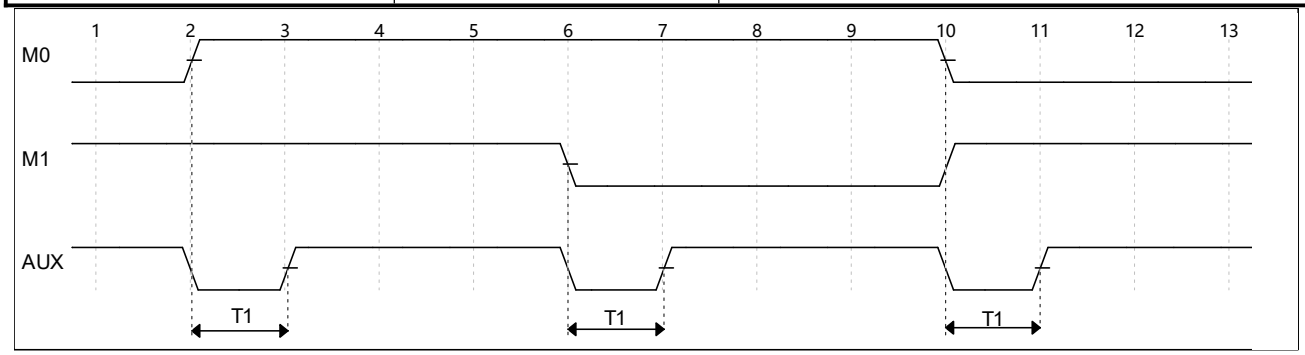


Figure 13 Mode Switching Sequence Diagram

5.2.5 Notes

Serial Number	AUX Notes
1	When the AUX output is low, it indicates that the module is busy and will not perform operating mode detection at this time.
2	If AUX remains at a high level, the mode switch will take effect immediately.
3	When the user transitions from Mode 3 (Sleep Mode) to another mode or during the reset process, the module will reset user parameters, during which the AUX output will be low.

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5.3 Serial Port Firmware Upgrade

- If customers need to upgrade the firmware, they must locate the corresponding BIN file provided by the official source and use the official PC software for the upgrade. Generally, users do not need to perform firmware upgrades; please do not use the "AT+IAP" command.
- The pins required for upgrading must be brought out (M1, M0, AUX, TXD, RXD, VCC, GND). Then, send the "AT+IAP" command in configuration mode to enter upgrade mode. To exit IAP upgrade mode, keep the device powered on and wait 60 seconds; the program will automatically exit. Otherwise, even after a reboot, the device will continuously enter upgrade mode.
- Upon entering upgrade mode, the baud rate automatically switches to 115200 and remains there until automatic exit. Log output will be displayed during this period.

5.3.1 Quick Guide to Host Computer Upgrade

- Enter configuration mode by changing M0 and M1 (Note: The baud rate in configuration mode is 9600);
- Open the configuration host computer and select the Firmware Upgrade tab.
- Open the official website configuration host computer, select Serial Port → Open Serial Port → Read Parameters → Select Firmware Upgrade → Click Open File and choose the required upgrade firmware → Click Download.



Figure 14 Firmware Upgrade Interface

6 Register Read/Write Control

6.1 Command Introduction

In sleep mode (Mode 3: M0=1, M1=1), the supported command list is as follows (when configured, only 9600 baud rate and 8N1 format are supported):

Serial Number	Command Format	Detailed Description
1	C0+ Operating Parameters	Send C0 + 5 bytes of operating parameters in hexadecimal format, totaling 6 bytes. Must be transmitted consecutively (preserved during power loss).
2	C1+C1+C1	Send three C1 commands in hexadecimal format. The module will return the saved parameters. Commands must be sent consecutively.
3	C2+ Operating Parameters	Send C2 + 5 bytes of working parameters in hexadecimal format, totaling 6 bytes. Must be sent consecutively (not retained after power loss).
4	C3+C3+C3	Send three C3 commands in hexadecimal format. The module will return version information. Commands must be sent consecutively. (It is recommended to use AT commands to read version information. For detailed usage, refer to Chapter 7 of this document.)
5	C4+C4+C4	Send three C4s in hexadecimal format; the module will generate a reset. The transmission must be continuous.

6.2 Reading of Operating Parameters

Command Format	Detailed Description
C1+C1+C1	In sleep mode (M0=1, M1=1), send the command (in HEX format) to the module's serial port: C1 C1 C1. The module will return its current configuration parameters, for example: C0 00 00 1A 06 44.

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6.3 Version Number Reading

Command Format	Detailed Description
C3+C3+C3	In sleep mode (M0=1, M1=1), send the command (in HEX format) to the module's serial port: C3 C3 C3. The module will return its current configuration parameters, e.g.: C3 32 XX YY; C3 denotes the command prefix, 32 represents the product model, XX indicates the version number, and YY signifies the interface format + maximum module power value (hexadecimal). TTL interface is 0x10, RS232 is 0x40, and RS485 is 0x80. It is recommended to use the command AT+DEVTYPE=? instead, which will retrieve the complete product model.

6.4 Reset command

Command Format	Detailed Description
C4+C4+C4	In sleep mode (M0=1, M1=1), send the command (in HEX format) C4 C4 C4 to the module's serial port. The module will perform a reset. During reset, the module conducts a self-test and outputs a low level on AUX. After reset completes, AUX outputs a high level, and the module resumes normal operation. At this point, mode switching or issuing the next command is possible.

6.5 Register Function Reference Table

Address	Name	Bit							
		bit 7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
00h	HEAD	Fixed Control Frame Header [7:0]							
01h	ADDH	Mailing Address [15:8]							
02h	ADDL	Mailing Address [7:0]							
03h	SPED	Serial Port Parity Type [1:0]		Serial Port Baud Rate [2:0]			Wireless transmission rate [2:0]		
04h	CHAN	Channel Control [7:0]							
05h	OPTION	Transmission Method	Retain	Air Wake-Up Period [2:0]			Forward error correction	Wireless transmission power [1:0]	

Note: For reference on register software structure design, consult the E32-xxxTBL-SC series sample code (available in the relevant download section of this page). See e32_demo.h for details.

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6.6 Register Specifications

Serial Number	Name	Description	Note
0	HEAD	Fixed at 0xC0 or 0xC2, indicating that this frame data is a control command.	Must be 0xC0 or C2 C0: Set parameters are retained after power loss. C2: Set parameters are not retained after power loss.
1	ADDH	High byte of module address (default 00H)	00H-FFH
2	ADDL	Low byte of module address (default 00H)	00H-FFH
3	SPED	7 / 6 / Serial Port Parity Bit	The serial port modes of the communicating parties may differ.
		0 / 0 / 8N1（Default）	
		0 / 1 / 8O1	
		1 / 0 / 8E1	
		1 / 1 / 8N1（Equivalent to 00）	
		5 / 4 / 3 / TTL Serial Port Speed (bps)	The baud rates of both communication parties may differ. The serial port baud rate is unrelated to wireless transmission parameters and does not affect wireless transceiver characteristics.
		0 / 0 / 0 / The serial port baud rate is 1200	
		0 / 0 / 1 / The serial port baud rate is 2400	
		0 / 1 / 0 / The serial port baud rate is 4800	
		0 / 1 / 1 / The serial port baud rate is 9600（Default）	
		1 / 0 / 0 / The serial port baud rate is 19200	
		1 / 0 / 1 / The serial port baud rate is 38400	
		1 / 1 / 0 / The serial port baud rate is 57600	
		1 / 1 / 1 / The serial port baud rate is 115200	
		2 / 1 / 0 / Universal Wireless Air Rate（bps）	The lower the air interface rate, the greater the transmission distance, the stronger the anti-interference capability, and the longer the transmission time. The air interface transmission rates of both communication parties must be identical.
		0 / 0 / 0 / Air Rate 2.4k	
		0 / 0 / 1 / Air Rate 2.4k	
		0 / 1 / 0 / Air Rate 2.4k（Default）	
		0 / 1 / 1 / Air Rate 4.8k	
		1 / 0 / 0 / Air Rate 9.6k	
		1 / 0 / 1 / Air Rate 19.2k	
		1 / 1 / 0 / Air Rate 19.2k	
		1 / 1 / 1 / Air Rate 19.2k	
4	CHAN	General Model	
		7 / 6 / 5 / Reserve unused	Write 0
		Communication channel	400 MHz band: 00H-1FH, corresponding to 410–441 MHz 900 MHz band: 00H-45H, corresponding to 862–930 MHz
		4–0, corresponding to (410MHz + CHAN * 1MHz), default 17H (433MHz) (for 400MHz band) 4–0, corresponding to (862MHz + CHAN * 1MHz), default 06H (868MHz) (for 900MHz band)	
5	OPTION	7 / Enable Bit for Fixed Transmission（Similar to MODBUS）	When set to 1, the first three bytes of each user data frame serve as the high address, low address, and channel. During
		0 / Transparent Transfer Mode	
		1 / Point-to-Point Transmission Mode	

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<table>
<tr><td></td><td></td><td></td><td colspan="4"></td><td>transmission, the module changes its own address and channel; upon completion, it reverts to the original settings.</td></tr>
<tr><td></td><td></td><td>6</td><td colspan="4">Retain</td><td></td></tr>
<tr><td></td><td></td><td>5</td><td>4</td><td>3</td><td colspan="2">Wireless Wake-Up Time</td><td rowspan="10">Both transmit and receive modules operate in Mode 0, rendering this delay time invalid and allowing any value.
The transmitter operates in Mode 1, continuously transmitting the corresponding call code duration.
The receiver operates in Mode 2, where this time represents the receiver's monitoring interval (wireless wake-up), capable of receiving only data from transmitters operating in Mode 1.</td></tr>
<tr><td></td><td></td><td>0</td><td>0</td><td>0</td><td colspan="2">250ms（Default）</td></tr>
<tr><td></td><td></td><td>0</td><td>0</td><td>1</td><td colspan="2">500ms</td></tr>
<tr><td></td><td></td><td>0</td><td>1</td><td>0</td><td colspan="2">750ms</td></tr>
<tr><td></td><td></td><td>0</td><td>1</td><td>1</td><td colspan="2">1000ms</td></tr>
<tr><td></td><td></td><td>1</td><td>0</td><td>0</td><td colspan="2">1250ms</td></tr>
<tr><td></td><td></td><td>1</td><td>0</td><td>1</td><td colspan="2">1500ms</td></tr>
<tr><td></td><td></td><td>1</td><td>1</td><td>0</td><td colspan="2">1750ms</td></tr>
<tr><td></td><td></td><td>1</td><td>1</td><td>1</td><td colspan="2">2000ms</td></tr>
<tr><td></td><td></td><td>2</td><td colspan="5">FEC Switch</td><td rowspan="3">After disabling FEC, the actual data transmission rate increases, but interference resistance weakens and the effective distance decreases. Please select based on your specific application requirements.
Both communication parties must either enable or disable FEC.</td></tr>
<tr><td></td><td></td><td>0</td><td colspan="5">Disable FEC error correction</td></tr>
<tr><td></td><td></td><td>1</td><td colspan="5">Enable FEC error correction (default)</td></tr>
<tr><td></td><td></td><td rowspan="2">1</td><td rowspan="2">0</td><td colspan="3">Transmit Power (Approximate Value)</td><td rowspan="5">The external power supply must provide an output current capacity of 250mA or higher, with power supply ripple less than 100mV.

Using lower power transmitters is not recommended, as their power supply efficiency is low.</td></tr>
<tr><td></td><td></td><td colspan="2">E32-T Series 30dBm Module</td><td>E32-T Series 20dBm Module</td></tr>
<tr><td></td><td></td><td>0</td><td>0</td><td colspan="2">30dBm（Default）</td><td>20dBm（Default）</td></tr>
<tr><td></td><td></td><td>0</td><td>1</td><td colspan="2">27dBm</td><td>17dBm</td></tr>
<tr><td></td><td></td><td>1</td><td>0</td><td colspan="2">24dBm</td><td>14dBm</td></tr>
<tr><td></td><td></td><td>1</td><td>1</td><td colspan="2">21dBm</td><td>10dBm</td></tr>
</table>

Example (meaning of byte 3 “SPED”):								
Binary bits of this byte	7	6	5	4	3	2	1	0
Specific value (user-configurable)	0	0	0	1	1	0	1	0
Representative meaning	Serial Port Parity Bit 8N1		The serial port baud rate is 9600.			Airborne speed is 2.4k		
Corresponding hexadecimal	1				A			

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6.7 Register factory default parameters

Model	Factory default parameter values for the 433MHz band: C0 00 00 1A 17 04 Factory default parameter values for the 900MHz band: C0 00 00 1A 06 04						
Module model	Frequency	Address	Channel	Air rate	Baud rate	Serial Port Format	Transmit Power
E32-433T20S E32-433T20D	433.125MHz	0x0000	0x17	2.4kbps	9600	8N1	20dbm
E32-433T30S E32-433T30D	433.125MHz	0x0000	0x17	2.4kbps	9600	8N1	30dbm
E32-900T20S E32-900T20D	868.125MHz	0x0000	0x12	2.4kbps	9600	8N1	20dbm
E32-900T30S E32-900T30D	868.125MHz	0x0000	0x6	2.4kbps	9600	8N1	30dbm

7 AT command

- Configuring parameters or querying using AT commands requires entering configuration mode (configuration mode serial port is fixed at 9600 8N1);
- For software versions (7459-0-18) and earlier, users do not need to add a carriage return/line feed character at the end of AT commands.
- Software versions (7459-0-19) and later automatically recognize the carriage return/line feed at the end of user AT commands; recognition remains unaffected even without the return/feed.
- AT command recognition or execution failures will respond with "=ERR".
- When input parameters exceed the valid range, restrictions will apply. Do not allow parameters to exceed the range to avoid unexpected conditions.

7.1 General Command

7.1.1 AT+RESET Software Reset

Command Format	AT+RESET
Execution Example	Send: AT+RESET Response: =OK
Feature Description	●Software versions (7459-0-19) and earlier will not respond with "=OK". ●Software versions (7459-0-20) and later will respond with "=OK". ●The actual reset process will only begin after the "=OK" response. Users should wait approximately 30ms before proceeding with the next operation.

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7.1.2 AT+DEFAULT Restore factory settings

Command Format	AT+DEFAULT
Execution Example	Send: AT+DEFAULT Response: =OK
Feature Description	After acknowledging (=OK), the system will perform parameter restoration and initiate a restart process. Please wait approximately 30 milliseconds before proceeding with the next operation.

7.1.3 AT+DEVTYPE Query Product Model

Command Format	AT+DEVTYPE=?
Execution Example	Send: AT+DEVTYPE=? Response: DEVTYPE=E32-433T30S
Feature Description	●Product Series: E32 ●Operating Frequency Band: 433 (433/900) ●Maximum Power: 30 (20/30/33)

7.1.4 AT+FWCODE Query Software Version

Command Format	AT+FWCODE=?
Execution Example	Send：AT+FWCODE=? Response：FWCODE=7459-0-20
Feature Description	●Major Version: 7459 ●Branch Number: 0 ●Minor Version: 20 (increments starting from 10)

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7.1.5 AT+SWITCH Software Switching Mode Enable

Command Format	AT+SWITCH=<on_off>
Setup Example	Send：AT+SWITCH=0 Response：=OK
Query Example	Send：AT+SWITCH=? Response：AT+SWITCH=0
Parameter Description	**<on_off>**: Switch 0 Off (default) 1 On
Feature Description	●Factory default is disabled. Use the M0M1 pin to switch operating modes (hard switch). ●When enabled, the M0M1 pin remains functional. The last triggered switch (hard or soft) takes precedence. ●After enabling, restart the system for it to take effect. ●When enabled, use AT+MODE to specify the operating mode (soft switch). Each soft switch immediately saves the operating mode number. ●When enabled, for software versions 7459-0-18 and earlier, the M0M1 hardware mode becomes the initial operating mode after power-cycle restart. ●When enabled, for software versions 7459-0-19 and later, the last soft-switch saved mode number becomes the initial operating mode after power-cycle restart. ●When disabled, the M0M1 hardware mode becomes the initial operating mode after power-cycle restart.

7.1.6 AT+MODE Software Mode Switching

Command Format	AT+MODE=<mode>
Setup Example	Send：AT+MODE=0 Response：AT+MODE=0
Query Example	Send：AT+MODE=? Response：AT+MODE=0
Parameter Description	**<mode>**: Operating Mode Number 0 Transmission Mode 1 Wake-on-Radio Transmission Mode (WOR Tx) 2 Wake-on-Radio Reception Mode (WOR Rx/Power-Saving Mode) 3 Sleep and Configuration Mode
Feature Description	●Must be enabled via AT+SWITCH before use ●Available in any operating mode ●Actual mode switching commences only after acknowledgment (=OK); users should wait approximately 15ms before proceeding ●Refer to AT+SWITCH feature documentation

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7.1.7 AT+UAUX Wireless AUX Indicator Enable

Command Format	AT+UAUX=**<on_off>**
Configuration Example	Send：AT+UAUX=0 Response：=OK
Query Example	Send：AT+UAUX=? Response：AT+UAUX=0
Parameter Description	**<on_off>**: Switch 0 Off (default) 1 On
Feature Description	●Software version (7459-0-18) and earlier do not support this command, and by default AUX does not indicate the wireless transmission process (does not pull low during transmission). ●Software version (7459-0-19) and later are disabled by default. When enabled, AUX will pull low to indicate wireless transmission during transmission.

7.1.8 AT+ADDR Communication Address (Matching Filter)

Command Format	AT+ADDR=**<address>**
Configuration Example	Send：AT+ADDR=0 Response：=OK
Query Example	Send：AT+ADDR=? Response：AT+ADDR=0
Parameter Description	**<address>** ： Mailing Address 0 - 65535
Feature Description	●Default address 0 ●The address is not an RF characteristic but merely an identifier carried within the packet, assisting the receiving software logic in determining whether to perform matching and filtering. ●Broadcast address 65535. When acting as a receiver, it can receive data sent from any address on the same channel (unfiltered). When acting as a sender, the transmitted packet carries the broadcast address, so the recipient will not filter it either (broadcast data).

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7.1.9 AT+CHANNEL Communication Channel (Carrier Frequency)

Command Format	AT+CHANNEL=**<ch>**	
Configuration Example	Send：AT+CHANNEL=0 Response：=OK	
Query Example	Send：AT+CHANNEL=? Response：AT+CHANNEL=0	
Parameter Description	**<ch>** ： Communication Channel 0 - 31 **E32-433T30D、E32-433T30S、E32-433T20D、E32-433T20S**	**<ch>** ： Communication Channel 0 - 69 **E32-900T30D、E32-900T30S、E32-900T20D、E32-900T20S**
Feature Description	●Product channel ranges differ across frequency bands; please note the distinctions. ●For the 433 MHz band, the actual carrier frequency corresponds to: 410 MHz + channel frequency × 1 MHz ●For the 933 MHz band, the actual carrier frequency corresponds to: 862 MHz + channel frequency × 1 MHz	

7.1.10 AT+UART Serial Port Baud Rate and Parity

Command Format	AT+UART=**<baud>**,**<parity>**
Configuration Example	Send：AT+UART=3,0 Response：=OK
Query Example	Send：AT+UART=? Response：AT+UART=3,0
Parameter Description	**<baud>** ： Serial Port Baud Rate 0 1200bps 1 2400bps 2 4800bps 3 9600bps (default) 4 19200bps 5 38400bps 6 57600bps 7 115200bps **<parity>** ： Serial Port Parity Type 0 No parity None (default) 1 Odd parity Odd 2 Even parity Even
Feature Description	●In configuration mode (M0M1 Mode 3), force fixed baud rate 9600, 8N1. ●Changes take effect after switching operating modes.

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7.1.11 AT+URXT Serial Port Frame Disconnection Condition

Command Format	AT+URXT=**<byte>**
Configuration Example	Send：AT+URXT=3 Response：=OK
Query Example	Send：AT+URXT=? Response：AT+URXT=3
Parameter Description	**<byte>** ： ByteTime 1 - 255
Feature Description	●By default, serial port frame break processing is handled based on a 3-byte timeout. ●The timeout duration varies by baud rate (measured in bytes). At 9600 baud, it is approximately 1 millisecond per byte; at 115200 baud, it is approximately 100 microseconds per byte. ●Some customers experience discontinuous data transmission from external microcontroller serial ports to the module (e.g., due to RTOS task interruptions). When data exceeds the module's configured byte time window, it is treated as a frame break and manifests as packet fragmentation at the receiving end.

7.1.12 AT+RATE Wireless Transmission Rate

Command Format	AT+RATE=**<rate>**
Configuration Example	Send：AT+RATE=2 Response：=OK
Query Example	Send：AT+UART=? Response：AT+UART=2
Parameter Description	**<rate>** ： Air rate 0 2.4Kbps 1 2.4Kbps 2 2.4Kbps (Default) 3 4.8Kbps 4 9.6Kbps 5 19.2Kbps 6 19.2Kbps 7 19.2Kbps
Feature Description	●The higher the airborne speed, the lower the communication delay (shorter transmission time), but the poorer the reception sensitivity (shorter communication range).

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7.1.13 AT+TRANS Wireless Transmission Mode (Transparent/Fixed Point)

Command Format	AT+TRANS=**<mode>**
Configuration Example	Send：AT+TRANS=0 Response：=OK
Query Example	Send：AT+TRANS=? Response：AT+TRANS=0
Parameter Description	**<mode>** ： Transmission Method 0 Transparent Transfer (Default) 1 Point-to-point transmission
Feature Description	●Point-to-point transmission applies special processing to the first three bytes of user input data. The first and second bytes are identified as the target communication address, while the third byte identifies the target communication channel (automatically switching channels). ●After completing data transmission, point-to-point transmission automatically switches back to the original channel.

7.1.14 AT+WTIME Wake-on-Air Period

Command Format	AT+WTIME=**<timeout>**
Configuration Example	Send：AT+WTIME=0 Response：=OK
Query Example	Send：AT+WTIME=? Response：AT+WTIME=0
Parameter Description	**<timeout>** ： Sleep time 0 250ms (Default) 1 500ms 2 750ms 3 1000ms 4 1250ms 5 1500ms 6 1750ms 7 2000ms
Feature Description	●The longer the air wake-up receiver sleep time, the lower the average power consumption, but the greater the communication delay. ●Software version (7459-0-13) and earlier do not support this command. Please use the HEX command to set the register instead.

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7.1.15 AT+FEC Forward Error Correction

Command Format	AT+FEC=**<on_off>**
Configuration Example	Send：AT+FEC=0 Response：=OK
Query Example	Send：AT+FEC=? Response：=OK
Parameter Description	**<on_off>** ： Switch 0 Close 1 Enable (Default)
Feature Description	● After disabling FEC, the actual data transmission rate increases, but interference resistance weakens and the effective distance may decrease. Please select based on your specific application. ● Both communication parties must either enable or disable FEC.

7.1.16 AT+POWER Power Tiering

Command Format	AT+POWER=**<Power>**	
Configuration Example	Send：AT+POWER=0 Response：AT+POWER=0	
Query Example	Send：AT+POWER=? Response：AT+POWER=0	
Parameter Description	**<Power>** ： Power **E32-433T30S、E32-433T30D、E32-900T30D、E32-900T30S** 0 30dBm （Default） 1 27dBm 2 24dBm 3 21dBm	**<Power>** ： Power **E32-433T20S、E32-433T20D、E32-900T20D、E32-900T20S** 0 20dBm （Default） 1 17dBm 2 14dBm 3 10dBm
Feature Description	-	

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7.2 Signaling Testing (Certification)

7.2.1 Test Command Declaration

The AT command testing section is intended solely for auxiliary use during product certification processes (e.g., CE, FCC certification, etc.). Do not use it for any other purposes.

EBYTE assumes no liability for damages resulting from failure to comply with relevant operational or design specifications. EBYTE strives to ensure the completeness, accuracy, and timeliness of features under development, but does not exclude the possibility of errors or omissions in such features. Unless otherwise agreed upon, no implied or statutory warranties are provided for the use of features under development. To the maximum extent permitted by applicable law, EBYTE shall not be liable for any damages incurred from using features under development, regardless of whether such damages were foreseeable.

7.2.2 Test Command Reference

For detailed documentation on command operations, please contact our sales channels through EBYTE.

AT Command	Function Overview
AT+FPOWER	Fine-tuning of transmit power
AT+XCAP	Crystal Oscillator Calibration
AT+ULORAM	Modifying LoRa Modulation Parameters (SF Spread Factor, BW Transmission Bandwidth, CR Coding Rate)
AT+OPTIMIZE	Low-Rate Optimization Option
AT+UFREQ	Carrier Frequency Adjustment (Starting Frequency Point, Channel Spacing)
AT+SWAVE	Fixed-frequency continuous single-carrier transmission
AT+MWAVE	Fixed-frequency continuous modulation wave transmission
AT+TFHSS	Frequency-hopping modulated wave transmission
AT+DUTYTX	Fixed-frequency continuous single carrier/modulation wave duty cycle transmission

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8 Hardware Design

- It is recommended to power this module using a DC regulated power supply with minimal ripple coefficient, and ensure the module is reliably grounded.
- Please note the correct connection of the power supply's positive and negative terminals; reverse polarity may cause permanent damage to the module.
- Check the power supply to ensure it operates within the recommended voltage range; exceeding the maximum value may cause permanent damage to the module.
- Verify power supply stability; voltage must not fluctuate significantly or frequently.
- When designing the power circuit for the module, it is often recommended to maintain a margin of at least 30% to ensure long-term stable operation of the entire system.
- Position the module as far as possible from power supplies, transformers, high-frequency traces, and other sources of significant electromagnetic interference;
- High-frequency digital traces, high-frequency analog traces, and power traces must avoid routing beneath the module. If routing beneath the module is unavoidable (assuming the module is soldered to the Top Layer), place a copper ground plane (fully copper-clad and properly grounded) on the Top Layer where the module contacts the board. Routing must be positioned close to the module's digital section and placed on the Bottom Layer;
- If the module is soldered or placed on the Top Layer, routing traces arbitrarily on the Bottom Layer or other layers is incorrect and will adversely affect the module's spurious emissions and reception sensitivity to varying degrees;
- Components emitting significant electromagnetic interference near the module will also severely degrade its performance. Depending on the interference strength, maintain an appropriate distance from the module. Where feasible, implement suitable isolation and shielding;
- If high-interference traces (high-frequency digital, high-frequency analog, power lines) exist near the module, performance will be severely degraded. Depending on interference intensity, maintain adequate distance from the module. Where feasible, implement appropriate isolation and shielding.
- Antenna mounting significantly impacts module performance. Ensure the antenna is exposed and ideally oriented vertically upward.
- When installing the module inside an enclosure, use a high-quality antenna extension cable to route the antenna externally.
- Never install the antenna inside a metal enclosure, as this will drastically reduce transmission range.

9 Frequently Asked Questions

9.1 Transmission distance is not ideal

- When direct line-of-sight obstructions exist, communication distance will correspondingly decrease;
- Temperature, humidity, and co-channel interference can increase packet loss rates;
- Ground absorption and reflection of radio waves result in poorer performance during ground-level testing;
- Seawater possesses extremely strong radio wave absorption capabilities, leading to poor testing results near the coast;

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- Signal attenuation becomes severe when metal objects are present near the antenna or when the module is housed in a metal enclosure;
- Incorrect power register settings or excessively high air interface rate (higher air interface rate reduces communication distance);
- Power supply voltage below recommended levels at room temperature; lower voltage results in reduced transmit power;
- Use of antennas poorly matched to the module or antennas with inherent quality issues.

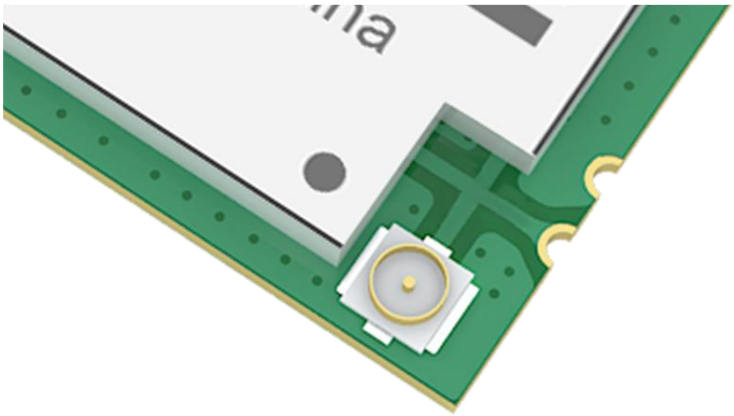
9.2 The module is vulnerable

- Check the power supply to ensure it falls within the recommended voltage range. Exceeding the maximum voltage may cause permanent damage to the module.
- Verify power supply stability; voltage must not fluctuate significantly or frequently.
- Ensure anti-static precautions during installation and operation, as high-frequency components are sensitive to static electricity.
- Maintain appropriate humidity levels during installation and operation, as certain components are moisture-sensitive.
- Unless specifically required, avoid operating in excessively high or low temperatures.

9.3 The error rate is too high

- Interference from nearby signals operating on the same frequency may occur. Move away from the interference source or modify the frequency/channel to avoid interference.
- Poor power supply quality may also cause garbled data. Ensure the power supply is reliable.
- Extension cables or feeders of inferior quality or excessive length can also lead to elevated error rates.

9.4 Antenna Selection



Enable both the IPEX interface and the stamp hole interface simultaneously. Either the IPEX interface or the stamp hole interface may be selected as needed.

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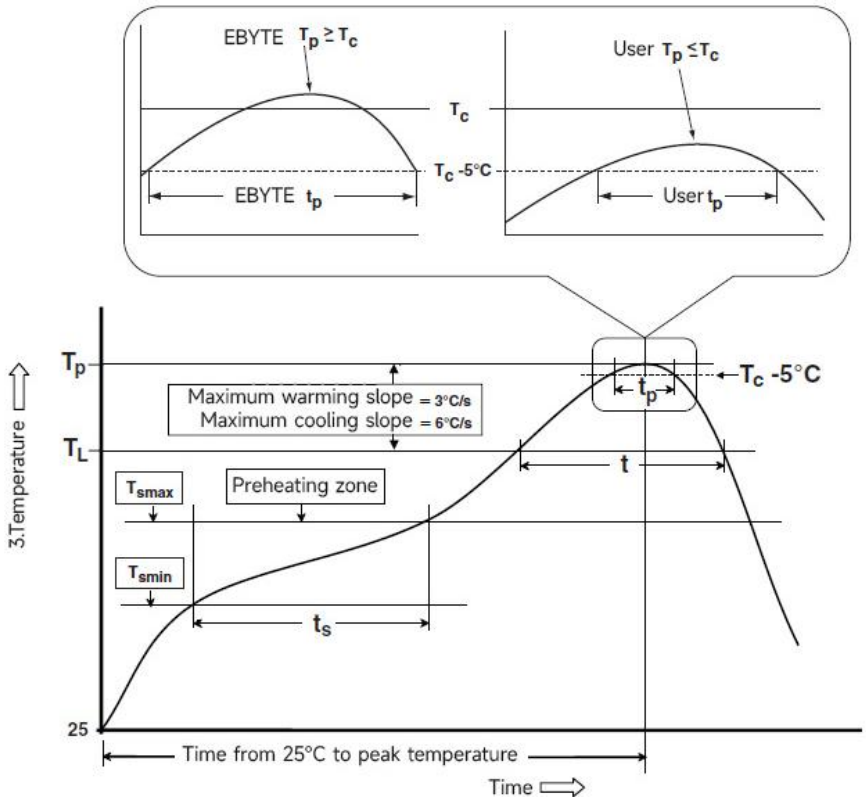
10 Welding Work Instructions

10.1 Reflow Soldering Temperature

Reflow Soldering Profile Characteristics		Lead-based assembly process	Lead-Free Assembly Process
Preheat/Keep Warm	Lowest temperature（Tsmin）	100℃	150℃
	Maximum temperature（Tsmax）	150℃	200℃
	Time（Tsmin~Tsmin）	60–120 seconds	60-120 seconds
Temperature rise slope（TL~Tp）		3°C/s, maximum value	3°C/s, maximum value
Liquid phase temperature（TL）		183℃	217℃
Hold time above TL		60~90 seconds	60~90 seconds
Peak Package Temperature Tp		Users must not exceed the temperature indicated on the product's “Moisture Sensitivity” label.	Users must not exceed the temperature indicated on the product's moisture sensitivity label.
Within the specified classification temperature (Tc) and time (Tp) of 5°C, see the figure below.		20 seconds	30 seconds
Cooling slope（Tp~TL）		6°C/s, maximum value	6°C/s, maximum value
Time from room temperature to peak temperature		6 minutes, maximum	8 minutes, maximum
※The tolerance for the peak temperature (Tp) of the temperature curve is defined as the user's upper limit.			

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10.2 Reflow Soldering Profile Chart



11 Antenna Guide

11.1 Antenna Recommendation

Antennas play a crucial role in communication processes, and substandard antennas can significantly impact communication systems. Therefore, our company recommends certain antennas as compatible accessories for our wireless modules, offering superior performance at a reasonable price.

Product Model	Type	Frequency(Hz)	Interface	Gain(dBi)	Height (mm)	Feeder (cm)	Features
TX433-JZG-6	Rubber antenna	433M	SMA-J	2.5	62	-	Ultra-short straight-type omnidirectional antenna
TX433-JW-5	Rubber antenna	433M	SMA-J	2.0	50	-	Flexible rubber rod, omnidirectional antenna
TX433-JWG-7	Rubber antenna	433M	SMA-J	2.5	75	-	Flexible rubber rod, omnidirectional antenna
TX433-JK-11	Rubber antenna	433M	SMA-J	2.5	110	-	Flexible rubber rod, omnidirectional antenna

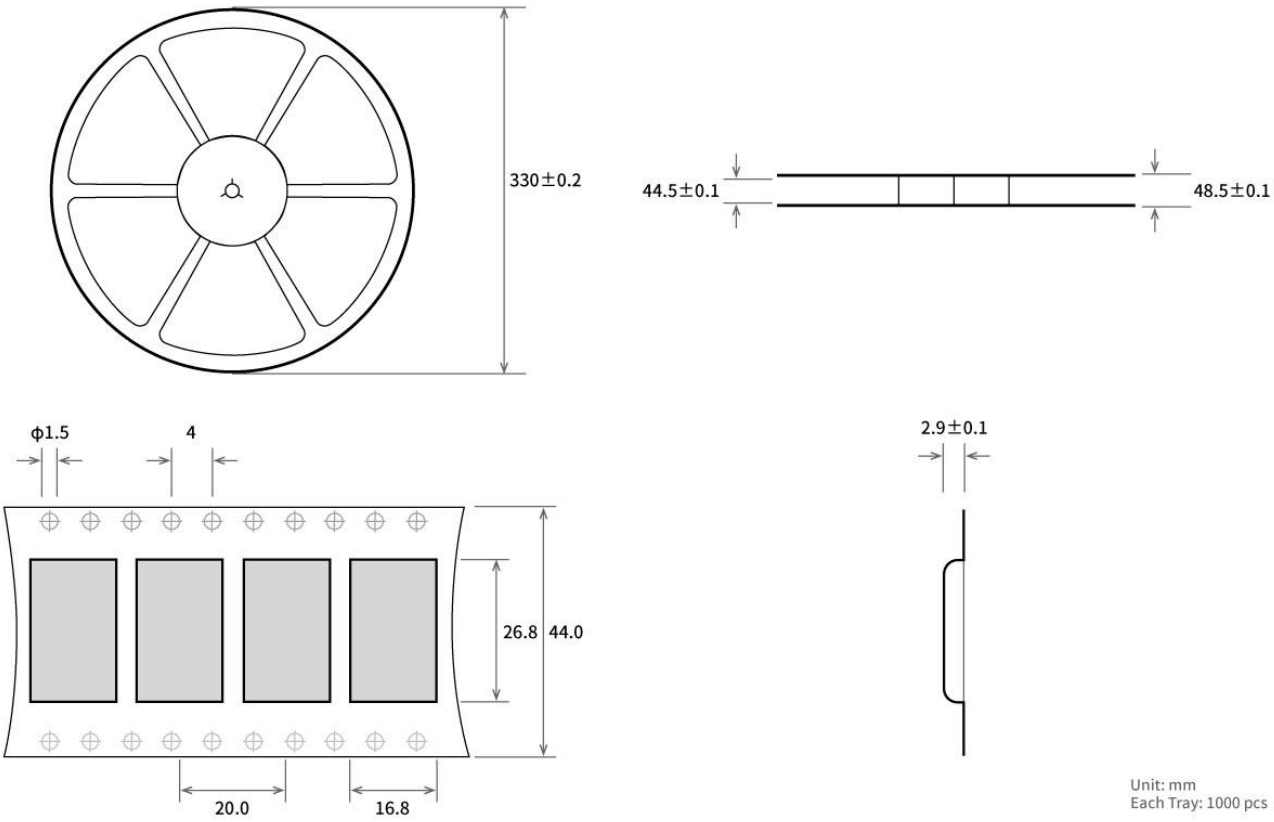
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Product Model	Type	Frequency(Hz)	Interface	Gain(dBi)	Height (mm)	Feeder (cm)	Features
TX433-XPL-100	Suction Cup Antenna	433M	SMA-J	3.5	185	100	Compact Suction Cup Antenna, Cost-Effective
TX433-XP-200	Suction Cup Antenna	433M	SMA-J	4.0	190	200	Neutral-point suction cup antenna, low loss
TX433-XPH-300	Suction Cup Antenna	433M	SMA-J	6.0	965	300	Large suction cup antenna, high gain
TX490-JZ-5	Rubber antenna	470/490M	SMA-J	2.0	50	-	Ultra-short straight-type omnidirectional antenna
TX490-XPL-100	Suction Cup Antenna	470/490M	SMA-J	3.5	120	100	Compact Suction Cup Antenna, Cost-Effective
TX868-JKS-IPX20	Rubber antenna	868M	IPEX-1	3.0	197	200	Flexible rubber rod, omnidirectional antenna
TX868-JZLW-15	Rubber antenna	868M	IPEX-1	3.0	165	150	Flexible rubber rod, omnidirectional antenna
TX868-XPL-100	Suction Cup Antenna	868M	SMA-J	3.5	290	100	Compact Suction Cup Antenna, Cost-Effective
TX868-JKD-20	Rubber antenna	868M	SMA-J	3.0	170	-	Flexible rubber rod, omnidirectional antenna
TX915-JKS-IPX20	Rubber antenna	915M	IPEX-1	3.0	197	200	Flexible rubber rod, omnidirectional antenna
TX915-JZLW-15	Rubber antenna	915M	IPEX-1	3.0	155	150	Flexible rubber rod, omnidirectional antenna
TX915-JKD-20	Rubber antenna	915M	SMA-J	3.5	200	-	Flexible rubber rod, omnidirectional antenna
TX915-XPL-100	Suction Cup Antenna	915M	SMA-J	3.5	260	100	Compact Suction Cup Antenna, Cost-Effective

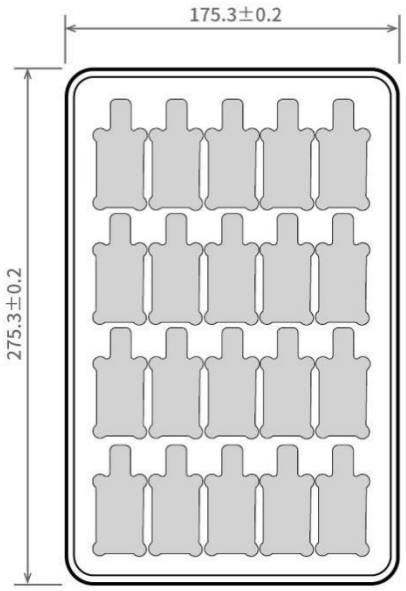
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12 Bulk Packaging Method

12.1 E32-433T20S & E32-900T20S Bulk Packaging Method



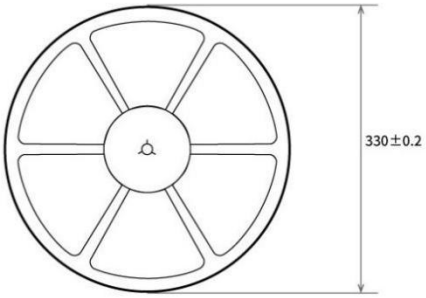
13.2 Bulk Packaging Method for E32-433T20D(30D) & E32-900T20D(30D)

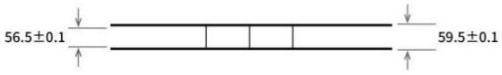


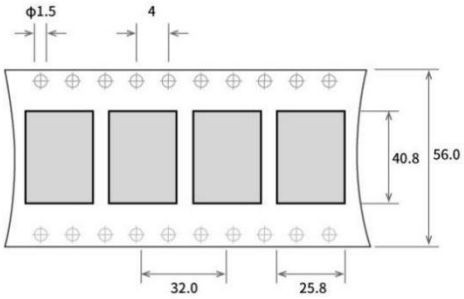


Unit: mm
Each Layer: 20 pcs
Each Package: 5 layers

13.3 E32-433T30S & E32-900T30S Bulk Packaging Method









Unit: mm
Each Tray: 400 pcs

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Revision history

Version	Date	Description	Issued by
1.0	2023-10-25	Initial Version	Hao
1.1	2024-6-7	Content Correction	Hao
1.2	2024-8-30	Corrected pin descriptions	Hao
1.3	2024-12-17	Revised sensitivity specifications	Hao
1.4	2024-12-26	Removed certification details	Lei
1.5	2025-10-23	Model consolidation and content restoration	Hao
1.6	2026-1-16	Content Correction	Hao
1.7	2026-5-29	Content Correction	Hao
1.8	2026-9-2	Content Correction	Hao

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