E78-470LN22S User Manual

LoRa Wireless Module



Chengdu Ebyte Electronic Technology Co.,Ltd.

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1. Overview

E78-470LN22S is a standard LoraWan node module designed and manufactured by Chengdu Ebyte Electronic Technology Co., Ltd., working frequency band CN470~510MHZ, supports CLASS-A/CLASS-C node type, supports ABP/OTAA two network access modes, and at the same time, this module With a variety of low-power modes, the external communication interface uses a standard UART. Users can easily access the standard LoraWan network through AT commands, making it an excellent choice for IoT applications.



1.1 main parameter

Product model	Core IC	Size	Net weight	working temperature	Working humidity	Storage temperature
E78-470LN22S	ASR6501	20* 14*2.8 mm	1.3±0.1g	-40 ~ 85℃	10% ~ 90%	-40 ~ 125°C

1.2 Parameter Description

- When designing the power supply circuit for the module, it is recommended to reserve more than 30% of the remaining amount, and the whole machine is conducive to long-term stable operation；
- The current required for the instant of launch is large but often because the launch time is extremely short, the total energy consumed may be smaller；
- When the customer uses an external antenna, the impedance matching degree between the antenna and the module at different frequency points will affect the magnitude of the emission current to varying degrees;
- The current consumed by the RF chip in the pure receiving state is called the receiving current. Some RF chips with communication protocols or developers have loaded some self-developed protocols on the whole machine, which may cause the receiving current of the test to be too large；
- The current in the purely receiving state is often mA level, and the "receiving current" of the μA level needs to be processed by the developer through software;
- The shutdown current is often much smaller than the current consumed by the power supply part of the whole machine at no load, without being overly demanding;
- Since the material itself has a certain error, a single LRC component has an error of ±0.1%. However, since a plurality of LRC components are used in the entire RF loop, there is a case where error accumulation occurs, resulting in a difference in emission current and reception current of different modules;
- Reducing the transmit power can reduce power consumption to some extent, but reducing the transmit power emissions for a number of reasons reduces the efficiency of the internal PA.

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2. Terms and definitions

2.1 LoRa

LoRa is one of the LPWAN communication technologies, the full name is Long Range Radio, which means “long-range radio” in Chinese; the company that currently dominates the technology is the foreign semtech company;
LoRa's main ISM brand is available worldwide for free bands: 433MHz, 470MHz, 868MHz, 915MHz, etc.
Features: Low power consumption, long distance, low cost.

2.2 LoRaWAN

The LoRa Alliance is an open, non-profit organization led by Semtech in March 2015. The Alliance publishes a low-power WAN standard based on the open source MAC layer protocol: the LoRaWAN protocol standard.
Network topology: star structure
Network composition: LoRa module, gateway (Gateway or base station), Server (including Network Server, Network control, Application Server).
LoRaWAN divides the LoRa nodes into three categories: A/B/C:

- Two-way transmission terminal(Class A)：

Class A's terminal will follow two short downlink receiving windows after each uplink to achieve two-way transmission. The terminal arranges transmission time slots based on its own communication requirements, with a small change on the basis of random time (ie, ALOHA protocol). This Class A operation provides the lowest power consumption end system for the application, and only requires the application to perform downlink transmission of the server in a short time after the terminal uplink transmission. The downstream transmission of the server at any other time has to wait for the next uplink of the terminal.

- Two-way transmission terminal delineating a reception slot(Class B)：

Class B terminals have more receive slots. In addition to Class A's random receive window, Class B devices also open other receive windows at the specified time. In order for the terminal to open the receiving window at a specified time, the terminal needs to receive a time-synchronized beacon (Beacon) from the gateway. This allows the server to know when the terminal is listening.

- Two-way transmission terminal that maximizes the reception slot (Class C)：

The terminal of Class C basically keeps the receiving window open, and only closes briefly when sending. Class C terminals consume more power than Class A and Class B, but the delay from the server to the terminal is also the shortest.

Note: The E78-470LN22S supports both Class A and Class C device types.

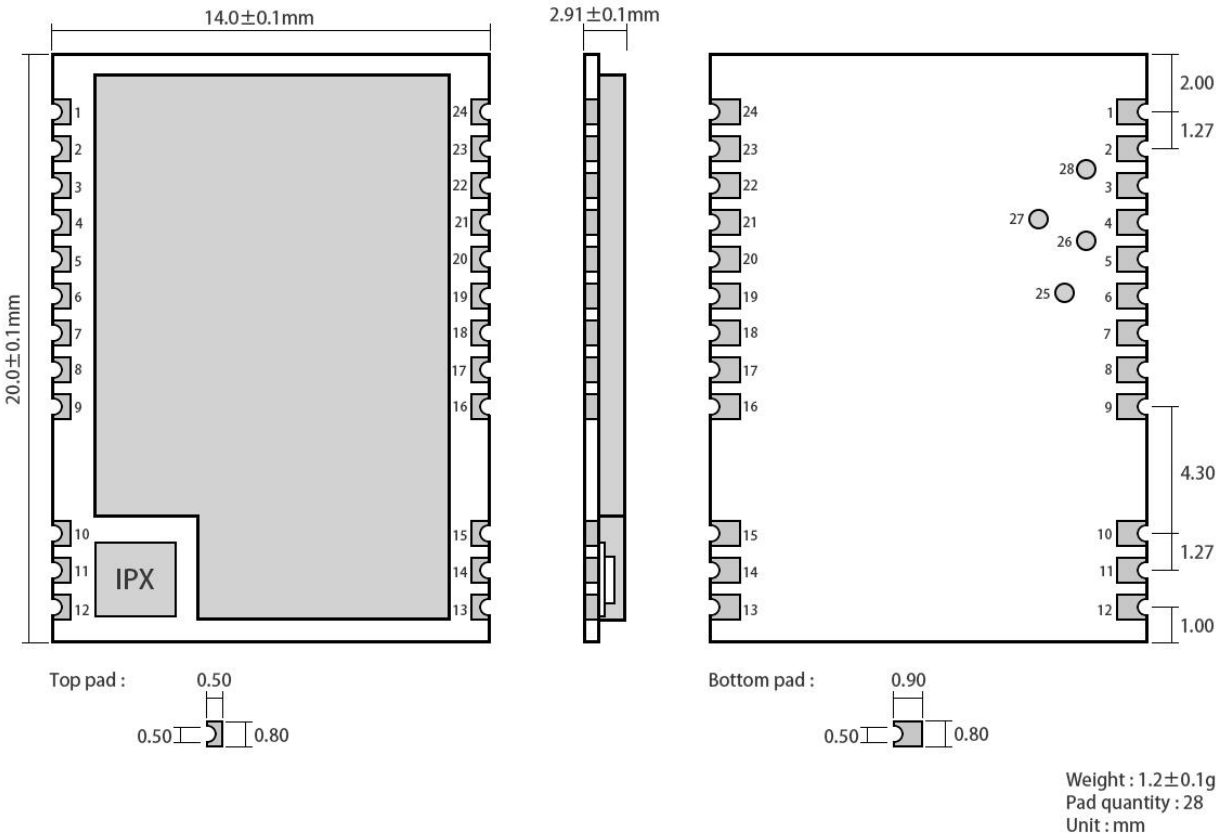
2.1.3 ADR

ADR Chinese is called adaptive data rate. In the loraWan network system, in order to maximize the battery life and overall network capacity of the terminal device, the LoRaWAN network server separately manages the data rate and RF output of each terminal device through an adaptive data rate (ADR) algorithm, through ADR technology, In the LORAWAN system, the server automatically updates the rate of setting the node according to the signal receiving capability of the node. The distance is far, the rate is low, and the distance is high, so the actual bandwidth greatly improves the effective bandwidth and load capacity of the network.

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3. Mechanical properties

3.1 E78-470LN22S Dimensions



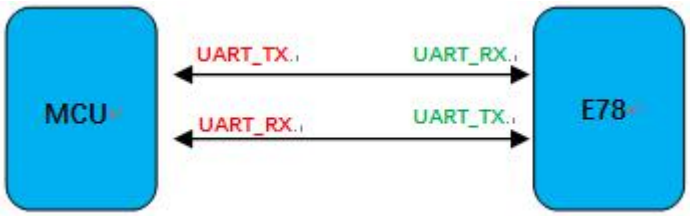
3.2 Pin definition

No.	Name	Direction	Function
1	GND		Ground wire, connected to the power reference ground
2	VCC		Power supply, range 2.5-3.7v (external ceramic filter capacitor is recommended)
3	SETB		Low power wake-up pin
4	DIO1	Input/output	NC (reserved pin)
5	BUSY	Input/output	NC (reserved pin)
6	I2C_SDA	Input/output	NC (reserved pin)
7	I2C_SCL	Input/output	NC (reserved pin)
8	UART_CTS	Input/output	NC (reserved pin)
9	UART_RTS	Input/output	NC (reserved pin)
10	GND		Ground wire, connected to the power reference

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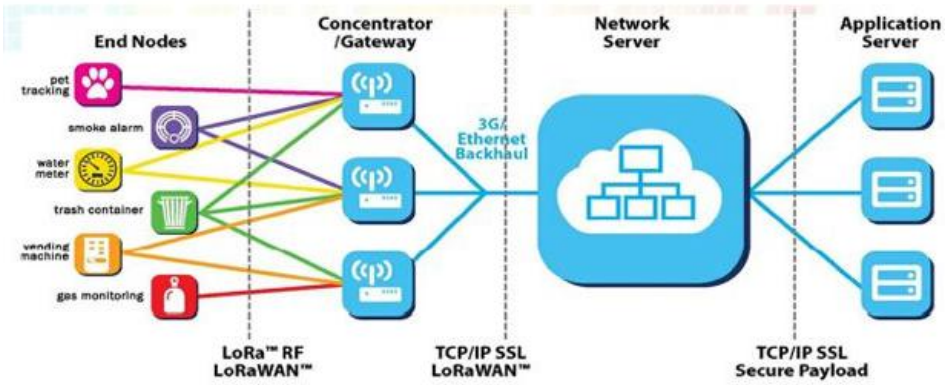
			ground
11	ANT		Antenna interface, stamp hole (50 ohm characteristic impedance)
12	GND		Ground wire, connected to the power reference ground
13	GND		Ground wire, connected to the power reference ground
14	GND		Ground wire, connected to the power reference ground
15	GND		Ground wire, connected to the power reference ground
16	XRES	Input	External reset pins
17	ADC_IN	Input	NC (reserved pin)
18	AUX	Input/output	NC (reserved pin)
19	SETA	Input/output	NC (reserved pin)
20	UART_RX	Input/output	UART RX pin
21	UART_TX	Input/output	UART TX pin
22	SWD_DATA	Input/output	SWD Data pin
23	SWD_CLK	Input/output	SWD Clock pin
24	GND		Ground wire, connected to the power reference ground
25	SPI_MISO	Input/output	SPI MISO test point, internally connected, cannot be used as external SPI
26	SPI_NSS	Input/output	SPI NSS test point, internally connected, cannot be used as an external SPI
27	SPI_MOSI	Input/output	SPI MOSI test point, internally connected, cannot be used as an external SPI
28	SPI_SCK	Input/output	SPI SCK test point, internally connected, cannot be used as external SPI
★ For the pin definition, software driver and communication protocol of the module, please refer to ASR official《ASR6501 Datasheet》 ★			

3.3 Recommended connection diagram

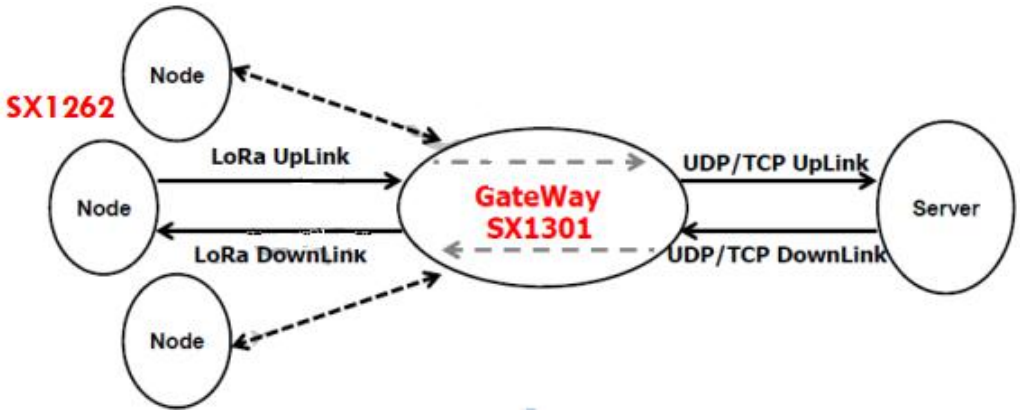


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4. LoraWan application model diagram



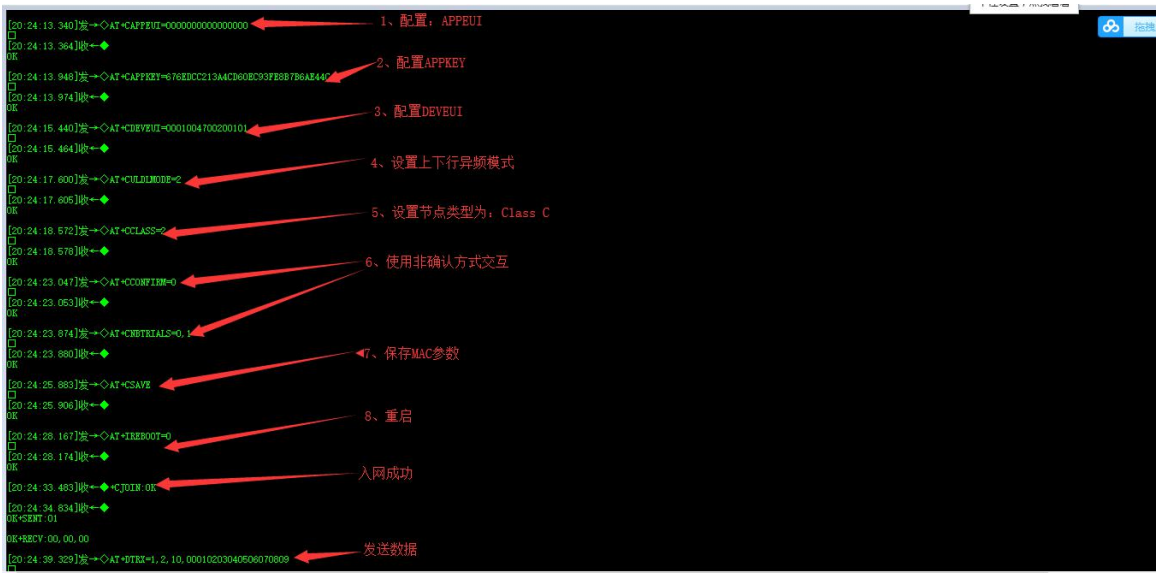
The complete LoraWan network system consists of: node, gateway, Lora NetWork Server, application server, the node is generally designed by LORA chip; the gateway is designed by SX1301 provided by semtech; Lora NetWork Server now has open source loraserver or commercial TTN (The ThingsNetwork), users can build their own; application server is designed and developed by users, mainly used for data exchange with Lora NetWork Server applications.



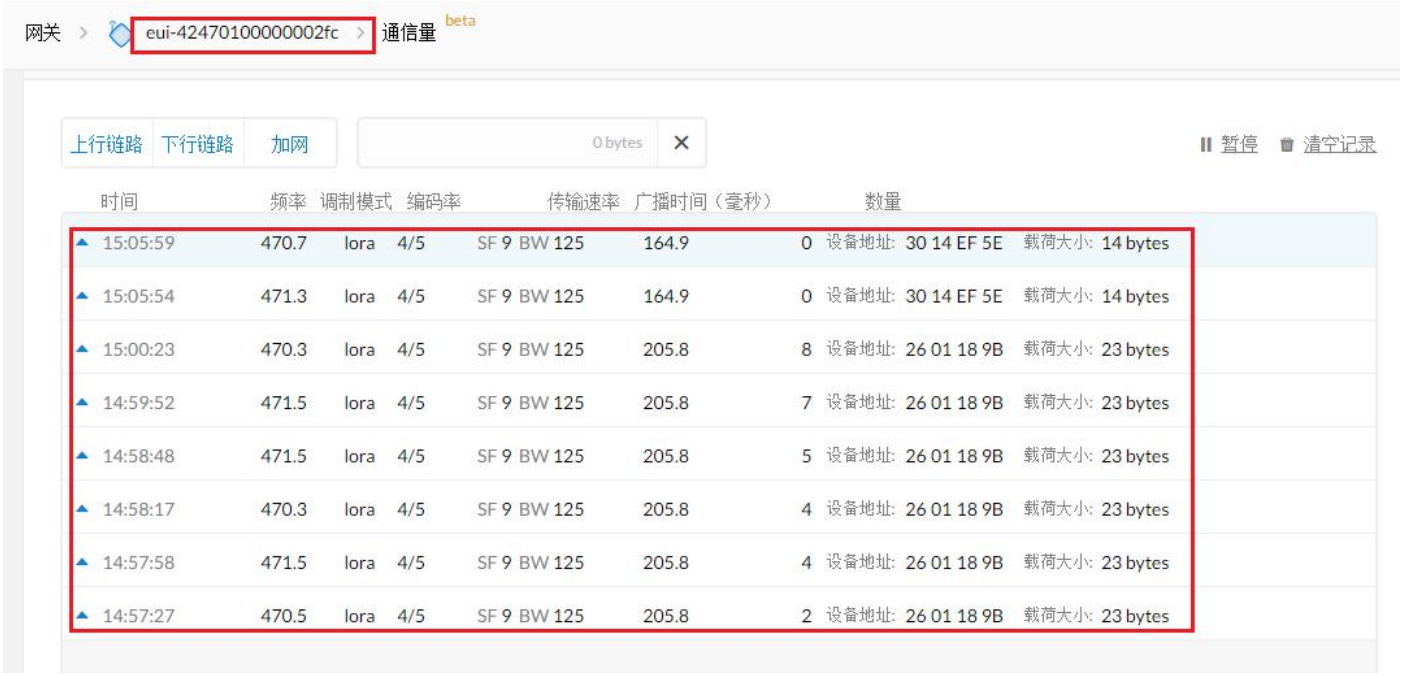
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5. Access demo

The demonstration kit is: E78-470LN22S as a node, E890 as a gateway to access the free TTN (TheThingsNetwork) test server for communication test; node-side OTAA access mode corresponding settings are as follows:

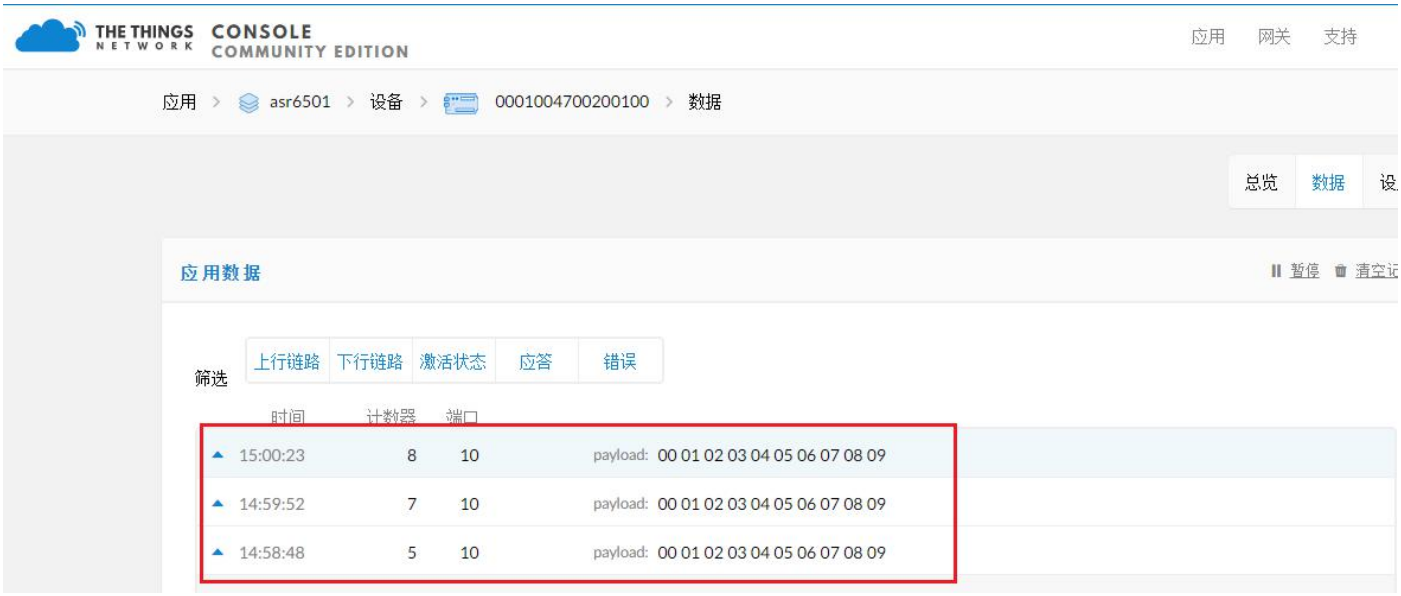


On the TTN, the gateway data record is as follows:



The TTN node data record is as follows:

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Note: For the TTN creation device and corresponding configuration process, please refer to 《LORAWAN Node + Gateway TTN Server Configuration Tutorial》

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6. AT command

a) Command format：

<CMD>[op][para1, para2, para3,…]<CR><LF>

：Command prefix

CMD：Control command

[op]：Command operator。Can be the following:

- ✓ “=”：indicates the parameter setting.
- ✓ “?”：Indicates the current value of the query parameter.
- ✓ “”：indicates the execution of the command.
- ✓ “=?”：Indicates the parameters of the query setting instruction.

[para-n]：Indicates the set parameter value or specifies the parameter to be queried.。

<CR><LF>：Enter to change lines，ASCII 0x0D 0x0A

Command	Description (general order)
CGMI	Read the manufacturer's logo
CGMM	Read module identification
CGMR	Read version identifier
CGSN	Read product serial number identifier
CGBR	Set the baud rate of the UART
CJOINMODE	Set the read join mode (OTAA, ABP)
CDEVEUI	Set to read DevEUI (OTAA when entering the network)
CJOINMODE	Set the read join mode (OTAA, ABP)
CDEVEUI	Set to read DevEUI (OTAA when entering the network)
CAPPEUI	Set to read AppEUI (OTAA when entering the network)
CAPPKEY	Set to read AppKey (OTAA when entering the network)
CDEVADDR	Set to read DevAddr (ABP when entering the network)
CAPPSKEY	Set to read AppSkey (ABP when accessing the network)
CNWKSKEY	Set to read NwkSkey (ABP when accessing the network)
CFREQBANDMASK	Set the read frequency mask (FreqBandMask)
CULDLMODE	Set to read the Ul/Dl mode (same frequency or different frequency)
CWORKMODE	Set the read working mode (normal working mode)
CCLASS	Set the read class type (Class A/C)
CBL	Read battery level
CSTATUS	Read node status
CJOIN	Initiate OTAA access to the network
DTRX	Send and receive data frames
DRX	Get the latest received data from Rx buffer and empty Rx buffer
Command	Description (MAC related configuration command)
CCONFIRM	Set the type of read send message (confirm or unconfirm)
CAPPPORT	Set the read application layer port
CDATARATE	Set the read data rate

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CRSSI	Get the RSSI value of the channel
CNBTRIALS	Set the read NbTrans parameter
CRM	Set the read report mode
CTXP	Set the read transmit power
CLINKCHECK	Enable Link check
CADR	Enable or disable ADR
CRXP	Set the read receive window parameters
CRX1DELAY	Set the delay to read TX and RX1
CSAVE	Save configuration
CRESTOREMAC	Restore default configuration
IREBOOT	System reset
CLPM	System low power settings
ECHO	Serial command echo configuration

Command character	Command Type	Command Format	response
CGMI (**Read the manufacturer's logo)**	Query command	AT+CGMI?	+CGMI=<manufacturer> OK
	Parameter Description	<manufacturer>： Manufacturer identification	
	Return value description		
	Example	AT+CGMI? +CGMI=Ebyte OK	
	Precautions		
Command character	Command Type	Command Format	response
CGMM (**Read module identification)**	Query command	AT+CGMM?	+CGMM=<model> OK
	Parameter Description	<model>： **module identification**	
	Return value description		
	Example	AT+CGMM? +CGMM=E78-470LN22S OK	
	Precautions		
Command character	Command Type	Command Format	response
CGMR	Query	AT+CGMR?	+CGMR=<revision>

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(**Read version identifier**)	command		OK
	Parameter Description	<revision>： version number	
	Return value description		
	Example	AT+CGMR? +CGMR=V4.1 OK	
	Precautions		
Command character	Command Type	Command Format	response
CGSN (**Read product serial number identifier**)	Query command	AT+CGSN?	+CGSN=<sn> OK
	Parameter Description	<sn>： Product serial number identifier	
	Return value description		
	Example	AT+CGSN? +CGSN=0539349E00032523 OK	
	Precautions		
Command character	Command Type	Command Format	response
CGBR (**Set baud rate**)	Query command	AT+CGBR?	+CGBR=<baud> OK
	Setting command	AT+CGBR=<baud>	OK
	Parameter Description	<baud>： **baud rate**	
	Return value description		
	Example	AT+CGBR=9600 OK	
	Precautions	Baud range：1200~460800bps；Default baud rate 115200；	
Command character	Command Type	Command Format	response
CJOINMODE (**Set the Join mode**)	Test command	AT+CJOINMODE=?	+CJOINMODE:**“**mode**”** OK
	Query command	AT+CJOINMODE?	+CJOINMODE:<mode> OK
	Setting command	AT+CJOINMODE=<mode>	OK
	Parameter	<mode>：Node Join mode	

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	Description	0:OTAA 1:ABP	
	Return value description		
	Example	AT+CJOINMODE=0 OK	
	Precautions	Different mode nodes have different network access modes. ABP should use this command before sending data.	
Command character	Command Type	Command Format	response
CDEVEUI (**Set DevEUI**)	Test command	AT+CDEVEUI=?	+CDEVEUI=<DevEUI:length is 16>
	Query command	AT+CDEVEUI?	+CDEVEUI:<value> OK
	Setting command	AT+CDEVEUI=<mode>	OK
	Parameter Description	<mode>：Node DevEUI	
	Return value description		
	Example	AT+CDEVEUI? +CDEVEUI=AABBCCDD00112233 OK	
	Precautions	Set or read DevEUI, return Y1Y2...Y8, hexadecimal format, and take 8 bytes.	
Command character	Command Type	Command Format	response
CAPPEUI (**Set AppEUI**)	Test command	AT+CAPPEUI=?	+CAPPEUI=<AppEUI:length is 16>
	Query command	AT+CAPPEUI?	+CAPPEUI:<value> OK
	Setting command	AT+CAPPEUI=<value>	OK
	Parameter Description	<value>： Node AppEUI	
	Return value description		
	Example	AT+CAPPEUI=AABBCCDD00112233 OK	
	Precautions	Used in OTAA, set or read AppEUI, return Y1Y2...Y8, hexadecimal format, and take 8 bytes.	
Command character	Command Type	Command Format	response
CAPPKEY	Test	AT+CAPPKEY=?	+CAPPKEY=<AppKey:length is 32>

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(**Set AppKey**)	command		
	Query command	AT+CAPPKEY?	+ CAPPKEY:<value> OK
	Setting command	AT+CAPPKEY =<value>	OK
	Parameter Description	<value>： Node AppEUI	
	Return value description		
	Example	AT+CAPPKEY=AABBCCDD00112233AABBCCDD00112233 OK	
	Precautions	Used in OTAA, set or read AppKey, return Y1Y2...Y16, hexadecimal format, and take 16 bytes.	
Command character	Command Type	Command Format	response
CDEVADDR (**Set DevAddr**)	Test command	AT+CDEVADDR=?	+CDEVADDR=<DevAddr:length is 8，Device address of ABP mode>
	Query command	AT+CDEVADDR?	+CDEVADDR:<value> OK
	Setting command	AT+CDEVADDR =<value>	OK
	Parameter Description	<value>：Node DevAddr	
	Return value description		
	Example	AT+CDEVADDR=00112233 OK	
	Precautions	Used in ABP, set or read DevAddr, return Y1Y2...Y4, hexadecimal format, and take 4 bytes.	
Command character	Command Type	Command Format	response
CAPPSKEY (**Set AppSKey**)	Test command	AT+CAPPSKEY=?	+CAPPSKEY=<AppSKey:length is 32>
	Query command	AT+CAPPSKEY=<value>	+CAPPSKEY:<value> OK
	Setting command	AT+CDEVADDR =<value>	OK
	Parameter Description	<value>：Node AppSKey	
	Return value description		
	Example	AT+CAPPSKEY=AABBCCDD00112233AABBCCDD00112233	

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		OK	
	Precautions	Used in ABP, set or read AppSKey, return Y1Y2...Y16, hexadecimal format, which takes 16 bytes.	
Command character	Command Type	Command Format	response
CNWKSKEY (**Set NwkSKey**)	Test command	AT+CNWKSKEY=?	+CNWKSKEY =<NwkSKey:length is 32>
	Query command	AT+CNWKSKEY?	+CNWKSKEY:<value> OK
	Setting command	AT+CNWKSKEY=<value>	OK
	Parameter Description	<value>： Node NwkSKey	
	Return value description		
	Example	AT+CNWKSKEY=AABBCCDD00112233AABBCCDD00112233 OK	
	Precautions	Used in ABP, set or read NwkSKey, return Y1Y2...Y16, hexadecimal format, and take 16 bytes.	
CFREQBANDMASK (**Set the band mask**)	Command Type	Command Format	response
	Test command	AT+CFREQBANDMASK=?	+CFREQBANDMASK:“mask” OK
	Query command	AT+CFREQBANDMASK?	+CFREQBANDMASK:<mask> OK
	Setting command	AT+CFREQBANDMASK=<mask>	OK
	Parameter Description	<mask>： The frequency point mask that the network may work, 16 bits corresponds to 16 frequency groups. See LoRaWAN access specification for details. For example: 0-7 channel, the corresponding mask is 0001, the corresponding mask of channel 8-15 is 0002, and so on.	
	Return value description		
	Example	AT+CFREQBANDMASK=0001 OK	
	Precautions	Need to set before Join.	
Command character	Command Type	Command Format	response
CULDLMODE (**Set upstream and downstream same/different frequency**)	Test command	AT+CULDLMODE=?	+CULDLMODE:**“**mode**”** OK
	Query command	AT+CULDLMODE?	+CULDLMODE:<mode> OK
	Setting command	AT+CULDLMODE=<mode>	OK

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	Parameter Description	<mode>： 1：Same frequency mode 2：Different frequency mode	
	Return value description		
	Example	AT+CULDLMODE=2 OK	
	Precautions	Set before Join	
Command character	Command Type	Command Format	response
CWORKMODE (**Set working mode**)	Test command	AT+CWORKMODE=?	+CWORKMODE:“mode” OK
	Query command	AT+CWORKMODE?	+CWORKMODE:<mode> OK
	Setting command	AT+CWORKMODE=<mode>	OK
	Parameter Description	<mode>： 2：Normal operation mode	
	Return value description		
	Example	AT+CWORKMODE=2 OK	
	Precautions	It needs to be set before joining, and the default is normal working mode Currently only normal operation mode is supported	
Command character	Command Type	Command Format	response
CCLASS (**Set Class**)	Test command	AT+CCLASS=?	+CCLASS:“class”,“branch”,“para1”,“para2”, “para3” ,“para4” OK
	Query command	AT+CCLASS?	+CCLASS:<class> OK
	Setting command	AT+CCLASS=<class>	OK
	Parameter Description	<class>： 0:classA 2:classC	
	Return value description		
	Example	AT+CCLASS=2 OK	
	Precautions	Need to be set before Join, the default is classA	
Command character	Command Type	Command Format	response
CSTAUS	Test	AT+CSTAUS=?	+CSTATUS:”status”

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(Query the current status of the device)	command		OK
	Query command	AT+CSTATUS?	+CSTATUS:<status> OK
	Setting command	<status>： 00 – No data operation 01 – Data transmission 02 – Data transmission failed 03 – Data sent successfully 04 – JOIN succeeded (only in the first JOIN process) 05 – JOIN failed (only in the first JOIN process) 06 – The network may be abnormal (Link Check result) 07 – Successful data transmission, no downstream 08 – Send data successfully, with downstream	
	Parameter Description		
	Return value description	AT+CSTATUS? +CSTATUS=03 OK	
	Example	Query the current status of the device	
Command character	Command Type	Command Format	response
CJOIN (**Set Join**)	Test command	AT+CJOIN=?	+CJOIN:<ParaTag1>,[ParaTag2],…[ParaTag4] OK
	Query command	AT+CJOIN?	+CJOIN:<ParaValue1>,[ParaValue2],…[Para Value4] OK
	Setting command	AT+CJOIN=<ParaValue1>， [ParaValue2],…. [ParaValue4]	If the input is legal, first return OK, then start automatic authentication and return the authentication result. +CJOIN:OK Authentication succeeded +CJOIN: FAIL authentication failed
	Parameter Description	<ParaTag1>， [ParaTag2]，……[ParaTag4]：Authentication parameter tag：1， 2，……4 ； [ParaValue1]， [ParaValue2]，……[ParaValue4]：Authentication parameter value： 1， 2，……4； <ParaTag1>， indicates that the JOIN operation is performed，，ParaTag1 Ranges： 0– stop JOIN 1– start JOIN，Restart the JOIN process again. For modules that enable hot start, performing this action clears the saved JOIN context parameters. [ParaTag2] Indicates whether the automatic JOIN function is enabled.The factory value is 1， ParaTag2 value range：	
	Return value description		

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		0 – turn off automatic JOIN 1 – The automatic JOIN. module automatically starts JOIN after entering the transparent mode. [ParaTag3]indicates the JOIN period,Range of values： 7~255, The unit is s. Factory default: 8。 [paratag4] indicates the maximum number of join attempts. Paratag4 value range: 1-255	
	Example	AT+CJOIN=1,1,10,8（Set the join parameter: enable automatic join, the join cycle is 10s, and the maximum number of attempts is 8） OK +CJOIN:OK	
	Precautions	Set before Join.	
Command character	Command Type	Command Format	response
DTRX (**Send and receive data**)	Test command	AT+DTRX=?	+DTRX:[confirm],[nbtrials],<Length>,<Pay load> OK
	Setting command	AT+DTRX=[confirm], [nbtrials],<Length>, <Payload> OK+SEND:TX_LEN OK+SENT:TX_CN	OK+SEND:TX_LEN OK+SENT:TX_CNT OK+RECV:TYPE,PORT,LEN,DATA 或者 ERR+SEND:ERR_NUM ERR+SENT:TX_CNT
	Parameter Description	Confirm and nbtrials refer to the corresponding AT command, which is valid only for this transmission, optional. Length：indicates the number of strings; the maximum value is described in the access specification; the byte lengths allowed to be transmitted at different rates are different (see LoRaWan protocol for details), and 0 indicates that empty packets are sent. Payloadhexadecimal (2 characters for 1 number);	
	Return value description	Return value: 1、 How to judge whether the data transmission is successful? Confirm type data: Each time a frame of data is sent, there should be a corresponding response message. When the module fails to receive the response message, if it does not reach the maximum number, it will retry again. If the downlink message is not received after the maximum number of times is reached, it is a failure and output. ERR+SENT message. During this period, if the transmission of the response message is received, it is successful and the OK+SEND,	

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		OK+SENT and OK+RECV messages are output. Unconfirm type data: The downlink response will not be requested after the data is sent, and the OK+SEND, OK+SENT message will be returned at the end of each transmission. If the downlink data is received, the OK+RECV message is sent. 2、Data sending status prompt OK+SEND: TX_LEN indicates that the data transmission request was successful, TX_LEN: 1Byte, the length of the transmitted data OK+SENT: TX_CNT indicates that the data transmission was successful, TX_CNT: 1Byte, the number of data transmissions. ERR+SEND: ERR_NUM indicates that the data transmission request failed for the reason indicated by ERR_NUM. ERR_NUM： 1 Byte， 0- Not in the network 1- Communication is busy, sending request failed 2- The data length exceeds the current transmittable length, and only the MAC command is sent. ERR+SENT: TX_CNT indicates that the data transmission failed, the maximum number of transmissions has been reached, TX_CNT: 1 Byte, and the number of data transmissions. OK+RECV:TYPE,PORT,LEN,DATA Successful data reception (received response message or active downlink data) TYPE： 1Byte，downstream transmission type Bit0： 0-unconfirm， 1-confirm Bit1： 0-not ACK， 1-ACK Bit2：0-not carried, 1-carried, indicating whether link command response is carried in downlink data Bit30-not carried, 1-carried, indicating whether time command response is carried in downstream data. Only when this bit is 1, time synchronization is successful Bit4~Bit7：default 0, reserved PORT： 1Byte，downstream transmission port LEN： 1Byte，downstream data length DATA： nByte，downstream data，When len = 0, this field does not exist.
	Example	AT+DTRX=1,2,10,0123456789 OK+SEND:03 OK+SENT:01 OK+RECV:02,01,00 Indicates that the confirm data is sent successfully. The valid data received by the server should be "0123456789", and the downstream confirmation has been received.
	Precautions	Enter the network first, then send data

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Command character	Command Type	Command Format	response
DRX (**Receive data**)	Test command	AT+DRX=?	+DRX:<Length>,<Payload> OK
	Query command	AT+DRX?	+DRX:<Length>,<Payload> OK
	Parameter Description	Return value: Length： 0 means empty packet; Payload：Hexadecimal string data; Ono exception in receiving data packet；	
	Return value description		
	Example	AT+DRX? OK	
	Precautions	Receive packets from the receive buffer and clear the receive buffer;	
Command character	Command Type	Command Format	response
CCONFIRM (**Set upstream transmission type**)	Test command	AT+CCONFIRM=?	+CCONFIRM:“value” OK
	Query command	AT+CCONFIRM?	+DRX:<Length>,<Payload> OK
	Setting command	AT+CCONFIRM =<value>	OK
	Parameter Description	<value>： as follows： 0: UnConfirmed up message 1: Confirmed up message	
	Return value description		
	Example	AT+CCONFIRM=1 OK	
	Precautions	Need to set before sending data	
Command character	Command Type	Command Format	response
CAPPPORT (**Set the upstream data port number**)	Test command	AT+CAPPPORT=?	+CAPPPORT:“value” OK
	Query command	AT+CAPPPORT?	+CAPPPORT:<value> OK
	Setting command	AT+CAPPPORT=<value>	OK
	Parameter Description	<value>： as follows: The port used, the data format is decimal, the factory value is 10. Value range: 1~223; Note: Port: 0x00 is the MAC command of LoRaWAN	
	Return value description		
	Example	AT+CAPPPORT=10 OK	
	Precautions	Need to set before sending data	

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Command character	Command Type	Command Format	response
CDATARATE (**Set the communication rate**)	Test command	AT+CDATARATE=?	+CDATARATE:**“**value**”** OK
	Query command	AT+CDATARATE?	+CDATARATE:<value> OK
	Setting command	AT+CDATARATE =<value>	OK
	Parameter Description	<value>： as follows: Rate value, the factory value is 3, the value range:	
	Return value description	0 - SF12， BW125 1 - SF11， BW125 2 - SF10， BW125 3 - SF9， BW125 4 - SF8， BW125 5 - SF7， BW125	
	Example	AT+CDATARATE=1 OK	
	Precautions	Need to be set before sending data, invalid after ADR is enabled.	
Command character	Command Type	Command Format	response
CRSSI (**Query channel signal strength**)	Test command	AT+CRSSI=?	+CRSSI OK
	Query command	AT+CRSSI FREQBANDIDX?	+CRSSI: 0:<Channel 0 rssi> 1:<Channel 1 rssi> … 7:<Channel 7 rssi> OK
	Setting command	<FREQBANDIDX>: Indicates the number of the frequency band, starting from 0, and the 1A2 group number is 1 Returns the RSSI of 8 channels in a band.	
	Return value description		
	Example	AT+CRSSI 1? +CRSSI: 0:-157 1:-157 2:-157 3:-157 4:-157 5:-157 6:-157 7:-157	

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		OK	
	Precautions		
Command character	Command Type	Command Format	response
CNBTRIALS (**Set the number of times to send**)	Test command	AT+CNBTRIALS=?	+CNBTRIALS: “MType”,“value” OK
	Query command	AT+CNBTRIALS?	+CNBTRIALS:<MType>,<value> OK
	Setting command	AT+CNBTRIALS=<MType>,<value>	OK
	Parameter Description	<MType>:0:unconfirm 包， 1:confirm 包。 <value>：the maximum number of times to send, value range: 1~15;	
	Return value description		
	Example	AT+CNBTRIALS=1,2 OK	
	Precautions	Need to set before sending data	
Command character	Command Type	Command Format	response
CRM **(Set reporting mode)**	Test command	AT+CRM=?	+CRM:“reportMode”,”reportInterval” OK
	Query command	AT+CRM?	+CTXP:<reportMode>,[reportInterval] OK
	Setting command	AT+CTXP=<reportMode>,[reportInterval]	OK
	Parameter Description	<reportMode>： 0- acyclic reporting data; 1- Periodic reporting of data; <reportInterval>： This parameter is only available when data is reported periodically. Time interval of periodic report data, unit: s.For different Dr's, the minimum period allowed is different. The definition of period level is adopted, as shown in the following table. Rate\cycle(s)\level LV1 LV2 DR0 150 300 DR1 75 150 DR2 35 70 DR3 15 30 DR4 10 20 DR5 5 10	
	Return value description		

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	Example	AT+CRM=1,10 OK	
	Precautions	Need to set before sending data	
Command character	Command Type	Command Format	response
CTXP (**Set the transmit power**)	Test command	AT+CTXP=?	+CTXP:“value” OK
	Query command	AT+CTXP?	+CTXP:<value> OK
	Setting command	AT+CTXP=<value>	OK
	Parameter Description	<is the transmission power size, the factory value is 0.	
	Return value description	0 - 17dBm 1 - 15dBm 2 - 13dBm 3 - 11dBm 4 - 9dBm 5 - 7dBm 6 - 5dBm 7 - 3dBm	
	Example	AT+CTXP=1 OK	
	Precautions	Need to set before sending data	
Command character	Command Type	Command Format	response
CLINKCHECK (**Verify network connectivity**)	Test command	AT+CLINKCHECK=?	+CLINKCHECK:“value” OK
	Setting command	AT+CLINKCHECK=<value>	OK
	Parameter Description	<value>: Enable control for Link Check 0 – Link Check is not enabled	
	Return value description	1 – Perform a Link Check 2 - The module automatically carries the linkcheck command in each upstream packet. Return OK, the setting is successful. If X1=1, after waiting for a while, it will return the second response message in the following format: +CLINKCHECK:Y0， Y1， Y2， Y3， Y4 ● YO indicates the Link Check result: ● 0 - indicates that the Link Check is successfully executed. ● Not 0 - indicates that the Link Check execution failed. Y1 is DemodMargin	

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		Y2 is NbGateways Y3 is the downstream RSSI Y4 is the downstream SNR	
	Example	AT+CLINKCHECK=1 OK +CLINKCHECK: 0， 0， 1， -68， 8	
	Precautions	Need to set before sending data	
Command character	Command Type	Command Format	response
CRXP (**Set the receive window parameters**)	Test command	AT+CRXP=?	+CRXP:“RX1DRoffest”,”RX2DataRate”,”RX2Frequency” OK
	Setting command	AT+CRXP?	+CRXP:<RX1DRoffest>,<RX2DataRate>,<RX2Frequency> OK
	Parameter Description	AT+CRXP=<RX1DRoffest>,<RX2DataRate>,<RX2Frequency>	OK
	Return value description	<RX1DRoffest>,<RX2DataRate>,<RX2Frequency>详见 LoRaWAN 协议。	
	Example		
	Precautions	AT+CRXP=1,1,471000000 OK	
	Test command	Need to be set before sending data. Use the default value when not setting.	
Command character	Command Type	Command Format	response
CRX1DELAY (**Set the number of times sent**)	Test command	AT+CRX1DELAY=?	+CRX1DELAY:“Delay” OK
	Query command	AT+CRX1DELAY?	+CRX1DELAY:<Delay> OK
	Setting command	AT+CRX1DELAY=<Delay>	OK
	Parameter Description	Delay: how long to open rx1 window after sending, unit: s;	
	Return value description		
	Example	AT+CRX1DELAY=2	

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		OK	
	Precautions	Set how long the rx1 window will open after sending, and set before sending data. It is the protocol default value when not set.	
Command character	Command Type	Command Format	response
CSAVE (**Save MAC parameter settings**)	Test command	AT+CSAVE=?	+CSAVE OK
	Setting command	AT+CSAVE	OK
	Parameter Description	<MType>: 0: unconfirm package, 1: confirm package. <value>: is the maximum number of transmissions, ranging from 1 to 15;	
	Return value description		
	Example	This command saves the configuration parameters to EERPOM/FLASH After executing the AT+RESET command, the module will use the new MAC configuration parameters for network initialization and operation.	
	Precautions	Need to save before sending data	
Command character	Command Type	Command Format	response
CRESTOREMAC (**Restore MAC default parameters**)	Test command	AT+CRESTOREMAC=?	+CRESTOREMAC OK
	Setting command	AT+CRESTOREMAC	OK
	Parameter Description	This command restores the MAC default configuration parameters to EERPOM/FLASH.	
	Return value description		
	Example	AT+CRESTOREMAC OK	
	Precautions		
Command character	Command Type	Command Format	response
IREBOOT (**Restart module**)	Test command	AT+IREBOOT=?	+IREBOOT:"Mode" OK
	Setting command	AT+IREBOOT=<mode>	OK
	Parameter Description	<mode>: restart mode; 0: Restart the communication module immediately. 1: Wait for the radio frame currently being sent in the communication module to complete and then restart.	
	Return value description		
	Example	AT+IREBOOT=1 OK	

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	Precautions	After receiving the instruction, the communication module will reply to OK and restart the communication module. No further AT commands are received until the restart is complete.	
Command character	Command Type	Command Format	response
CLPM (**Enable low power consumption**)	Test command	AT+CLPM=?	+CLPM:"Mode" OK
	Setting command	AT+CLPM=<mode>	OK
	Parameter Description	<mode>: Low power mode 1: The device enters low power consumption	
	Return value description		
	Example	AT+CLPM=1 OK	
	Precautions	After entering low power consumption, send the serial port command again to wake up; Because the UART start part byte may be transmitted incorrectly when transmitting above 40kbps, AT+CLPM=0 may be recognized as an error and return "+CME ERROR". It is recommended to use "000000000D0A" (hexadecimal) for wakeup.	
Command character	Command Type	Command Format	response
ECHO (**Instruction echo**)	Query command	AT+ECHO?	+ ECHO:"Mode" OK
	Setting command	AT+ECHO=<mode>	OK
	Parameter Description	<mode>: command echo; 0: The instruction turns off the echo. 1: The command turns on echo.	
	Return value description		
	Example	AT+ECHO =1 OK	
	Precautions	Turn on the echo command and return to the corresponding configuration command. The command is powered off and not saved.	

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7. FAQ

7.1 Communication range is too short

- The communication distance will be affected when obstacle exists.
- Data lose rate will be affected by temperature, humidity and co-channel interference.
- The ground will absorb and reflect wireless radio wave, so the performance will be poor when testing near ground.
- Sea water has great ability in absorbing wireless radio wave, so performance will be poor when testing near the sea.
- The signal will be affected when the antenna is near metal object or put in a metal case.
- Power register was set incorrectly, air data rate is set as too high (the higher the air data rate, the shorter the distance).
- The power supply low voltage under room temperature is lower than 2.5V, the lower the voltage, the lower the transmitting power.
- Due to antenna quality or poor matching between antenna and module.

7.2 Module is easy to damage

- Please check the power supply source, ensure it is 2.0V~3.6V, voltage higher than 3.6V will damage the module.
- Please check the stability of power source, the voltage cannot fluctuate too much.
- Please make sure antistatic measure are taken when installing and using, high frequency devices have electrostatic susceptibility.
- Please ensure the humidity is within limited range, some parts are sensitive to humidity.
- Please avoid using modules under too high or too low temperature.

8. Important statement

1. EBYTE reserves the right of final interpretation and modification of all contents in this manual.
2. As the hardware and software of the product continue to improve, this manual may be subject to change without further notice, and the final version of the manual shall prevail.
3. To protect the environment, everyone is responsible: in order to reduce the use of paper, this manual only prints the Chinese part, the English manual only provides electronic documents, if necessary, please go to our official website to download; in addition, if the user does not require special, when the user orders in bulk, We only provide product specifications according to a certain percentage of the order quantity. Not every digital radio station is equipped with one by one, please understand.

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9. Revision history

Version	Date	Description	Issued by
1.0	2018/04/16	initial version	-
1.1	2019/4/01	Bug modification	Ly
1.2	2019-9-2	Format revision	Lyl
1.3	2019-11-12		Ren
1.4	2019-12-09		Ren
1.5	2021-3-5	Optimize the instructions	Linson

10. About us

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