E78-915LN22S (6601)

ASR6601 LoraWan Wireless Module

Chengdu Ebyte Electronic Technology Co.,Ltd.

Contents

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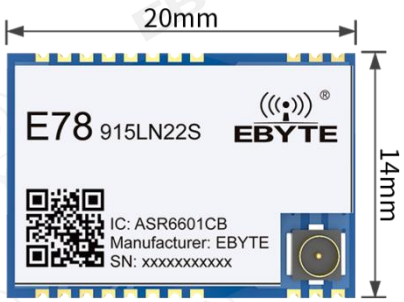
1 Product Overview

1.1 Introduction

E78- 915 LN22S (6601) series products are standard LoraWan node modules designed and produced by Chengdu Ebyte Electronic Technology Co., Ltd., operating frequency band EU8 50 ~ 925 MHZ, support US915/EU868 standard, support CLASS-A/CLASS-C node type , supports ABP/OTAA two network access methods, at the same time, the module has a variety of low-power modes, the external communication interface adopts standard UART, the user can access the standard LoraWan network through simple configuration of AT commands, which is the current Internet of Things application. Excellent choice.



1.2 Application scenarios

- Smart home and industrial sensors, etc.;
- Security system, positioning system;
- Wireless remote control, drone;
- wireless game remote control;
- healthcare products;
- Wireless voice, wireless headset;
- Automotive industry applications.

2 Parameters

2.1 Main parameters

Product number	Core IC	size	Module net weight	Operating temperature	Working humidity	Storage temperature
E78-868LN22S (6601)	ASR6 601CB	20* 14*2.8mm	1.2g	-40 ~ 85℃	10% ~ 90%	-40 ~ 125°C

2.2 Working parameters

Parameter category	Min	Typ	Max	unit
Emission current (Lora@2.4kbps)	1 10	1 20	1 30	mA
Receive current (Lora@2.4kbps)	13	14	15	mA
off current	2.4	2.5	2.6	uA
transmit power	21.0	21.2	21.8	dBm
Receive sensitivity	-139	-140	-140	dBm
TCXO crystal oscillator	32	32	32	MHZ
TCXO crystal oscillator voltage configuration	1.8	1.8	3.3	V
Recommended working frequency band	850	868/900/915	925	MHZ
Supply voltage	2.5	3.3	3.7	V
communication level	2.5	3.3	3.7	V

2.3 Hardware parameters

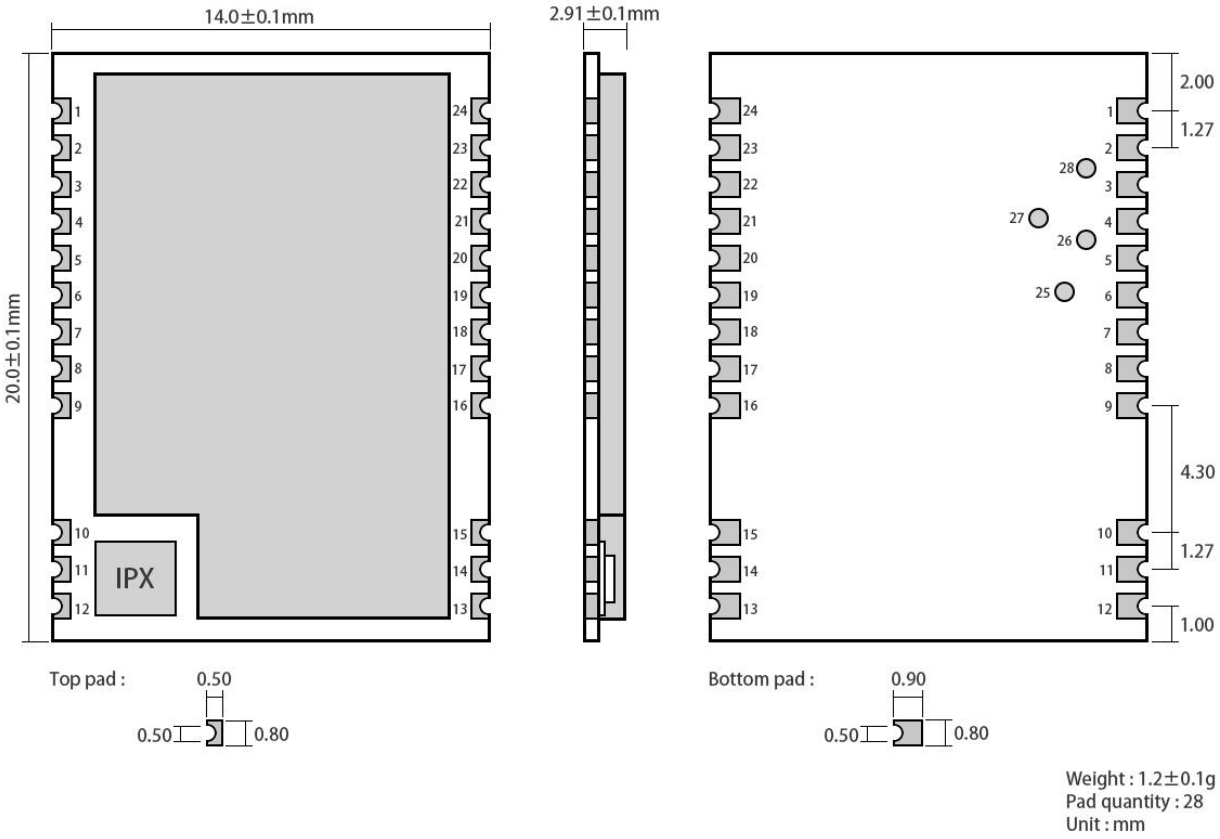
The main parameters	describe	Remark
reference distance	5600m	Clear and open, antenna height 2 meters, air rate 1kbps
Crystal frequency	32MHz	-
Modulation	LoRa (recommended)	GFSK Mode, FLRC Mode, LoRa Mode
Packaging method	SMD	-
interface	1.27mm	-
Communication Interface	SPI	0 to 10Mbps
Dimensions	20*14mm	-
Antenna interface	IPEX/ stamp hole	Equivalent impedance is about 50 Ω

2.4 Developing Notice

- When designing the power supply circuit for the module, it is often recommended to reserve more than 30% of the margin, so that the whole machine can work stably for a long time;
- The current required at the moment of launch is larger, 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 size of the emission current to varying degrees;
- The current consumed by the RF chip when it is 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 shutdown current is often far less than the current consumed by the power supply part of the whole machine when it is not loaded, so it is not necessary to be too demanding;
- Due to the material itself has a certain error, a single LRC element has an error of ±0.1%, but hesitant to use multiple LRC elements in the entire RF circuit, there will be accumulation of errors, resulting in the difference between the transmitting current and the receiving current of different modules;
- Reducing the transmit power can reduce power consumption to a certain extent, but reducing the transmit power transmission will reduce the efficiency of the internal PA for many reasons.

3 Mechanical Dimensions and Pin Definition

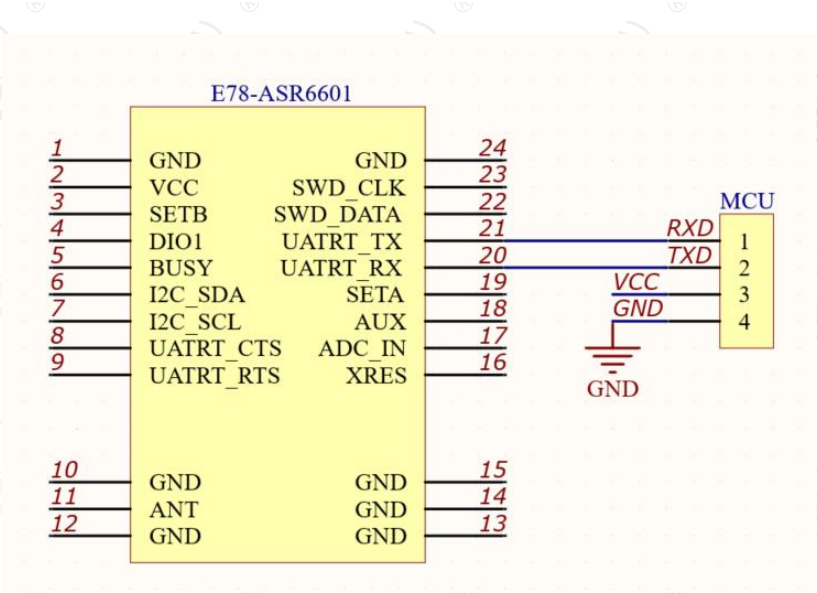
3.1 Dimensions of E78- 915 LN22S (6601)



3.2 Pin Definition

pin number	pin name	Pin Orientation	pin usage
1	GND	-	Ground wire, connected to the power reference ground
2	VCC	-	Power supply, range 2.5V~3.7V (It is recommended to add external ceramic filter capacitors)
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 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	enter	External reset pin
17	ADC_IN	enter	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
twenty one	UART_TX	input Output	UART TX pin
twenty two	SWD_DATA	input Output	SWD Data pin
twenty three	SWD_CLK	input Output	SWD Clock pin
twenty four	GND	-	Ground wire, connected to the power reference ground
25	SPI_MISO	input Output	SPI MISO test point, connected internally, cannot be used as external SPI
26	SPI_NSS	input Output	SPI NSS test point, connected internally, cannot be used as external SPI
27	SPI_MOSI	input Output	SPI MOSI test point, connected internally, cannot be used as external SPI
28	SPI_SCK	input Output	SPI SCK test point, connected internally, cannot be used as external SPI
For the pin definition, software driver and communication protocol of the module, please refer to the "ASR6601 Datasheet" ★			

3.3 Recommended wiring diagram



4 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 currently leading the technology is a foreign semtech company;

The main ISM brand of LoRa is in free frequency bands around the world: 433MHz, 470MHz, 868MHz, 915MHz, etc.

Features: Low power consumption, long distance, low cost.

2.2 LoRaWAN

LoRa Alliance is an open, non-profit organization led by Semtech in March 2015. The alliance released a low-power wide area network standard based on an open source MAC layer protocol: 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 LoRa nodes into three categories: A/B/C:

- Two-way transmission terminal (Class A):

The terminal of Class A will follow two short downlink receiving windows after each uplink, so as to realize bidirectional transmission. The terminal arranges transmission time slots based on its own communication requirements, with minor changes on the basis of random time (ie, the ALOHA protocol). This Class A operation provides the terminal system with the lowest power consumption for the application, and only requires the application to perform downlink transmission from the server within a short time after the terminal uplink transmission. The downlink transmission performed by the server at any other time has to wait for the next uplink from the terminal.

- Two-way transmission terminal (Class B) that demarcates the receive time slot:

Class B terminals will have more receive slots. In addition to the random receive windows of Class A, Class B devices also open other receive windows at specified times. 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 (Class C) that maximizes receive slots:

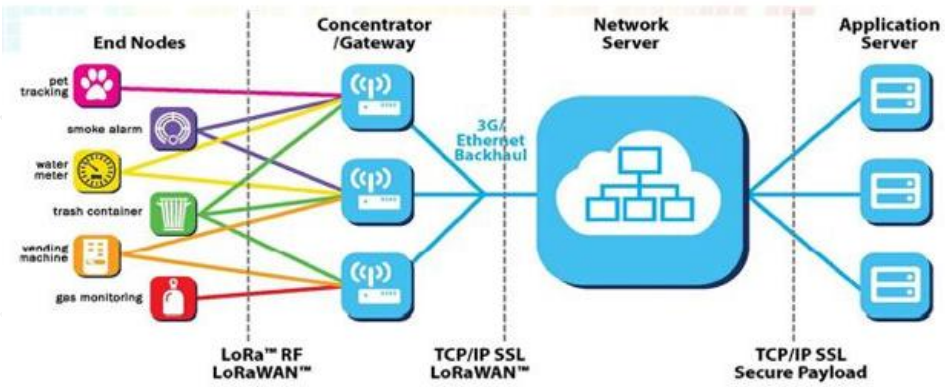
Class C terminals basically keep the receiving window open all the time, and only close briefly when sending. Class C terminals consume more power than Class A and Class B terminals, but at the same time, the delay from the server to the terminal is the shortest.

Note: E78-868LN22S (6601) supports two types of equipment, Class A and Class C;

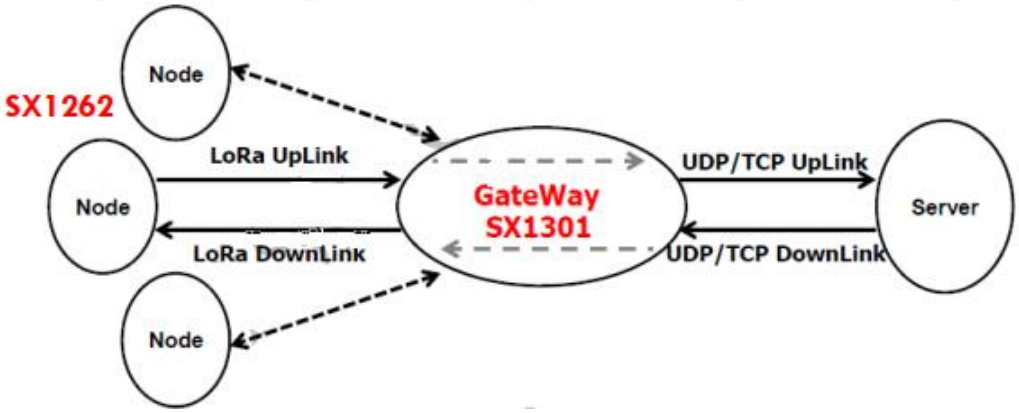
2.3 ADRs

ADR is called adaptive data rate in Chinese. In the loraWan network system, in order to maximize the battery life of the terminal device and the overall network capacity, the LoRaWAN network server manages the data rate and RF output of each terminal device separately through the Adaptive Data Rate (ADR) algorithm. In the LORAWAN system, the server automatically updates and sets the rate of the node according to the signal receiving capability of the node. The rate is low when the distance is far, and the rate is high when the distance is short. In practical applications, the effective bandwidth and load capacity of the network are greatly improved.

5 LoraWan Application Model Diagram



The complete LoraWan network system consists of: nodes, gateways, Lora NetWork Server, and application servers. The nodes are generally designed by Lora chips; the gateway is designed by SX1301 provided by semtech; ThingsNetwork), users can build it by themselves; the application server is designed and developed by the user, mainly for exchanging application data with Lora NetWork Server.

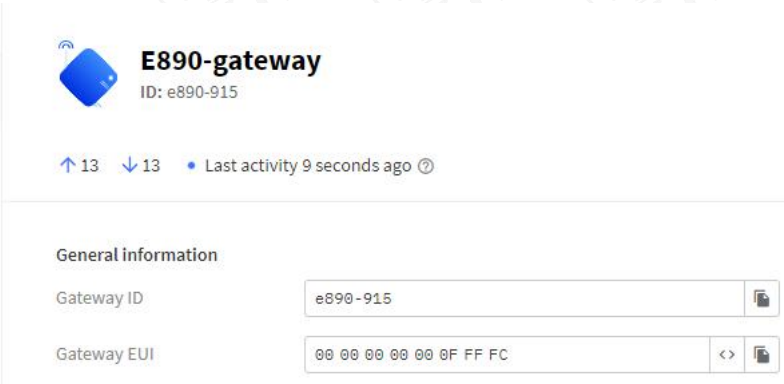


6 Access Demonstration

This demonstration kit is: E78- 915 LN22S (6601) as a node, E890 as a gateway to access the free TTN (The Things Network) test server for communication testing;

The corresponding settings of the OTAA access mode on the node side are as follows:

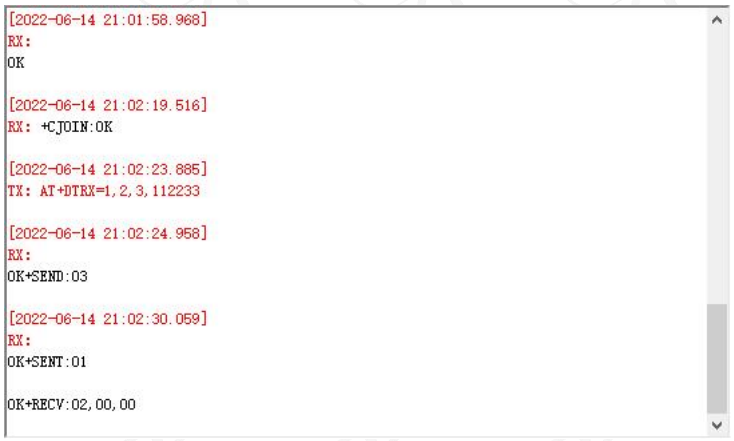
On TTN, the gateway information is as follows:



The gateway data looks like this:

The TTN node data record is as follows:

Node serial port:



Note: Please refer to "LORAWAN Node + Gateway TTN Server Configuration Tutorial" for the TTN creation device and corresponding configuration process

7 AT Commands

a)Instruction format:

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

: command prefix

CMD: control directive

[op]: Instruction operator. Can be the following:

- ✓ "=": Indicates parameter settings.
- ✓ "?": Indicates the current value of the query parameter.
- ✓ "": Indicates the execution of the command.
- ✓ "=?": Indicates the parameters of the query setting command.

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

<CR><LF>: carriage return line feed, ASCII 0x0D 0x0A

instruction	Description (common command)
CGMI	Read the manufacturer's logo
CGMM	Read the module ID
CGMR	Read version ID
CGSN	Read product serial number identification
CGBR	Set the baud rate of the UART
CJOINMODE	Set read Join mode (OTAA, ABP)
CDEVEUI	Set to read DevEUI (when OTAA is connected to the network)
CJOINMODE	Set read Join mode (OTAA, ABP)
CDEVEUI	Set to read DevEUI (when OTAA is connected to the network)
CAPPEUI	Set to read AppEUI (when OTAA is connected to the network)
CAPPKEY	Set to read AppKey (when OTAA is connected to the network)
CDEVADDR	Set to read DevAddr (when ABP is connected to the network)
CAPPSKEY	Set to read AppSkey (when ABP is connected to the network)
CNWKSKEY	Set to read NwkSkey (when ABP is connected to the network)
CFREQBANDMASK	Set the read frequency mask (FreqBandMask)
CULDLMODE	Set read Ul/Dl mode (same frequency or different frequency)
CWORKMODE	Set 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 network access
DTRX	Send and receive data frames
DRX	Get the latest received data from the Rx buffer and empty the Rx buffer
REGION	Setting Region (EU868/US915)
JOINDR	Set the network airspeed
Order	Description (MAC related configuration commands)
CCONFIRM	Set the type of read and send messages (confirm or unconfirm)
CAPPPORT	Set the read application layer Port
CDATARATE	Set read data rate
CRSSI	Get the RSSI value of the channel
CNBTRIALS	Set read NbTrans parameters
CRM	Set read report mode
CTXP	Set read transmit power
CLINKCHECK	Enable Link check
CADR	Enable or disable ADR
CRXP	Set read receive window parameters
CRX1DELAY	Set the delay for reading TX and RX1
CSAVE	save configuration
CRESTORE	restore default configuration
IREBOOT	System reset

command characters	Command type	command format	response
CGMI (**Read the manufacturer's logo**)	query command	AT+CGMI?	+CGMI=<manufacturer> OK
	Parameter Description	<manufacturer>: Manufacturer ID	
	Return value description		
	Example	AT+CGMI? +CGMI=Ebyte OK	
	Precautions		
command characters	Command type	command format	response
CGMM (**Read the module ID**)	query command	AT+CGMM?	+CGMM=<model> OK
	Parameter Description	<model>: Module ID	
	Return value description		
	Example	AT+CGMM? +CGMM=E78- 915 LN22S (6601) OK	
	Precautions		
command characters	Command type	command format	response
CGMR (**read version ID**)	query command	AT+CGMR?	+CGMR=<revision> OK
	Parameter Description	<revision>: version number	
	Return value description		
	Example	AT+CGMR? +CGMR=SF V1.0 OK	
	Precautions		
command characters	Command type	command format	response
CGSN (**Read the product serial number logo**)	query command	AT+CGSN?	+CGSN=<sn> OK
	Parameter Description	<sn>: Product serial number identification	

	Return value description		
	Example	AT+CGSN? +CGSN=0539349E00032523 OK	
	Precautions		
command characters	Command type	command format	response
CGBR (**set baud rate**)	query command	AT+CGBR?	+CGBR=<baud> OK
	set command	AT+CGBR=<baud>	OK
	Parameter Description	<baud>: Product serial number identification	
	Return value description		
	Example	AT+CGBR=9600 OK	
	Precautions	Baud range: 1200~ 9600 bps	
command characters	Command type	command format	response
CJOINMODE (**Set the Join method**)	test command	AT+CJOINMODE=?	+CJOINMODE: " mode " OK
	query command	AT+CJOINMODE?	+CJOINMODE:<mode> OK
	set command	AT+CJOINMODE=<mode>	OK
	Parameter Description	<mode>: Node Join mode 0: OTAA 1: ABP	
	Return value description		
	Example	AT+CJOINMODE=0 OK	
	Precautions	Different mode nodes have different network access methods. Please use this command to set ABP before sending data.	
command characters	Command type	command format	response
CDEVEUI (**Set up DevEUI**)	test command	AT+CDEVEUI=?	+CDEVEUI=<DevEUI:length is 16>
	query command	AT+CDEVEUI?	+CDEVEUI:<value> OK
	set 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, value 8 bytes.	
command characters	Command type	command format	response
CAPPEUI (**Set AppEUI**)	test command	AT+CAPPEUI=?	+CAPPEUI=<AppEUI:length is 16>
	query command	AT+CAPPEUI?	+CAPPEUI:<value> OK
	set 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, value 8 bytes.	
command characters	Command type	command format	response
CAPPKEY (**Set AppKey**)	test command	AT+CAPPKEY=?	+CAPPKEY=<AppKey:length is 32>
	query command	AT+CAPPKEY?	+ CAPPKEY:<value> OK
	set 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, value 16 bytes.	
command characters	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
	set 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, value 4 bytes.	
command characters	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
	set command	AT+CDEVADDR =<value>	OK
	Parameter Description	<value>: Node AppSKey	
	Return value description		
	Example	AT+CAPPSKEY=AABBCCDD00112233AABBCCDD00112233 OK	
	Precautions	Use, set or read AppSKey in ABP, return Y1Y2 **…** Y16, hexadecimal format, value 16 bytes.	
command characters	Command type	command format	response
CNWKSKEY (**set NwkSKey**)	test command	AT+CNWKSKEY=?	+CNWKSKEY =<NwkSKey:length is 32>
	query command	AT+CNWKSKEY?	+CNWKSKEY:<value> OK
	set command	AT+CNWKSKEY=<value>	OK
	Parameter Description	<value>: Node NwkSKey	
	Return value description		
	Example	AT+CNWKSKEY=AABBCCDD00112233AABBCCDD00112233	

		OK	
	Precautions	Use, set or read NwkSKey in ABP, return Y1Y2 … Y16, hexadecimal format, value 16 bytes.	
CFREQBANDMASK (**set band mask**)	Command type	command format	response
	test command	AT+CFREQBANDMASK=?	+CFREQBANDMASK: "mask" OK
	query command	AT+CFREQBANDMASK?	+CFREQBANDMASK:<mask> OK
	set command	AT+CFREQBANDMASK=<mask>	OK
	Parameter Description	<mask>: The frequency mask that the network may work with, 16bit corresponds to 16 frequency groups, see LoRaWAN access specification for details. For example: 0-7 channel, the corresponding mask is 0001, 8-15 channel corresponding mask is 0002, and so on	
	Return value description		
	Example	AT+CFREQBANDMASK=0001 OK	
	Precautions	It needs to be set before Join.	
command characters	Command type	command format	response
CULDLMODE (**Set the same and different frequency of uplink and downlink**)	test command	AT+CULDLMODE=?	+CULDLMODE: " mode " OK
	query command	AT+CULDLMODE?	+CULDLMODE:<mode> OK
	set command	AT+CULDLMODE=<mode>	OK
	Parameter Description	<mode>: 1: Same frequency mode 2: Different frequency mode	
	Return value description		
	Example	AT+CULDLMODE=2 OK	
	Precautions	Need to set before Join	
command characters	Command type	command format	response
CWORKMODE (**Set working mode**)	test command	AT+CWORKMODE=?	+CWORKMODE: " mode " OK
	query command	AT+CWORKMODE?	+CWORKMODE:<mode> OK
	set command	AT+CWORKMODE=<mode>	OK
	Parameter Description	<mode>: 2: normal working mode	

	Return value description		
	Example	AT+CWORKMODE=2 OK	
	Precautions	It needs to be set before Join, the default is normal working mode. Currently only supports normal working mode	
command characters	Command type	command format	response
CCLASS (**Set Class**)	test command	AT+CCCLASS=?	+CCLASS: " class " , " branch " , " para1 " , " para2 " , " para3 " , " para4 " OK
	query command	AT+CCCLASS?	+CCLASS:<class> OK
	set command	AT+CCLASS=<class>	OK
	Parameter Description	<class>: 0: classA 2: classC	
	Return value description		
	Example	AT+CCLASS=2 OK	
	Precautions	It needs to be set before Join, the default is classA	
command characters	Command type	command format	response
CSTAUS (**Query the current status of the device**)	test command	AT+CSTAUS=?	+CSTATUS: " status " OK
	query command	AT+CSTATUS?	+CSTATUS:<status> OK
	Parameter Description	<status>: 00 – no data operation	
	Return value description	01 – data sending 02 - data sending failed 03 – Data sent successfully 04 – JOIN succeeded (only in the first JOIN process) 05 – JOIN fails (only during the first JOIN process) 06 – The network may be abnormal (Link Check result) 07 – Send data successfully, no downlink 08 – Send data successfully, there is downlink	
	Example	AT+CSTATUS? +CSTATUS=03 OK	

	Precautions	Query the current status of the device	
command characters	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
	set command	AT+CJOIN=<ParaValue1>, [ParaValue2],…. [ParaValue4]	If the input is valid, 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]: Names of authentication parameters 1, 2,...4; [ParaValue1], [ParaValue2],...[ParaValue4]: parameter values of authentication parameters 1, 2,...4; <ParaTag1>, means to perform JOIN operation, ParaTag1 value range: 0 – stop JOIN 1 – Start JOIN and restart the JOIN process. For modules with warm restart enabled, executing this operation clears the saved JOIN context parameters. [ParaTag2] Indicates whether to enable the automatic JOIN function. The factory default value is 1, and the value range of ParaTag2: 0 – Turn off automatic JOIN 1 – Automatic JOIN. After the module enters the transparent transmission mode, JOIN is automatically started. [ParaTag3] represents the JOIN period, the value range: 7~255, the unit is s. Factory default: 8. [ParaTag4] indicates the maximum number of JOIN attempts, the value range of ParaTag4: 1~255	
	Return value description		
	Example	AT+CJOIN=1,1,10,8 (set the JOIN parameter: enable automatic JOIN, the JOIN period is 10s, and the maximum number of attempts is 8) OK +CJOIN: OK	
	Precautions	Need to set before Join	
command characters	Command type	command format	response
DTRX (**send and receive data**)	test command	AT+DTRX=?	+DTRX:[confirm],[nbtrials],<Length>,<Pay load> OK

	set 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 or ERR+SEND:ERR_NUM ERR+SENT:TX_CNT
	Parameter Description	For confirm and nbtrials, please refer to the corresponding AT command, which is only valid for this transmission, optional.	
	Return value description	Length: Indicates the number of strings; the maximum value is shown in the access specification; the length of bytes allowed to be transmitted at different rates is different (see the LoRaWan protocol for details), and 0 means sending an empty packet. Payload: Hexadecimal (2 characters represent 1 number); 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 times out and does not receive a response message, if the maximum number of times is not reached, it will retry again, until the maximum number of times is reached and no downlink message is received, it is a failure, and output ERR+SENT message. During this period, if the completion of the transmission of the response message is received, it is successful, and the OK+SEND, OK+SENT and OK+RECV messages are output. Unconfirm type data: No downlink response is requested after data is sent, and OK+SEND and OK+SENT messages are returned at the end of each transmission. If the downlink data is received, the OK+RECV message will be sent again. 2. Data sending status prompt OK+SEND:TX_LEN indicates that the data sending request is successful, TX_LEN: 1Byte, the length of the data sent OK+SENT: TX_CNT means that the data is sent successfully, TX_CNT: 1Byte, the number of data sending. ERR+SEND:ERR_NUM indicates that the data sending request failed, and the reason is indicated by ERR_NUM. ERR_NUM: 1Byte, 0- Not connected to the network 1- Communication is busy, send request failed 2- The data length exceeds the current sendable length, only send the MAC command ERR+SENT: TX_CNT indicates that the data transmission failed, and the number of transmissions reaches the maximum number. TX_CNT: 1Byte, the number of data transmissions. OK+RECV:TYPE,PORT,LEN,DATA Data received successfully (response message or active downlink data received) TYPE: 1Byte, downlink transmission type Bit0: 0-unconfirm, 1-confirm	

		Bit1: 0-Not ACK, 1-ACK Bit2: 0-not carried, 1-carried, indicating whether the downlink data carries the LINK command response Bit3: 0-not carried, 1-carried, indicating whether the downlink data carries the TIME command response, only when the bit is 1, it means the time synchronization is successful Bit4~Bit7: Default 0, reserved PORT: 1Byte, downstream transmission port LEN: 1Byte, downlink 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 means that the confirm data is sent successfully, the valid data received by the server should be " 0123456789 " , and Downstream acknowledgment received.	
	Precautions	Access the network first, then send data	
command characters	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 data packet; Payload: hexadecimal string data; OK: no abnormality in the received data packet;	
	Return value description		
	Example	AT+DRX? OK	
	Precautions	Receive data packets from the receive buffer, and clear the receive buffer;	
command characters	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
	set 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 characters	Command type	command format	response
CAPPPORT (**Set the uplink data port number**)	test command	AT+CAPPPORT=?	+CAPPPORT: " value " OK
	query command	AT+CAPPPORT?	+CAPPPORT:<value> OK
	set command	AT+CAPPPORT=<value>	OK
	Parameter Description	<value>: as follows: The port used, the data format is decimal, and the factory value is 10.	
	Return value description	Value range: 1~223; Note: Port: 0x00 is the LoRaWAN MAC command	
	Example	AT+CAPPPORT=10 OK	
	Precautions	Need to set before sending data	
command characters	Command type	command format	response
CADR (set rate adaptive)	test command	AT+CADR=?	+CADR:"value" OK
	query command	AT+CADR?	+CADR: <value> OK
	set command	AT+CADR=<value>	OK
	Parameter Description	<value>: as follows: 0: Turn off ADR 1: Enable ADR	
	Return value description		
	Example		
	Precautions		
command characters	Command type	command format	response
CDATARATE (**Set the communication rate**)	test command	AT+CDATARATE=?	+CDATARATE: " value " OK
	query command	AT+CDATARATE?	+CDATARATE:<value> OK
	set 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	It needs to be set before sending data, and it will be invalid after enabling ADR.	
command characters	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
	Parameter Description	<FREQBANDIDX>: Indicates the number of the frequency band, starting from 0, 1A2 group number is 1 Returns the RSSI of 8 channels within 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 OK	
	Precautions		
command characters	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
	set command	AT+CNBTRIALS=<MType>, <value>	OK
	Parameter Description	<MType>:0:unconfirm packet, 1:confirm packet. <value>: is the maximum sending times, the value range: 1~15;	
	Return value		

	description		
	Example	AT+CNBTRIALS=1,2 OK	
	Precautions	Need to set before sending data	
command characters	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
	set command	AT+CTXP=<reportMode>,[reportInterval]	OK
	Parameter Description	<reportMode>: 0- non-periodic reporting data; 1-periodic reporting data; <reportInterval>: This parameter is only available when reporting data periodically. Time interval for periodic reporting of data, unit: s. For different DRs, the allowable minimum cycle is different, which is defined by cycle level, as shown in the following table.	
	Return value description	Rate\Period(s)\Level LV1 LV2 DR0 150 300 DR1 75 150 DR2 35 70 DR3 15 30 DR4 10 20 DR5 5 10	
	Example	AT+CRM=1,10 OK	
	Precautions	Need to set before sending data	
command characters	Command type	command format	response
CTXP **(Set the transmit power)**	test command	AT+CTXP=?	+CTXP: " value " OK
	query command	AT+CTXP?	+CTXP:<value> OK
	set command	AT+CTXP=<value>	OK
	Parameter Description	<value>: is the transmission power, the factory value is 0 0 - 17dBm	

	Return value description	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 characters	Command type	command format	response
CLINKCHECK (**verify network connection**)	test command	AT+CLINKCHECK=?	+CLINKCHECK: " value " OK
	set command	AT+CLINKCHECK=<value>	OK
	Parameter Description	<value>: Enable Control 0 for Link Check – Disable Link Check 1 - Execute Link Check once 2 - The module automatically carries the linkcheck command in each upstream data packet.	
	Return value description	Return OK, the setting is successful. If X1=1, after waiting for a period of time, the second response message will be returned, the format is as follows: +CLINKCHECK: Y0, Y1, Y2, Y3, Y4 YO represents the Link Check result: ● 0 - Indicates that this Link Check was executed successfully ● Non-0 - Indicates that this Link Check failed to execute Y1 is DemodMargin Y2 is NbGateways Y3 is the RSSI of this downlink Y4 is the SNR of this downlink	
	Example	AT+CLINKCHECK=1 OK + CLINKCHECK: 0, 0, 1, -68, 8	
	Precautions	Need to set before sending data	
command characters	Command type	command format	response
CRXP	test	AT+CRXP=?	+CRXP: " RX1DRoffest " , " RX2DataRate " , "

(Set receive window parameters)	command		RX2Frequency " OK
	query command	AT+CRXP?	+CRXP:<RX1DRoffest>,<RX2DataRate>,<RX2Frequency> OK
	set command	AT+CRXP=<RX1DRoffest>,<RX2DataRate>,<RX2Frequency>	OK
	Parameter Description	<RX1DRoffest>,<RX2DataRate>,<RX2Frequency> See LoRaWAN protocol for details.	
	Return value description		
	Example	AT+CRXP=1,1,868000000 OK	
	Precautions	It needs to be set before sending data. Do not use default value	
command characters	Command type	command format	response
CRX1DELAY **(set the number of times to send)**	test command	AT+CRX1DELAY=?	+CRX1DELAY: “ Delay ” OK
	query command	AT+CRX1DELAY?	+CRX1DELAY:<Delay> OK
	set command	AT+CRX1DELAY=<Delay>	OK
	Parameter Description	Delay: how long to open the RX1 window after sending, unit: s;	
	Return value description		
	Example	AT+CRX1DELAY=2 OK	
	Precautions	Set how long to open the RX1 window after sending, before sending data. Default value of protocol when not set.	
command characters	Command type	command format	response
CSAVE **(Save MAC parameter settings)**	test command	AT+CSAVE=?	+CSAVE OK
	set command	AT+CSAVE	OK
	Parameter	<MType>:0:unconfirm packet, 1:confirm packet.	

	Description	<value>: is the maximum sending times, the value range: 1~15;	
	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 characters	Command type	command format	response
CRESTORE (**restore MAC default parameters**)	test command	AT+CRESTORE=?	+CRESTOREMAC OK
	set command	AT+CRESTORE	OK
	Parameter Description	This command restores the default configuration parameters of MAC to EERPOM/FLASH.	
	Return value description		
	Example	AT+CRESTORE OK	
	Precautions		
command characters	Command type	command format	response
IREBOOT (**restart the mod**)	test command	AT+IREBOOT=?	+IREBOOT:"Mode" OK
	set command	AT+IREBOOT=<mode>	OK
	Parameter Description	<mode>: restart mode; 0: Restart the communication module immediately. 1: Wait for the wireless frame currently being sent in the communication module to complete before restarting.	
	Return value description		
	Example	AT+IREBOOT=1 OK	
	Precautions	After the communication module receives the command, it replies OK and restarts the communication module. No further AT commands will be received until the reboot is complete .	
command characters	Command type	command format	response
JOINDR (set network	test command	AT+ JOINDR =?	+ JOINDR : " value " OK

access)			
	set command	AT+ JOINDR =< value >	OK
	Parameter Description	< value >: Rate value, the value range of the network access rate :	
	Return value description	0 - SF12, BW125 1 - SF11, BW125 2 - SF10, BW125 3 - SF9, BW125 4 - SF8, BW125 5 - SF7, BW125	
	Example	AT+ JOINDR = 0 OK	
	Precautions	EU868 has the above 6 network access speeds to choose from. US915 stipulates that the relationship between network access frequency and airspeed cannot be manually set.	
command characters	Command type	command format	response
REGION (locale setting)	test command	AT+ REGION= ?	+ REGION :" value " OK
	query command	AT+ REGION ?	+ REGION : <value> OK
	set command	AT+ REGION =< value >	OK
	Parameter Description	< value >: 0: EU868 . 1: US915 .	
	Return value description		
	Example	AT+ REGION = 0 OK	
	Precautions	A restart is required after setting the specified locale file	

8 Frequently Asked Questions

8.1 The communication distance is very close

- When there is a straight-line communication obstacle, the communication distance will be correspondingly attenuated.
- Temperature, humidity, and co-channel interference will increase the communication packet loss rate.
- The ground absorbs and reflects radio waves, and the test effect close to the ground is poor.
- Seawater has a strong ability to absorb radio waves, so the seaside test results are poor.
- If there is a metal object near the antenna, or is placed in a metal case, the signal attenuation will be very serious.
- The power register is set incorrectly, and the air speed is set too high (the higher the air speed, the closer the distance).
- The low voltage of the power supply at room temperature is lower than the recommended value, and the lower the voltage, the lower the output power.
- The antenna and the module are poorly matched or the quality of the antenna itself is a problem.

8.2 Module is easily damaged

- Please check the power supply to ensure that it is between the recommended values, as exceeding the maximum value will cause permanent damage to the module.
- Please check the power supply stability, the voltage should not fluctuate greatly and frequently.
- Please ensure anti-static operation during installation and use, and high-frequency components are electrostatically sensitive.
- Please ensure that the humidity during installation and use should not be too high, and some components are humidity-sensitive devices.
- If there is no special requirement, it is not recommended to use it at too high or too low temperature.

Important Notice

- Ebyte reserves the right of final interpretation and modification of all contents in this manual.
- Due to the continuous improvement of the hardware and software of the product, this manual may be changed without prior notice, and the latest version of the manual shall prevail.
- Users who use this product need to go to the official website to pay attention to the product dynamics, so that users can obtain the latest information of this product in time.

Revision History

Version	revision date	Revision Notes	Maintenance man
1.0	2021-9-15	initial version	Linson
2.4	2022-6-20	Revised format	Yan
2.5	2022-8-29	Bug fixes	Yan

About us

Technical support: support@cdebyte.com

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

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

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Fax: 028-64146160 Web: https://www.cdebyte.com

Address: B5 Mould Industrial Park, 199# Xiqu Ave, High tech Zone, Chengdu, Sichuan, China

Chengdu Ebyte Electronic Technology Co.,Ltd.