E78-433LN22S(6601)

ASR6601 Wireless Module

Chengdu Ebyte Electronic Technology Co.,Ltd.

CONTENTS

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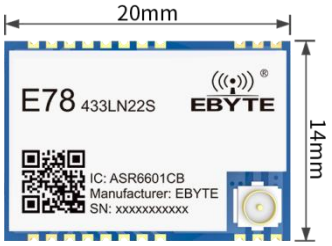
1 Introduction

1.1 Product overview

The E78-433LN22S (6601) module is standard LoraWan node modules designed and produced by Chengdu Ebyte Electronic Technology Co., Ltd., with the operating frequency band of 433.175~434.665Mhz, supporting EU433 standard, CLASS – A/CLASS-C node type, and ABP/OTAA network access modes. It has a variety of low power consumption modes. The external communication interface is standard UART. Users can access the standard LoraWan network through simple configuration of AT commands, It is an excellent choice for the current Internet of Things applications.



1.2 Applications

- Smart home and industrial sensors;
- Security system and positioning system;
- Wireless remote control, UAV;
- Wireless game remote control;
- Medical care products;
- Wireless voice, wireless headset;
- Application in automobile industry.

2 General parameter

2.1Main parameter

Model No.	Core IC	Size	Weight	Operating temperature	Operating humidity	Storage temperature
E78-433LN22S(6601)	ASR6601CB	20* 14*2.8 mm	1.2g	-40 ~ 85℃	10% ~ 90%	-40 ~ 125℃

2.2 Operating parameter

Parameter category	Min	Typ	Max	Unit
TX current（Lora@2.4kbps）	110	120	130	mA
RX current（Lora@2.4kbps）	13	14	15	mA
Turn off current	2.4	2.5	2.6	uA
TX power	21.0	21.2	21.8	dBm
Receiving sensitivity	-139	-140	-140	dBm
TCXO	32	32	32	MHZ
TCXO voltage	1.8	1.8	3.3	V
Operating frequency	433.175	433	434.665	MHZ
Supply voltage	2.5	3.3	3.7	V
Communication level	2.5	3.3	3.7	V

Main parameter	Description	Remarks
Distance for reference	5600m	Test condition：clear and open area, antenna gain: 5dBi，antenna height: 2.5m，air data rate: 1kbps
Crystal frequency	32MHz	-
Modulation	LoRa(Recommended)	GFSK Mode ，FLRC Mode，LoRa Mode
Package	SMD	-
Connector	1.27mm	-
Communication Interface	SPI	0～10Mbps
Size	20*14mm	-

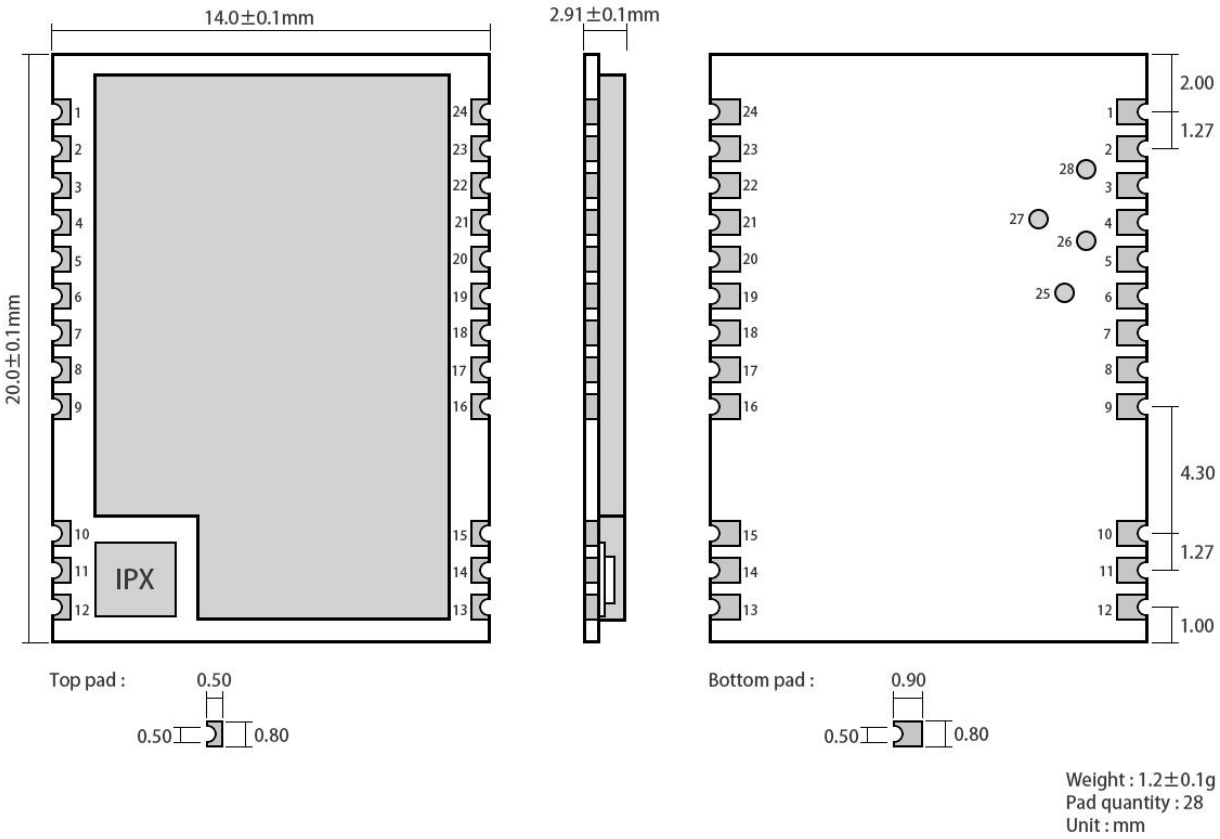
Antenna	IPEX/Stamp hole	50 ohm impedance

2.3 Parameter instruction

- When designing power supply circuit for modules, it is recommended to reserve more than 30% margin, which is conducive to long-term stable operation of the module;
- The current required at the moment of transmission is large, but the total energy consumed may be smaller due to short transmission time;
- When the customer uses an external antenna, the impedance matching between the antenna and the module at different frequency points will affect the size of the transmission current to varying degrees;
- The current consumed when the RF chip is in the pure receiving state is called the receiving current. Some RF chips with communication protocols or the developer has loaded some self-developed protocols on the whole machine, which may cause the receiving current tested to be too large;
- The turning off current is often far less than the current consumed by the power supply of the whole machine during no-load, so it is unnecessary to be overly demanding;
- Due to the material itself has a certain error, a single LRC element has an error of ± 0.1%, but hesitates to use multiple LRC elements in the entire RF circuit, which may lead to error accumulation, resulting in differences between the transmission current and the reception current of different modules;
- Reducing transmission power can reduce power consumption to a certain extent, but reducing transmission power for many reasons will reduce the efficiency of internal PA.

3 Size and pin definition

3.1 E78-433LN22S(6601) size

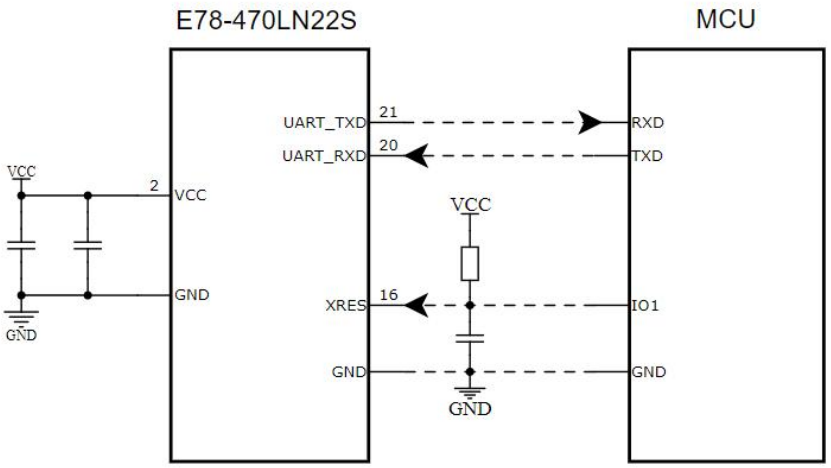


3.2 Pin definition

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	Input/output	NC (reserved 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

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	UART RX pin
21	UART_TX	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《ASR6601 Datasheet》 ★			

3.3 Recommended circuit


E78-470LN22S
MCU
UART_TXD
21
RXD
UART_RXD
20
TXD
VCC
2
VCC
GND
GND
VCC
XRES
16
IO1
GND
GND
GND

4 Terms and definitions

4.1 LoRa

LoRa is one of the LPWAN communication technologies. Its full name is Long Range Radio, which means "long-distance radio" in Chinese;

The company that currently dominates this technology is Semtech, a foreign company;

LoRa's main ISM brands are in the global free frequency bands: 433MHz, 470MHz, 868MHz, 915MHz, etc.

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

4.2 LoRaWAN

LoRa Alliance is an open and non-profit organization led by Semtech in March 2015 The Alliance released a low power WAN standard based on the open source MAC layer protocol: LoRaWAN protocol standard

Network topology: star structure

Network composition: LoRa module, gateway (or base station), server (including network server, network control, application Server）。

LoRaWAN divides LoRa nodes into A/B/C:

- Two way transmission terminal(Class A)：

The Class A terminal will be followed by two short downlink receiving windows after each uplink to achieve bidirectional transmission. The terminal arranges the transmission timeslot based on its own communication needs, which has a small change on the basis of random time (i.e. ALOHA protocol). This Class A operation provides the terminal system with the lowest power consumption for applications, and only requires applications

The server's downlink transmission is carried out within a short time after the terminal's uplink transmission. The server's downlink transmission at any other time must wait for the next uplink of the terminal.

- Bidirectional transmission terminal defining receiving time slot(Class B)：

Class B terminals will have more receiving time slots. In addition to the random receiving window of Class A, Class B devices will open other receiving windows at the specified time. In order for the terminal to open the receiving window at a specified time, the terminal needs to receive time synchronized beacons from the gateway. This allows the server to know when the terminal is listening.

Bidirectional transmission terminal with maximum receiving time slot(Class C)：

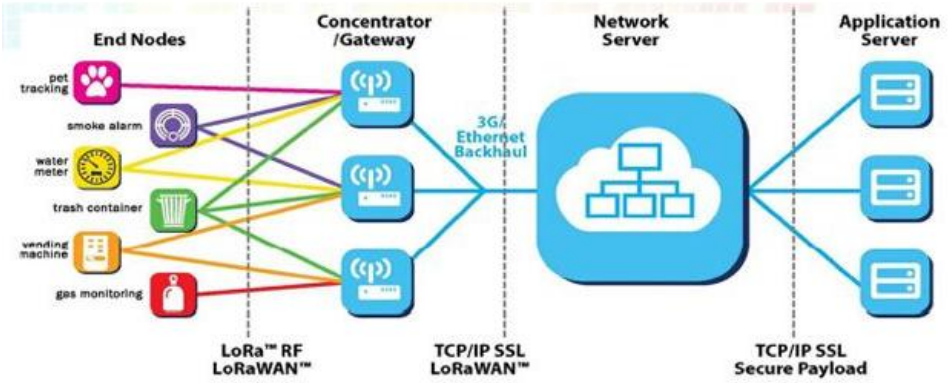
The Class C terminal basically keeps the receiving window open, and only closes briefly when sending. Class C terminals consume more power than Class A and Class B terminals, but at the same time, the delay from the server to the terminals is also the shortest.

Note: E78-433LN22S (6601) supports Class A and Class C equipment types;

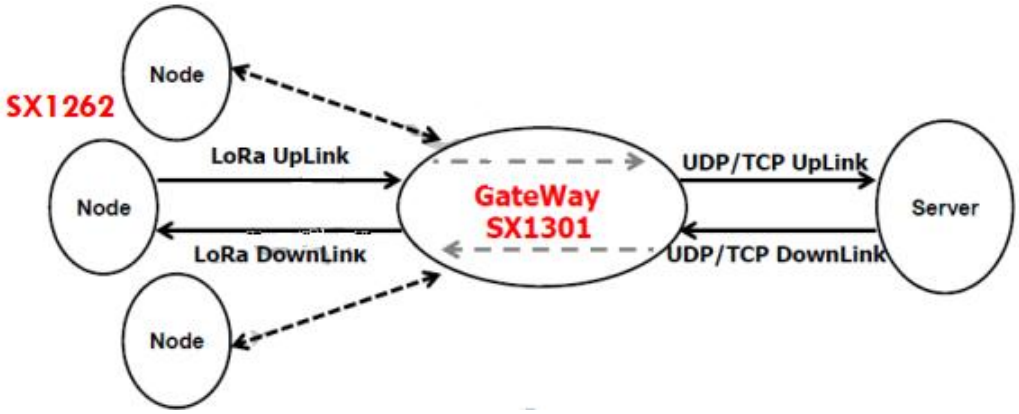
4.3 ADR

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 equipment, the LoRaWAN network server manages the data rate and RF output of each terminal equipment through the adaptive data rate (ADR) algorithm. Through ADR technology, the server automatically updates and sets the rate of the node according to the node's signal receiving capacity. The rate is low if the distance is far, and high if the distance is near, This maximizes the effective bandwidth and load carrying capacity of the network in practical applications.

5 LoraWan application model diagram



The complete LoraWan network system is composed 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; Lora NetWork Server now has an open source loraserver or a commercial TTN (The ThingsNetwork) in the industry, which users can build by themselves; The application server is designed and developed by users and is mainly used to exchange application data with Lora NetWork Server.



6 Access Demo

The demonstration suite is: E78-433LN22S (6601) as a node, E890 as a gateway to access the free TTN (The Things Network) test server for communication test;

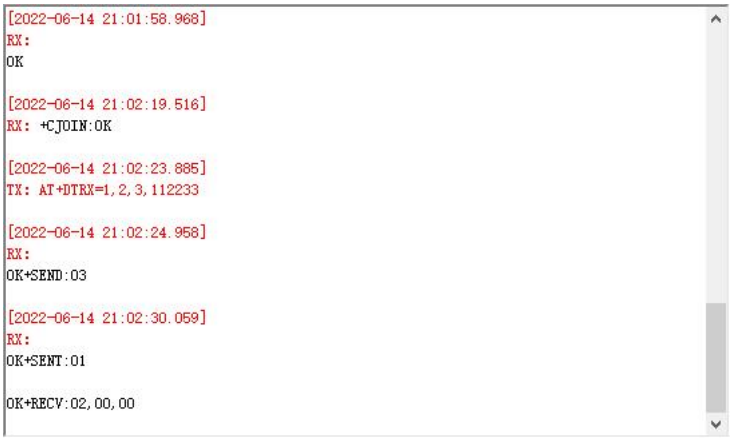
The corresponding settings of node side OTAA access mode are as follows:

On TTN，gateway info is as below：

Gateway data is as below:

TTN node data record is as below：

Node UART end：



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

7 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 to 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)
CWORKMODE	Set to read working mode (normal working mode)
CCLASS	Set to 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
JOINDR	Set air data rate for Network access
Command	Description (MAC related configuration command)
CCONFIRM	Set to read the type of sent message (confirm or unconfirm)
CAPPPORT	Set to read application layer port
CDATARATE	Set to read data rate
CRSSI	Get the RSSI value of the channel
CNBTRIALS	Set to read NbTrans parameter
CRM	Set to read report mode
CTXP	Set to read transmit power
CLINKCHECK	Enable Link check
CADR	Enable or disable ADR
CRXP	Set to read receive window parameters
CRX1DELAY	Set to read the delayof TX and RX1
CSAVE	Save configuration
CRESTORE	Restore default configuration
IREBOOT	System reset

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	
	Notes		
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=E78-433LN22S(6601) OK	
	Notes		
Command character	Command Type	Command Format	response
CGMR (read version)	Query	AT+CGMR?	+CGMR=<revision> OK
	Parameter Description	<revision>： version	
	Return value description		
	For example	AT+CGMR? +CGMR=SF V1.0 OK	
	Notes		
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		
	For example	AT+CGSN? +CGSN=0539349E00032523 OK	
	Notes		
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		
	For example	AT+CGBR=9600 OK	
	Notes	Baud：1200~9600bps	
Command character	Command Type	Command Format	response
CJOINMODE (set **join mode**)	Test command	AT+CJOINMODE=?	+CJOINMODE:“mode” OK
	Query command	AT+CJOINMODE?	+CJOINMODE:<mode> OK
	Setting command	AT+CJOINMODE=<mode>	OK
	Parameter Description	<mode>：node join mode 0:OTAA 1:ABP	
	Return value description		
	For example	AT+CJOINMODE=0 OK	
	Notes	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	AT+CDEVEUI=<mode>	OK

	command		
	Parameter Description	<mode>：node DevEUI	
	Return value description		
	For example	AT+CDEVEUI? +CDEVEUI=AABBCCDD00112233 OK	
	Notes	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		
	For example	AT+CAPPEUI=AABBCCDD00112233 OK	
	Notes	Used in OTAA, set or read AppEUI, return Y1Y2...Y8, hexadecimal format, and take 8 bytes.	
Command character	Command Type	Command Format	response
CAPPKEY (Set **AppKey**)	Test command	AT+CAPPKEY=?	+CAPPKEY=<AppKey:length is 32>
	Query command	AT+CAPPKEY?	+ CAPPKEY:<value> OK
	Setting command	AT+CAPPKEY =<value>	OK
	Parameter Description	<value>： node AppEUI	
	Return value description		
	For example	AT+CAPPKEY=AABBCCDD00112233AABBCCDD00112233 OK	

	Notes	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		
	For example	AT+CDEVADDR=00112233 OK	
	Notes	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+CAPPSKEY =<value>	OK
	Parameter Description	<value>：node AppSKey	
	Return value description		
	For example	AT+CAPPSKEY=AABBCCDD00112233AABBCCDD00112233 OK	
	Test command	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	AT+CNWKSKEY=<value>	OK

	command		
	Parameter Description	<value>： node NwkSKey	
	Return value description		
	For example	AT+CNWKSKEY=AABBCCDD00112233AABBCCDD00112233 OK	
	Notes	Used in ABP, set or read NwkSKey, return Y1Y2...Y16, hexadecimal format, and take 16 bytes.	
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 working mode	
	Return value description		
	For example	AT+CWORKMODE=2 OK	
	Test command	Set before joining, default is normal working mode which is only available mode	
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		
	For example	AT+CCLASS=2 OK	

	Notes	Set before joining, default is classA	
Command character	Command Type	Command Format	response
CSTATUS (**Query current device state**)	Test command	AT+CSTATUS=?	+CSTATUS:”status” OK
	Query command	AT+CSTATUS?	+CSTATUS:<status> OK
	Parameter Description	<status>： 00 – No data operation 01 - Data sending 02 - Data sending failed 03 - Data transmission succeeded 04 – JOIN succeeded (only during the first JOIN) 05 – JOIN failure (only in the first JOIN process) 06 - Network may be abnormal (Link Check result) 07 - Succeeded in sending data, no downlink 08 - Succeeded in sending data, with downlink	
	Return value description		
	For example	AT+CSTATUS? +CSTATUS=03 OK	
	Notes	Check device current state	
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 valid, first return to OK, and then start automatic authentication Right to return the authentication result. +CJOIN:OK Authentication succeeded +CJOIN:FAIL Authentication failed
	Parameter Description	<ParaTag1>， [ParaTag2]，……[ParaTag4]：parameter 1， 2，……4’s tag； [ParaValue1]， [ParaValue2]，……[ParaValue4]: parameter1， 2，……4’s value；	
	Return value description	<ParaTag1>, Indicates the JOIN operation is executed. ParaTag1 value range: 0– Stop JOIN 1– Start JOIN，Successfully restart the JOIN process. For modules that enable hot start, executing this operation will clear the saved JOIN context parameters. [ParaTag2] Indicates whether the automatic JOIN function is enabled. The factory value is 1, and the value range of ParaTag2 is:	

		0 – turn off auto-JOIN 1 – Auto-JOIN. After the module enters the transparent transmission mode, JOIN will be started automatically [ParaTag3] Represents the JOIN cycle. Value range: 7~255, unit: s. Factory default value: 8. [ParaTag4] Indicates the maximum number of JOIN attempts, and the value range of ParaTag4： 1~255	
	For example	AT+CJOIN=1,1,10,8(Set JOIN parameters: enable automatic JOIN, the JOIN cycle is 10s, and the maximum number of attempts is 8) OK +CJOIN:OK	
	Notes	Set before joining	
Command character	Command Type	Command Format	response
DTRX (**Send RX Data**)	Test command	AT+DTRX=?	+DTRX:[confirm],[nbtrials],<Length>,<Payload> 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 or ERR+SEND:ERR_NUM ERR+SENT:TX_CNT
	Parameter Description	Confirm and nbtrials refer to the corresponding AT commands, which are only valid for this transmission and optional.	
	Return value description	Length: indicates the number of strings; See the access specification for the maximum value; The length of bytes allowed to be transmitted at different rates is different (see LoRaWan protocol for details). 0 means sending empty packets. 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 reply message. When the module times out and does not receive a reply message, if the maximum number of times is not reached, it will retry again. If the maximum number of times is reached and no downlink message is received, it is a failure, and the output ERR+SENT message. During this period, if the transmission of the received reply message ends, it is successful, and OK+SEND, OK+SENT and OK+RECV messages are output. Unconfirm type data: No downlink response will be requested after sending data, and OK+SEND and	

		OK+SENT messages will be returned at the end of each transmission. If the downlink data is received, the OK+RECV message will be sent. 2. Data sending status prompt OK+SEND:TX_ LEN indicates that the data sending request is successful, TX_ LEN: 1 Byte, length of data sent OK+SENT:TX_ CNT indicates successful data transmission, TX_ CNT: 1 Byte, data transmission times. ERR+SEND:ERR_ NUM indicates that the data sending request failed because ERR_ NUM means. ERR_ NUM： 1Byte， 0 - Not connected to the network 1 - Communication busy, sending request failed 2 - The data length exceeds the current sending length, and only MAC commands are sent ERR+SENT:TX_ CNT indicates that the data transmission fails, and the transmission times reach the maximum, TX_ CNT: 1 Byte, data transmission times. OK+RECV: successful receipt of TYPE, PORT, LEN, DATA data (receipt of reply message or active downlink data) TYPE： 1Byte，Downlink transmission type Bit0： 0-unconfirm， 1-confirm Bit1： 0-non 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 this bit is 1 does the time synchronization succeed Bit4~Bit7: 0 by default, reserved PORT: 1 Byte, downlink transmission port LEN: 1 Byte, downlink data length DATA: n Byte, downlink data. When LEN=0, this field does not exist.	
	For example	AT+DTRX=1,2,10,0123456789 OK+SEND:03 OK+SENT:01 OK+RECV:02,01,00 It indicates that the confirm data has been sent successfully. The valid data received by the server should be "0123456789" and the downlink confirmation has been received.	
	Notes	First access the network, then send data	
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 indicates an empty packet;	

	Return value description	Payload: hexadecimal string data; OK: The received data packet is normal;	
	For example	AT+DRX? OK	
	Notes	Receive data packets from the receiving buffer and clear the receiving buffer;	
Command character	Command Type	Command Format	response
CCONFIRM (**Set the uplink 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 below 0: UnConfirmed up message 1: Confirmed up message	
	Return value description		
	For example	AT+CCONFIRM=1 OK	
	Notes	Need to set before sending data	
Command character	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
	Setting command	AT+CAPPPORT=<value>	OK
	Parameter Description	<value>： As follows: The port used is in decimal data format and the factory value is 10. Value range: 1~223; Note: Port: 0x00 is the MAC command of LoRaWAN	
	Return value description		
	For example	AT+CAPPPORT=10 OK	
	Notes	Need to set before sending data	
Command character	Command Type	Command Format	response
CADR （Set rate adaption）	Test command	AT+CADR=?	+CADR:"value" OK
	Query	AT+CADR?	+CADR:<value>

	command		OK
	Setting command	AT+CADR=<value>	OK
	Parameter Description	<value>： as below: 0: turn off ADR 1: turn on ADR	
	Return value description		
	For example		
	Notes		
Command character	Command Type	Command Format	response
CDATARATE (**Set 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 below: Rate value, factory value is 3, value range:	
	Return value description	0 - SF12， BW125 1 - SF11， BW125 2 - SF10， BW125 3 - SF9， BW125 4 - SF8， BW125 5 - SF7， BW125	
	For example	AT+CDATARATE=1 OK	
	Notes	It needs to be set before sending data, and it will become invalid after enabling ADR	
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
	Parameter Description	<FREQBANDIDX>：Indicates the number of frequency band, starting from 0, and the number of 1A2 group is 1	
	Return	Returns the RSSI of 8 channels in a frequency band.	

	value description		
	For example	AT+CRSSI 1? +CRSSI: 0:-157 1:-157 2:-157 3:-157 4:-157 5:-157 6:-157 7:-157 OK	
	Notes		
Command character	Command Type	Command Format	response
CNBTRIALS (Set TX times)	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 packet， 1:confirm packet <value>： Max TX times,value range： 1~15;	
	Return value description		
	For example	AT+CNBTRIALS=1,2 OK	
	Notes	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 - Non periodic report data; 1 - Periodically report data; <reportInterval>: This parameter is available only when data is reported periodically. Time interval for periodic data reporting, unit: s. For different DRs, the allowable minimum cycle is different, and the cycle level definition is adopted, 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	
	For example	AT+CRM=1,10 OK	
	Notes	Need to set before sending data	
Command character	Command Type	Command Format	response
CTXP (**Set TX power**)	Test command	AT+CTXP=?	+CTXP:“value” OK
	Query command	AT+CTXP?	+CTXP:<value> OK
	Setting command	AT+CTXP=<value>	OK
	Parameter Description	<value>： tx power value, default is 0 0 - 12.15dBm 1 - 10.15dBm 2 - 8.15dBm 3 - 6.15dBm 4 - 4.15dBm 5 - 2.15dBm	
	Return value description		
	For example	AT+CTXP=1 OK	
	Notes	Need to set before sending data	
Command character	Command Type	Command Format	response
CLINKCHECK (**Check network link**)	Test command	AT+CLINKCHECK=?	+CLINKCHECK:“value” OK
	Setting command	AT+CLINKCHECK=<value>	OK
	Parameter	<value>： is Link Check enable to control	

	Description	0 - Disable Link Check 1 – Perform a Link Check 2 - The module automatically carries the linkcheck command in each uplink packet.	
	Return value description	Return to OK, and the setting is successful If X1=1, after waiting for a period of time, the second response message will be returned in the following format: +CLINKCHECK:Y0， Y1， Y2， Y3， Y4 YO represents the link check result: 0 - indicates that the Link Check is successfully executed Non zero - indicates that the execution of this Link Check failed Y1 is the DemodMargin Y2 is NbGateways Y3 is the downlink RSSI Y4 is the SNR of this downlink	
	For example	AT+CLINKCHECK=1 OK +CLINKCHECK: 0， 0， 1， -68， 8	
	Notes	Need to set before sending data	
Command character	Command Type	Command Format	response
CRXP (**Set receiving window parameters**)	Test command	AT+CRXP=?	+CRXP:“RX1DRoffest”,”RX2DataRate”,”RX2Frequency ” OK
	Query command	AT+CRXP?	+CRXP:<RX1DRoffest>,<RX2DataRate>,<RX2Frequency> OK
	Setting command	AT+CRXP=<RX1DRoffest>,<RX2DataRate>,<RX2Frequency>	OK
	Parameter Description	<RX1DRoffest>,<RX2DataRate>,<RX2Frequency> see LoRaWAN protocol.	
	Return value description		
	For example	AT+CRXP=1,1,434665000 OK	
	Notes	It needs to be set before sending data. Do not set the default value	
Command character	Command Type	Command Format	response

CRX1DELAY (**Set RX1 receiving window delay**)	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		
	For example	AT+CRX1DELAY=2 OK	
	Notes	Set how long to open RX1 window after sending, and set before sending data. If it is not set, it is the default value of the protocol.	
Command character	Command Type	Command Format	response
CSAVE (Store **MAC parameter setting**)	Test command	AT+CSAVE=?	+CSAVE OK
	Setting command	AT+CSAVE	OK
	Parameter Description	<MType>:0:unconfirm packet， 1:confirm packet。 <value>： max tx times, value range： 1~15;	
	Return value description		
	For 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.	
	Notes	Need to save data before sending	
Command character	Command Type	Command Format	response
CRESTORE (**Restore MAC default parameters**)	Test command	AT+CRESTORE=?	+CRESTOREMAC OK
	Setting command	AT+CRESTORE	OK
	Parameter Description	This command restores the MAC default configuration parameters to EERPOM/FLASH.	
	Return value description		
	For example	AT+CRESTORE	

		OK	
	Notes		
Command character	Command Type	Command Format	response
IREBOOT (Restart mode)	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 wireless frame currently being sent in the communication module to complete before restarting.	
	Return value description		
	For example	AT+IREBOOT=1 OK	
	Notes	After receiving the command, the communication module replies OK and restarts the communication module. Do not receive any follow-up until the restart is completed AT instruction of.	
Command character	Command Type	Command Format	response
JOINDR (Set the network access airspeed)	Test command	AT+JOINDR=?	+JOINDR:"value" OK
	Setting command	AT+JOINDR=<value>	OK
	Parameter Description	<value>： Rate value, network access rate range： 0 - SF12， BW125 1 - SF11， BW125 2 - SF10， BW125 3 - SF9， BW125 4 - SF8， BW125 5 - SF7， BW125	
	Return value description		
	For example	AT+JOINDR=0 OK	

8 FAQ

8.1 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.

8.2 Module is easy to damage

- Please check the power supply source, ensure it is in recommended range.
- 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.

Revision history

Version	Date	Description	Issued by
1.0	2022-12-6	Initial version	Yan

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