E78-915LN22S(6601)

ASR6601 LoraWan Node Module



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Contents

DISCLAIMER AND COPYRIGHT NOTICE 3
1 PRODUCT OVERVIEW 4
1.1 INTRODUCTION 4
1.2 APPLICATION SCENARIOS 4
2 SPECIFICATIONS 5
2.1MAIN PARAMETERS 5
2.2WORKING PARAMETERS 5
2.3 HARDWARE PARAMETERS 5
2.4 PARAMETER DESCRIPTION 6
3 MECHANICAL DIMENSIONS AND PIN DEFINITION 7
3.1 E78-900LN22S(6601) (6601) DIMENSIONS 7
3.2 PIN DEFINITION 7
3.3 RECOMMENDED CONNECTION DIAGRAM 8
4 TERMS AND DEFINITIONS 9
2.1 LORA 9
2.2 LORAWAN 9
2.3 ADR 10
5 LORAWAN APPLICATION MODEL DIAGRAM 11
6 ACCESS DEMONSTRATION 12
7 AT COMMANDS 14
Read the manufacturer's logo + CGMI 16
Read module ID + CGMM 16
Read the version identifier + CGMR 16
Read product serial number identification + CGSN 17
Setting the baud rate + CGBR 17
Set or read Join Way + CJOINMODE 18
Set or read DevEUI + CDEVEUI 18
Set or read AppEUI + CAPPEUI 19
Set or read AppKey + CAPPKEY 19
set or read DevAddr +CDEVADDR 20
Set or read AppSKey + CAPPSKEY 20
set or read NwkSKey +CNWKSKEY 21
Set or read frequency group mask + CFREQBANDMASK 21
Set or read the uplink and downlink frequencies + CULDLMODE 22
Set or read working mode + CWORKMODE 22
Set or read Class + CCLASS 23
Query the device power level + CBL 24
Query the current status of the device + CSTATUS 24
Set up Join + CJOIN 25
Sending and receiving data + DTRX 26
Receive data + DRX 28
Set or read the upstream transmission type + CCONFIRM 28

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Set or read the upstream data port number + CAPPPORT *29*
Set or read the communication rate + CDATARATE *29*
Query channel signal strength + CRSSI *30*
Set or read the maximum number of times to send + CNBTRIALS *30*
Set or read reporting mode + CRM *31*
Set or read the transmit power + CTXP *32*
Verify network connection + CLINKCHECK *33*
Enable ADR + CADR *34*
Set or read receive window parameters + CRXP *34*
Set or read the sending and receiving delay + CRX 1 DELAY *35*
save MAC parameter settings + CSAVE *35*
Recover MAC Default parameters + CRESTORE *36*
PingSlotInfo ask + CPINGSLOTINFOREQ *36*
Add multicast address + CADDMUTICAST *37*
Deleting a multicast address + CDELMUTICAST *37*
Query the number of multicasts + CNUMMUTICAST *38*
Restart the module + IREBOOT *38*
Encrypted device key + CKEYSPROTECT *39*
Working mode + CNWM *40*
Operating frequency + CPFREQ *40*
Spreading factor +CPSF *41*
Coding rate + CP CR *41*
Bandwidth +CP BW *42*
Preamble length + CP PL *42*
Transmit power+CPTP *43*
Send data+CPSEND *43*
P2P unified configuration information +CP2P *44*
8 FREQUENTLY ASKED QUESTIONS 45
8.1 THE COMMUNICATION DISTANCE IS VERY CLOSE 45
8.2 MODULES ARE EASILY DAMAGED 45
IMPORTANT STATEMENT 45
REVISE HISTORY 46

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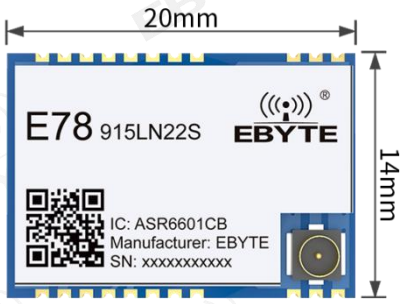
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1 Product Overview

1.1 Introduction



The E78-900LN22S (6601) series products are standard LoraWan node modules designed and produced by Chengdu Yibite Electronic Technology Co., Ltd. The operating frequency band is EU850-925MHZ, supports US915/AU915/AS923/KR920 standards, supports CLASS-A/CLASS-C node types, and supports two network access methods, ABP/OTAA. At the same time, the module has a variety of low-power modes, and the external communication interface uses a standard UART. Users can access the standard LoraWan network through simple configuration of AT commands, which is an excellent choice for current IoT applications. The module code demo is open, and secondary development can be downloaded from the official website.

1.2 Application scenarios

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

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2 Specifications

2.1Main parameters

Product number	Core IC	size	Module net weight	Operating temperature	Working humidity	Storage temperature
E78-900LN22S(6601)	ASR6 601CB	20*14*2.8 mm	1.2g	-40~85℃	10%~90%	-40~125°C

2.2Working parameters

Parameter category	Min	Typ	Max	unit
Transmission current (Lora@2.4kbps)	1 10	1 20	1 30	mA
Receive current (Lora@2.4kbps)	13	14	15	mA
shutdown 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 operating 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 sky, antenna height 2 meters, air speed 1kbps
Crystal frequency	32MHz	-
Modulation	L o R a (recommended)	GFSK Mode, FLRC Mode, LoRa Mode
Packaging method	SMD type	-

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Interface mode	1.27mm	-
Communication Interface	SPI	0 ～ 10Mbps
Dimensions	20*14mm	-
Antenna interface	IPEX/ stamp hole	Equivalent impedance is about 50 Ω

2.4 Parameter Description

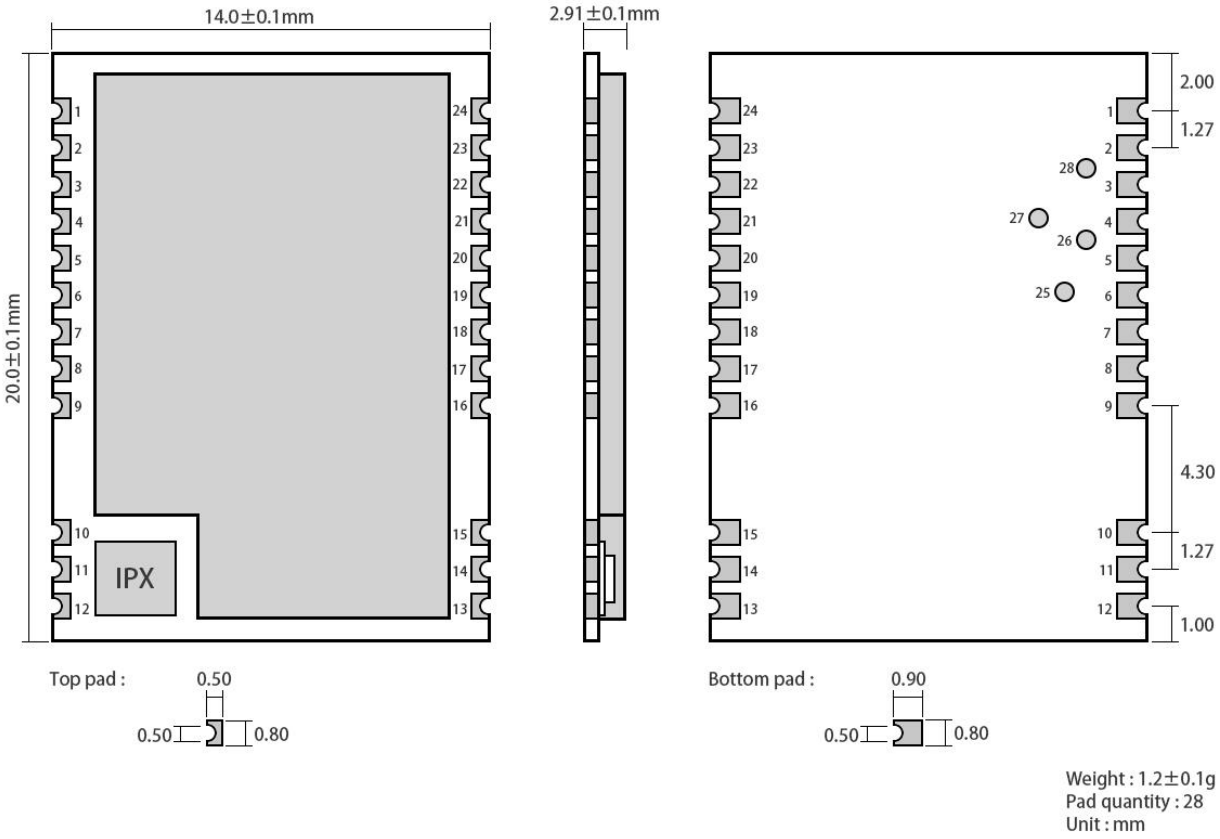
- When designing the power supply circuit for the module, it is often recommended to retain more than 30% margin, so that the whole machine can work stably for a long time;
- The current required at the moment of transmission is large, but often because the transmission time is extremely short, the total energy consumed may be smaller;
- When customers use an external antenna, the impedance matching between the antenna and the module at different frequencies will affect the magnitude of the transmission current to varying degrees;
- The current consumed when the RF chip is in a 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 device, which may cause the receiving current of the test to be too large;
- The shutdown current is often much smaller than the current consumed by the power supply of the whole machine when it is not loaded, so there is no need to be overly demanding.
- Since the material itself has a certain error, a single LRC component has an error of ±0.1%. However, if multiple LRC components are used in the entire RF circuit, errors will accumulate, resulting in differences in the transmit current and receive current of different modules.
- Reducing the transmit power can reduce power consumption to a certain extent, but reducing the transmit power will reduce the efficiency of the internal PA for many reasons.

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3 Mechanical Dimensions and Pin Definition

3.1 E78-900LN22S(6601) (6601) Dimensions



3.2 Pin Definition

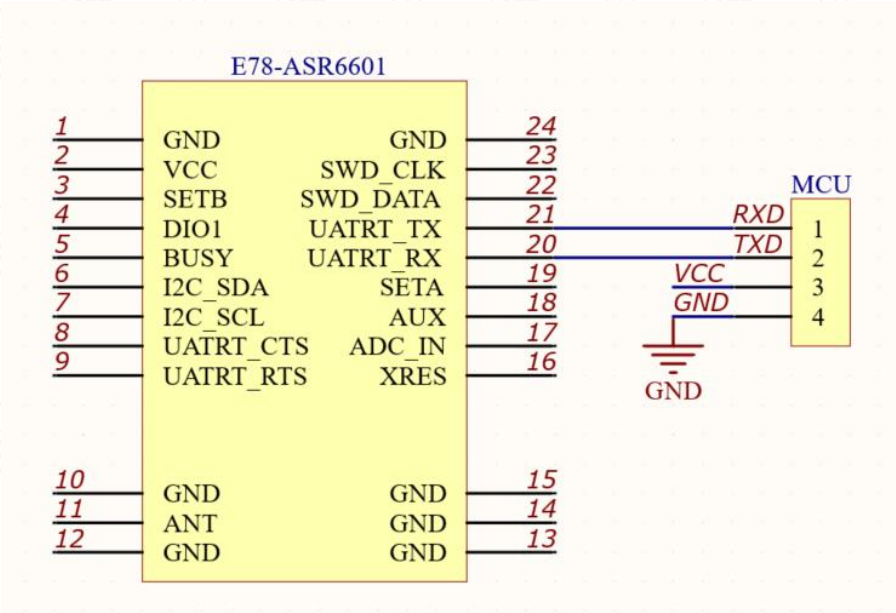
Pin number	Pin Name	Pin Direction	Pin Purpose
1	GND	-	Ground wire, connected to the power reference ground
2	VCC	-	Power supply, range 2.5V~3.7V (it is recommended to add external ceramic filter capacitor)
3	SETB	-	Low power wake-up pin
4	DIO1	input Output	NC (reserved pin)
5	BUSY	input Output	NC (reserved 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 (pin reserved)
10	GND	-	Ground wire, connected to the power reference ground
11	ANT	-	Antenna interface, stamp hole (50 ohm characteristic

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			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 (pin reserved)
18	AUX	input Output	NC (pin reserved)
19	SETA	input Output	NC (pin reserved)
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, wired internally, cannot be used as external SPI
26	SPI_NSS	input Output	SPI NSS test point, wired internally, cannot be used as external SPI
27	SPI_MOSI	input Output	SPI MOSI test point, wired internally, cannot be used as external SPI
28	SPI_SCK	input Output	SPI SCK test point, internally connected, cannot be used as an external SPI
★ For details about the module's pin definition, software driver and communication protocol, please refer to ASR's official "ASR6 6 01 Datasheet" ★			

3.3 Recommended connection diagram



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4 Terms and Definitions

2.1 LoRa

LoRa is a type of LPWAN communication technology. Its full name is Long Range Radio, which means "long-range radio" in Chinese.

The company currently leading this technology is the foreign company Semtech;

LoRa's main ISM brand is in the global free frequency 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 founded by Semtech in March 2015. The Alliance released a low-power wide area network standard based on the 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:

- Bidirectional transmission terminal (Class A):

Class A terminals will be followed by two short downlink reception windows after each uplink to achieve two-way transmission. The terminal arranges transmission time slots based on its own communication needs, with small changes based on random time (ie, ALOHA protocol). This Class A operation provides the lowest power consumption terminal system for applications and only requires the application to perform downlink transmission from the server within a short period of time after the terminal's uplink transmission. Downstream transmissions performed by the server at any other time have to wait for the next upstream transmission from the terminal.

- Bidirectional transmission terminal demarcating reception time slots (Class B):

Class B terminals will have more receive slots. In addition to the random receiving window of Class A, Class B equipment will also open other receiving windows at designated times. In order for the terminal to open the receiving window at the 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.

- Bidirectional transmission terminal that maximizes receive slots (Class C):

Class C terminals basically keep the receiving window open all the time, and only close it 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 also the shortest.

Note: E78-868LN22S (6601) supports Class A and Class C devices.

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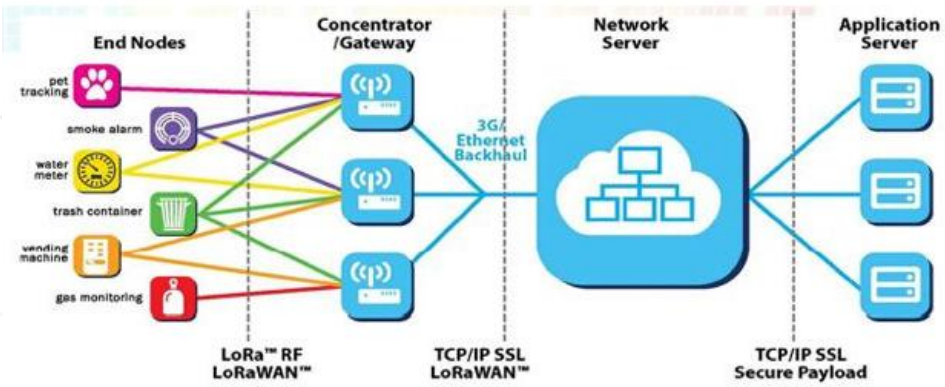
2.3 ADR

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. Through ADR technology, in the LoRaWAN system, the server automatically updates 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 close. In practical applications, this maximizes the effective bandwidth and carrying capacity of the network.

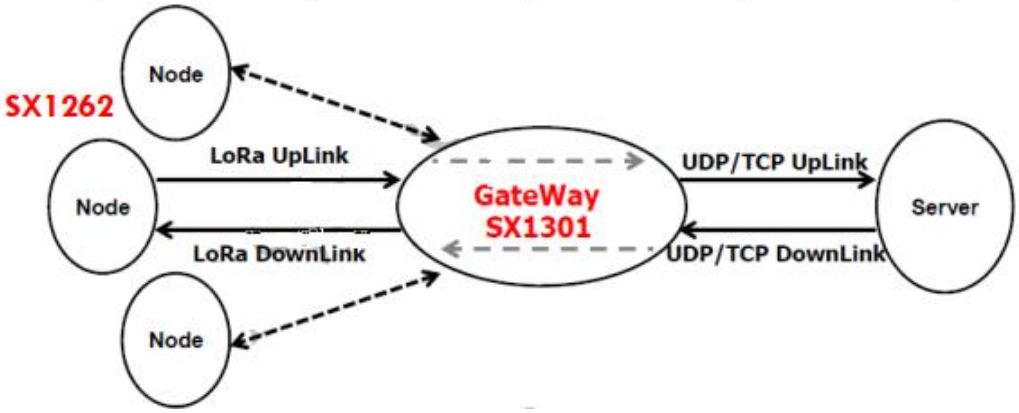
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5 LoraWan Application Model Diagram



The complete LoraWan network system consists of nodes, gateways, Lora NetWork Servers, and application servers. Nodes are generally designed with Lora chips; gateways are designed with SX1301 provided by Semtech; Lora NetWork Servers currently have open source loraservers or commercial TTN (The Things Network) in the industry, which users can build by themselves; application servers are custom designed and developed by users, and are mainly used to exchange application data with Lora NetWork Servers.



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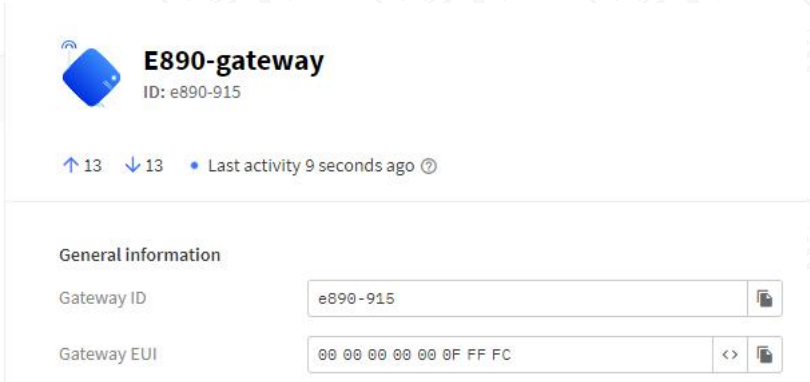
6 Access Demonstration

The demonstration kit for this time is: E78-900LN22S(6601) (6601) as a node, E890 as a gateway to access the free TTN (TheThingsNetwork) test server for communication testing;

The corresponding settings of the node-side OTAA access method are as follows:



On TTN, the gateway information is as follows:



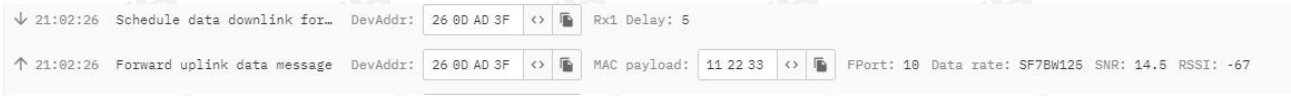
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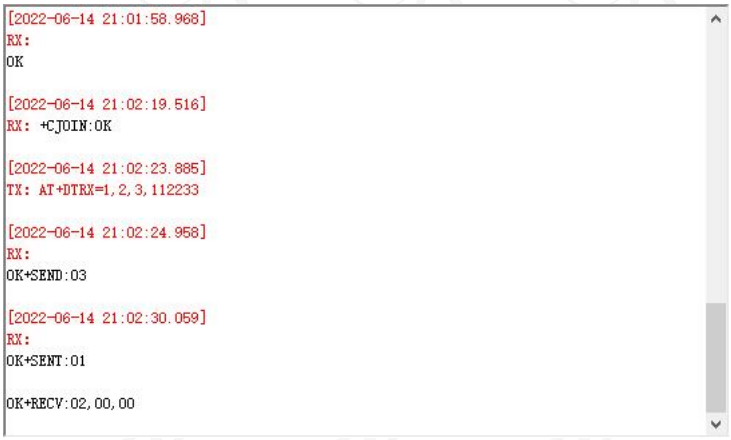
The gateway data is as follows:



TTN node data records are as follows:



Node serial port:



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

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7 AT Commands

a) Instruction format:

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

area	illustrate
AT+	Command message prefix
CMD	Command String
Op	Command operator. It can be the following: ●“=”: indicates parameter setting. ●“?”: Indicates the current value of the query parameter. ●“”: indicates executing a command. ●“=?”: indicates querying the parameters of the setting command.
para-1,para-2,...para-n	Indicates the parameter value to be set, or specifies the parameter to be queried
<CR><LF>	Carriage return line feed, ASCII 0x0D 0x0A

The response message format is <\r\n>[+CMD:][para-1,para-2,……para-n]<\r\n> or <\r\n><STATUS><\r\n>, or both.

area	illustrate
\r\n	Newline character, ASCII code is 0x0A
+CMD	The corresponding command string
para-1,para-2,...para-n	The corresponding parameter string
STATUS	Command execution status. Can be the following: ●“OK”: indicates that the command is executed successfully. ●"ERROR": indicates that the command execution failed. ●"+CME ERROR:<err>": Indicates that the command execution failed and the corresponding error code.

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instruction	Description (general command)
CGMI	Read manufacturer identification (manufacturer identification)
CGMM	Read module identification (model identification)
CGMR	Read revision identification
CGSN	Read product serial number identification (product serial number identification)
CGBR	Set the UART baud rate (baud rate on UART interface)
CJOINMODE	Set or read Join mode (OTAA, ABP)
CDEVEUI	Set or read DevEUI (when OTAA is connected to the network)
CAPPEUI	Set or read AppEUI (when OTAA is connected to the network)
CAPPKEY	Set or read AppKey (when OTAA joins the network)
CDEVADDR	Set or read DevAddr (when ABP joins the network)
CAPPSKEY	Set or read AppSkey (when ABP joins the network)
CNWKSKEY	Set or read NwkSkey (when ABP joins the network)
CFREQBANDMASK	Set or read the frequency group mask (FreqBandMask)
CULDLMODE	Set or read Ul/Dl mode (same frequency or different frequency)
CWORKMODE	Set or read the working mode (normal working mode)
CCLASS	Set or read the class type (Class A/B/C)
CBL	Reading the 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 clear the Rx buffer
REGIONCFG	Set up reading region file (AS923/AU915/EU868/KR920/IN865/RU864/US915)
JOINDR	Set the network airspeed
CCONFIRM	Set or read the type of message sent (confirm or unconfirm)
CAPPPORT	Set or read application layer Port
CDATARATE	Set or read data rate
CRSSI	Get the RSSI value of the channel
CNBTRIALS	Set or read NbTrans parameters
CRM	Set or read the reporting mode
CTXP	Set or read the transmit power
CLINKCHECK	Enable Link Check
CADR	Enable or disable ADR
CRXP	Set or read receive window parameters
CRX1DELAY	Set or read the delay between TX and RX1
CSAVE	Save Configuration
CRESTORE	Restore default configuration
IREBOOT	System Reset
CADDMUTICAST	Add multicast address
CDELMUTICAST	Deleting a multicast address
CNUMMUTICAST	Query the number of multicast
CNWM	Switch to P2P or lorawan mode
C PFREQ	Query or set the frequency in P2P mode
C PSF	Query or set the spreading factor in P2P mode
CPCR	Query or set the encoding rate in P2P mode
CPBW	Query or set the bandwidth in P2P mode
CPPL	Query or set the preamble length in P2P mode
CPTP	Query or set the transmit power in P2P mode
CP2P	Query or set unified configuration information in P2P mode
CPSEND	Sending data in P2P mode

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Read the manufacturer's logo + CGMI

Query command and response	AT + CGMI ?	+ CGMI =< manufacturer > OK
Parameters and return Value Description	**< manufacturer >** : manufacturer identification	
Example	AT + CGMI ? + CGMI = Ebyte OK	

Read module ID + CGMM

Query command and response	AT + CGMM ?	+ CGMM = <model> OK
Parameters and returns Value description	**<model> :** module **identifier**	
Example	AT + CGMM ? + CGMM = E78-9 15 LN22S(6601) OK	

Read the version identifier + CGMR

Query command and response	AT + CGMR ?	+ CGMR =< revision > OK
Parameters and returns Value Description	**< revision >** : version identifier	
Example	AT + CGMR ? + CGMR = SF V 5.3 OK	

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Read product serial number identification + CGSN

Query command and response	AT + CGSN ?	+ CGMR =< sn > OK
Parameters and returns Value description	**< sn >** : product serial number identification	
Example	AT + CGSN ? + CGSN =0539349 E 0003252 3 OK	

Setting the baud rate + CGBR

Query command and response	AT + CGBR ?	+ CGBR =< baud > OK
Set the command and response	AT + CGBR = <baud>	OK
Parameters and returns Value description	**< baud >** : baud rate	
Example	AT + CGBR =9600 OK	
Precautions	Because LPUART is used , the baud rate cannot exceed 9600	

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Set or read Join Way + CJOINMODE

Test commands and response	AT + CJOINMODE = ?	+ CJOINMODE : " mode " OK
Query command and response	AT + CJOINMODE ?	+ CJOINMODE : < mode > OK
Execute commands and response	AT + CJOINMODE = <mode>	OK or + CME ERROR : <err>
Parameters and returns Value description	**<mode> :** Node Join The method is as follows: ●0 : OTAA ●1 : ABP **<err>** : error code	
Example	AT + CJOINMODE = 0 OK	
Precautions	OTAA is used by default Way. If you need to use ABP Network access method, please use this command to set it before sending data.	

Set or read DevEUI + CDEVEUI

test commands and response	AT + CDEVEUI =?	+ CDEVEUI =< DevEUI : length is 16>
Query command and response	AT + CDEVEUI ?	+ CDEVEUI :< value > OK
Execute orders and response	AT + CDEVEUI = <value>	OK or + CME ERROR :< err >
Parameters and return Value Description	**< value >** : node DevEUI	
Example	AT + CDEVEUI ? + CDEVEUI = AABBCCDD 00112233 OK	
Precautions	Set or read DevEUI returns Y1Y2…Y8 in hexadecimal format, with a value of 8 bytes.	

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Set or read AppEUI + CAPPEUI

Test commands and response	AT + CAPPEUI =?	+ CAPPEUI =< AppEUI : length is 16>
Query command and response	AT + CAPPEUI ?	+ CAPPEUI :< value > OK
Execute commands and response	AT + CAPPEUI = <value>	OK or + CME ERROR :< err >
Parameters and returns Value description	**< value >** : node AppEUI **<err>** : error code	
Example	AT + CAPPEUI = AABBCCDD 00112233 OK	
Precautions	OTAA Use, set or read AppEUI , returns Y 1 Y 2… Y 8 , hexadecimal format, 8 characters Festival.	

Set or read AppKey + CAPPKEY

Test commands and response	AT + CAPPKEY =?	+ CAPPKEY =< AppKey : length is 32 >
Query command and response	AT + CAPPKEY ?	+ CAPPKEY :< value > OK
Execute commands and response	AT + CAPPKEY = <value>	OK or + CME ERROR : <err>
Parameters and returns Value description	**< value >** : Node AppKey **<err>** : error code	
Example	AT + CAPPKEY = AABBCCDD 00112233 AABBCCDD 0011223 3 OK	
Precautions	OTAA used when Set or read AppKey , return Y 1 Y 2... Y 16 , hexadecimal format, value 16 words Festival.	

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set or read DevAddr +CDEVADDR

test commands and response	AT + CDEVADDR = ?	+ CDEVADDR =< DevAddr : length is 8 , Device address of ABP mode >
Query command and response	AT + CDEVADDR ?	+ CDEVADDR :< value > OK
Execute orders and response	AT + CDEVADDR = <value>	OK or + CME ERROR :< err >
Parameters and return Value Description	**< value >** : node DevAddr **< err >** : error Code	
Example	AT + CDEVADDR =00112233 OK	
Precautions	ABP When used, set or read DevAddr , returns Y1Y2…Y4 , hexadecimal format, 4 bytes.	

Set or read AppSKey + CAPPSKEY

Test commands and response	AT + CAPPSKEY =?	+ CAPPSKEY =< AppSKey : length is 32>
Query command and response	AT + CAPPSKEY ?	+ CAPPSKEY :< value > OK
Execute commands and response	AT + CAPPSKEY = <value>	OK or + CME ERROR :< err >
Parameters and return Value Description	**< value >** : Node AppSKey **< err >** : error Code	
Example	AT + CAPPSKEY = AABBCCDD 00112233 AABBCCDD 00112233 OK	
Precautions	ABP When used, set or read AppSKey , return Y 1 Y 2... Y 16 , hexadecimal format, value 16 words Festival.	

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set or read NwkSKey +CNWKSKEY

test commands and response	AT + CNWKSKEY = ?	+ CNWKSKEY =< NwkSKey : length is 32>
Query command and response	AT + CNWKSKEY ?	+ CNWKSKEY : <value> OK
Execute orders and response	AT + CNWKSKEY =< value >	OK or + CME ERROR : <err>
Parameters and returns Value description	**< value >** : node NwkSKey **<err>** : error code	
Example	AT + CNWKSKEY = AABBCCDD 00112233 AABBCCDD 00112233 OK	
Precautions	ABP When used, set or read NwkSKey , return Y 1 Y 2... Y 16 , hexadecimal format, value 16 words Festival.	

Set or read frequency group mask + CFREQBANDMASK

test commands and response	AT + CFREQBANDMASK = ?	+ CFREQBANDMASK : " mask " OK
Query command and response	AT + CFREQBANDMASK ?	+ CFREQBANDMASK : <mask> OK
Execute orders and response	AT + CFREQBANDMASK = <mask>	OK or + CME ERROR : <err>
Parameters and return Value Description	**< mask >** : The frequency group mask on which the network may work, 16 bits Corresponding to 16 frequency groups, *see LoRaWAN catch* Please refer to the " *Introduction to the Standards"* and a brief example is given below. For example: The corresponding mask for channels 0-7 is 0001 , the corresponding mask for channels 8-15 is 0002 , and so on. The frequency corresponding to the channel needs to be checked in the region Protocol, such as channels 0-7 in CN 470 correspond to : 470.3 , 470.5 , 470.7 , 470 .9 , 471.1 , 471.3 , 471.5 , 471.7 (unit: MHz). **< err >** : error Code	
Example	AT + CFREQBANDMASK =0001 OK	
Precautions	exist Join Need to set up before.	

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Set or read the uplink and downlink frequencies + CULDLMODE

Test commands and response	AT + CULDLMODE =?	+ CULDLMODE :“ mode ” OK
Query command and response	AT + CULDLMODE ?	+ CULDLMODE :< mode > OK
Execute commands and response	AT + CULDLMODE = <mode>	OK or + CME ERROR :< err >
Parameters and return Value Description	**< mode >** : as follows ● 1 : Same frequency mode ●2 : Different frequency mode **< err >** : error Code	
Example	AT + CULDLMODE =2 OK	
Precautions	exist Join Need to set up before.	

Set or read working mode + CWORKMODE

test commands and response	AT + CWORKMODE =?	+ CWORKMODE : " mode " OK
Query command and response	AT + CWORKMODE ?	+ CWORKMODE : <mode> OK
Execute orders and response	AT + CWORKMODE = <mode>	OK or + CME ERROR : <err>
Parameters and returns Value description	**<mode> :** as **follows** ● 2 : Normal working mode **<err>** : error code	
Example	AT + CWORKMODE =2 OK	
Precautions	Join Previously, it was required to set, and the default was normal working mode. Currently, only normal working mode is supported .	

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Set or read Class + CCLASS

Test commands and response	AT + CCLASS =?	+ CCLASS : " class ", " branch ", " para 1", " par a 2 ", " para 3", " para 4" OK
Query command and response	AT + CCLASS ?	+ CCLASS :< class > OK
Execute orders and response	AT + CCLASS = < class > , [branch], [para 1] , [para 2], [para 3], [para 4]	OK or + CME ERROR :< err >
Parameters and return Value Description	**< class >** : as follows ●0 : classA ● 1 : classB ●2 : classC Depending on the device type, the following optional parameters are available : ●If <class> =1 , and [branch] =0 , then: There is only the [para 1] parameter, which is used to set Ping slot periodicity , range 0~ 7 , corresponding actual cycle time is 0.96*2^ periodicity Second. ●If < class >=1 and [branch]=1 , then: [para 1] Set beacon Frequency point, unit is Hz ; [para 2] Set beacon DataRate , [para 3] set ping Frequency point, unit is Hz ; [para 4] Setup ping DataRate . For the range of each parameter, please refer *to LoRaWAN Access Specifications* . **< err >** : error Code	
Example	AT + CCLASS =2 OK	
Precautions	Join Need to be set before, the default is ClassA .	

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Query the device power level + CBL

test commands and response	AT + CBL =?	+ CBL : " value " OK
Query command and response	AT + CBL ?	+ CBL :< value > OK
Parameters and returns Value description	**< value >** : Node power level, the range refers to LoRaWAN Protocol definition	
Example	AT + CBL ? + CBL = 0 OK	
Precautions	Check the device power level.	

Query the current status of the device + CSTATUS

test commands and response	AT + CSTATUS =?	+ CSTATUS :" status " OK
Query command and response	AT + CSTATUS ?	+ CSTATUS :< status > OK
Parameters and return Value Description	**< status >** : Current uplink result, defined as follows: ● 00 : No data operation ● 01 : Data is being sent ● 02 : Data sending failed ● 03 : Data sent successfully ● 04 : JOIN successful (only occurs during the first JOIN process) ● 05 : JOIN failed (only occurs during the first JOIN process) ● 06 : The network may be abnormal(Link Check results) ● 07 : Data sent successfully, no downlink ● 08 : Data sent successfully, there is downlink	
Example	AT + CSTATUS ? + CSTATUS = 03 OK	
Precautions	Query the current status of the device.	

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Set up Join + CJOIN

Test commands and response	AT + CJOIN =?	+ CJOIN :< ParaTag 1>,[ParaTag 2],…[ParaTag 4] OK
Query command and response	AT + CJOIN ?	+ CJOIN :< ParaValue 1>,[ParaValue 2],…[ParaValue 4] OK
Execute commands and response	AT + CJOIN = < ParaValue 1>,[ParaValue 2], … [ParaValue 4]	OK or + CME ERROR : <err> If the input is legal, first return OK and then start automatic authentication. Right, returns the authentication result : + CJOIN : OK Authentication successful + CJOIN : FAIL Authentication failed
Parameters and return Value Description	**< ParaTag 1 >** , **[ParaTag2]** , ... **[ParaTag4]** : The names of authentication parameters 1 , 2 , ...4 . **< ParaValue 1>** , **[ParaValue 2]** , ... **[ParaValue 4]** : Authentication parameter 1 , 2 , ...4 parameters numerical value. **<ParaTag1> :** Indicates performing JOIN operation, value range: ● 0 : Stop JOIN ●1 : Start JOIN and restart JOIN. process. For modules with hot start enabled, execute this The operation will clear the saved JOIN context parameters **[ParaTag 2]** : Indicates whether automatic JOIN is enabled Function. The factory value is 1 , and the value range is: ● 0 : Turn off automatic JOIN ● 1 : Automatic JOIN , after the module enters transparent transmission mode, it automatically starts JOIN **[ParaTag 3]** : Indicates JOIN Period, value range: 7~255 (unit: s), factory default value: 8 **[ParaTag4]** : Indicates the maximum number of JOIN attempts, value range: 1~256 , see " *LoRaWAN catch Entry Specifications* **< err >** : error Code
Example	AT + CJOIN = 1 , 0, 10, 8 (Set JOIN Parameter: Disable automatic JOIN , JOIN The cycle is 10 s , the maximum Number of attempts(8 times) OK + CJOIN : OK	

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Sending and receiving data + DTRX

Test commands and response	AT + DTRX =?	+ DTRX :[confirm],[nbtrials],< Length >,< Payload > OK
Execute orders and response	AT + DTRX =[confirm],[nbtrials], < Length >,< Payload >	OK + SEND : TX_LEN OK + SENT : TX_CNT OK + RECV : TYPE , PORT , LEN , DATA or ERR + SEND : ERR_NUM ERR + SENT : TX_CNT or + CME ERROR :< err >
Parameters and return Value Description	**[confirm]** and **[nbtrials]** Only valid for this sending, optional. **<Length>** : Indicates the number of strings; for the maximum value , **see " LoRaWAN** *Access Specification"* ; different rates The length of bytes allowed to be transmitted is different (see LoRaWan for details) protocol stipulates), 0 means sending an empty data packet **<Payload> :** Hexadecimal(2 characters represent 1 number) **return value Q & A :** 1 . How to judge whether data sending is successful? ● ForConfirm Type data: Each time a frame of data is sent, there should be a corresponding response message. If the maximum number of times has not been reached , the system will try again until the maximum number of times has not been reached. If a downlink message is received, it is considered a failure and ERR + SENT is output. During this period, if you receive After receiving the response message , the transmission is completed, which is successful, and OK+SEND , OK+SENT and OK + RECV are output. information. ● For Unconfirm Type data: After sending data, no downlink response will be requested. Each time the transmission is completed, OK + SEND will be returned . OK + SENT If the downlink data is received, it will send OK + RECV information. 2 . How many types of prompts are there for data sending status? ● ***OK + SEND : TX_LEN*** Indicates that the data sending request is successful. TX_LEN : 1 Byte , means sending sent . ● ***OK + SENT : TX _ CNT*** Indicates that data is sent successfully. TX_CNT : 1 Byte , indicating that data is sent Number of deliveries . ● ***ERR + SEND : ERR _ NUM*** Indicates that the data sending request failed, the reason is ERR_NUM surface Show. ERR_NUM : 1 Byte , the meaning of the error code is as follows: # 0 : Not connected to the network. # 1 : The communication is busy and the request failed to be sent . # 2 : The data length exceeds the current sendable length, and only the MAC command is sent. ● ***ERR + SENT : TX_CNT*** Indicates that the data transmission failed and the number of transmissions has reached the maximum value. TX_CNT : 1 Byte , indicating the number of times data is sent.	

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	● ***OK + RECV : TYPE , PORT , LEN , DATA*** Indicates that data is received successfully (acknowledgement message is received). information or downlink data). #TYPE: 1Byte , downlink transmission type #Bit0: - 0 : unconfirm - 1 : confirm #Bit1: - 0 : Not ACK - 1 : ACK #Bit2: - 0 : Not carried - 1 : Carry, indicating that the downlink data carries LINK Command Response #Bit3: - 0 : Not carried - 1 : Carry, indicating that the downlink data carries TIME Command response, only when this bit for 1 o'clock indicates that the time synchronization is successful # Bit 4~ Bit 7 : Default 0 , reserved #PORT : 1Byte , downstream transmission port # LEN : 1 Byte , downlink data length # DATA : nByte , downstream data. When LEN=0 , this field does not exist. **< err >** : error Code
Example	AT + DTRX =1,2,5,0123456789 OK + SEND :05 OK + SENT :01 OK + RECV :02,01,00 This example indicates confirm The data is sent successfully. The valid data received by the server should be: 0 x 01 0 x 23 0 x 45 0x67 0x89 and received a downlink confirmation .
Precautions	first , then send data.

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Receive data + DRX

Test commands and response	AT + DRX =?	+ DRX :< Length >,< Payload > OK
Query command and response	AT + DRX ?	+ DRX :< Length >,< Payload > OK or + CME ERROR :< err >
Parameters and return Value Description	**<Length> :** 0 indicates **an** empty data packet **< Payload >** : 1 Hexadecimal string data **OK** : No abnormality in receiving data packets **< err >** : error Code	
Example	AT + DRX ? OK	
Precautions	From the receive buffer Receive data packets and clear the receive buffer .	

Set or read the upstream transmission type + CCONFIRM

Test commands and response	AT + CCONFIRM = ?	+ CCONFIRM :“ value ” OK
Query command and response	AT + CCONFIRM ?	+ CCONFIRM :< value > OK
Execute orders and response	AT + CCONFIRM =< value >	OK or + CME ERROR : <err>
Parameters and returns Value description	**< value >** : as follows ●0 : Uplink message needs to be confirmed ●1 : No need to confirm uplink messages **< err >** : error Code	
Example	AT + CCONFIRM = 1 OK	

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Set or read the upstream data port number + CAPPPORT

Test commands and response	AT + CAPPPORT =?	+ CAPPPORT : " value " OK
Query command and response	AT + CAPPPORT ?	+ CAPPPORT :< value > OK
Execute orders and response	AT + CAPPPORT =< value >	OK or + CME ERROR : <err>
Parameters and returns Value description	**<value> :** The port used by the application , its data format is decimal , and the factory value **is** 10 . Ranges: 1~223 . *Note : Port : 0x00 It's LoRaWAN MAC Order.* **< err >** : error Code	
Example	AT + CAPPPORT =1 0 OK	
Precautions	Need to be set before sending data.	

Set or read the communication rate + CDATARATE

Test commands and response	AT + CDATARATE =?	+ CDATARATE :" value " OK
Query command and response	AT + CATARATE ?	+ CATARATE :< value > OK
Execute orders and response	AT + CATARATE =< value >	OK or + CME ERROR : <err>
Parameters and returns Value description	**<value> : Rate value** , the factory value is 3 , the value range is as follows: ●0 : SF 1 2 , BW125 ● 1 : SF11 , BW125 ●2 : SF 1 0 , BW125 ●3 : S F 9 , BW 125 ●4 : SF 8 , BW 125 ●5 : SF 7 , BW 125 **< err >** : error Code	
Example	AT + CDATARATE =1 OK	
Precautions	Need to be set before sending data. ADR is enabled , you cannot change DATARATE . If you need to change DATARATE , please execute AT + CADR =0 .	

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Query channel signal strength + CRSSI

Test commands and response	AT + CRSSI =?	+ CRSSI OK
Query command and response	AT + CRSSI FREQBANDIDX ?	+ CRSSI : 0 :< Channel 0 rssi > 1 :< Channel 1 rssi > … 15:< Channel 8 rssi > OK
Parameters and return Value Description	**<FREQBANDIDX> :** Indicates the number of the frequency band , starting from 0 , 1 A **2** group number is 1 . Returns the RSSI of 8 channels within a frequency band .	
Example	AT + CRSSI 1? + CRSSI : 0 : - 157 1 :-157 2 :-157 3 : - 157 4:- 157 5 : - 157 6 : - 157 7:- 157 OK	
Precautions	Only supports CN 470 A	

Set or read the maximum number of times to send + CNBTRIALS

Test commands and response	AT + CNBTRIALS = ?	+ CNBTRIALS : " MType ", " value " OK
Query command and response	AT + CNBTRIALS ?	+ CNBTRIALS :< MType >,< value > OK
Execute orders and response	AT + CNBTRIALS =< MType >,< value >	OK or + CME ERROR : <err>
Parameters and returns Value description	**<MType> :** as follows ●0 : unconfirm Bag ●1 : confirm Bag **< value >** : is the maximum number of sending times , value range: 1~15 **<err>** : error code	
Example	AT + CNBTRIALS =1,2 OK	
Precautions	Needs to be set before sending data.	

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Set or read reporting mode + CRM

<table>
<tr><td>test commands and response</td><td>AT + CRM = ?</td><td>+ CRM : " reportMode ", " reportInterval " OK</td></tr>
<tr><td>Query command and response</td><td>AT + CRM ?</td><td>+ CTXP :< reportMode >,[reportInterval] OK</td></tr>
<tr><td>Execute orders and response</td><td>AT + CTXP =< reportMode >,[reportInterval]</td><td>OK
or
+ CME ERROR :< err ></td></tr>
<tr><td>Parameters and return Value Description</td><td colspan="2">This command is mainly used for testing .
< reportMode > : as follows
●0 : Non-periodic reporting of data
● 1 : Periodic reporting of data
<reportInterval> : This parameter is only available when periodic data reporting is performed. The time interval for periodic data reporting is The unit is seconds . For different DRs , the minimum period allowed is different and is defined using the period level as follows: surface.
<table>
<tr><td>Rate \ Period(s)\ Level</td><td>LV 1</td><td>LV 2</td></tr>
<tr><td>DR 0</td><td>15 0</td><td>300</td></tr>
<tr><td>DR 1</td><td>75</td><td>15 0</td></tr>
<tr><td>DR 2</td><td>3 5</td><td>70</td></tr>
<tr><td>DR 3</td><td>15</td><td>3 0</td></tr>
<tr><td>DR 4</td><td>10</td><td>20</td></tr>
<tr><td>DR 5</td><td>5</td><td>10</td></tr>
</table>
<err> : error code</td></tr>
<tr><td>Example</td><td colspan="2">AT + CRM =1,10
OK</td></tr>
<tr><td>Precautions</td><td colspan="2">Needs to be set before sending data.</td></tr>
</table>

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Set or read the transmit power + CTXP

Test commands and response	AT + CTXP =?	+ CTXP :“ value ” OK
Query command and response	AT + CTXP ?	+ CTXP :< value > OK
Execute commands and response	AT + CTXP =< value >	OK or + CME ERROR : <err>
Parameters and returns Value description	**<value> :** It is the transmitting power, the factory value is **0** , the actual value range is related to the final product, CN470A Under the frequency band , value The value range of is as follows: ● 0 : 17 dBm ●1 : 15 dBm ● 2 : 13 dBm ● 3 : 11 dBm ●4 : 9 dBm ●5 : 7 dBm ●6 : 5 dBm ●7 : 3 dBm **< err >** : error Code	
Example	AT + CTXP =1 OK	
Precautions	Needs to be set before sending data.	

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Verify network connection + CLINKCHECK

test commands and response	AT + CLINKCHECK =?	+ CLINKCHECK : " value " OK
Execute orders and response	AT + CLINKCHECK =< value >	OK + CLINKCHECK : < Y 0>, < Y 1>, < Y 3>, < Y 4> or + CME ERROR : <err>
Parameters and returns Value description	**<value> :** for Link Check Enable control. The definition is as follows: ● 0 : Disable Link Check ● 1 : Execute Link once Check ● 2 : The module automatically carries linkcheck in each uplink data packet. Order	
	Return OK , the setting is successful. If < value >=1 , after a period of time, the second response message will be returned in the following format: + *CLINKCHECK : < Y 0>, < Y 1>, < Y 3>, < Y 4>* ● Y 0 means Link Check result: # 0 : Indicates that this Link Check was executed successfully. # Non- 0 : Indicates that the Link Check execution failed this time ● Y 1 is DemodMargin ● Y 2 for NbGateways ● Y 3 is the RSSI of this downward trend ● Y 4 is the SNR of this downturn	
	< err > : error Code	
Example	AT + CLINKCHECK =1 OK +CLINKCHECK : 0 , 0 , 1 , -68 , 8	
Precautions	Need to be set before sending data.	

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Enable ADR + CADR

Test commands and response	AT + CADR =?	+ CADR :“ value ” OK
Query command and response	AT + CADR ?	+ CADR :< value > OK
Execute commands and response	AT + CADR =< value >	OK or + CME ERROR :< err >
Parameters and return Value Description	**< value >** : ADR Enable control, the factory value is 1 , and the definition is as follows: ●0 : ADR Disable ●1 : ADR Enable **<err>** : error code	
Example	AT + CADR =1 OK	
Precautions	before sending data. ADR is enabled by default .	

Set or read receive window parameters + CRXP

test commands and response	AT + CRXP =?	+ CRXP : “ RX 1 DRoffest ”, “ RX 2 DataRate ” , ” RX 2 Frequency ” OK
Query command and response	AT + CRXP ?	+ CRXP :< RX 1 DRoffest >,< RX 2 DataRat e > ,< RX 2 Frequency > OK
Execute commands and response	AT + CRXP =< RX 1 DRoffest >,< RX 2 Data Rate > ,< RX 2 Frequency >	OK or + CME ERROR :< err >
Parameters and return Value Description	**< RX 1 DRoffest >** , **< RX 2 DataRate >** , **< RX 2 Frequency >** : See LoRaWAN for details protocol **< err >** : error Code	
Example	AT + CRXP = 1,1,471000000 OK	
Precautions	Need to be set before sending data. Do not set the default value .	

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Set or read the sending and receiving delay + CRX 1 DELAY

Test commands and response	AT + CRX 1 DELAY =?	+ CRX 1 DELAY :“ Delay ” OK
Query command and response	AT + CRX 1 DELAY ?	+ CRX 1 DELAY :< Delay > OK
Execute commands and response	AT + CRX 1 DELAY =< Delay >	OK or + CME ERROR : <err>
Parameters and returns Value description	**<Delay> : How long to open the** RX 1 window after sending , unit is s **<err>** : error code	
Example	AT + CRX 1 DELAY =2 OK	
Precautions	Set how long after sending to open the RX 1 window, set before sending data. If not set, it is the default value.	

save MAC parameter settings + CSAVE

test commands and response	AT + CSAVE =?	+ CSAVE OK
Execute orders and response	AT + CSAVE	OK or + CME ERROR : <err>
Parameters and returns Value description	This command saves configuration parameters to EEPROM / FLASH , the module will use the new MAC after restarting Configuration parameters number for network initialization and operation. **<err>** : error code	
Example	AT + CSAVE OK	
Precautions	The data needs to be saved before sending it.	

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Recover MAC Default parameters + CRESTORE

test commands and response	AT + CRESTORE = ?	+ CRESTORE OK
Execute orders and response	AT + CRESTORE	OK or + CME ERROR : <err>
Parameters and returns Value description	This command restores MAC Default configuration parameters to EEPROM / FLASH middle. **<err>** : error code	
Example	AT + CRESTORE OK	
Precautions		

PingSlotInfo ask + CPINGSLOTINFOREQ

Test commands and response	AT + CPINGSLOTINFOREQ = ?	+ CPINGSLOTINFOREQ : < periodicity > OK
Query command and response	AT + CPINGSLOTINFOREQ ?	+ CPINGSLOTINFOREQ : < periodicity > OK
Execute orders and response	AT + CPINGSLOTINFOREQ = < periodicity >	OK or + CME ERROR : <err>
Parameters and returns Value description	**< periodicity >** : ping slot cycle **<err>** : error code	
Example	AT + CPINGSLOTINFOREQ = 3 OK	
Precautions	The command is ClassB Special commands.	

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Add multicast address + CADDMUTICAST

test commands and response	AT + CADDMUTICAST = ?	+ CADDMUTICAST :" DevAddr "," AppSKey " , " NwkSKey "," Periodicity "," Datarate " OK
Execute commands and response	AT + CADDMUTICAST = <DevAddr> , <AppSKey> , <NwkSKey> , [Periodicity], [Datarate]	OK or + CME ERROR : <err>
Parameters and returns Value description	**<DevAddr> :** multicast **address** **<AppSKey> : Multicast** application session key **<NwkSKey> : Multicast network** session key **[Periodicity]** : ping slot Period parameters **[Datarate]** : Data rate **<err>** : error code	
Example	AT + CADDMUTICAST = 67678 d 5 e ,5 ac 8 eb 2016 f 11 f 19 ad 19 d 7 f 530592 c 44,5954306 90 10279 fa 7317 f 85 f 47 c 46926, 2, 2 OK	
Precautions	Please JOIN settings before.	

Deleting a multicast address + CDELMUTICAST

Test commands and response	AT + CDELMUTICAST = ?	+ CDELMUTICAST :" DevAddr " OK
Execute commands and response	AT + CDELMUTICAST = <DevAddr>	OK or + CME ERROR : <err>
Parameters and returns Value description	**<DevAddr> :** multicast **address** **<err>** : error code	
Example	AT + CDELMUTICAST =67678 d 5 e OK	

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Query the number of multicasts + CNUMMUTICAST

Test commands and response	AT + CNUMMUTICAST = ?	+ CNUMMUTICAST : " number " OK
Query command and response	AT + CNUMMUTICAST ?	+ CNUMMUTICAST : < number > OK
Parameters and return Value Description	**<number> : multicast** number	
Example	AT + CNUMMUTICAST ? + CNUMMUTICAST : 0 OK	

Restart the module + IREBOOT

test commands and response	AT + IREBOOT = ?	+ IREBOOT : " Mode " OK
Execute orders and response	AT + IREBOOT = <mode>	OK or + CME ERROR : < err >
Parameters and return Value Description	**< mode >** : Restart mode, defined as follows : ● 0 : Restart the communication module immediately ● 1 : Wait for the wireless frame currently being sent in the communication module to complete before restarting **< err >** : error Code	
Example	AT + IREBOOT = 1 OK	
Precautions	After receiving the command, the communication module replies OK After that, restart the communication module. Before the restart is complete, no more calls will be received. What subsequent AT Order.	

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Encrypted device key + CKEYSPROTECT

Test commands and response	AT + CKEYSPROTECT = ?	+ CKEYSPROTECT =< ProtectKey : length is 32> OK
Query command and response	AT + CKEYSPROTECT ?	+ CKEYSPROTECT :< protected > OK
Execute commands and response	AT + CKEYSPROTECT =< key >	OK or + CME ERROR :< err >
Parameters and return Value Description	**< key >** : node protection key **< err >** : error Code	
Example	AT + CKEYSPROTECT = AABBCCDD 00112233 AABBCCDD 00112233 OK	
Precautions	After using this command, the device triplet information will be encrypted and stored, and only the ciphertext can be read but cannot be modified.	

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Working mode + CNWM

Query command and response	AT+CNWM?	+ CPFREQ :< mode > < mode > : 0: LoRaWAN 1: P2P OK
Execute commands and response	AT+CNWM=<mode>	OK or + CME ERROR :< err >
Parameters and return Value Description	<mode>: 0: LoRaWAN 1: P2P <err>: error code	
Example	AT+CNWM=1 OK	
Precautions	Switch to P2P working mode .	

Operating frequency + CPFREQ

Query command and response	AT + CPFREQ ?	+CPFREQ:<PFREQ> OK
Execute commands and response	AT + CPFREQ = <PFREQ>	OK or + CME ERROR :< err >
Parameters and return Value Description	<PFREQ> : Frequency range : 850000000 - 950000000 <err> : error code	
Example	AT + CPFREQ = 850000000 OK	
Precautions	Modify the operating frequency in P2P mode .	

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Spreading factor +CPSF

Query command and response	AT+ CPSF ?	+ CPSF : <CPSF> OK
Execute orders and response	AT + CPSF = <CPSF>	OK or + CME ERROR : <err>
Parameters and returns Value description	<CPSF> : Spreading factor range: 5~ 12 <err>: error code	
Example	AT + CPCR = 6 OK	
Precautions	Modify the spreading factor in P2P mode .	

Coding rate + CP CR

Query command and response	AT+ CP CR ?	+ CPSF :< CP CR > OK
Execute commands and response	AT+ CP CR =< CP CR >	OK or + CME ERROR : <err>
Parameters and returns Value description	< CP CR >: Coding rate range: 1~4 <err>: error code	
Example	AT + CPCR = 4 OK	
Precautions	the encoding rate in P2P mode .	

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Bandwidth +CP BW

Query command and response	AT+ CP BW ?	+ CPCR :< CP BW > OK
Execute orders and response	AT + CP BW =< CP BW >	OK or + CME ERROR :< err >
Parameters and return Value Description	< CP BW >: Bandwidth range: 0-9 <err>: error code	
Example	AT + CPCR = 2 OK	
Precautions	Modify the bandwidth in P2P mode .	

Preamble length + CP PL

Query command and response	AT+ CPPL ?	+ CPCR : <CPPL> OK
Execute orders and response	AT + CPSF = <CPPL>	OK or + CME ERROR : <err>
Parameters and returns Value description	<CPPL> : Preamble length range: 10~ 65535 <err>: error code	
Example	AT + CPPL = 2 OK	
Precautions	the preamble length in P2P mode .	

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Transmit power+CPTP

Query command and response	AT+ CPTP ?	+ CPTP : <CPTP> OK
Execute orders and response	AT + CPTP =< CPTP >	OK or + CME ERROR :< err >
Parameters and return Value Description	< CPTP >: Transmit power range: 1~20 <err>: error code	
Example	AT + CPTP = 2 OK	
Precautions	the transmit power in P2P mode .	

Send data+CPSEND

Query command and response	AT+ CPSEND ?	+ CPSEND :< CPSEND > OK
Execute orders and response	AT + CPSEND = <date>	OK or + CME ERROR : <err>
Parameter and return value description	<date> : data <err>: error code	
Example	AT + CPSEND =1234 data length 1-242 (hex string (length 1-484)) OK	

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P2P unified configuration information +CP2P

Query command and response	AT+ CP2P ?	+ CP2P :< CP2P > OK
Execute commands and responses	AT+ CP2P = < frequency , spreading factor coding rate , bandwidth , preamble length , transmit power >	OK or + CME ERROR : <err>
Parameters and returns Value description	< Frequency , spreading factor coding rate , bandwidth , preamble length , transmit power > <err>: error code	
Example	AT+ CPTP = 900000000,12,1,1,10,20 OK	
Precautions	parameters in P2P mode .	

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8 Frequently Asked Questions

8.1 The communication distance is very close

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

8.2 Modules are easily damaged

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

Important statement

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

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Revise history

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1.0	2021-9-15	initial version	Linson
2.4	2022-6-20	revision format	Yan Yan
2.5	2022-8-29	Recommended wiring diagram modifications	Yan Yan
2.6	2023-11-21	Modify manual description	LM

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