



Chengdu Ebyte Electronic Technology Co.,Ltd

Wireless Modem

User Manual

E78-DTU(470LN22)



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1. Overview

1.1. Introduction

E78-DTU(470LN22) product is a standard LoraWan node radio designed and produced by Chengdu Ebyte Electronic Technology Co. , Ltd. It is developed based on our company's E78-470LN22 S module. The working frequency band is CN470~510MHZ and supports CLASS -A/CLASS- C node type, supports ABP/OTAA two network access methods ; the external communication interface of the radio adopts RS485 communication , the user can access the standard LoraWan network through AT commands or simple configuration of the host computer , and the radio has transparent transmission and active polling. It supports serial port upgrade and remote configuration, and is an excellent choice for current IoT applications.

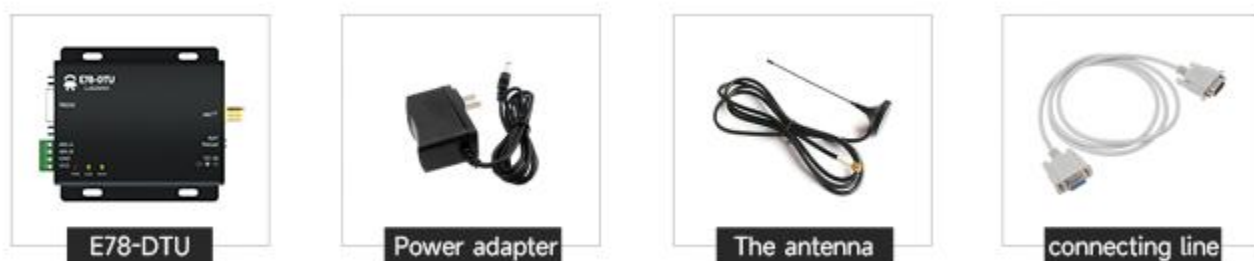


1.2. Features

- Serial port upgrade;
- Support transparent transmission;
- Support active polling;
- Support hardware reset;
- Adopt Lo R a Wan communication technology ;
- Support automatic modbus CRC check;
- AT command/host computer/remote configuration;
- Working temperature range: -40°C ~ +85°C, suitable for all kinds of harsh working environment, real industrial grade products.
- All aluminum alloy shell, compact size, easy installation, good heat dissipation; perfect shielding design, good electromagnetic compatibility, strong anti-interference ability.
- Power reverse connection protection, over-connection protection, antenna surge protection and other multiple protection functions greatly increase the reliability of the radio.

2. Quick Start

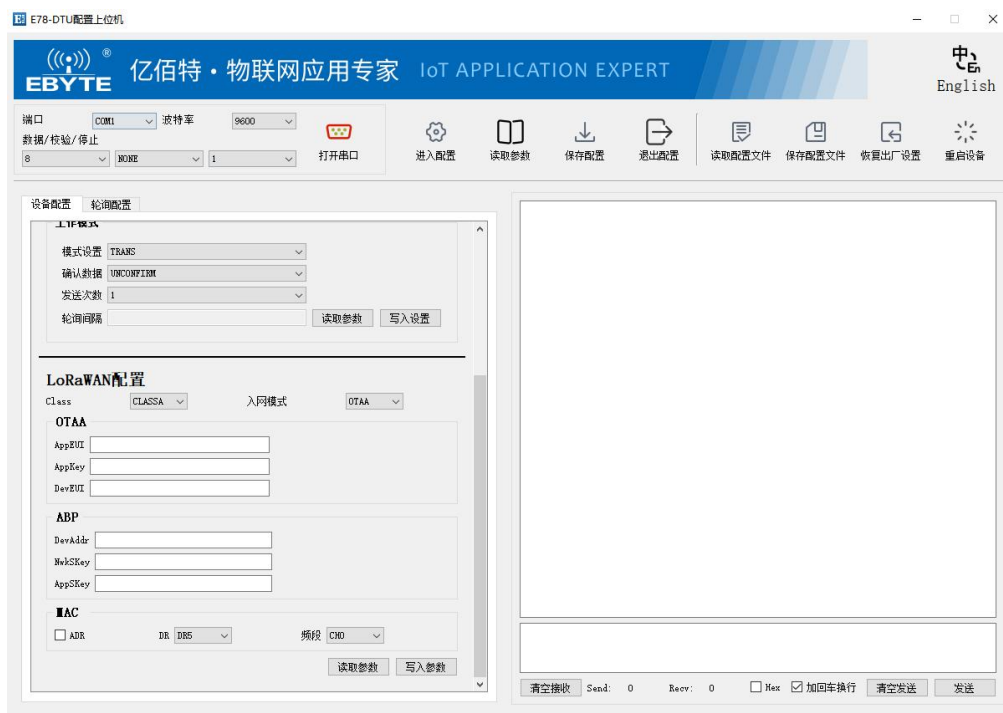
you need to prepare: Radio antenna power adapter 485 communication line。



1.First install the antenna for the radio, then install the power supply, and make sure that the DIP switch is in the correct state. The user can choose either the crimping method or the power adapter to supply power according to their needs;

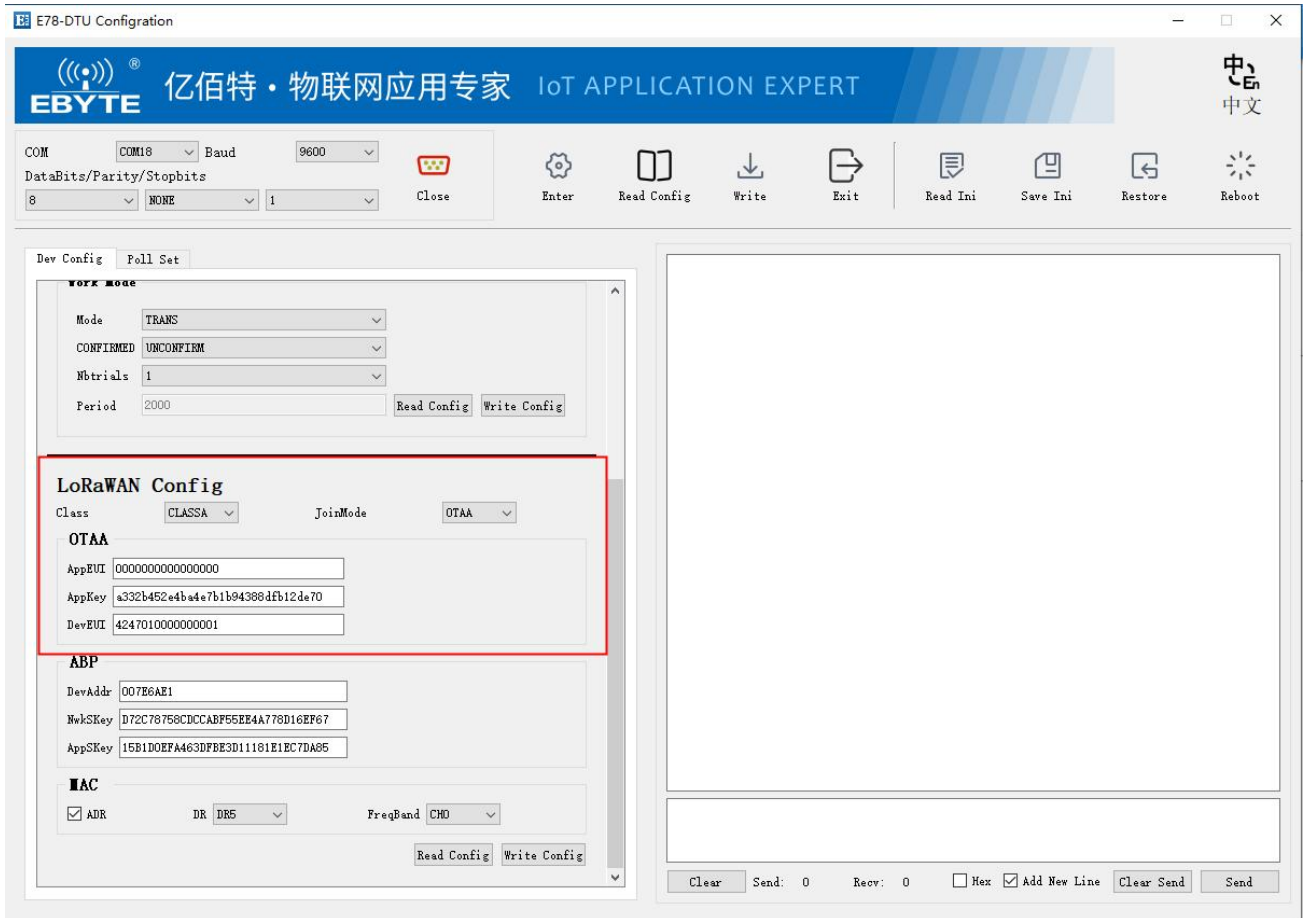
2.Use USB to RS-485 to connect the computer to the radio;

3.Start a serial port debugging assistant, select the serial port baud rate as 9600bps, and check the mode as 8N1. After the network access parameters are configured by THE AT instruction or the upper computer, the device will automatically send the network access request, and the device can access the network after the nearby gateway accepts the request



Access demo:

In this demonstration kit, the device is used as a node, and E890-470LG11 is used as a gateway to access the free ChirpStack Application Server test server for communication testing; the corresponding settings of the OTAA access method on the node side are as follows:



On ChirpStack Application Server, the gateway data record looks like this:

ChirpStack

Search organization, application, gateway or device

admin

Dashboard

Network-servers

Gateway-profiles

Organizations

All users

API keys

chirpstack

Org. dashboard

Org. users

Org. API keys

Service-profiles

Device-profiles

Gateways

Applications

Gateways / e890-ffff

DELETE

GATEWAY DETAILS

GATEWAY CONFIGURATION

CERTIFICATE

GATEWAY DISCOVERY

LIVE LORAWAN FRAMES

HELP

PAUSE

DOWNLOAD

CLEAR

Jul 21 9:53:57 AM	JoinAccept	500.5 MHz	SF7	BW125	GW: 00000000000000ff	
Jul 21 9:53:57 AM	JoinRequest	470.5 MHz	SF7	BW125	DevEUI: 4247010000000001	
Jun 22 1:24:36 PM	JoinAccept	501.5 MHz	SF7	BW125	GW: 00000000000000ff	
Jun 22 1:24:36 PM	JoinRequest	471.5 MHz	SF7	BW125	DevEUI: 0000000000001110	
Jun 22 1:24:03 PM	UnconfirmedDataDown	500.5 MHz	SF9	BW125	FCnt: 0	DevAddr: 0112972d
Jun 22 1:24:03 PM	ConfirmedDataUp	470.5 MHz	SF9	BW125	FCnt: 65	DevAddr: 0112972d
Jun 22 1:23:56 PM	JoinAccept	500.3 MHz	SF7	BW125	GW: 00000000000000ff	
Jun 22 1:23:56 PM	JoinRequest	470.3 MHz	SF7	BW125	DevEUI: 0000000000001110	
Jun 22 1:23:45 PM	JoinRequest	471.5 MHz	SF7	BW125	DevEUI: 0000000000001110	
Jun 22 1:23:36 PM	JoinRequest	471.5 MHz	SF7	BW125	DevEUI: 1000000000000001	

ChirpStack Application Server node data record is as follows:

The screenshot shows the ChirpStack web interface. The left sidebar contains navigation links: Dashboard, Network-servers, Gateway-profiles, Organizations, All users, API keys, and a dropdown for 'chirpstack'. The main content area is titled 'Applications / E78-470 / Devices / e78-01' and has a 'DELETE' button. Below the title are tabs: DETAILS, CONFIGURATION, KEYS (OTAA), ACTIVATION, DEVICE DATA, and LORAWAN FRAMES. The 'LORAWAN FRAMES' tab is active, showing a list of frames with columns for timestamp, direction, frequency, SF, BW, FPort, FCnt, DevAddr, and GW. The frames are as follows:

Timestamp	Direction	Freq	SF	BW	FPort	FCnt	DevAddr	GW
Jul 21 10:23:58 AM	UnconfirmedDataDown	501.1 MHz	SF7	BW125	FPort: 4	FCnt: 4	DevAddr: 00462cff	GW: 00000000000000fffd
Jul 21 10:23:58 AM	UnconfirmedDataUp	471.1 MHz	SF7	BW125	FPort: 65	FCnt: 4	DevAddr: 00462cff	
Jul 21 10:23:56 AM	UnconfirmedDataDown	500.7 MHz	SF7	BW125	FPort: 3	FCnt: 3	DevAddr: 00462cff	GW: 00000000000000fffd
Jul 21 10:23:56 AM	UnconfirmedDataUp	470.7 MHz	SF7	BW125	FPort: 65	FCnt: 3	DevAddr: 00462cff	
Jul 21 10:23:54 AM	UnconfirmedDataDown	501.5 MHz	SF7	BW125	FPort: 2	FCnt: 2	DevAddr: 00462cff	GW: 00000000000000fffd
Jul 21 10:23:54 AM	UnconfirmedDataUp	471.5 MHz	SF7	BW125	FPort: 65	FCnt: 2	DevAddr: 00462cff	
Jul 21 10:23:52 AM	UnconfirmedDataDown	501.1 MHz	SF7	BW125	FPort: 1	FCnt: 1	DevAddr: 00462cff	GW: 00000000000000fffd
Jul 21 10:23:52 AM	UnconfirmedDataUp	471.1 MHz	SF7	BW125	FPort: 65	FCnt: 1	DevAddr: 00462cff	
Jul 21 10:23:51 AM	UnconfirmedDataDown	501.7 MHz	SF9	BW125	FPort: 0	FCnt: 0	DevAddr: 00462cff	GW: 00000000000000fffd
Jul 21 10:23:51 AM	UnconfirmedDataUp	471.7 MHz	SF9	BW125	FPort: 65	FCnt: 0	DevAddr: 00462cff	

An example of access in transparent transmission mode is as follows:

The screenshot shows the ChirpStack web interface with the 'LORAWAN FRAMES' tab active. The left sidebar is the same as in the previous screenshot. The main content area shows the same list of frames. On the right side, a terminal window is open, displaying the following text:

```
TX:AT+I9EBOOT=1
RX:
OK
TX:#####
TX:#####
TX:#####
TX:#####
TX:#####
TX:#####
TX:#####
TX:#####
TX:#####
TX:#####
TX:#####
TX:#####
```

Below the terminal window, there are buttons for 'Clear', 'Send', '114', 'Recv', '6', 'Run', 'Add New Line', 'Clear Send', and 'Send'.

APP in transparent transmission mode Server receives data:

Gateways / e890-fffd DELETE

GATEWAY DETAILS GATEWAY CONFIGURATION CERTIFICATE GATEWAY DISCOVERY **LIVE LORAWAN FRAMES**

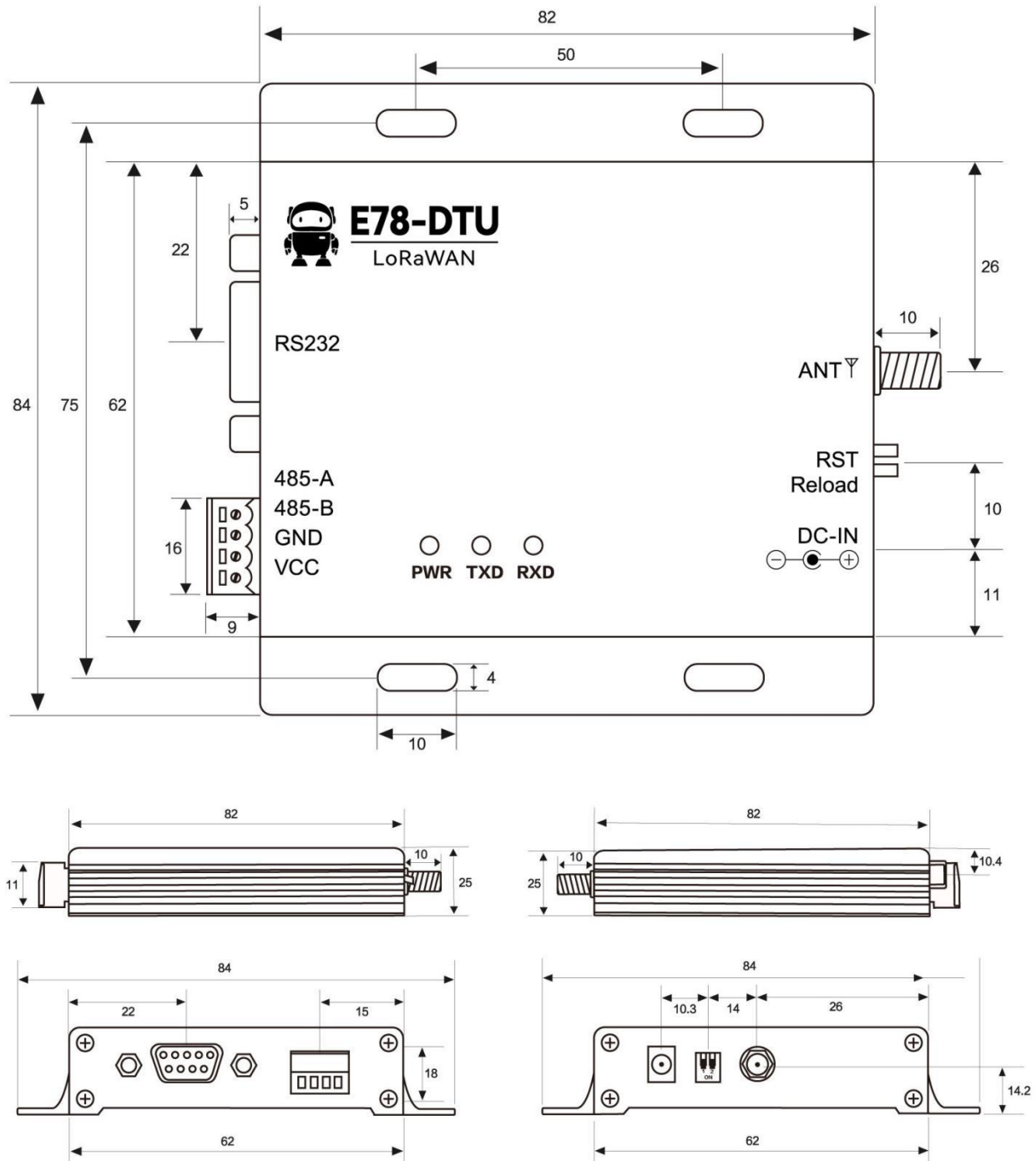
HELP PAUSE DOWNLOAD CLEAR

Time	Status	Freq	SF	BW	FPort	FCnt	DevAddr	GW
Jul 21 10:23:58 AM	UnconfirmedDataDown	501.1 MHz	SF7	BW125	FPort: 65	FCnt: 4	DevAddr: 00462cff	GW: 00000000000000fffd
Jul 21 10:23:58 AM	UnconfirmedDataUp	471.1 MHz	SF7	BW125	FPort: 65	FCnt: 4	DevAddr: 00462cff	
Jul 21 10:23:56 AM	UnconfirmedDataDown	500.7 MHz	SF7	BW125	FPort: 65	FCnt: 3	DevAddr: 00462cff	GW: 00000000000000fffd
Jul 21 10:23:56 AM	UnconfirmedDataUp	470.7 MHz	SF7	BW125	FPort: 65	FCnt: 3	DevAddr: 00462cff	
Jul 21 10:23:54 AM	UnconfirmedDataDown	501.5 MHz	SF7	BW125	FPort: 65	FCnt: 2	DevAddr: 00462cff	GW: 00000000000000fffd
Jul 21 10:23:54 AM	UnconfirmedDataUp	471.5 MHz	SF7	BW125	FPort: 65	FCnt: 2	DevAddr: 00462cff	
Jul 21 10:23:52 AM	UnconfirmedDataDown	501.1 MHz	SF7	BW125	FPort: 65	FCnt: 1	DevAddr: 00462cff	GW: 00000000000000fffd
Jul 21 10:23:52 AM	UnconfirmedDataUp	471.1 MHz	SF7	BW125	FPort: 65	FCnt: 1	DevAddr: 00462cff	
Jul 21 10:23:51 AM	UnconfirmedDataDown	501.7 MHz	SF9	BW125	FPort: 65	FCnt: 0	DevAddr: 00462cff	GW: 00000000000000fffd
Jul 21 10:23:51 AM	UnconfirmedDataUp	471.7 MHz	SF9	BW125	FPort: 65	FCnt: 0	DevAddr: 00462cff	

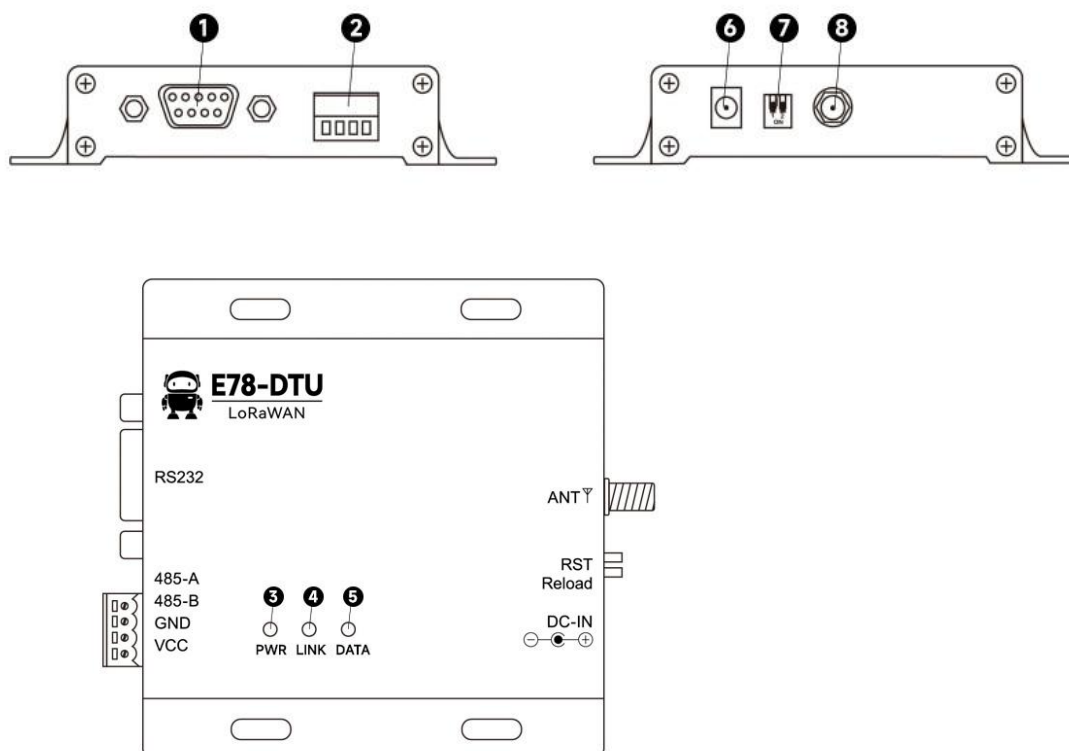
Note: Please refer to "LORAWAN Node + Gateway TTN Server Configuration Tutorial" for the TTN creation device and corresponding configuration process

3. Installation Dimensions

3.1. Size(Unit: mm)



3.2. Interfaces



No.	Name	Function	Description
1	DB-9 female socket	RS-232 interface	Standard RS-232 interface
2	3.81 Terminals	RS-485, power interface	Standard RS-485 interface and crimped power interface
3	PWR-LED	Power Indicator	Red, lights up when the power is on
4	LINK -LED	send indicator	Yellow, flashes when sending data
5	DATA -LED	Receive indicator	Yellow, blinks when receiving data
6	DC power interface	Power interface	In-line round hole, outer diameter 5.5mm, inner diameter 2.5mm
7	DIP switch	DIP switch	Reload and RST DIP switch
8	Antenna interface	SMA-K interface	External thread inner hole, length 10mm, characteristic impedance 50Ω

4. Interface Definition

4.1. Power interface description



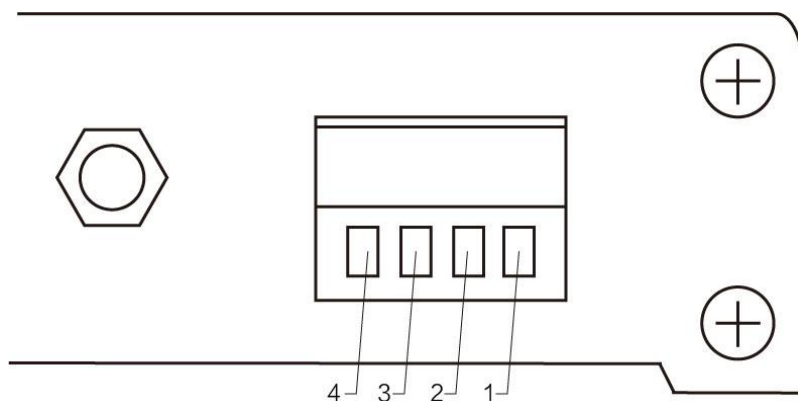
Users can choose ⑥ DC power interface for power supply, and use the interface to supply power to the power adapter with an outer diameter of 5.5mm and an inner diameter of 2.5mm;

You can also supply power to the VCC terminal and GND terminal in ②, just choose any one of the power supply methods;

E78-DTU can be powered by 8 ~ 28 V DC power supply, 12V or 24V DC power supply is recommended.

4.2. RS485 interface definition

E78-DTU can use the 485_A terminal and 485_B terminal in ② to connect with the A terminal and B terminal of the RS-485 of the device respectively.



Foot number	standard definition	Function	illustrate
1	VCC	Crimp power interface, positive	DC 8~ 28V, 12V or 24V is recommended
2	GND	Crimp power interface, negative pole	The negative pole of the power supply is connected to the system ground and the shell
3	485_B	RS-485 interface, B interface	RS-485 interface B interface is connected with device B interface
4	485_A	RS-485 interface, A interface	The RS-485 interface A interface is connected to the device A interface

5. Technical Specifications

5.1. Model Specifications

Model	working frequency	TX power	Ideal Range	Specifications
	Hz	W	km	
E78-DTU(470LN22)	470-510Mhz	22dbm	3KM	LoRa Wan system

Note: Reference distance test environment: sunny weather, open environment without obstruction, 12 V2A power supply, 5dBi gain suction cup antenna, the antenna height is 5 meters from the ground, and the factory default parameters are used.

5.2. General Specifications

No.	Name	Specification	remark
1	Product Size	100*84*25mm	See chapter 3.1 for details
2	product weight	120g	Weight tolerance 5 g
3	Operating temperature	-40°C ~ 85 °C	Meet the needs of industrial use
4	Antenna impedance	50Ω	Standard 50Ω impedance
5	voltage range	8 ~ 28v DC	12V or 24 V recommended
6	Current parameters	TX current: 15mA@12V	Standby current: 10mA@12V
7	Interface	RS232/RS485	Standard DB9 hole, 3.81 terminal block
8	baud rate		Factory default 9600
9	Address capacity	Factory default 0	Max 65536 address available

6. Working Mode

E78-DTU has two working modes, the radio is configured as transparent transmission mode for normal communication; the default setting of the radio is also transparent transmission mode when it leaves the factory.

Mode	Notes
Communication mode	In this mode, the device can communicate with the server
configuration mode	AT command configuration mode

6.1. Transparent transmission mode (mode 0)

type	Notes
TX	Users can input data through the serial port, and the module will start wireless transmission.
RX	The wireless receiving function of the module is turned on, and after receiving wireless data, it will be output through the serial port TXD pin.

6.2. Configuration Mode (Mode 2)

type	Notes
TX	off
RX	off
configure	User can access registers to configure module operating status

7. Detailed function

7.1. Transparent transmission mode

In this mode, the radio can configure the network access parameters through AT commands or the host computer. After the radio successfully accesses the network, the data communication between the radio and the lorawan server can be realized.

7.2. Active Polling

Active polling mode can be configured through the host computer or AT command, this mode supports HEX mode, supports automatic modbus CRC check, and can configure 64 polling commands.

7.3. Remote configuration

When the radio is successfully connected to the network, the parameters of the radio can be configured by sending commands from the lorawan server.

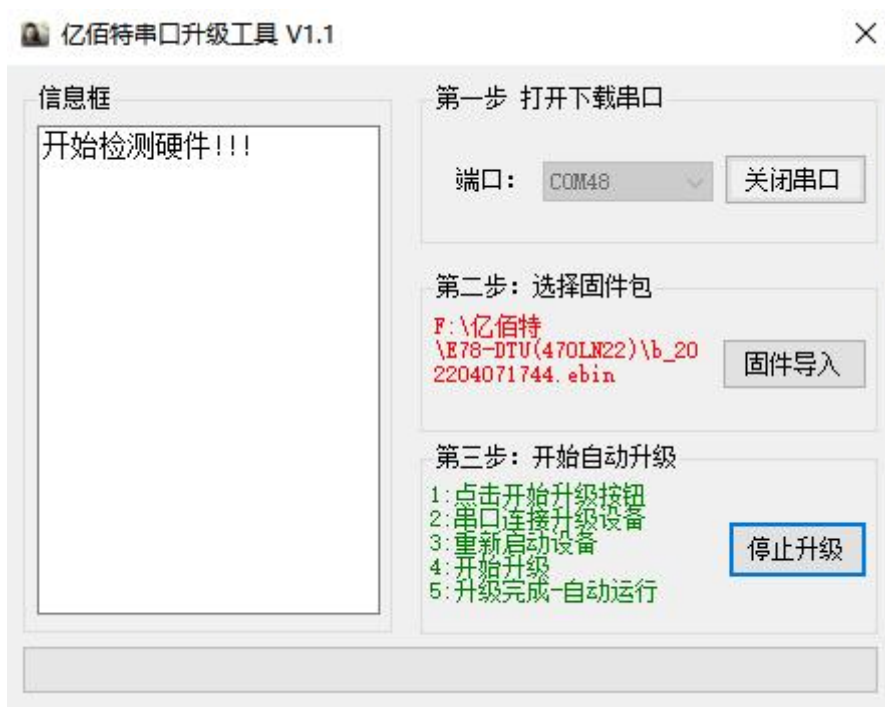
7.4. Serial port upgrade

The firmware can be upgraded through the RS485 serial port. The specific demonstration is as follows:

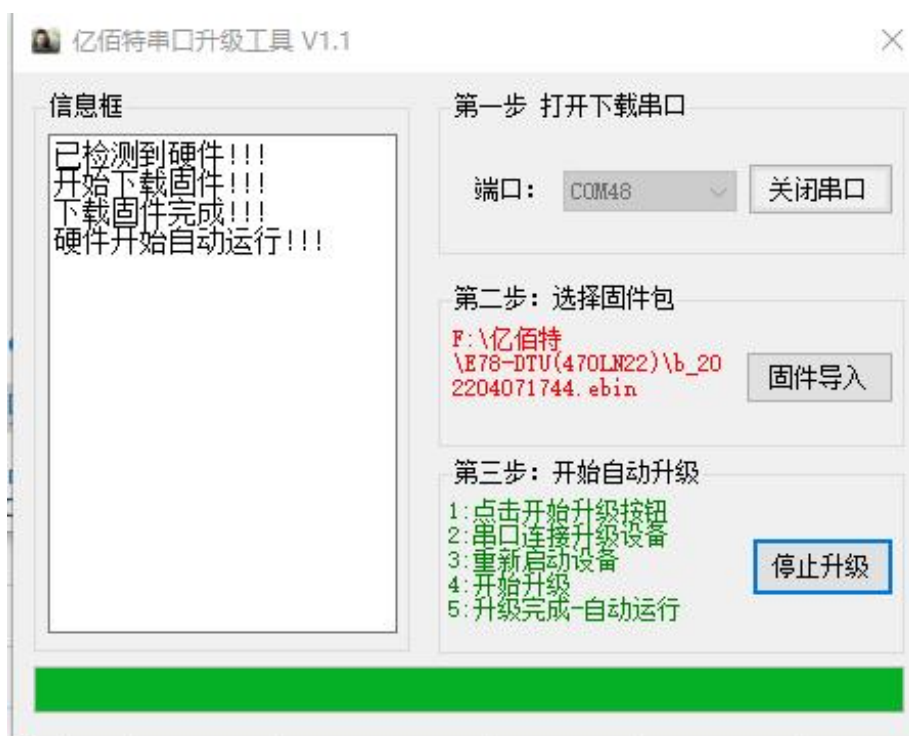
Connect the device to the computer and open the upgrade tool.



Select the corresponding port and open it, select the firmware package to be upgraded, and click to start the upgrade after importing.

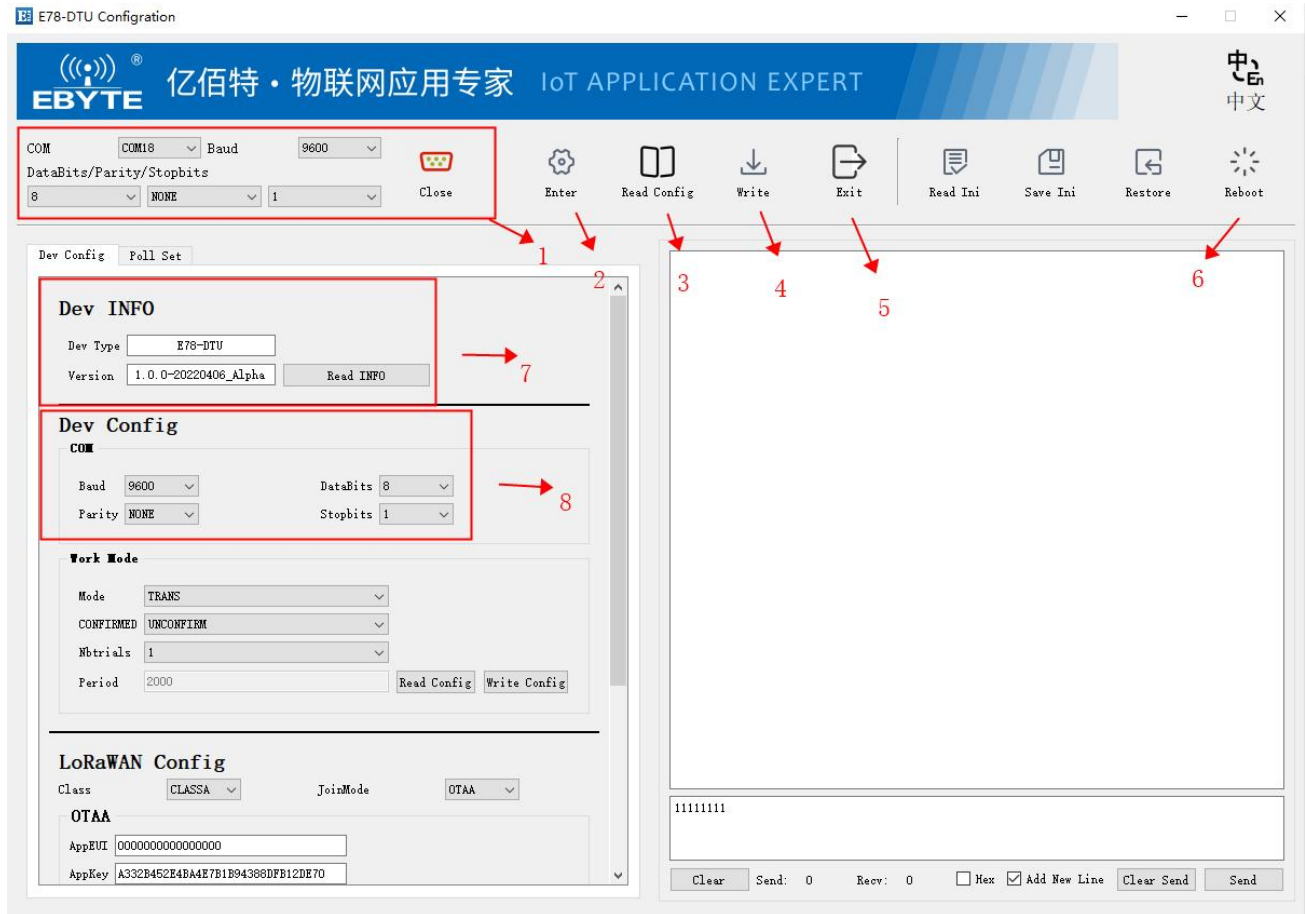


At this time, power on the device that needs to be upgraded, and then it can be upgraded by itself.



8. Host Computer Configuration Instructions

Parameters can be configured through the host computer, as shown in the following figure:



Arrow 1: Select the port corresponding to the device and the baud rate data bit, parity bit, stop bit in this area

Arrow 2: Click to enter the configuration state after selecting the appropriate port information

Arrow 3: After entering the configuration, click to read the device parameters

Arrow 4: After modifying the parameters, click to save the modified configuration

Arrow 5: Click to exit configuration state

Arrow 6: After entering the configuration, click to restart the device

Arrow 7: After entering the configuration, read the parameters to read the model and version information of the device

Arrow 8: After entering the configuration, modify the serial port parameter information of the device in this area, and restart the device after saving the configuration.



Arrow 9: Select the working mode in the drop-down box: TRANS is the transparent transmission mode, POLL is the polling mode

Arrow 10: drop-down box to select whether to confirm the data

Arrow 11: drop-down box to select the number of times to send a single packet of data (1-8)

Arrow 12: Select the CLASS class of the device (CLASSA/CLASSC)

Arrow 13: Select the network access method of the device (OTAA/ABP)

Arrow 14: Enter the network access parameters in OTAA mode in this area

Arrow 15: Enter the network access parameters in ABP mode in this area

Arrow 16: Select DR level or previous ADR (Auto Adjustment Level)

Arrow 17: Select the frequency band (CH0-CH7) under CN470



Arrow 18: Set the polling command number

Arrow 19: Turn on or off a command enable

Arrow 20: Set the command's response timeout (10-3000ms)

Arrow 21: Set the waiting time from executing a complete polling cycle to the next polling cycle (3000-50000ms)

Arrow 22: Input the specific command to be polled in the input box

Arrow 23: Click to add instructions to the buffer

Arrow 24: Select the buffer area command and click the modify command to synchronize the parameters to the setting area

Arrow 25: Set the command sending times

Arrow 26: Select the selected cache area command and click the delete command to delete it

Arrow 27: Click to read the existing instruction of the device to the buffer area

Arrow 28: Click to write the buffer command to the device

Arrow 30: Click to delete device instruction

9. AT Command Configuration Instructions

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)

	two work)
CDEVADDR	Set to read DevAddr (when ABP is connected to the network)
CAPPSKEY	Set to read AppSkey (when ABP is connected to the network)
CNWSKEY	Set to read NwkSkey (when ABP is connected to the network)
CFREQBANDMASK	Set the read frequency mask (FreqBandMask)
CULDLMODE	Set read UI/DI 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
CPASSTHOUGHMODE	Enter transparent transmission mode
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; AT+CADR=1 on, AT+CADR=0 off, the default is on
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=E78-470LN22S 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=V4.4 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, default baud rate 9600 ;	
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	
	Return value description	0: OTAA 1: ABP	
	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=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		

	e description		
	Example	AT+CNWKSKEY=AABBCCDD00112233AABBCCDD00112233 OK	
	Precautions	Use, set or read NwkSKey in ABP, return Y1Y2 ... Y16, hexadecimal format, value 16 bytes.	
CFREQBAND MASK (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, 16 bit corresponds to 16 frequency groups, see LoRaWAN access specification for details.	
	Return value description	For example: 0-7 channel, the corresponding mask is 0001, 8-15 channel corresponding mask is 0002, 16-23 channel corresponding mask is 0004 and so on. The frequency corresponding to the specific channel needs to check the region protocol. For example, the channel 0-7 in CN470 corresponds to: 470.3MHz, 470.5MHz, 470.7MHz, 470.9MHz, 471.1MHz, 471.3MHz, 471.5MHz, 471.7MHz .	
	Example	AT+CFREQBANDMASK=0001 OK	
	Precautions	It needs to be set before Join.	
command characters	Command type	command format	response
CULDLMODE (Set the same)	test command	AT+CULDLMODE=?	+CULDLMODE: " mode " OK

and different frequency of uplink and downlink)	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>:	
	Return value description	0: classA 2: classC	
	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>:	
	Return value description	00 – no data operation 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], ... [ParaValue4] 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;	
	Return value description	[ParaValue1], [ParaValue2],...[ParaValue4]: parameter values of authentication parameters 1, 2,...4;	

	n	<p><ParaTag1>, means to perform JOIN operation, ParaTag1 value range:</p> <p>0 – stop JOIN</p> <p>1 – Start JOIN and restart the JOIN process. For modules with warm restart enabled, executing this operation clears the saved JOIN context parameters.</p> <p>[ParaTag2] Indicates whether to enable the automatic JOIN function. The factory default value is 1, and the value range of ParaTag2:</p> <p>0 – Turn off automatic JOIN</p> <p>1 – Automatic JOIN. After the module enters the transparent transmission mode, JOIN is automatically started.</p> <p>[ParaTag3] represents the JOIN period, the value range: 7~255, the unit is s.</p> <p>Factory default: 8.</p> <p>[ParaTag4] indicates the maximum number of JOIN attempts, the value range of ParaTag4: 1~255</p>	
	Example	<p>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)</p> <p>OK</p> <p>+CJOIN: OK</p>	
	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>,<Payload>

			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+RCV: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	<p>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), 0 means sending empty data packets.</p> <p>Payload: Hexadecimal (2 characters represent 1 number);</p> <p>return value:</p> <p>1. How to judge whether the data transmission is successful?</p> <p>Confirm type data:</p> <p>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</p> <p>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+RCV messages are output.</p> <p>Unconfirm type data:</p> <p>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+RCV message</p>	

		<p>e will be sent again.</p> <p>2. Data sending status prompt</p> <p>OK+SEND:TX_LEN indicates that the data sending request is successful, TX_LEN: 1Byte, the length of the data sent</p> <p>OK+SENT: TX_CNT means that the data is sent successfully, TX_CNT: 1Byte, the number of data sending.</p> <p>ERR+SEND:ERR_NUM indicates that the data sending request failed, and the reason is indicated by ERR_NUM. ERR_NUM: 1Byte,</p> <p>0- Not connected to the network</p> <p>1- Communication is busy, send request failed</p> <p>2- The data length exceeds the current sendable length, only send the MAC command</p> <p>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.</p> <p>OK+RCV:TYPE,PORT,LEN,DATA Data received successfully (response message or active downlink data received)</p> <p>TYPE: 1Byte, downlink transmission type</p> <p>Bit0: 0-unconfirm, 1-confirm</p> <p>Bit1: 0-Not ACK, 1-ACK</p> <p>Bit2: 0-not carried, 1-carried, indicating whether the downlink data carries the LINK command response</p> <p>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</p> <p>Bit4~Bit7: Default 0, reserved</p> <p>PORT: 1Byte, downstream transmission port</p> <p>LEN: 1Byte, downlink data length</p> <p>DATA: nByte, downstream data, when LEN=0, this field does not exist.</p>
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	Example	<p>AT+DTRX=1,2,10,0123456789</p> <p>OK+SEND:03</p> <p>OK+SENT:01</p> <p>OK+RECV:02,01,00</p> <p>means that the confirm data is sent successfully, the valid data received by the server should be " 0123456789 " , and Downstream acknowledgment received.</p>	
	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:	
	Return value description	<p>Length: 0 means empty data packet;</p> <p>Payload: hexadecimal string data;</p> <p>OK: no abnormality in the received data packet;</p>	
	Example	<p>AT+DRX?</p> <p>OK</p>	
	Precautions	Receive data packets from the receive buffer, and clear the receive buffer;	
command characters	Command type	command format	response
CPASSTHOUGHMODE (transparent transmission mode)	test command	AT+CPASSTHOUGHMODE=?	+CPASSTHOUGHMODE:[mode],[confirm],[nbtrials]
	set command	AT+CPASSTHOUGHMODE=[mode],[confirm],[nbtrials]	OK

	Parameter Description	When mode is 1, it enters transparent transmission mode. For confirm and nbtrials, please refer to the corresponding AT command, which is only valid for this transmission, and needs to be reset after exiting.				
	Return value description	OK means to enter the transparent transmission mode.				
		Description of return value in transparent transmission mode:				
		frame header	Status bit 1byte	1byte	1byte	nbyte
		A1 A1	00 (not connected to the network)	\	\	\
			01 (send data)	send length	\	\
			02 (data sending)	\	\	\
			03 (send timeout, unconfirm msg has no such return)	Send timeout	\	\
			04 (successfully sent, the server return value is received, unconfirm msg has no such return)	The port number	Length of received data (when it is 0, no data is sent)	Send data (when the data length is 0, this bit is invalid)
			05 (Exit transparent transmission mode)	\	\	\
	FF (data too long)		\	\	\	
	Example	In AT command mode: AT+CPASSTHOUGHMODE=1,1,8				

		<p>OK</p> <p>In transparent transmission mode (hexadecimal):</p> <p>00 11 22 33 44 55 66 77 88 99</p> <p>A1 A1 01 0A</p> <p>A1 A1 04 02 00 00</p>	
	Precautions	<p>1. The module must be connected to the network before sending data, otherwise the data cannot be sent, and the return value of A 1 A1 00 will be received.</p> <p>2. The module cannot exit the transparent transmission mode while waiting for the server response. It needs to wait for the server response or send timeout before sending +++ (hex: 2B 2B 2B) to exit the transparent transmission mode.</p> <p>3. Before entering the transparent transmission mode, please set AT+CMR=0,10 (use aperiodic reporting), AT+CLINKCHECK=0 (disable network verification).</p>	
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.	
	Return value description	<p>0: UnConfirmed up message</p> <p>1: Confirmed up message</p>	
	Example	<p>AT+CCONFIRM=1</p> <p>OK</p>	
	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. Value range: 1~223; Note: Port: 0x00 is the LoRaWAN MAC command	
	Return value description		
	Example	AT+CAPPPORT=10 OK	
	Precautions	Need to set before sending data	
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.	
	Return value description	<value>: is the maximum sending times, the value range: 1~15;	
	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	<p><value>: Enable Control</p> <p>0 for Link Check – Disable Link Check</p> <p>1 - Execute Link Check once</p> <p>2 - The module automatically carries the linkcheck command in each upstream data packet.</p> <p>Return OK, the setting is successful.</p> <p>If X1=1, after waiting for a period of time, the second response message will be returned, the format is as follows:</p> <p>+CLINKCHECK: Y0, Y1, Y2, Y3, Y4</p> <p>Y0 represents the Link Check result:</p> <p>0 - Indicates that this Link Check was executed successfully</p> <p>Non-0 - Indicates that this Link Check failed to execute</p> <p>Y1 is DemodMargin</p> <p>Y2 is NbGateways</p> <p>Y3 is the RSSI of this downlink</p> <p>Y4 is the SNR of this downlink</p>	
	Return value description		
	Example	<p>AT+CLINKCHECK=1</p> <p>OK</p> <p>+ CLINKCHECK: 0, 0, 1, -68, 8</p>	
	Precautions	Need to set before sending data	
command characters	Command type	command format	response
CADR (Set the number of times to	test command	AT+CADR=?	+CADR:"value" OK
	query command	AT+CADR?	+CADR:<value>

send)	mand		OK
	set command	AT+CADR=<value>	OK
	Parameter Description	<value>: as follows. ADR enable control, the factory value is 1 0 - ADR disabled 1 - ADR enabled	
	Return value description		
	Example	AT+CADR=1 OK	
	Precautions	It needs to be set before sending data. ADR is enabled by default.	
command characters	Command type	command format	response
CRXP (Set receive window parameters)	test command	AT+CRXP=?	+CRXP: " RX1DRoffest " , " RX2DataRate " , " 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		

	e description		
	Example	AT+CRXP=1,1,471000000 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 p	test command	AT+CSAVE=?	+CSAVE OK

parameter settings)	set command	AT+CSAVE	OK
	Parameter Description	<MType>:0:unconfirm packet, 1:confirm packet.	
	Return value description	<value>: is the maximum sending times, the value range: 1~15;	
	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=?	+CRESTORE 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	test command	AT+IREBOOT=?	+IREBOOT:"Mode"

(restart the module)	nd		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 .	

10. Revision History

Version	Date	Description	Issued by
1.1	2020-07-21	Initial version	LM

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