E77-M Series Module User Manual

STM32WLE5 433/868/915MHz LoRaWAN Wireless Module



Chengdu Ebyte Electronic Technology Co.,Ltd.

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1 Product Overview

1.1 Introduction

The E77-M series modules are standard LoRaWAN node modules independently developed and manufactured by Chengdu Ebyte Electronic Technology Co., Ltd. They are fully compatible with LoRaWAN 1.0.3 (EU433/CN470) and 1.0.4 (EU868/US915/AU915/AS923/IN865/KR920/RU864) protocol standards, support Class A/Class C dual-node types, and are compatible with OTAA/ABP dual-network access modes. The modules feature multiple low-power modes and use a standard UART communication interface. Users can quickly connect to the standard LoRaWAN network by completing simple configuration via AT commands, making them a highly reliable and preferred solution for IoT applications. For detailed product selection comparisons, please see Section 2.1 of this document .

1.2 Features and Functions

- Under ideal conditions, with custom-developed minimum airspeed for point-to-point communication , the communication distance can reach 7.5 km @ 30dBm ;
- Under ideal conditions, using LoRaWAN standard firmware, the communication distance can reach 3.5km for E77-400/900M22 and 4.4km @ 30dBm for E77-915M30S ;
- Maximum transmit power can reach 30dBm , and the software is adjustable in multiple levels;
- The E7 7-400M22S supports LoRaWAN 1.0.3 EU433 /CN470 standards;
- The E7 7-900M22S supports LoRaWAN 1.0.4 EU868 /US915/AU915/AS923/IN865/KR920/RU864 standards;
- The E77-915M30S supports LoRaWAN 1.0.4 US915 /AU915 standards;
- Supports both Class A and Class C device types;
- ~12SF spreading factors introduced for dense networks ;
- The external crystal oscillator is a high-precision industrial-grade crystal oscillator of 32.768KHz and 32MHz.
- Small surface-mount packaging facilitates system integration development;
- Industrial-grade standard design, supporting long-term use at temperatures ranging from -40°C to +85°C;
- Dual antennas are optional (IPEX/stamp hole), which facilitates secondary development and integration for users;

1.3 Application scenarios

- Smart home and industrial sensors, etc.;
- Security systems, positioning systems;
- Wireless remote control, drone;
- Wireless game remote control;
- Healthcare products;
- Wireless voice communication, wireless headphones;
- Applications in the automotive industry.

2 Specifications

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2.1 E77-M Series Product Selection Comparison

Product Model	Chip solutions	Carrier frequency Hz	Transmit power dBm	Test distance km	Product dimensions (mm)	Antenna type
E77-400M22S	STM32WLE5CCU6	410 ~ 510M	22	5.6	2 0 * 14	IPEX -1 / Stamp Hole
E77-900M22S	STM32WLE5CCU6	850 ~ 930 M	22	5.6	2 0 * 14	IPEX -1 / Stamp Hole
E77-915M22S	STM32WLE5CCU6	902 ~ 928M	30	7.5	2 6 * 16	IPEX -1 / Stamp Hole

Note:

(1)Carrier frequency ①: Frequency band range can be customized by the user;

(2)Transmit power ②: 22dBm=158mW/30dBm=1000mW, error range ±1dBm, adjustable by software, requires user to develop and set it themselves;

(3)Test distance ③: Transparent transmission protocol (see demo example), clear and open environment, antenna gain 3.5dBi, height 2m (for reference only, actual measurement is recommended);

(4)Antenna type ④: Equivalent impedance approximately 50Ω;

(5)Modules operating on the same frequency band can communicate with each other.

2.2 Basic parameters

Conditions: Tc=25℃, VCC=3.3/5.0V, 433MHz/470MHz/868MHz/915MHz

Parameter	Description
IC stands for IC full name	STM32WLE5CCU6
Kernel	Cortex-M4
FLASH	256 KB
RAM	64 KB
Crystal oscillator frequency	32MHz / 32.768KHz, external temperature-compensated crystal oscillator
Interface	Stamp perforation
Communication interface	UART, comes with LoRaWAN protocol firmware pre-installed.
	UART, SPI, I²C, GPIO, and ADC require user-defined configuration.
Packaging method	SMD
Work environment	
Operating temperature	-40℃~+85℃, industrial grade standard
Operating humidity	10–90% RH, no condensation
Storage temperature	-40℃~+125℃
RF parameters	
Transmit power	22dBm = 158mW, power adjustable in multiple levels , requires user-developed settings, applicable to E7 7-400M22S & E7 7-900M22S modules .
	30dBm = 1000mW, power adjustable in multiple levels, requires user-developed settings, applicable to E7 7-915M30S module .

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Parameter	Description		
Operating frequency band	The E7 7-400M22 supports 410-510MHz.		
	The E7 7-900M22S supports 850–930MHz.		
	The E7 7-915M30S supports 902-928MHz.		
Communication distance	E77-400M22S & E7 7-900M22S	LoRaWAN protocol	3.5km, clear and open environment, antenna gain 3.5dBi, height 2m
		Pass-through protocol	5.6km, clear and open environment, antenna gain 3.5dBi, height 2m
	E77-915M30S	LoRaWAN protocol	4.4km, clear and open environment, antenna gain 3.5dBi, height 2m
		Pass-through protocol	7.5km, clear and open environment, antenna gain 3.5dBi, altitude 2m
Spreading factor	5～12		
Receiver sensitivity	-118 dBm, GFSK, airspeed 1.2 kbps		
Blocking power	10dBm		
Electrical parameters			
Power supply voltage	The voltage range is 1.8 to 3.6V. When the operating voltage is ≥3V, the output power requirement can be met. Operating voltage exceeding 3.6V poses a risk of burnout. Suitable for E7 7-400M22S & E7 7-900M22S modules .		
	The voltage range is 3.3 to 5.5V. When the operating voltage is ≥5V, the output power requirement can be met. Operating voltage exceeding 5.5V poses a risk of burnout. This technology is suitable for the E7 7-915M30S module .		
Communication level	3.3V , using 5.0V TTL requires a level converter.		
Emission current	≈128mA, instantaneous power consumption @22dBm, 3.3V power supply, suitable for E7 7-400M22S & E7 7-900M22S modules		
	≈670mA, instantaneous power consumption @30dBm, 5V power supply, suitable for E7 7-915M30S module		
Received current	≈14mA, suitable for E7 7-400M22S & E7 7-900M22S modules		
	≈21mA, suitable for E7 7-915M30S module		
Dormant current	≈2uA, software shutdown , applicable to E7 7-400M22S & E7 7-900M22S modules		
	≈3uA, software shutdown , applicable to E7 7-915M30S module		

2.3 Parameter Description

- When designing power supply circuits for modules, it is often recommended to retain a margin of more than 30% to ensure long-term stable operation of the entire unit.
- The current required at the moment of launch is relatively large, but because the launch time is extremely short, the total energy consumed may be even smaller.
- When customers use an external antenna, the different impedance matching between the antenna and the module at different frequency points will affect the magnitude of the transmission current to varying degrees.
- The current consumed by an RF chip when it is in pure receiving mode is called the receiving current. Some RF chips with communication protocols or some self-developed protocols have been loaded into the whole device by the developer, which may cause the received current to be too large during testing.
- The shutdown current is often much smaller than the current consumed by the power supply section of the whole machine under no-load conditions, so there is no need to be demanding .

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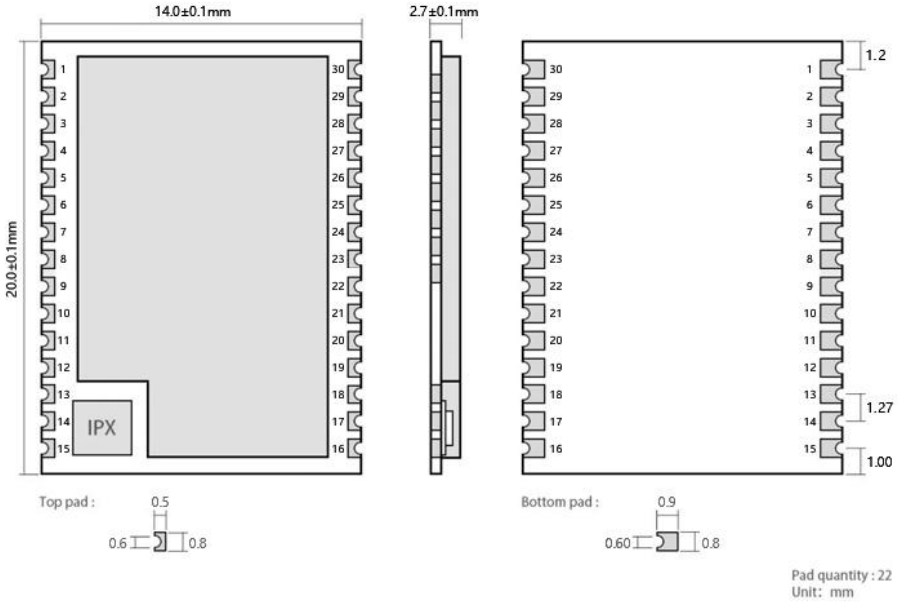
- Due to the inherent error of the materials themselves, a single LRC element has an error of ±0.1%. However, since multiple LRC elements are used in the entire RF circuit, there will be an accumulation of errors, resulting in differences in the transmit current and receive current of different modules.
- Reducing the transmit power can reduce power consumption to some extent, but for many reasons, reducing the transmit power will reduce the efficiency of the internal PA.

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3 Mechanical Dimensions and Pin Definitions

3.1 Pin Definitions and Dimensions of E77-400M22S & E77-900M22S



Pin definitions:

Pin number	Pin Name	Pin direction	Pin Applications
1	PB3	Input/Output	TX_LED, data transmission indicator pin, outputs a high level upon completion of transmission.
2	PB4	Input/Output	RX_LED, receive data indicator pin, outputs high level upon completion of reception.
3	PB5	Input/Output	LINK_LED, network access status indicator pin, outputs a high level when network access is successful.
4	PB6	Input/Output	USART1_TX (Includes unused firmware, reserved)
5	PB7	Input/Output	USART1_RX (Includes unused firmware, reserved)
6	PB8	Input/Output	Configurable general-purpose I/O ports (see STM32WLE5CCU6 manual for details)
7	PA0	Input/Output	The soft boot pin is pulled low for 1 second upon power-on to enter IAP upgrade mode.
8	PA1	Input/Output	Configurable general-purpose I/O ports (see STM32WLE5CCU6 manual for details)
9	PA2	Input/Output	LP_USART 2_TX (AT command serial port transmit pin)
10	PA3	Input/Output	LP_USART 2_RX (AT command serial port receive pin)
11	PA4	Input/Output	Configurable general-purpose I/O ports (see STM32WLE5CCU6 manual for details)
12	PA5	Input/Output	Configurable general-purpose I/O ports (see STM32WLE5CCU6 manual for details)
13	GND	Input/Output	Ground wire, connected to power reference ground
14	ANT	Input/Output	Antenna interface, stamp hole (50 Ω characteristic impedance)
15	GND	Input/Output	Ground wire, connected to power reference ground
16	PA8	Input/Output	Configurable general-purpose I/O ports (see STM32WLE5CCU6 manual for details)
17	NRST	enter	Chip reset trigger input pin, active low (built-in 0.1uF ceramic capacitor)
18	PA9	Input/Output	Configurable general-purpose I/O ports (see STM32WLE5CCU6 manual for details)
19	PA12	Input/Output	Configurable general-purpose I/O ports (see STM32WLE5CCU6 manual for details)
20	PA11	Input/Output	Configurable general-purpose I/O ports (see STM32WLE5CCU6 manual for details)
21	PA10	Input/Output	Configurable general-purpose I/O ports (see STM32WLE5CCU6 manual for details)
22	PB12	Input/Output	Configurable general-purpose I/O ports (see STM32WLE5CCU6 manual for details)
23	PB2	Input/Output	Configurable general-purpose I/O ports (see STM32WLE5CCU6 manual for details)
24	PB0	Input/Output	The passive crystal oscillator version can be configured as a general-purpose I/O port (see the STM32WLE5CCU6 manual for details) . The active crystal oscillator version cannot be used with the hardware; this pin must

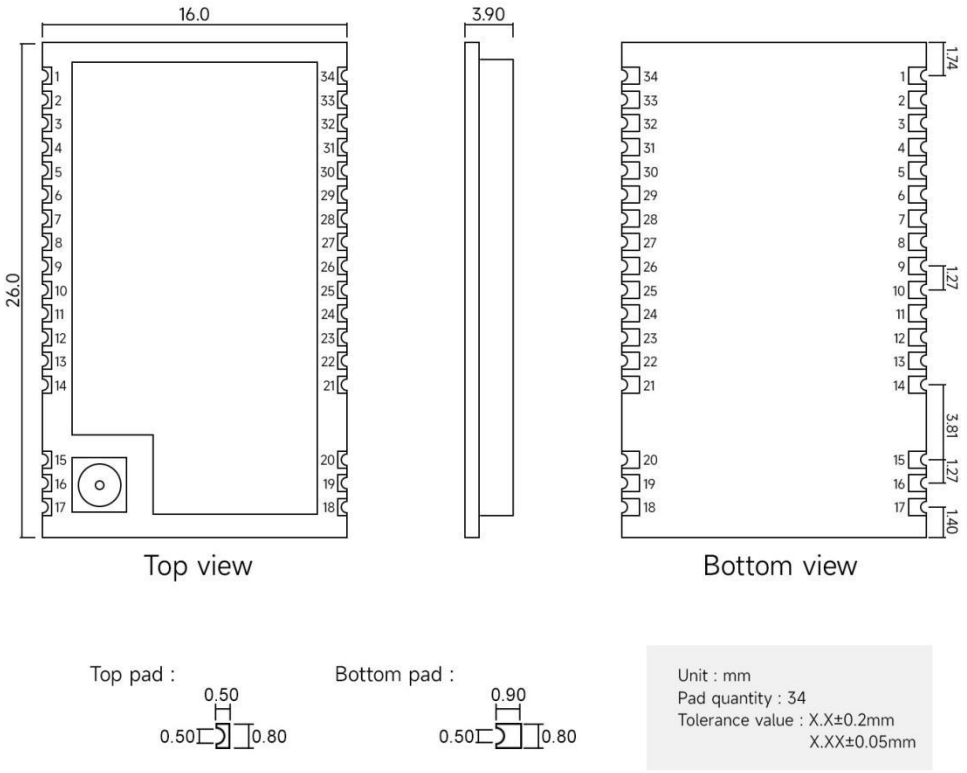
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Pin number	Pin Name	Pin direction	Pin Applications
			be left floating. See Chapter 8 for specific version differentiation methods.
25	PA15	Input/Output	Configurable general-purpose I/O ports (see STM32WLE5CCU6 manual for details)
26	PC13	Input/Output	Configurable general-purpose I/O ports (see STM32WLE5CCU6 manual for details)
27	GND	Output	Ground wire, connected to power reference ground
28	VDD	enter	Power supply range: 1.8 V to 3.6 V (external ceramic filter capacitor recommended).
29	SWDIO	enter	Program Download
30	SWCLK	enter	Program Download

*The pins in red are the pins used by the LoRaWAN firmware that comes with the module;
Note 1: PA6 and PA7 pins are used as internal control RF switches of the module. PA6 = RF_TXEN, PA7 = RF_RXEN. RF_TXEN=1 and RF_RXEN=0 are the transmit channel, and RF_TXEN=0 and RF_RXEN=1 are the receive channel.
Note 2: The PC14-OSC32_IN and PC15-OSC32_OUT pins have a 32.768KHz crystal oscillator connected inside the module for users to choose to use during secondary development.
Note 3: The OSC_IN and OSC_OUT pins have a 32MHz crystal oscillator connected inside the module for users to choose to use during secondary development.

3.2 **E77-915M30S** Pin Definitions and Dimensions



Pin definitions:

Pin number	Pin Name	Pin direction	Pin Applications
1	PB3	Input/Output	TX_LED, data transmission indicator pin, outputs a high level upon completion of transmission.
2	PB4	Input/Output	RX_LED, receive data indicator pin, outputs high level upon completion of reception.
3	PB5	Input/Output	LINK_LED, network access status indicator pin, outputs a high level when network access is successful.
4	PB6	Input/Output	USART1_TX (Includes unused firmware, reserved)
5	PB7	Input/Output	USART1_RX (Includes unused firmware, reserved)
6	PB8	Input/Output	Configurable general-purpose I/O ports (see STM32WLE5CCU6 manual for details)
7	PA0	Input/Output	The soft boot pin is pulled low for 1 second upon power-on to enter IAP upgrade mode.
8	PA1	Input/Output	Configurable general-purpose I/O ports (see STM32WLE5CCU6 manual for details)

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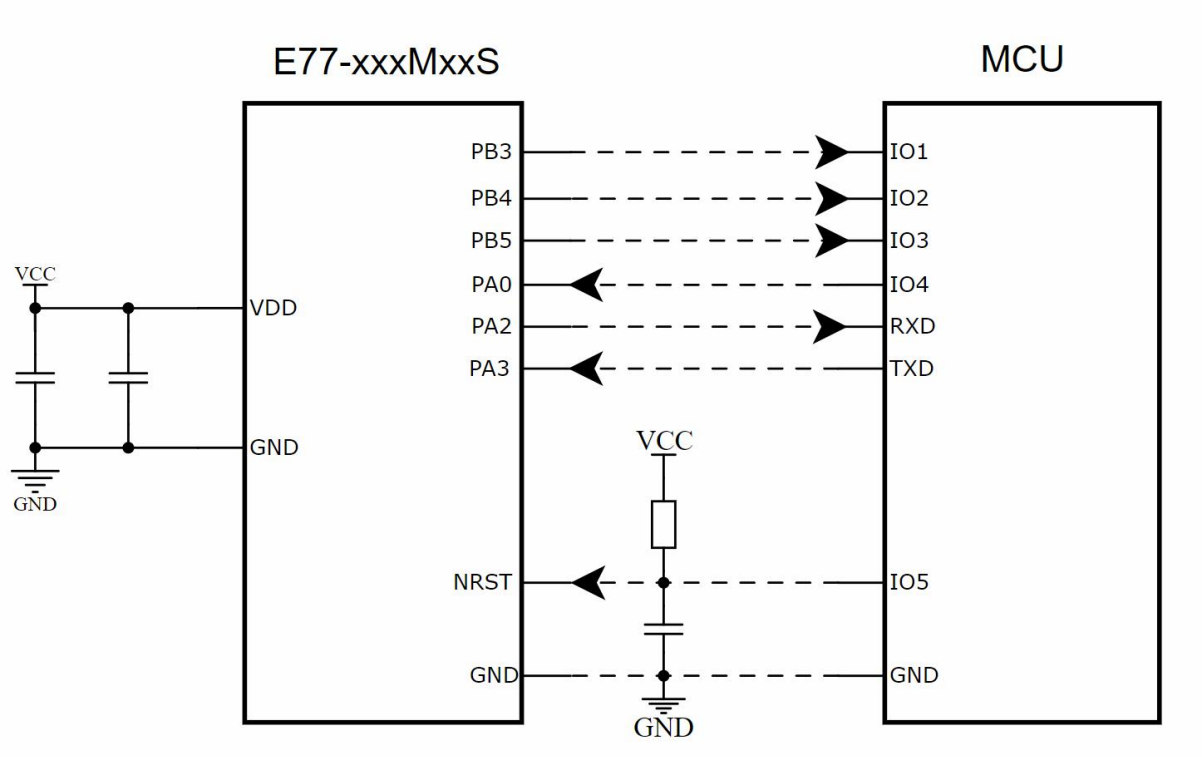
Pin number	Pin Name	Pin direction	Pin Applications
9	PA2	Input/Output	LP_USART 2_TX (AT command serial port transmit pin)
10	PA3	Input/Output	LP_USART 2_RX (AT command serial port receive pin)
11	PA4	Input/Output	Configurable general-purpose I/O ports (see STM32WLE5CCU6 manual for details)
12	PA5	Input/Output	Configurable general-purpose I/O ports (see STM32WLE5CCU6 manual for details)
13	PA8	Input/Output	Configurable general-purpose I/O ports (see STM32WLE5CCU6 manual for details)
14	PA9	Input/Output	Configurable general-purpose I/O ports (see STM32WLE5CCU6 manual for details)
15	GND	Input/Output	Ground wire, connected to power reference ground
16	ANT	Input/Output	Antenna interface, stamp hole (50 Ω characteristic impedance)
17	GND	Input/Output	Ground wire, connected to power reference ground
18	GND	Input/Output	Ground wire, connected to power reference ground
19	GND	Input/Output	Ground wire, connected to power reference ground
20	GND	Input/Output	Ground wire, connected to power reference ground
21	NC	-	-
22	PB2	Input/Output	Configurable general-purpose I/O ports (see STM32WLE5CCU6 manual for details)
23	PB12	Input/Output	Configurable general-purpose I/O ports (see STM32WLE5CCU6 manual for details)
24	PA10	Input/Output	Configurable general-purpose I/O ports (see STM32WLE5CCU6 manual for details)
25	PA11	Input/Output	Configurable general-purpose I/O ports (see STM32WLE5CCU6 manual for details)
26	PA12	Input/Output	Configurable general-purpose I/O ports (see STM32WLE5CCU6 manual for details)
27	GND	Input/Output	Ground wire, connected to power reference ground
28	PA15	Input/Output	Configurable general-purpose I/O ports (see STM32WLE5CCU6 manual for details)
29	PC13	Input/Output	Configurable general-purpose I/O ports (see STM32WLE5CCU6 manual for details)
30	NRST	Input	Chip reset trigger input pin, active low (built-in 0.1uF ceramic capacitor)
31	SWDIO	Input	Program Download
32	SWCLK	Input	Program Download
33	VCC	Input	Power supply range: 3.3 V to 5.5 V (external ceramic filter capacitor recommended).
34	GND	Output	Ground wire, connected to power reference ground

*The pins in red are the pins used by the LoRaWAN firmware that comes with the module;
Note 1: PA6 and PA7 pins are used as internal control RF switches for the module. PA6 = RF_TXEN, PA7 = RF_RXEN. RF_TXEN=1 and RF_RXEN= 1 indicate the transmit channel, RF_TXEN=0 and RF_RXEN=1 indicate the receive channel , and RF_TXEN=0 and RF_RXEN= 0 indicate the off channel.
Note 2: The PC14-OSC32_IN and PC15-OSC32_OUT pins have a 32.768KHz crystal oscillator connected inside the module for users to choose to use during secondary development.
Note 3: The OSC_IN and OSC_OUT pins have a 32MHz crystal oscillator connected inside the module for users to choose to use during secondary development.

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3.3 Recommended connection diagram



*Only applicable to LoRaWAN firmware applications that come pre-installed with the module; users need to define the pin functions themselves for secondary development.

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4 Terms and Definitions

4.1 LoRa

- LoRa is a type of LPWAN communication technology, short for Long Range Radio, which means "long-distance radio" in Chinese.
- The company currently leading this technology is the foreign company Semitech .
- LoRa's main ISM brands are available in globally free frequency bands: 433MHz, 470MHz, 868MHz, 915MHz, etc.
- Features: Low power consumption, long range, low cost.

4.2 LoRaWAN

- The LoRa Alliance is an open, non-profit organization founded in March 2015 by Semtech. The alliance released a low-power wide-area network standard based on an open-source MAC layer protocol: the LoRaWAN protocol standard.
- Network topology: Star topology
- Network components: LoRa module, gateway (or base station), server (including Network Server, Network control, and Application). Server).
- LoRaWAN classifies LoRa nodes into three categories: A, B, and C.
  - Two-way transmission terminal (Class A):

Class A terminals achieve bidirectional transmission by immediately following each uplink with two brief downlink receive windows. The terminals schedule transmission time slots based on their own communication needs, exhibiting minimal variation over random intervals (i.e., the ALOHA protocol). This Class A operation provides applications with the lowest power terminal system, requiring only that the application...

Downlink transmissions from the server occur very quickly after an uplink transmission from the terminal. Any downlink transmissions performed by the server at any other time must wait for the terminal's next uplink transmission.

- Bidirectional transmission terminal (Class B) with designated receive time slots:

Class B devices have more receive slots. In addition to the random receive window of Class A, Class B devices also open additional receive windows at specified times. For a device to open a receive window at a specified time, it needs to receive a time-synchronized beacon from the gateway. This allows the server to know when the device is listening.

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

Class C terminals essentially keep their receive window open, only briefly closing it when sending data. Class C terminals consume more power than Class A and Class B terminals, but they also have the shortest latency when sending data from the server to the terminal.

Note: The E77-400 /900M 22S supports both Class A and Class C device types ;

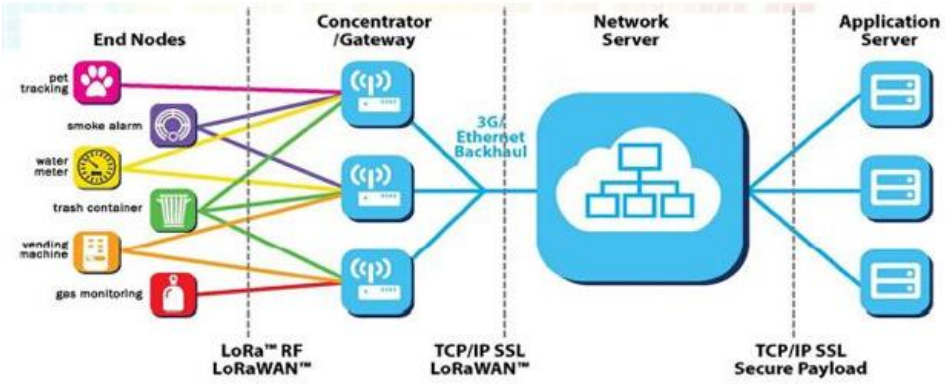
4.3 ADR

ADR stands for Adaptive Data Rate. In the LoRaWAN network system, to maximize the battery life of terminal devices 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, the server automatically updates the node's rate settings based on the node's signal reception capability; the rate is lower for longer distances and higher for shorter distances. This maximizes the network's effective bandwidth and load capacity in practical applications.

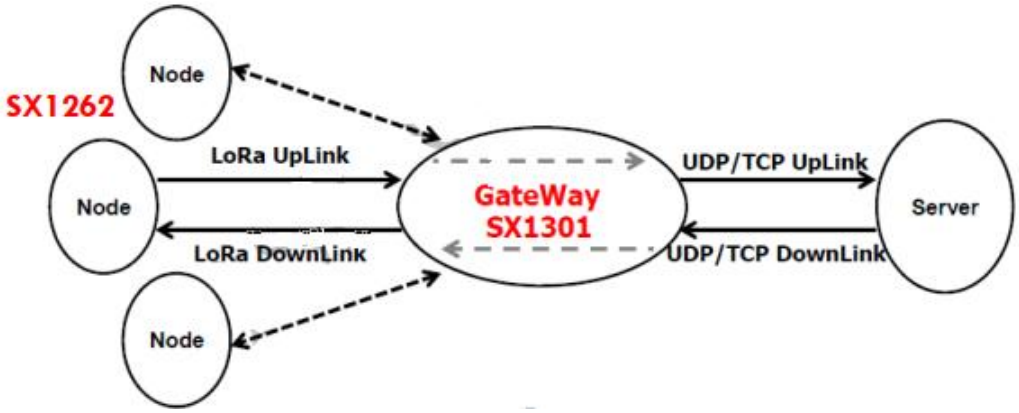
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5 LoRaWan Application Model Diagram



A complete LoRaWAN network system consists of nodes, gateways, a LoRa Network Server, and an application server. Nodes are generally designed using LoRa chips; gateways are designed using the SX1301 provided by Semtech; LoRa Network Servers are currently available in the industry as either open-source loraserver or commercial TTN (The ThingsNetwork), which users can build themselves; application servers are custom-designed and developed by users and are mainly used for exchanging application data with the LoRa Network Server.



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6 Access Demonstration

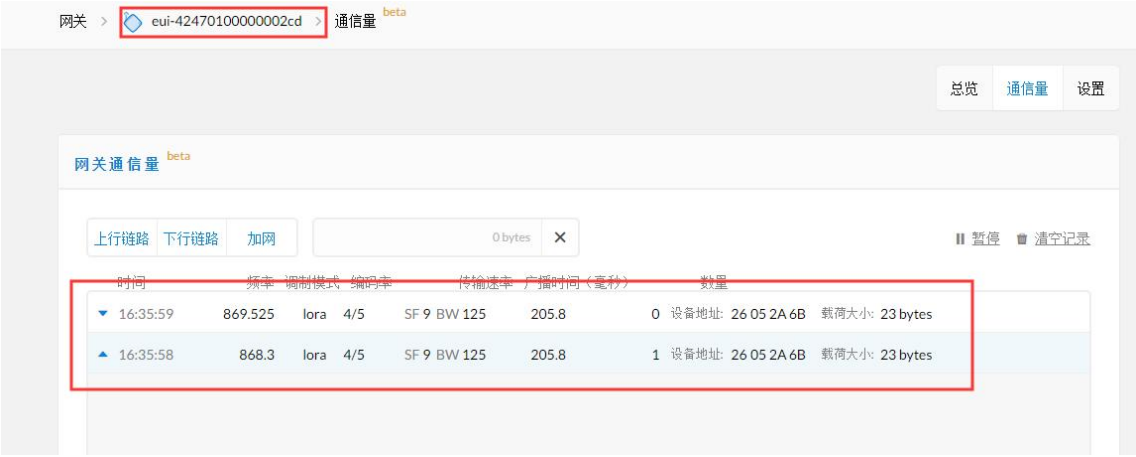
The demonstration kit consists of an E7 7-900M22S as a node and an E890 as a gateway to connect to the free TTN (TheThingsNetwork) test server for communication testing; the serial port uses pins 9 and 10, LP_USART2_TX , with a baud rate of 9600bps 8N1.

Demonstration 1: The corresponding settings for OTAA access method on the node are shown below:

- AT+RESTORE //Restore default configuration
- AT+REGION=5 //eu868 band
- AT+CDEVEUI=70B3D57ED0063EC9 //Set DEVEUI
- AT+CAPPEUI=0000000 0 00000000 //Set appeui
- AT+CAPPKEY=20000000000000000000000000000001 //Set appkey
- AT+ C JOIN=1 :0 //otaa Network access, automatically connects to the network without powering on.
- On the TTN, the gateway information is as follows:



- The gateway data is shown below:



- The TTN node data records are shown below:

AT+SEND=3:1: 1: 112233 // Send data Parameter 1: Port number Parameter 2: Maximum number of retransmissions Parameter 3: ACK response Parameter 4: Hex data.

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Node serial port:

Demonstration 2: ABP Mode Access:

- ABP mode allows local network access without requesting a server; simply configure the corresponding key to send data directly.
- AT+CDEVADDR=26:0D:D8:F9 //Set ABP mode address
- AT+CNWKSKEY=30EB77C7BC41A36BE9E751CBCA302577 //Set NWKSKEY
- AT+CAPPKEYSKEY=0587608A7FCC551B2784B17EFA49B962 //Set APPKSKEY
- AT+CJOIN=0:0 //abp local network access
- AT+SEND=3:1:1:112233 // Port number 3, send if there is an acknowledgment, retransmission count 1, data 0x11, 0x22, 0x33

```
[2025-03-21 15:18:35.858]
TX: AT+SEND=3:1:1:112233

[2025-03-21 15:18:35.950]
RX:
OK

[2025-03-21 15:18:41.126]
RX:
OK+SENT:01
+EVT:SEND_CONFIRMED
+EVT:RX_1, PORT 0, DR 5, RSSI -58, SNR 10
```

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

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7 AT Commands

7.1 Command Format

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

Command prefix

CMD: Control Command Line

[op]: Instruction operator. It can be one of the following:

- ✓ "=": indicates parameter settings.
- ✓ "?": Indicates the parameters of the query setting command .
- ✓ “”: indicates that the instruction is executed.
- ✓ "=?": indicates the current value of the query parameter.

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

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

7.2 AT Command Set

Command	Explanation (General Commands)
AT	Test command
AT+VER	Read lorawan version information
AT+FWCODE	Read software code
AT+DEVTYPE	Read device model
AT+LOGLEVEL	Set log level
AT+UART	Set the serial port baud rate and parity.
AT+IAP	IAP upgrade
AT+LTIME	Get local time
AT+RESTORE	Restore default parameters
AT+CSAVE	Save current parameters
AT+RST	Command reset
AT+BAT	Check battery level
AT+REGION	Set region options
AT+CCLASS	Set device type
AT+DUTYCYCLE	Set whether to enable duty cycle.
AT+CTXP	Set transmit power
AT+CAPPEUI	Configure APPEUI (for OTAA network access)
AT+CDEVEUI	Configure DEVEUI (for OTAA network access)
AT+CAPPKEY	Set APPKEY (for OTAA network access)
AT+CNWKSKEY	Configure NWKSKEY (for ABP network access)
AT+CAPPSKEY	Set APPSKEY (for ABP network access)
AT+CDEVADDR	Configure DEVADDR (for ABP network access)
AT+CJOIN	Network access
AT+SEND	Send data
AT+CNWKID	Set port number
AT+LINKC	Query link status
AT+CFREQBANDMASK	Set the channel mask
AT+CMANUALMASK	Enable manual mask setting.
AT+CADR	Set airspeed adaptive
AT+CDATARATE	Set airspeed
AT+CJN1DL	Set network access time (rx1)
AT+CJN2DL	Set network access time (RX2)
AT+CRX1DL	Set rx1 time
AT+CRX2DL	Set rx2 time

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Command	Explanation (General Commands)
AT+CRX2DR	Set RX2 airspeed
AT+CRX2FQ	Set the rx2 receiving frequency
AT +CADDMULC	Add multicast
AT+CRMVMULC	Deleting multicast
AT+CLSTMULC	Query multicast
AT+CADDCHANNEL	Manually add channels
AT+CRMVCHANNEL	Manually delete channel
AT+CLSTCHANNEL	Query currently enabled channels
AT+AS923_BAND	Configure AS923 sub-band
AT+RANDOMDEVNOCE	Enable devnoce compatibility mode

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7.3 AT Command Description

Command characters	Command type	Command format	Response
AT (Test)	Execute instructions	AT	OK
	Example	AT OK	
	illustrate	Test if AT commands are working correctly	
command characters	Command type	command format	response
VER (Reads protocol-related information)	Test command	AT+VER?	AT+VER Get the FW version
	Query command	AT+VER= ?	APPLICATION_VERSION: <version> L2_SPEC_VERSION: <version> RP_SPEC_VERSION: <version>
	Parameter Description	APPLICATION_VERSION: SDK version number L2_SPEC_VERSION: lorawan version RP_SPEC_VERSION: Lorawan regional version	
	Return value description		
	Example	AT+ VER= ? APPLICATION_VERSION: V1.3.0 L2_SPEC_VERSION: V1.0.4 RP_SPEC_VERSION: V2-1.0.1 OK	
	Precautions	-	
command characters	Command type	command format	response
FWCODE (Reading software code)	Test command	AT+FWCODE?	AT+FWCODE Get firmware code OK
	Query command	AT+ FWCODE= ?	FWCODE = <code> OK
	Parameter Description	<code> : Software coding	
	Return value description		
	Example	AT+ FWCODE= ? FWCODE=748 3 -1-10 OK	
	Precautions	-	

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command characters	Command type	command format	response
DEVTYPE (Read device model)	Test command	AT+DEVTYPE?	AT+DEVTYPE Get Device type
	Query command	AT+ DEVTYPE= ?	DEVTYPE = <type> OK
	Parameter Description	<type> : Equipment Model	
	Return value description		
	Example	AT+ DEVTYPE= ? DEVTYPE=E7 7 - 400M 22S OK	
	Precautions	-	
command characters	Command type	command format	response
LOGLEVEL (Set log level)	Test command	AT+LOGLEVEL?	AT+LOGLEVEL=<Level><CR>. Set the log Verbose Level=[0:Off , 1 : On] OK
	Query command	AT+LOGLEVEL=?	<Level> OK
	Setting commands	AT+LOGLEVEL =<Level>	OK
	Parameter Description	<Level> : Log level Range: 0-1, 0 off, 1 on	
	Return value description		
	Example	AT+LOGLEVEL= 1 OK AT+LOGLEVEL=? 1 OK	
	Precautions	Default level 0, no data saved upon power failure.	
command characters	Command type	command format	response
UART (Set baud rate)	Test command	AT+UART?	AT+UART=<baud> : <parity>. Get or Set Uart baud and parity OK
	Query command	AT+UART=?	<baud> : <parity> OK

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	Setting commands	AT+UART= <baud> : <parity>	OK
	Parameter Description	<baud> : Baud rate [0-2] 0:2400 1:4800 2: 9600 <parity> : Parity bit [0-2] 0 : 8N1 1:8E1 2: 8O1	
	Return value description		
	Example	AT+UART=2:0 OK AT+UART=? 2:0 OK	
	Precautions	Re-powering on	
command characters	Command type	command format	response
IAP (Online upgrade)	Test command	AT+ IAP?	AT+IAP IAP Upgrade OK
	Execute command	AT+IAP	AT+IAP=OK
	Parameter Description	-	
	Return value description		
	Example	AT+ IAP AT+IAP = OK C C C	
	Precautions	This command is not required for user IAP upgrades; use our accompanying upgrade host machine to send it.	
command characters	Command type	command format	response
LTIME (Get local time)	Test command	AT+LTIME?	AT+LTIME Get the local time in UTC format OK
	Query command	AT+ LTIME= ?	LTIME:<h><m><s>on day/month/year/ OK
	Parameter Description	h: hours m: minutes s: seconds	
	Return value		

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	description		
	Example	AT+ LTIME = ? LTIME:00h00m00s on 01/01/1970 OK	
	Precautions	Each power-on begins at 00h00m00s on January 1, 1970.	
command characters	Command type	command format	response
RESTORE (Restore default configuration)	Test command	AT+ RESTORE?	AT+RESTORE: Restore EEPROM Factory Settings OK
	Execute command	AT+ RESTORE	OK
	Parameter Description	-	
	Return value description		
	Example	AT+ RESTORE OK	
	Precautions	-	
command characters	Command type	command format	response
CSAVE (Save parameters)	Test command	AT+CSAVE?	AT+CSAVE: Store current context to EEPROM OK
	Execute command	AT+CSAVE	NVM DATA STORED OK
	Parameter Description	-	
	Return value description		
	Example	AT+CSAVE NVM DATA STORED OK	
	Precautions	-	
command characters	Command type	command format	response
AT+RST (Restart module)	Test command	AT+ RST ?	AT+ RST Trig a MCU reset OK
	Setting commands	AT+ RST	OK
	Parameter Description	-	
	Return value description		

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	Example	AT+ RST OK	
	Precautions	After receiving the command, the communication module replies "OK" and then restarts. It will not receive any further messages until the restart is complete. AT commands.	
command characters	Command type	command format	response
BAT (Battery level)	Test command	AT+BAT?	AT+BAT Get the battery Level in mV OK
	Query command	AT+BAT=?	<value>
	Parameter Description	<value>: Current supply voltage, in mV	
	Return value description		
	Example	AT+BAT=? 3300 OK	
	Precautions	-	
command characters	Command type	command format	response
REGION (Set the operating frequency band)	Test command	AT+ REGION ?	AT+REGION=<BandID><CR>. Get or Set the Active Region BandID=[0:AS923, 1:AU915, 2:CN470, 4:EU433, 5:EU868, 6:KR920, 7:IN865, 8:US915, 9:RU864] OK
	Query command	AT+ REGION= ?	<region> OK
	Setting commands	AT+ REGION=<region>	OK
	Parameter Description	<region> ： Regional Standards 0:AS923 1:AU915 2:CN470 4:EU433 5:EU868 6:KR920 7:IN865 8:US915	
	Return value description		

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		9:RU864	
	Example	AT+REGION=? 5:EU868 OK AT+REGION=5 OK	
	Precautions	Before joining, you need to configure the settings . Before switching regions, use AT+RESTORE to restore the default configuration. The E77-915M30S only supports AU195 and US915 (these two bands meet the protocol requirements at 30dBm).	
command characters	Command type	command format	response
CCLASS (Set Class)	Test command	AT+CCLASS?	AT+CCLASS=<Class><CR>. Get or Set the Device Class=[A, C] OK
	Query command	AT+CCLASS = ?	+CCLASS:<class> OK
	Setting commands	AT+CCLASS=<class>	OK
	Parameter Description Return value description	<class>: In Class A mode, receiving only opens a window after sending. C, Class C mode, receive is always enabled.	
	Example	AT+CCLASS= C +EVT:SWITCH_TO_CLASS_C OK //Not connected to the network AT+CCLASS=C AT_NO_NETWORK_JOINED	
	Precautions	All network access is CLASS A. To switch to CLASS C, you need to do so after network access; otherwise, an error will occur.	
command characters	Command type	command format	response
DUTYCYCLE (Set duty cycle)	Test command	AT+DUTYCYCLE?	AT+DUTYCYCLE=<DutyCycle><CR>. Get or Set the ETSI DutyCycle=[0:disable, 1:enable] - Only for testing
	Query command	AT+DUTYCYCLE = ?	<DutyCycle> OK

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	Setting commands	AT+DUTYCYCLE = <DutyCycle>	OK
	Parameter Description	<DutyCycle> 0: Turn off ETSI duty cycle 1: Enable ETSI duty cycle	
	Return value description		
	Example	AT+DUTYCYCLE = 0 OK	
	Precautions	After DCS is activated, the data transmission frequency follows the Lorawan protocol standard, with a duty cycle typically of 1%. After transmitting one data packet at low airspeed, there is a relatively long wait before the next packet can be transmitted.	
command characters	Command type	command format	response
CTXP (Set transmit power)	Test command	AT+CTXP?	+CTXP: “ value ” OK
	Query command	AT+CTXP = ?	+CTXP:<value> OK
	Setting commands	AT+CTXP=<value>	OK
	Parameter Description	<value>: This represents the transmission power. The factory default value is 0. The maximum power varies depending on the regional standard.	
	Return value description	0 - 17dBm 1 - 15dBm 2 - 13dBm 3 - 11dBm 4 - 9dBm 5 - 7dBm 6 - 5dBm 7 - 3dBm	
	Example	AT+CTXP=1 OK	
	Notice	The power rating here is based on the CN470 standard; it may vary by region, see Appendix 2.	
command characters	Command type	command format	response
CAPPEUI (**Setting up AppEUI**)	Test command	AT+CAPPEUI?	AT+CAPPEUI=<XXXXXXXXXXXXXXXX><CR>. Get or Set the App Eui
	Query command	AT+CAPPEUI = ?	<appeui> OK
	Setting commands	AT+CAPPEUI = <appeui>	OK
	Parameter	<appeui> : Node AppEUI	

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	Description	8 bytes long, hexadecimal format	
	Return value description		
	Example	AT+CAPPEUI=AABBCCDD00112233 OK	
	Precautions	Parameters are automatically saved after network access.	
command characters	Command type	command format	response
CDEVEUI (Setting up DEVEUI)	Test command	AT+CDEVEUI?	AT+CDEVEUI=<XXXXXXXXXXXXXXXX><CR> . Get or Set the Device EUI OK
	Query command	AT+CDEVEUI = ?	+CDEVEUI:< deveui > OK
	Setting commands	AT+CDEVEUI = <deveui>	OK
	Parameter Description	<devui> : Node DevEUI 8 bytes long, hexadecimal format	
	Return value description		
	Example	AT+CDEVEUI? +CDEVEUI=AABBCCDD00112233 OK	
	Precautions	The current parameters will be automatically saved after joining the network.	
command characters	Command type	command format	response
CAPPKEY (**Set AppKey**)	Test command	AT+CAPPKEY?	AT+CAPPKEY=<XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX><CR>: Get or Set the Application Key OK
	Query command	AT+CAPPKEY = ?	<APPKEY> OK
	Setting commands	AT+CAPPKEY = <APPKEY>	OK
	Parameter Description	<APPKEY> : Node APPKEY 16 bytes long, hexadecimal format	
	Return value description		
	Example	AT+CAPPKEY= 20000000000000000000000000000001 OK	
	Precautions	The current parameters will be automatically saved after joining the network.	
command characters	Command type	command format	response
CDEVADDR	Test	AT+CDEVADDR?	AT+CDEVADDR=<XX : XX : XX : XX><CR>. Get

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(**Set DevAddr**)	command		or Set the Device address OK
	Query command	AT+CDEVADDR = ?	CDEVADDR : <DEVADDR> OK
	Setting commands	AT+CDEVADDR = <DEVADDR>	OK
	Parameter Description	<DEVADDR> : Node DevAddr 4 bytes long, hexadecimal format	
	Return value description		
	Example	AT+CDEVADDR=00 : 11 : 22 : 33 OK	
	Precautions	Used during ABP, the current parameters will be automatically saved after network access.	
command characters	Command type	command format	response
CAPPSKEY (Set **AppSKey**)	Test command	AT+CAPPSKEY?	AT+CAPPSKEY=<XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX><CR>: Get or Set the Application Session Key OK OK
	Query command	AT+CAPPSKEY =?	<appskey> OK
	Setting commands	AT+CAPPSKEY = <appskey>	OK
	Parameter Description	<appskey> : Node AppSKey 16 bytes long, hexadecimal format	
	Return value description		
	Example	AT+CAPPSKEY= 20000000000000000000000000000001 OK	
	Precautions	Used during ABP, the current parameters will be automatically saved after network access.	
command characters	Command type	command format	response
CNWKSKEY (**Set NwkSKey**)	Test command	AT+CNWKSKEY?	AT+CNWKSKEY=<XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX><CR>: Get or Set the Network Session Key OK
	Query command	AT+CNWKSKEY = ?	< nwkskey > OK
	Setting	AT+CNWKSKEY =	OK

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	commands	<nwkskey>	
	Parameter Description	<nwkskey> : Node NwkSKey 16 bytes long, hexadecimal format	
	Return value description		
	Example	AT+CNWKSKEY= 20000000000000000000000000000001 OK	
	Precautions	Used during ABP, the current parameters will be automatically saved after network access.	
command characters	Command type	command format	response
CNWKID (Set Network ID)	Test command	AT+CNWKID?	AT+CNWKID=<NwkID><CR>. Get or Set the Network ID=[0..127] OK
	Query command	AT+CNWKID = ?	<nwkid> OK
	Setting commands	AT+CNWKID =<nwkid>	OK
	Parameter Description	<nwkid>: Network ID	
	Return value description		
	Example	AT+CNWKID = ? 0 OK	
	Precautions	No settings are required.	
command characters	Command type	command format	response
CMANUALMASK (Enable manual mask setting)	Test command	AT+ CMANUALMASK ?	AT+CMANUALMASK Set/get Manual channel frequency band mask OK
	Query command	AT+ CMANUALMASK = ?	<>
	Setting commands	AT+ CMANUALMASK=<value>	
	Parameter Description	<value> : 0 (default) Disables manual masking . 1. Enable manual masking	
	Return value description		
	Example	AT+ CMANUALMASK = 1 OK	

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	Precautions	When manual masking is not enabled, the subnet mask will be automatically synchronized to the server-configured subnet mask during network access or airspeed adaptive switching.	
command characters	Command type	command format	response
CFREQBAND MASK (Set mask)	Test command	AT+CFREQBANDMASK?	AT+CFREQBANDMASK Set channel frequency band mask
	Query command	AT+CFREQBANDMASK = ?	<mask 0 > :<mask1>: <mask 2 > :<mask3>: <mask 4 > :<mask5> OK
	Setting commands	AT+CFREQBANDMASK=< mask 0 > :<mask1>: <mask 2 > :<mask3>: <mask 4 > :<mask5>	OK
	Parameter Description	<mask>: The frequency mask that the network may operate on. One mask represents 16 channels , and mask0 represents the lower 16 channels. See the LoRaWAN access specification for details. Only CN470, AU915, and US915 require configuration.	
	Return value description		
	Example	AT+CFREQBANDMASK= 0007 : 0000 : 0000 : 0000 : 0000 : 0000 OK	
command characters	Command type	command format	response
CJOIN (Set up Join)	Test command	AT+CJOI N ?	AT+CJOIN=<Mode>:<autojoin><CR>. Join network with Mode=[0:ABP, 1:OTAA] OK
	Setting commands	AT+CJOIN= <mode>:<auto_join>	If the input is valid, first return OK, then start automatic verification. Return the authentication result. +EVT:JOINED Authentication successful +EVT:JOIN FAILED Authentication failed
	Parameter Description	<mode>: Network access mode 0: ABP mode. This mode does not actually require network access; executing this command simply switches the local state. 1: OTAA mode, over-the-air network access <auto_join>: Whether to automatically join the network upon power-on.	
	Return value description		
	Example	AT+CJOIN = 1:0 OK +EVT:JOINED	
command characters	Command type	command format	response
SEND (**Send data**)	Test command	AT+ SEND ?	AT+SEND=<Port>:<Ack>:<Payload><CR>. Send binary data with the application Port=[1..199] and Ack=[0:unconfirmed, 1:confirmed]

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			OK
	Setting commands	AT+SEND=<Port>: <Nbtarns>: <Ack>:<Payload><CR>	+EVT:SEND_CONFIRMED +EVT:RX_1, PORT 0, DR 3, RSSI -49, SNR 10 AT_NO_NETWORK_JOINED AT_DUTYCYCLE_RESTRICTED
	Parameter Description	<Port> : Port number <Nbtarns>: Maximum number of retransmissions when ACK is available. <Ack> : Whether to enable answering <Payload> : Hexadecimal data, two bits constitute one byte	
	Return value description		
	Example	AT+SEND=3:1: 1: 112233 + EVT:SEND_CONFIRMED +EVT:RX_1, PORT 0, DR 3, RSSI -47, SNR 11	
	Precautions	First join the network, then send data.	
command characters	Command type	command format	response
CADR (Set rate to adaptive)	Test command	AT+CADR?	AT+CADR=<ADR><CR>. Get or Set the Adaptive Data Rate setting ADR=[0:off, 1:on] OK
	Query command	AT+CADR=?	+CADR: <value> OK
	Setting commands	AT+CADR=<value>	OK
	Parameter Description	<value>: as follows: 0: Disable ADR 1: Enable ADR	
	Return value description		
	Example		
	Precautions	Enabled by default	
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
	Setting commands	AT+CDATARATE =<value>	OK
	Parameter Description	<value>: as follows: Rate value, factory default value, range of values:	

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	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	Before sending data, you need to configure it so that ADR is disabled after being enabled . That is, you need to set AT+CADR=0 before you can configure the rate. The airspeed value range may vary in different regions, see Appendix 1.	
command characters	Command type	command format	response
LINK C (**Verify network connectivity**)	Test command	AT+LINK C ?	AT+LINKC. Piggyback a Link Check Request to the next uplink
	Execute command	AT+LINK C	OK
	Parameter Description	-	
	Return value description		
	Example	AT+LINK C OK	
	Precautions	After executing this command, the server will send a response message on the next uplink.	
command characters	Command type	command format	response
CJN1DL (Set the network access RX1 window delay)	Test command	AT+CJN1DL?	AT+CJN1DL= <Delay> <CR>. Get or Set the Join Accept Delay between the end of the Tx and the Join Rx Window 1 in ms
	Query command	AT+CJN1DL = ?	<Delay> OK
	Setting commands	AT+CJN1DL=<Delay>	OK
	Parameter Description	<Delay> Gets or sets the Join-Accept Delay (milliseconds) between the end of Tx and Join-Rx window 1.	
	Return value description		
	Example	AT+CJN1DL= 1000	
	Notice		
command characters	Command type	command format	response

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CJN2DL (Setting the network access RX2 window delay)	Test command	AT+CJN2DL?	AT+CJN 2 DL=<Delay><CR>. Get or Set the Join Accept Delay between the end of the Tx and the Join Rx Window 2 in ms
	Query command	AT+CJN2DL = ?	<Delay> OK
	Setting commands	AT+CJN 2 DL=<Delay>	OK
	Parameter Description	<Delay> Gets or sets the Join-Accept Delay (milliseconds) between the end of Tx and Join-Rx window 2.	
	Return value description		
	Example	AT+CJN 2 DL= 2000	
	Notice	Rx2_delay = rx1_delay + 1000 ms	
command characters	Command type	command format	response
CRX1DL (Setting RX1 window delay)	Test command	AT+ CRX1DL ?	AT+CRX1DL=<Delay><CR>. Get or Set the delay between the end of the Tx and the Rx Window 1 in ms
	Query command	AT+ CRX1DL = ?	<Delay> OK
	Setting commands	AT+ CRX1DL =<Delay>	OK
	Parameter Description	<Delay> Gets or sets the delay between the end of Tx and window 1 of Rx, in milliseconds.	
	Return value description		
	Example	AT+ CRX1DL = 2000	
	Notice	No configuration is needed; the module will automatically synchronize if it's configured on the server.	
command characters	Command type	command format	response
CRX2DL (Setting RX2 window delay)	Test command	AT+ CRX2DL ?	AT+CRX1DL=<Delay><CR>. Get or Set the delay between the end of the Tx and the Rx Window 2 in ms
	Query command	AT+ CRX2DL = ?	<Delay> OK
	Setting commands	AT+ CRX2DL = <Delay>	OK
	Parameter Description	<Delay> Gets or sets the delay between the end of Tx and window 2 of Rx, in milliseconds.	
	Return value description		

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	Example	AT+ CRX2DL = 3000	
	Notice	No configuration is needed; the module will automatically synchronize if it's configured on the server. Rx2_delay = rx1_delay + 1000 ms	
command characters	Command type	command format	
CRX2DR (Setting the RX2 receiver airspeed)	Test command	AT+ CRX2DR ?	
	Query command	AT+ CRX2DR = ?	
	Setting commands	AT + CRX2DR = <DR>	
	Parameter Description	<D R > rx2 receive airspeed	
	Return value description		
	Example	AT+ CRX2 = 2	
	Notice	Refer to the appendix for airspeed indicator settings; exceeding the range will result in an error.	
command characters	Command type	command format	response
CRX2FQ (Set the frequency of receive window 2)	Test command	AT+ CRX2FQ ?	AT+CRX2FQ=<Freq><CR>. Get or Set the Rx2 window Freq in Hz OK
	Query command	AT+ CRX2FQ = ?	<Freq> OK
	Setting commands	AT+ CRX2FQ= <Freq>	
	Parameter Description	<Freq> , the frequency of the second receive window.	
	Return value description		
	Example	AT+ CRX2FQ = 869525000	
command characters	Command type	command format	response
CADDMULC (Add multicast)	Test command	AT+CADDMULC?	AT+CADDMULC add a new multicast group OK
	Query command	-	-

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	Setting commands	AT+CADDMULC= <id>, <addr>,<nwkskey>,<appskey >,<frequency>,<datarate>	OK
	Parameter Description	<id>: Multicast IDs 0-3, a total of four groups. <addr>: Multicast address <nwkskey>: multicast nwkskey <appskey>: multicast appskey <frequency>: Multicast receive frequency <datarare> : Multicast airspeed	
	Return value description		
	Example	AT+CADDMULC=0,ad372503,73b091d0ffa6c2d92c11bc9f6947668b,91f35f7637b4503035878840c0e690c0,505300000,02 OK	
	Precautions	When joining the network, parameters can be automatically saved or saved using commands. Note that the multicast receiving frequency must correspond to the selected regional protocol. When using four multicast groups together, the receiving frequency and receiving airspeed must be the same.	
command characters	Command type	command format	response
CLSTMULC (Query Multicast)	Test command	AT+CLSTMULC?	AT+CLSTMULC view multicast group information OK
	Query command	AT+CLSTMULC = ?	<id0>: <addr 0 > : <nwksey> : <appskey> : <frequency> : <datarate> ,<id1>: <addr 1 > : <nwksey> : <appskey> : <frequency> : <datarate> ,<id2>: <addr 2 > : <nwksey> : <appskey> : <frequency> : <datarate> ,<id3>: <addr 3 > : <nwksey> : <appskey> : <frequency> : <datarate>
	Setting commands	-	-
	Parameter Description	<id>: Multicast IDs 0-3, a total of four groups. <addr>: Multicast address <nwkskey>: multicast nwkskey <appskey>: multicast appskey <frequency>: Multicast receive frequency <datarare> : Multicast airspeed	
	Return value description		
	Example	AT+CLSTMULC=? AD372503:73B091D0FFA6C2D92C11BC9F6947668B:91F35F7637B4503035878840C0E690C0:505300000:02 ,00000000:00000000000000000000000000000000:00000000000000000000000000000000:000000000:00 ,00000000:00000000000000000000000000000000:00000000000000000000000000000000:000000000:00,0000000:00000000000000000000000000000000:00000000000000000:00000000000000000000000000000000:0000000000:00	

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		OK	
	Precautions	-	
command characters	Command type	command format	response
C RMV MULC (Delete Multicast)	Test command	AT+C RMV MULC?	AT+CRMVMULC delete a multicast group OK
	Query command	-	-
	Setting commands	AT+ C RMV MULC =<addr>	OK
	Parameter Description	<addr>: Multicast address	
	Return value description		
	Example	AT+ C RMV MULC = AD372503 OK	
	Precautions	-	
command characters	Command type	command format	response
CADDCHANNEL (Manually add channel)	Test command	AT +CADDCHANNEL ?	AT+CADDCHANNEL ABP mode add channel OK
	Query command	-	-
	Setting commands	AT+CADDCHANNEL=<id>, <frequency>	OK
	Parameter Description	<id>: Channel ID <frequency>: The frequency to be set	
	Return value description		
	Example	AT+CADDCHANNEL=3,867100000	
	Precautions	This is typically used in ABP mode when the server cannot automatically allocate channels, requiring manual channel addition. Channels are added starting from the ID one position after the default channel count.	
command characters	Command type	command format	response
CLSTCHANNEL (Query currently enabled channels)	Test command	AT +CADDCHANNEL ?	AT+CLSTCHANNEL ABP mode channel list OK

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	Query command	AT+CLSTCHANNEL=?	<id>: <frequency>, <id>: <frequency> <id>: <frequency>
	Setting commands	-	-
	Parameter Description	<id>: Channel ID <frequency>: Enable frequency	
	Return value description		
	Example	AT+CLSTCHANNEL=? 0:868100000, 1:868300000, 2:868500000, 3:867100000, OK	
	Precautions	The default number of channels varies depending on the region; generally, it's padded to eight for use.	
command characters	Command type	command format	response
C RMVCHANNEL (Manually delete channel)	Test command	AT+C RMVCHANNEL ?	AT+CRMVCHANNEL ABP mode remove channel OK
	Query command	-	-
	Setting commands	AT+ C RMVCHANNEL=<id>	OK
	Parameter Description	<id>: Channel ID	
	Return value description		
	Example	AT+CRMVCHANNEL=3 OK	
	Precautions	Do not delete the default channel; it is only recommended to use it when the ABP mode server cannot allocate a channel.	
command characters	Command type	command format	response
AS923_BAND (Sets the AS923 sub-band)	Test command	AT+AS923_BAND ?	AT+AS923_BAND set/get as923 sub band OK
	Query command	AT+AS923_BAND=?	<band>
	Setting commands	AT+AS923_BAND = <band>	OK
	Parameter Description	<band> : as923 1-4	
	Return value		

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	description		
	Example	AT+AS923_BAND=1 OK	
	Precautions	This command is only available for modules operating in the 900 band. If AS923 is not used, this command does not need to be configured; setting it will automatically switch to the corresponding region configuration for AS923. E77-915M30S does not support frequency band modification.	
command characters	Command type	command format	response
RANDOMDEVNOCE (devnoce compatible)	Test command	AT+RANDOMDEVNOCE ?	AT+RANDOMDEVNOCE=<random>. Get or Set random devnoce OK
	Query command	AT+RANDOMDEVNOCE= ?	<random> OK
	Setting commands	AT+RANDOMDEVNOCE=<random>	OK
	Parameter Description	<random>: 0. Do not enable random devnoce. 1. Enable random devnoce	
	Return value description		
	Example	AT+RANDOMDEVNOCE=0 OK	
	Precautions	This command only applies to the E77-900M22S and is intended to ensure server compatibility with protocols prior to Lorawan 1.0.4.	

8 Secondary Development

- Please refer to the E77-400M22S DEMO example provided on the Chengdu E-Best website. This example only demonstrates simple transmit and receive functions under LoRa ™ modulation and demodulation .
- LoRaWAN ™ development, please download and refer to the usage instructions in ST's stm32cubewl library file, and use the stm32cubemx software to generate the protocol stack project for the relevant development platform ;
- When developing LoRaWAN ™ , if using the passive crystal oscillator version module, please adjust the internal load capacitance of the crystal oscillator in the software. Recommended value: XTAL_DEFAULT_CAP_VALUE = 0x0B;
- When using the active crystal oscillator version module, there is no need to adjust the crystal oscillator load capacitor. Modules with SN codes starting from xxxxx are all active crystal oscillator versions.

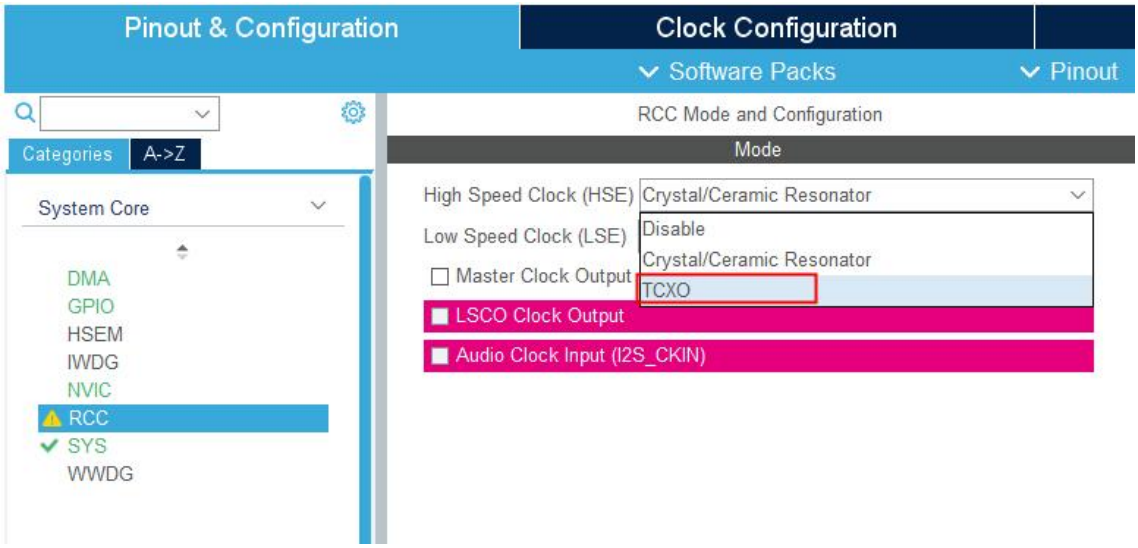
  There are two points that need to be modified for the active crystal oscillator:

  ① In the BSP_RADIO_IsTCXO() function in stm32wlxx_nucleo_radio.c, change `return

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RADIO_CONF_TCXO_NOT_SUPPORTED` to `return RADIO_CONF_TCXO_SUPPORTED`;

② When configuring STM32CubeMX, select TCXO as the external clock.



- the E77-400/900M22S are used as internal control RF switches. PA6 = RF_TXEN, PA7 = RF_RXEN. RF_TXEN=1 and RF_RXEN=0 is the transmit channel, and RF_TXEN=0 and RF_RXEN=1 is the receive channel. RF_TXEN and RF_RXEN cannot be high at the same time . RF_TXEN=0 and RF_RXEN= 0 is the off state.
- the E77-915M30S are used as internal control RF switches. PA6 = RF_TXEN, PA7 = RF_RXEN. RF_TXEN=1 and RF_RXEN= 1 indicate the transmit channel, RF_TXEN=0 and RF_RXEN=1 indicate the receive channel , and RF_TXEN=0 and RF_RXEN= 0 indicate the off channel.
- When performing secondary development on the E77-915M30S, the preamp power can be programmed up to 16dBm to output 30dBm. If it exceeds 16dBm, the current will increase.
- Hardware version differentiation method :

The E77-400M22S module includes both active crystal oscillator and passive crystal oscillator versions. Users can distinguish them by the production batch number of the module's serial number (SN). The production batch number ≥3202995 is the active crystal oscillator version (except for user-customized passive crystal oscillator versions), and the rest are passive crystal oscillator versions.

SN code explanation: S3202995S00001, where 3202995 is the production batch and 00001 is the production serial number.



Example:

1. The user's module production batch is 3202996, 3202996≥3202995, and the module with production batch

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3202996 is an active crystal oscillator module;

2. The user's module production batch is 3202994, 3202994 < 3202995, and the module with production batch 3202994 is a passive crystal oscillator module.

The E77-900M22S module includes both active crystal oscillator and passive crystal oscillator versions. Users can distinguish them by the production batch number of the module's serial number (SN). The production batch number ≥3202996 is the active crystal oscillator version (except for user-customized passive crystal oscillator versions), and the rest are passive crystal oscillator versions.

SN code explanation: S3202996S00001, 3202996 is the production batch, and 00001 is the production serial number.



Example:

1. The user's module production batch is 3202997, 3202997≥3202996, and the module with production batch 3202997 is an active crystal oscillator module;

2. The user's module production batch is 3202995, 3202995 < 3202996, and the module with production batch 3202995 is a passive crystal oscillator module.

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9 Data Rates for Each Frequency Band

EU433/EU868/RU864/ AS923

Data rate	Configuration	Represents physical data rate [bit/s]
0	LoRa: SF12 / 125 kHz	250
1	LoRa: SF11 / 125 kHz	440
2	LoRa: SF10 / 125 kHz	980
3	LoRa: SF9 / 125 kHz	1760
4	LoRa: SF8 / 125 kHz	3125
5	LoRa: SF7 / 125 kHz	5470
6	LoRa: SF7 / 250 kHz	11000
7	FSK: 50 kbps	50000
8 ~ 15	RFU	

CN470/ KR920

Data rate	Configuration	Represents physical data rate [bit/s]
0	LoRa: SF12 / 125 kHz	250
1	LoRa: SF11 / 125 kHz	440
2	LoRa: SF10 / 125 kHz	980
3	LoRa: SF9 / 125 kHz	1760
4	LoRa: SF8 / 125 kHz	3125
5	LoRa: SF7 / 125 kHz	5470
6 ~ 15	RFU	

US915:

Data rate	Configuration	Represents physical data rate [bit/s]
0	LoRa: SF10 / 125 kHz	980
1	LoRa: SF9 / 125 kHz	1760
2	LoRa: SF8 / 125 kHz	3125
3	LoRa: SF7 / 125 kHz	5470
4	LoRa: SF8 / 500 kHz	12500
5 ~ 7	RFU	
8	LoRa: SF12 / 500 kHz	980
9	LoRa: SF11 / 500 kHz	1760
10	LoRa: SF10 / 500 kHz	3900
11	LoRa: SF9 / 500 kHz	7000
12	LoRa: SF8 / 500 kHz	12500
13	LoRa: SF7 / 500 kHz	21900
14 ~ 15	RFU	

0-4 represents an upward trend, while 8-13 represents a downward trend.

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AU915:

Data rate	Configuration	Represents physical data rate [bit/s]
0	LoRa: SF12 / 125 kHz	250
1	LoRa: SF11 / 125 kHz	440
2	LoRa: SF10 / 125 kHz	980
3	LoRa: SF9 / 125 kHz	1760
4	LoRa: SF8 / 125 kHz	3125
5	LoRa: SF7 / 125 kHz	5470
6	LoRa: SF8 / 500 kHz	12500
7	RFU	RFU
8	LoRa: SF12 / 500 kHz	980
9	LoRa: SF11 / 500 kHz	1760
10	LoRa: SF10 / 500 kHz	3900
11	LoRa: SF9 / 500 kHz	7000
12	LoRa: SF8 / 500 kHz	12500

0-6 indicates an upward trend, 8-12 indicates a downward trend.

IN865:

Data rate	Configuration	Represents physical data rate [bit/s]
0	LoRa: SF12 / 125 kHz	250
1	LoRa: SF11 / 125 kHz	440
2	LoRa: SF10 / 125 kHz	980
3	LoRa: SF9 / 125 kHz	1760
4	LoRa: SF8 / 125 kHz	3125
5	LoRa: SF7 / 125 kHz	5470
6	RFU	RFU
7	FSK: 50 kbps	50000
8 ~ 15	RFU	RFU

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10 Maximum Power in Each Frequency Band

Note: The actual power will be 2.15 dBm less than the set value. This is because the Lorawan protocol includes antenna gain in its calculations.

EU868 :

By default, the maximum value MaxEIRP is +16dBm.

Transmit power	Configuration
0	MaxEIRP
1	MaxEIRP - 2 dB
2	MaxEIRP - 4 dB
3	MaxEIRP - 6 dB
4	MaxEIRP - 8 dB
5	MaxEIRP - 10 dB
6	MaxEIRP - 12 dB
7	MaxEIRP - 14 dB

US915:

Transmit power	Configuration
0	30 dBm - 2*TXpower
1	28 dBm
2	26 dBm
3 ~ 9	-
10	10 dBm
11 ~ 15	RFU

The agreement specifies that the module's maximum power is 22 dBm.

AU915

By default, the maximum value MaxEIRP is +30dBm.

Transmit power	Configuration
0	MaxEIRP
1 ~ 10	MaxEIRP - 2*TXPower
11 ~ 10	RFU

The agreement specifies that the module's maximum power is 22dBm.

KR920

By default, the maximum value MaxEIRP is +14dBm.

Transmit power	Configuration
0	MaxEIRP
1	MaxEIRP - 2 dB
2	MaxEIRP - 4 dB
3	MaxEIRP - 6 dB
4	MaxEIRP - 8 dB
5	MaxEIRP - 10 dB
6	MaxEIRP - 12 dB
7	MaxEIRP - 14 dB

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AS923:

By default, the maximum value MaxEIRP is +16dBm.

Transmit power	Configuration
0	MaxEIRP
1	MaxEIRP - 2 dB
2	MaxEIRP - 4 dB
3	MaxEIRP - 6 dB
4	MaxEIRP - 8 dB
5	MaxEIRP - 10 dB
6	MaxEIRP - 12 dB
7	MaxEIRP - 14 dB
8 ~ 15	RFU

IN865:

By default, the maximum value MaxEIRP is +30dBm.

Transmit power	Configuration
0	MaxEIRP
1	MaxEIRP - 2 dB
2	MaxEIRP - 4 dB
3	MaxEIRP - 6 dB
4	MaxEIRP - 8 dB
5	MaxEIRP - 10 dB
6	MaxEIRP - 12 dB
7	MaxEIRP - 14 dB
8	MaxEIRP - 16 dB
9	MaxEIRP - 18 dB
10	MaxEIRP - 20 dB
11 ~ 15	RFU

The agreement specifies that the module's maximum power is 22dBm.

RU864 :

By default, the maximum value MaxEIRP is +16dBm.

Transmit power	Configuration
0	MaxEIRP
1	MaxEIRP - 2 dB
2	MaxEIRP - 4 dB
3	MaxEIRP - 6 dB
4	MaxEIRP - 8 dB
5	MaxEIRP - 10 dB
6	MaxEIRP - 12 dB
7	MaxEIRP - 14 dB

CN470

By default, the maximum value MaxEIRP is +19.15 dBm.

Transmit power	Configuration
0	MaxEIRP
1	MaxEIRP 2 dB
2	MaxEIRP 4 dB
3	MaxEIRP 6 dB
4	MaxEIRP 8 dB
5	MaxEIRP - 10 dB
6	MaxEIRP - 12 dB
7	MaxEIRP - 14 dB
8 ~ 15	RFU

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EU433

By default, the maximum value MaxEIRP is +12.15 dBm.

Transmit power	Configuration
0	MaxEIRP
1	MaxEIRP - 2 dB
2	MaxEIRP - 4 dB
3	MaxEIRP - 6 dB
4	MaxEIRP - 8 dB
5	MaxEIRP - 10 dB
6 ~ 15	RFU

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11 Maximum Transmit Load of Each Frequency Band

Note: In the table below, M represents the length of the packet with MAC header, and N represents the maximum data length to be sent without MAC header.

EU868:

Data rate	M	N
0	59	51
1	59	51
2	59	51
3	123	115
4	250	242
5	250	242
6	250	242
7	250	242
8 ~ 15	-	-

US915:

Data rate	M	N
0	19	11
1	61	53
2	133	125
3	250	242
4	250	242
5 ~ 7	Not Defined	Not Defined
8	61	53
9	137	129
10	250	242
11	250	242
12	250	242
13	250	242
14 ~ 15	Not Defined	Not Defined

AU915

Data rate	M	N
0	59	51
1	59	51
2	59	51
3	123	115
4	250	242
5	250	242
6	250	242
7	Not Defined	Not Defined
8	61	53
9	137	129
10	250	242
11	250	242
12	250	242
13	250	242
14 ~ 15	Not Defined	Not Defined

KR920:

Data rate	M	N

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Data rate	M	N
0	59	51
1	59	51
2	59	51
3	123	115
4	250	242
5	250	242
6 ~ 15	Not Defined	Not Defined

AS923:

Data rate	Uplink MAC load size (M)		Downlink MAC load size (N)	
	UplinkDwellTime = 0	UplinkDwellTime = 1	DownlinkDwellTime = 0	DownlinkDwellTime = 1
0	59	N/A	59	N/A
1	59	N/A	59	N/A
2	59	19	59	19
3	123	61	123	61
4	250	133	250	133
5	250	250	250	250
6	250	250	250	250
7	250	250	250	250
8	RFU		RFU	

IN865:

Data rate	M	N
0	59	51
1	59	51
2	59	51
3	123	115
4	250	242
5	250	242
6	250	242
7	250	242
8 ~ 15	-	-

RU864:

Data rate	M	N
0	59	51
1	59	51
2	59	51
3	123	115
4	230	222
5	230	222
6	230	222
7	230	222
8 ~ 15	-	-

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CN470:

Data rate	M	N
0	59	51
1	59	51
2	59	51
3	123	115
4	250	242
5	250	242
6 ~ 15	-	-

EU433:

Data rate	M	N
0	59	51
1	59	51
2	59	51
3	123	115
4	250	242
5	250	242
6	250	242
7	250	242
8 ~ 15	-	-

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12 FAQs

12.1 The communication distance is very short.

- When there are obstacles in line-of-sight communication, the communication distance will be reduced accordingly.
- Temperature, humidity, and co-channel interference can all lead to increased packet loss rates in communications.
- The ground absorbs and reflects radio waves, and the test results are poor when the ground is close to the ground.
- Seawater has a strong ability to absorb radio waves, so tests conducted at the seaside are ineffective.
- If there are metal objects near the antenna, or if it is placed inside a metal casing, the signal attenuation will be very severe.
- The power register is set incorrectly, and the air speed is set too high (the higher the air speed, the closer the distance).
- At room temperature, the power supply voltage is lower than the recommended value; the lower the voltage, the lower the power output.
- The antenna may be poorly matched with the module or have quality issues.

12.2 Module is easily damaged

- Please check the power supply and ensure it is within the recommended range. Exceeding the maximum value may cause permanent damage to the module.
- Please check the power supply stability; the voltage should not fluctuate significantly or frequently.
- Please ensure anti-static operation during installation and use, as high-frequency devices are sensitive to electrostatic discharge.
- Please ensure that the humidity is not too high during installation and use, as some components are humidity-sensitive.
- Unless there are special requirements, it is not recommended to use it at excessively high or low temperatures.

12.3 Network access failed

- For OTAA network access, please check whether the three parameters APPKEY, DEVKEY, and DEVEUI are the same as those set on the server, and check whether the node frequency band, gateway frequency band, and server frequency band are the same.
- If this module has already been successfully registered with the network, and you are re-registering the network as a new node after changing the APPKEY, DEVKEY, and DEVEUI parameters, you need to reset the parameters using AT+RESTORE before setting them again.

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- When using ABP communication, the server records the frame count (fcnt) of each uplink from the module. If the count is less than the previous value, communication fails. The module does not save the fcnt for each uplink, as this would significantly increase flash memory wear. When using TTN, the MAC parameters need to be reset each time; when using chirpstack, the frame ignore option needs to be selected.
- The OTAA network entry display shows "devnoce to small". This feature only appears in version 1.0.4. The devnoce is incremented by one each time the network is entered. This module records this information. However, if the module restores the default parameters, the devnoce of the corresponding server needs to be manually set to 0.

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Revision History

Version	Revision Date	Revision Notes	Maintainer
1.0	2024-04-16	Merged manual, added AT commands	Bin
1.1	2024-05-11	Content revision	Bin
1.2	2024-08-02	Content revision	Bin
1.3	2025-3-13	Add product image authentication mark	LAU
1.4	2025-6-20	Modify and add AT commands	LAU
1.5	2026-3-3	Model merging	Hao
1.6	2026-06-16	Content revision	Bin

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Technical support: support@cdebyte.com

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Web: https://www.cdebyte.com

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

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