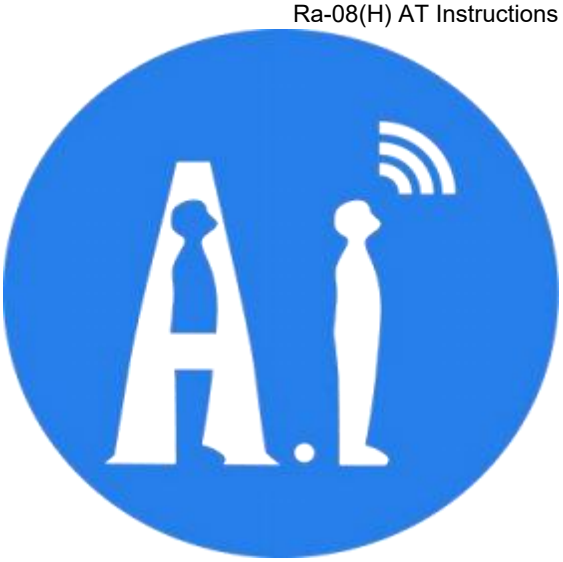

Ra-08(H)

AT command

Version 0.1.0

Date 2022-03-20

About this document

This document mainly introduces the AT command set of LoRa module communication in the Internet of Things field, including the configuration, operation, data sending and receiving of LoRa and modules.

Reader object

This document is mainly applicable to the following engineers:：

- Single board hardware development Engineer
- Software engineer
- Technical Support Engineer

Product model

The built-in chip models for the Ra-08 product corresponding to this document are as follows:

Model	**Flash**	**SRAM**	**Core**	Package	**Frequency**
ASR6601CB	128 KB	16 KB	32-bit 48 MHz ARM STAR	QFN48, 6*6 mm	150 ~ 960 MHz

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2022.03	V0. 1.0	First Edition

Contents

Content

1. Summarize

This document mainly introduces the AT command set of Ra-08 module communication in the Internet of Things field, including the configuration, operation, data sending and receiving of LoRa and modules.

1.1 Term, definition, and abbreviation

1.1.1 Term, definition, and abbreviation

- **LoRa**

  LoRa is one type of LPWAN communication technology, which is the expansion frequency adopted and promoted by Semtech Technology of ultra-long-distance wireless transmission scheme.

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

- **LoRaWAN**

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

  Network topology: star structure.

  Network composition: LoRa module, Gateway (Gateway or base station), Server (including Network Server, Network Control, and Application Server).

  LoRaWAN divides the LoRa modules into three A / B / C categories.

1.1.2 Abbreviation

The following abbreviations apply to this document.

Table 1-1 Summary Table of Abbreviations

Abbreviation	Full name of English
MCU	Microcontroller Unit
MT	Mobile Terminal
TA	Terminal Agent
TE	Terminal Equipment

1.2 Functional overview

The terminal device (TE, Terminal Equipment) may control the mobile terminal (MT, Mobile Terminal), functions and related network services by sending the AT commands described in this document. Terminal adapter (TA, Terminal Agent) completes the command and message adaptation function between terminal devices and mobile devices.

Physical implementation of terminal devices (TE), terminal adapters (TA), and mobile terminals (MT) can be achieved in the following conditions：

- TE, TA, and MT are three independent entities；
- TE is an independent entity, and TA is integrated into MT ；
- MT is an independent entity, and the TA is integrated into TE;
- The TE, TA, and MT would integrated into one entity too.

In this standard, TE is taken as the MCU module at the IoT device, and TA is a communication module and integrated into MT. The Communication module in this standard is the LoRa communication module.

The system structure of terminal equipment (TE), terminal adapter (TA) and mobile terminal (MT) and the basic process of establishing mutual association are shown in Figure 1-1.

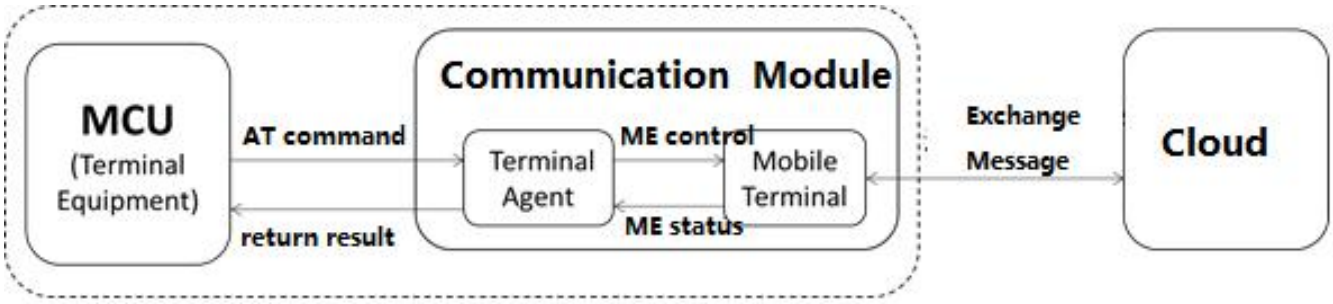

Figure 1-1 Architecture oveview

According to Figure 1-1, the MCU module and the communication module are jointly integrated into the IoT devices. The MCU communicates with the TA through the AT command to control the MT (ME refers to the mobile equipment) and realize the interaction between the Internet of Things devices and the cloud.

The interaction between IoT device and the cloud is done through LoRa technology. In this document, the standard AT commands are extended to support the LoRa commands, so as to realize the message interaction between the IoT devices and the cloud.

2. AT Command syntax

The AT command accept the ASCII code's character, the command form as the follows:

Request message format is: AT+<CMD>[OP][para-1,para-2, … … para-n]<\r>

Table 2-1 The AT Request message format

Field	Explanation
AT+	Command message prefix
CMD	Instruction string
Op	Instruction operator. It can be the following content: • "=": indicates parameter setting • "?": indicates inquire parameter's current setting • "": indicates execute the instruction • "=?": indicates inquire the arguments of the instruction
para-1,para-2, … …para-n	Indiate the argument of the instruction or the specified inquired argument.
\r	Carriage return character, its ASCII code is 0x0D

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

Table 2-2 The AT Reply message format

Field	Explanation
\r\n	Line break, its ASCII code is 0x0A
+CMD	Instruction string
para-1,para-2, … …para-n	Instruction arguments
STATUS	Instruction execution status. It can be the following content: • "OK": Instruction execute success • "ERROR": Instruction execute failed • "+CME ERROR:<err>": Instruction execute failed, return the related error-code.

Notes：

(1) <>：Indicates it is must include in instruction.

(2) []：Indicates it is optional include in instruction.

(3) \r： Carriage return character，its ASCII code is 0x0D

(4) \n： Line break，its ASCII code is 0x0A。

(5) For example，inquire the connection mode of MQTT，type the command as：

(6) AT+IMQTTMODE?\r

(7) The reply message as：

(8) \r\n+IMQTTMODE: 1\r\n

(9) \r\nOK\r\n

(10) This document will hide the '\r\n' in command format later for convenient.

(11) UART's parameter setting：baudrate 115200，data bit 8，stop bit 1，check bit 0

(12) Current command support the 'echo'，but not support the (BackSpace)，and the shortcut key of history command.

3. Example program description

3.1 Jump Wire connection

LORAWAN_AT project uses low-power serial port for receive, so the jumper JP8 received by serial port needs to be connected.

Table 3-1 Jump wire connection state

Wire	**Connect state**
JP1	Connected
JP2	Connected
JP3	Connected
JP4	Connected
JP5	Connected
JP6 (only in ASR6601CB-EVAL)	Disconnected
JP7	Connected
JP8	Connected

3.2 Code position

LORAWAN_AT project in SDK by projects \ $ {DEMO- In the BOARD} \ examples \ lorawan \ lorawan_at directory, where $ {DEMO-BOARD} is the model of the demo board, take the ASR6601SE demo board as an example, it is: projects\ASR6601SE-EVAL\examples\lorawan\lorawan_at. For source code, please contact Ai-Thinker Can business department.

3.3 Serial port setting

The serial port configuration information is as follows:

```
Baud rate: 9600
Data bits: 8
Stop bits: 1
Parity: None
Flow Control: None
```

3.4 Simple example

Node A as an example of the steps using the AT command to configure network access：

(1) Node A information

```
DEVEUI： D896E0FF00000240 APPEUI：
D896E0E000005203 APPKEY：
077EE45C6E4564D96D76AE55AFD3AA89
Node for type： ClassA
Gate frequency group mask： 0001
```

(2) Node ternary group the keys information configuration

```
ASR6601:~# AT+CDEVEUI=D896E0FF00000240

OK

ASR6601:~# AT+CAPPEUI=D896E0E000005203

OK

ASR6601:~# AT+CAPPKEY=077EE45C6E4564D96D76AE55AFD3AA89

OK
```

(3) Node type configuration

```
ASR6601:~# AT+CCLASS=0

OK
```

(4) Node frequency mask settings

Using AT+CFREQBANDMASK, each bit represents 1 frequency group (8 frequency points) and up to 128 frequency points. For example, 0001 is 470.3-471.7MHz, see the parameter description of the **AT+CFREQBANDMASK** command.

```
ASR6601:~# AT+CFREQBANDMASK=0001

OK
```

(5) Start networking connect

```
ASR6601:~# AT+CJOIN=1,0,8,8

OK

ASR6601:~#[1232969]Start to Join, method 1, nb_trials:8
+CJOIN:OK
[ 1238352]Joined
```

(6) Send data

```
AT+DTRX=1,2,3,1 12233

OK+SEND:03

OK+SENT:01
[ 1351754]receive data: rssi = -17, snr = 1 1, datarate = 3
[ 1351759]rx, ACK, index 1

OK+RECV:02,00,00
```

4.AT commands

4.1 LoRa AT command classification

Classification	Description	Notes
General commands	Manufacturer identification，Module identification，Version identification，Product sequence number	General Command
Network Related Parameters Config Command	Frequency Band Mask, Multicast Address, Same frequency/Different frequency, Device's DevEUI	Network Related Parameters Config Command
Control and Status Commands	Initiate Join, Work Mode，Class, Battery capacity，Model Status	Node Control and Status Command
MAC setup Commands	LoRaWAN protocol related MAC instructions	MAC Config Command
Send/receive data	Receive Data and Send Data	Data Command
Other commands	Log level, Restart, Reset to Factory	
Manufacture Private commands	LoRa manufacture's private commands	Manufacturer Private Command

4.1.1 LoRaWAN General Command Sets

Command	Description	Option
AT+CGMI	Read manufacturer identification	Optional
AT+CGMM	Read model identification	Optional
AT+CGMR	Read revision identification	Optional
AT+CGSN	Read product serial number identification	Optional
AT+CGBR	Set UART budrate on UART interface	Optional

4.1.2 LoRaWAN Network Related Parameter Setup Command Sets

Command	Description	Option
AT+CJOINMODE	Set/read Join mode (OTAA, ABP)	Optional
AT+CDEVEUI	Set/read DevEUI (only when OTAA join)	Optional
AT+CAPPEUI	Set/read AppEUI (only when OTAA join)	Optional
AT+CAPPKEY	Set/read AppKey (only when OTAA join)	Optional
AT+CDEVADDR	Set/read DevAddr (only when ABP join)	Optional
AT+CAPPSKEY	Set/read AppSkey (only when ABP join)	Optional
AT+CNWKSKEY	Set/read NwkSkey (only when ABP join)	Optional
AT+CFREQBANDMASK	Set/read FreqBank mask (FreqBandMask)	Optional
AT+CULDLMODE	Set/read Ul/Dl mode(Same frequency or different frequency)	Optional
AT+CADDMUTICAST	Add one Multicast Address	Optional
AT+CDELMUTICAST	Delete one Multicast Address	Optional
AT+CNUMMUTICAST	Inquire The Number of Multicast	Optional

4.1.3

Command	Description	Option
AT+CWORKMODE	Set/read operation mode	Optional
AT+CCLASS	Set/read class type (Class A/B/C)	Optional
AT+CBL	Read device’s battery level	Optional
AT+CSTATUS	Read Device’s statues	Optional
AT+CJOIN	Initate OTAA	Optional
AT+CPINGSLOTINFOREQ	Initate pingslot info request	Optional

4.1.4

Command	Description	Option
AT+DTRX	Send data frame	Mandatory
AT+DRX	Receive Data from RX Buffer then Empty the RX Buffer	Mandatory

4.1.5 LoRaWAN MAC Setup command sets

Command	Description	Option
AT+CCONFIRM	Set/Read Send Message Type (confirm or Unconfirm)	Mandatory
AT+CAPPPORT	Set/Read Application Port	Mandatory
AT+CDATARATE	Set/Read Data Rate Mandatory	Mandatory
AT+CRSSI	Get RSSI	Mandatory
AT+CNBTRIALS	Set/Read Number of NbTrans	Mandatory
AT+CRM	Set/Read Report Mode	Mandatory
AT+CTXP	Set/Read TX Power	Mandatory
AT+CLINKCHECK	Enable Link check	Mandatory
AT+CADR	Enable/Disable ADR Function	Mandatory
AT+CRXP	Set/Read Receive Window Parameter	Mandatory
AT+CRX1DELAY	Set/Read TX and RX1 Delay	Mandatory
AT+CSAVE	Save configuration	Mandatory
AT+CRESTORE	Restore to Default Configuration	Mandatory

4.1.6 Other commands sets

Command	Description	Option
AT+IREBOOT	Reboot	Optional
AT+ILOGLVL	Set log level	Optional

4.1.7 Private commands sets

Command	Description	Option
AT+CKEYSPROTECT	Device pricate key encrypt	Optional

4.2 AT Command Format

4.2.1 Read Manufacturer Identification + CGMI

Inquire Command	AT+CGMI?	+CGMI=<manufacture r> OK
Parameters and Returns	**<manufacturer>**: Manufacturer Identification	
Example	AT+CGMI? +CGMI=ASR OK	

4.2.2 Read Model Identification +CGMM

Inquire Command	AT+CGMM?	+CGMM=<model> OK
Parameters and Returns	**<model>**: Model Identification	
Example	AT+CGMM? +CGMM=6601 OK	

4.2.3 Read Version Identification +CGMR

Inquire Command	AT+CGMR?	+CGMR=<revision > OK
Parameters and Returns	**<revision>**: Version Identification	
Example	AT+CGMR? +CGMR=v 1.1. 0 OK	

4.2.4 Read Product Sequence Number +CGSN

Inquire Command	AT+CGSN?	+CGMR=<sn> OK
Parameters and Returns	**<sn>**: Product Sequence Number	
Example	AT+CGSN? +CGSN=0539349E000325 23 OK	

4.2.5 Set Baud-rate +CGBR

Inquire Command	AT+CGBR?	+CGBR=<baud > OK
Set Command	AT+CGBR=<baud>	OK
Parameters and Returns	**<baud>**: Baud-rate	
Example	AT+CGBR=9600 OK	
Notice	Use LPUART, so buat-rate can't exceed 9600	

4.2.6 Set/Read Join Mode +CJOINMODE

Test Command	AT+CJOINMODE=?	+CJOINMODE:“mode” OK
Inquire Command	AT+CJOINMODE?	+CJOINMODE:<mode > OK
Execute command and response	AT+CJOINMODE=<mode>	OK o +CME ERROR:<err>
Parameters and Returns	**<mode>**: Node Join mode, as follow: • 0 : OTAA • 1 : ABP **<err>**: error code	
Example	AT+CJOINMODE=0 OK	
Notice	Default using the OTAA mode; If need ABP mode, please use the command before send any data.	

4.2.7 Set/Read DevEUI +CDEVEUI

Test command	AT+CDEVEUI=?	+CDEVEUI=<DevEUI:length is 16>
Inquire command	AT+CDEVEUI?	+CDEVEUI:<value > OK
Set command	AT+CDEVEUI=<value>	OK or+CME ERROR:<err>
Parameters and returns	**<value>**: Device Node’s DevEUI	
Example	AT+CDEVEUI? +CDEVEUI=AABBCCDD001122 33 OK	
Notice	Set or Read Device Node’s DevEUI, the return result’s format are Y1Y2…Y8 in hexdemical format, the value is 8 byte.	

4.2.8 Set/Read AppEUI +CAPPEUI

Test command	AT+CAPPEUI=?	+CAPPEUI=<AppEUI:length is 16>
Inquire command	AT+CAPPEUI?	+CAPPEUI:<value > OK
Set command	AT+CAPPEUI=<value>	OK Or +CME ERROR:<err>
Parameters and Returns	<value>：Device Node's AppEUI <err>：error code，refer detail from<AT command set for User Equipment (UE)>.	
Example	AT+CAPPEUI=AABBCCDD0011223 3 OK	
Notice	used in OTAA mode，Set or Read the AppEUI, the return result's format is Y1Y2…Y8 in hexdemical format, the value is 8 byte.	

4.2.9 Set/Read AppKey +CAPPKEY

Test Command	AT+CAPPKEY=?	+CAPPKEY=<AppKey:length is 32>
Inquire command	AT+CAPPKEY?	+CAPPKEY:<value > OK
Set command	AT+CAPPKEY=<value>	OK or+CME ERROR:<err>
Parameters and Returns	**<value>**：Device node's AppKey **<err>**：error code	
Example	AT+CAPPKEY=AABBCCDD00112233AABBCCDD00112 233 OK	
Notice	used in OTAA mode，Set or Read the AppKey, the return result's format is Y1Y2…Y16 in hexdemical format, the value is 16 byte.	

4.2.10 Set/Read DevAddr +CDEVADDR

Test Command	AT+CDEVADDR=?	+CDEVADDR=<DevAddr: length is 8， Device address of ABP mode>
Inquire Command	AT+CDEVADDR?	+CDEVADDR:<value> OK
Set Command	AT+CDEVADDR=<value>	OK or+CME ERROR:<err>
Parameters and Returns	**<value>**: Device node's DevAddr **<err>**: error code	
Example	AT+CDEVADDR=0011223 3 OK	
Notice	Used in ABP mode, Set or Read the DevAddr, the return result's format is Y1Y2…Y4 in hexdecimal format, the value is 4 byte.	

4.2. 1 1 Set/Read AppSKey +CAPPSKEY

Test Command	AT+CAPPSKEY=?	+CAPPSKEY=<AppSKey: length is 32>
Inquire Command	AT+CAPPSKEY?	+CAPPSKEY:<value> OK
Set Command	AT+CAPPSKEY=<value>	OK or+CME ERROR:<err>
Parameters and Returns	**<value>**: Device node's AppSKey **<err>**: error code	
Example	AT+CAPPSKEY=AABBCCDD00112233AABBCCDD0011 2233 OK	
Notice	Used in ABP mode, Set or read AppSKey, the return result's format is Y1Y2…Y16 in hexdecimal format, the value is 16byte.	

4.2.12 Set/Read NwkSKey +CNWKSKEY

Test Command	AT+CNWKSKEY=?	+CNWKSKEY =<NwkSKey: length is 32>
Inquire Command	AT+CNWKSKEY?	+CNWKSKEY:<value> OK
Set Command	AT+CNWKSKEY=<value>	OK or+CME ERROR:<err>
Parameters and Returns	**<value>**: Device node's NwkSKey **<err>**: error code	
Example	AT+CNWKSKEY=AABBCCDD00112233AABBCCDD0011 2233 OK	
Notice	Used in ABP mode, Set or read NwkSKey, the return result's format is Y1Y2…Y16 in hexdecimal format, the value is 16byte.	

4.2. 13 **Set Frequency Band Mask** +CFREQBANDMASK

Test Command	AT+CFREQBANDMASK=?	+CFREQBANDMASK:" mask" OK
Inquire Command	AT+CFREQBANDMASK?	+CFREQBANDMASK:<ma sk> OK
Set Command	AT+CFREQBANDMASK=<mask>	OK or+CME ERROR:<err>
Parameters and Returns	<mask>: Network workable frequency band mask, there is 16 bit to 16 frequency group, refer detail from <LoRaWAN join specifications>. For example: 0-7 channel, its mask is 0001, 8-15 channel, its mask is 0002, and so on. The frequency corresponding to the specific channel is the region protocol, such as 0-7, and the channel in CN470 , 470.3, 470.5 , 470.7 , 470.9 , 471. 1 , 471.3 , 471.5 , 471.7 (uint: MHz) **<err>**: error code, refer detail from<AT command set for User Equipment (UE)>	
Example	AT+CFREQBANDMASK=0001 OK	
Notice	Need set it before the Join command.	

4.2.14 Set/Read Upload/Download Same/Different Frequency +CULDLMODE

Test Command	AT+CULDLMODE=?	+CULDLMODE:“ mode ” OK
Inquire Command	AT+CULDLMODE?	+CULDLMODE:<mode> OK
Set Command	AT+CULDLMODE=<mode>	OK or+CME ERROR:<err>
Parameters and Returns	**<mode>**: as the follows • 1 Same Frequency Mode • 2： Different Frequency Mode **<err>**: error code, refer detail from<AT command set for User Equipment (UE)>	
Example	AT+CULDLMODE= 2 OK	
Notice	Need set it before the Join command.	

4.2.15 Set/Read Work Mode +CWORKMODE

Test Command	AT+CWORKMODE=?	+CWORKMODE:“ mod e” OK
Inquire Command	AT+CWORKMODE?	+CWORKMODE:<mode> OK
Set Command	AT+CWORKMODE=<mode>	OK or+CME ERROR:<err>
Parameters and Returns	**<mode>**: as the follows • 2： Normal Work Mode **<err>**: error code, refer detail from<AT command set for User Equipment (UE)>	
Example	AT+CWORKMODE =2 OK	
Notice	Need set it before the Join command, default is the normal work mode. Currently Only normal work mode is supported.	

4.2.16 Set/Read Class +CCLASS

Test Command	AT+CCLASS=?	+CCLASS:“class” ,“ branch” ,“ para1” ,“ pa r a2” ,“ para3” ,“para4” OK
Inquire Command	AT+CCLASS?	+CCLASS:<class> OK
Set Command	AT+CCLASS=<class> ,[branch], [para1], [para2], [para3] , [para4]	OK or+CME ERROR:<err>
Parameters and Returns	**<class>**: as the follows • 0 : classA • 1 : classB • 2 : classC According different device type, there are the following parameters: If class is 1 and branch is 0, then only para1 parameter is used to set the ping slot periodicity, who’s value range is 0~7, the related period time is 0.96*2^periodicity seconds； If class is 1 and branch is 1, then para1 is used to set the frequency of beacon, its unit is Hz; para2 is used to set the data rate of beacon; para3 is used to set the frequency of ping slot, its unit is Hz; para4 is used to set the data rate of ping slot. Each parameter’s value range please refer to the LoRaWAN protocol <err>：error code，refer detail from<AT command set for User Equipment (UE)>	
Example	AT+CCLASS= 2 OK	
Notice	It need be set before the “Join” procedure, the default class is ClassA.	

4.2.17 Inquire the Battery level of Device Node +CBL

Test Command	AT+CBL=?	+CBL:“value” OK
Inquire Command	AT+CBL?	+CBL:<value> OK
Parameters and Returns	<value>：device node’s battery level, the range please refer to the LoRaWAN protocol.	
Example	AT+CBL? +CBL=0 OK	
Notice	Inquire the battery level of device node.	

4.2. 18 Inquire Device Current Status +CSTATUS

Test Command	AT+CSTATUS=?	+CSTATUS:”status ” OK
Inquire Command	AT+CSTATUS?	+CSTATUS:<statu s> OK
Parameters and Returns	**<status>**: the definition as the follows: • **00: there is no data operation** • **01：there is data in sending** • **02：there is data sent but failed** • **03：there is data sent and success** • **04：JOIN success (only appear in first join procedure)** • **05：JOIN fail (only appear in first join procedure)** • **06：** Network may abnormal **(Link Check result)** • **07：data sent success，but no download** • **08：data send and success，there is download too.**	
Example	AT+CSTATUS? +CSTATUS=0 3 OK	
Notice	Inquire the current status of the device node	

4.2.19 Set/Read Join +CJOIN

Test Command	AT+CJOIN=?	+CJOIN:<ParaTag1>,[ParaTag2], … [ParaTag 4] OK
Inquire Command	AT+CJOIN?	+CJOIN:<ParaValue1>,[ParaValue2], … [Para Val ue4] OK
Set Command	AT+CJOIN =<ParaValue1>,[ParaValue 2], … [ParaValue4]	OK or+CME ERROR:<err> If input parameter is legal, return OK firstly, then start the automatic authentication and return the result of authentication +CJOIN:OK Authentication Success +CJOIN:FAIL Authentication Fail
Parameters and Returns	<ParaTag1>，[ParaTag2]，……[ParaTag4]：Authentication parameter1，2，……4's name； [ParaValue1]，[ParaValue2]，……[ParaValue4]：Authentication parameter1，2，…… 4's value； **<ParaTag1>**：represent do the JOIN operation，ParaTag1's value range： • 0：Stop JOIN • 1：Start JOIN，restart one JOIN procedure, for module which have enable the warm boot, do the oeration will clear the parameters of JOIN procedure. **[ParaTag2]**：represent if enable the auto-JOIN function, its factory value is 1, ParaTag2's value range: • 0：Disable auto JOIN • 1：Enable auto-JOIN. When module enter into passthrough mode, enable auto-JOIN **[ParaTag3]** represent the period of JOIN, ParaTag3's value range is 7~255, its unit is seconds. Factory default value：8 **[ParaTag4]**：represent the period of JOIN, ParaTag3's value range is 1~256,refer detail from 《*LoRa WAN* Access specification》 **<err>**：error code	
Example	AT+CJOIN=1,0, 10,8 (Set JOIN parameter：enable auto-JOIN, the period of JOIN is 10s, and the maximum retry times of JOIN is 8 times) OK +CJOIN:OK	

4.2.20 Send/Receive +DTRX

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_CNT OK+RECV:TYPE,PORT,LEN,DATA orERR+SEND:ERR_NUM ERR+SENT:TX_CNT or+CME ERROR:<err>
Parameters and Returns	**[confirm]** and **[nbtrials]** please refer to other related AT command, it is valid only to this send, there are optional option. **[Length]** represent the number of characters; the maximum value please refer to LoRaWAN protocol; different datarate allow different maximum transfer **[Payload]** (more detail please refer to LoRaWAN protocol), 0 represent the empty package. Payload is hexdecimal(two charactors represent one digit). **Return value Q&A**: 1，If data send success? ● **Confirm data：** Each confirm data will have one response ack message from network server, when module can't receive ack message and exceed the maximum transmit times, data send failed with log output "ERR+SENT"; if ack message being received, data send success with log output" OK+SEND", "OK+SENT", "OK+RECV" ● **Unconfirm data：** Unconfirm data without ack message from network server, each unconfirm data send done will have log output "OK+SEND"，"OK+SENT", if received the download data of network server, it will have additional log output "OK+RECV". 2, Data send status indication ● **OK+SEND:TX_LEN** represent data send success,TX_LEN：1Byte，represent the length of data sent. ● **OK+SENT:TX_CNT** represent data send success,TX_CNT：1Byte，represent the times of data sent. ● **ERR+SEND:ERR_NUM** represent data send fail, the fail reason is represented by ERR_NUM, ERR_NUM：1Byte. 0- Not Join Network success 1- Communication path bush, data send fail 2- data length exceed the allowable length, just send the MAC command ● **ERR+SENT:TX_CNT** represent data send fail, send times exceed the maximum times, TX_CNT：1Byte TX_CNT represent the data send times. ● **OK+RECV:TYPE,PORT,LEN**,DATA represent data send success (receive the ack message when confirmed data or receive the download package from network server) #TYPE：1Byte, represent the download transfer type #Bit0：0-unconfirm，1-confirm #Bit1：0-non-ACK，1-ACK #Bit2：0-non-carry，1-carry，indicate if download data have carry the ack of LINK command. #Bit3：0-non-carry，1-carry，indicate if download data have carry the ack of TIME command. Only when the bit is 1, it means time sync success.	

	#Bit4~Bit7：default is 0，reserved #PORT：1Byte，download transport port #LEN：1Byte，download data length #DATA：nByte，download data, when the LEN is 0, the DATA not exist **<err>：error code**，refer detail from<AT command set for User Equipment (UE)>
Example	AT+DTRX=1,2,10,0123456789 OK+SEND:03 OK+SENT:01 OK+RECV:02,01,00 Represent confirm data have send successfully, network server have received the data “0123456789”, and give device node the download ack
Notice	It is need to first join into the network, then send data later.

4.2.21 Receive Data +DRX

Test Command	AT+DRX=?	+DRX:<Length>,<Payload> OK
Inquire Command	AT+DRX?	+DRX:<Length>,<Payload> OK or+CME ERROR:<err>
Parameters and Returns	**<Length>**: 0 represent there is empty packet **<Payload>**: hexdecimal string characters **OK**: receive payload without abnormal issues **<err>**：error code，refer detail from<AT command set for User Equipment (UE)>	
Example	AT+DRX ? OK	
Notice	Receive payload from RX-buffer, then clear the RX-buffer	

4.2.22

Test Command	AT+CCONFIRM=?	+CCONFIRM:"value" OK
Inquire Command	AT+CCONFIRM?	+CCONFIRM:<value> OK
Set Command	AT+CCONFIRM =<value>	OK or+CME ERROR:<err>
Parameters and Returns	**<value>**: as the follows • 0 : UnConfirmed up message • 1 : Confirmed up message **<err>**: error code	
Example	AT+CCONFIRM= 1 OK	

4.2.23 Set/Read Upload Transform Type +CAPPPORT

Test Command	AT+CAPPPORT=?	+CAPPPORT:“valu e” OK
Inquire Command	AT+CAPPPORT?	+CAPPPORT:<value> OK
Set Command	AT+CAPPPORT=<value>	OK or+CME ERROR:<err>
Parameters and Returns	**<value>**: The application port used in decimal format and the factory default value is 10. Value range:1~223. Note1：application port:0x00 is designed for LoRaWAN’s MAC command **<err>**: error code	
Example	AT+CAPPPORT=10 OK	
Notice	The command need be used before send data.	

4.2.24 Set/Read Data Rate+CDATARATE

Test Command	AT+CDATARATE=?	+CDATARATE:“value” OK
Inquire Command	AT+CDATARATE?	+CDATARATE:<value > OK
Set Command	AT+CDATARATE=<value>	OK or+CME ERROR:<err>
Parameters and Returns	**<value>**: rate value, the factory default value is 3, its value range is: • 0 : SF12, BW125 • 1 : SF11 , BW125 • 2 : SF10, BW125 • 3 : SF9, BW125 • 4 : SF8, BW125 • 5 : SF7, BW125 **<err>**: error code	
Example	AT+CDATARATE=1 OK	
Notice	The command need be used before send data. After enable the ADR function, the command’s effect will disappear, if you need to change DATARATE , please perform below command first, AT+CADR=0	

4.2.25 Inquire RSSI +CRSSI

Test Command	AT+CRSSI=?	+CRSSI OK
Inquire Command	AT+CRSSI FREQBANDIDX?	+CRSSI: 0:<Channel 0 rssi> 1:<Channel 1 rssi> … 15:<Channel 8 rssi> OK
Parameters and Returns	**<FREQBANDIDX>**: <FREQBANDIDX>：represent the frequency's serial number, it is start from 0, group 1A2's serial number is 1 Return all the 8 channels's RSSI in one frequency group.	
Example	AT+CRSSI 1? +CRSSI : 0:-157 1:-157 2:-157 3:-157 4:-157 5:-157 6:-157 7:-157 OK	
Notice	Only support CN470A	

4.2.26 Set/Read MAX Send Times +CNBTRIALS

Test Command	AT+CNBTRIALS=?	+CNBTRIALS: “MType” ,“value” OK
Inquire Command	AT+CNBTRIALS?	+CNBTRIALS:<MType>,<value > OK
Set Command	AT+CNBTRIALS=<MType>,<value>	OK or+CME ERROR:<err>
Parameters and Returns	**<MType>**: as follows • 0 : unconfirm package • 1 : confirm package **<value>**: maximum send times, its value range is 1~15 **<err>**: error code	
Example	AT+CNBTRIALS=1, 2 OK	
Notice	The command need be used before send data.	

4.2.27 Set/Read Upload Mode +CRM

<table>
<tr><td>Test Command</td><td>AT+CRM=?</td><td>+CRM:“ reportMode” ,” reportInterval ” OK</td></tr>
<tr><td>Inquire Command</td><td>AT+CRM?</td><td>+CTXP:<reportMode>,[reportInterval] OK</td></tr>
<tr><td>Set Command</td><td>AT+CTXP=<reportMode>,[reportInterval]</td><td>OK
or+CME ERROR:<err></td></tr>
<tr><td>Parameters and Returns</td><td colspan="2">This command is mainly used for test purpose.
<reportMode>: as follow
• 0 : Report data aperiodically
• 1 : Periodic Data Reporting
<reportInterval>: This parameter is available only when data is reported periodically. Period Indicates the interval for reporting data (unit: s). For different DR, the minimum allowed period is different, and the period is adopted,Level definition, as shown in table:

<table>
<tr><td>Data-rate\period(s)\level</td><td>LV1</td><td>LV2</td></tr>
<tr><td>DR0</td><td>150</td><td>300</td></tr>
<tr><td>DR1</td><td>75</td><td>150</td></tr>
<tr><td>DR2</td><td>35</td><td>70</td></tr>
<tr><td>DR3</td><td>15</td><td>30</td></tr>
<tr><td>DR4</td><td>10</td><td>20</td></tr>
<tr><td>DR5</td><td>5</td><td>10</td></tr>
</table>

<err>: error code</td></tr>
<tr><td>Example</td><td colspan="2">AT+CRM=1,10
OK</td></tr>
<tr><td>Notice</td><td colspan="2">The command need be used before send data.</td></tr>
</table>

4.2.28 Set/Read TX Power +CTXP

Test Command	AT+CTXP=?	+CTXP:“value” OK
Inquire Command	AT+CTXP?	+CTXP:<value > OK
Set Command	AT+CTXP=<value>	OK or+CME ERROR:<err>
Parameters and Returns	**<value>**: Is the transmission power, and the factory value is 0. The actual value range is related to the final product. CN470A In the frequency band, the value ranges are as follows: ● 0: 17 dBm ● 1: 15 dBm ● 2: 13 dBm ● 3: 11 dBm ● 4 : 9 dBm ● 5 : 7 dBm ● 6 : 5 dBm ● 7 : 3 dBm **<err>**: error code	
Example	AT+CTXP=1 OK	
Notice	The command need be used before send data.	

4.2.29 Verifying the Network Connection +CLINKCHECK

Test Command	AT+CLINKCHECK=?	+CLINKCHECK:“value” OK
Set Command	AT+CLINKCHECK=<value>	OK +CLINKCHECK: <Y0>, <Y1>, <Y3>, <Y4> or +CME ERROR:<err>
Parameters and Returns	**<value>**: Example Enable control for Link Check. The definition is as follows: • 0：Description Link Check was disabled • 1：Perform a Link Check • 2：The module automatically carries the linkcheck command in each uplink data packet Return OK and the setting is successful. If <value>=1, after a period of time, a second response message is returned in the following format: *+CLINKCHECK: < Y0>, < Y1>, < Y3>, < Y4>* • Y0 indicates the Link Check result: # 0: indicates that the Link Check is successfully executed # non-0: indicates that the Link Check fails • Y1 is DemodMargin • Y2 is NbGateways • Y3 is the RSSI of this downlink • Y4 is the SNR of this downlink **<err>**: error code	
Example	AT+CLINKCHECK=1 OK +CLINKCHECK: 0 , 0 , 1 , -68, 8	
Notice	Need to set it up before sending data.	

4.2.30Enable ADR +CADR

Test Command	AT+CADR=?	+CADR:“value” OK
Inquire Command	AT+CADR?	+CADR:<value > OK
Set Command	AT+CADR=<value>	OK or+CME ERROR:<err>
Parameters and Returns	**<value>**: ADR enables control, the factory value is 1, which is defined as follows: • 0：ADR Weak Disable • 1：ADR Enable **<err>**: error code	
Example	AT+CADR=1 OK	
Notice	Need to set it up before sending data. ADR is enabled by default.	

4.2.31 Sets or reads the receive window parameters +CRXP

Test Command	AT+CRXP=?	+CRXP:“RX1DRoffest” ,”RX2DataRate” , ”RX2Frequency” OK
Inquire Command	AT+CRXP?	+CRXP:<RX1DRoffest>,<RX2DataRate>,<RX2Frequency> OK
Set Command	AT+CRXP=<RX1DRoffest>,<RX2DataRate>,<RX2Frequency>	OK or+CME ERROR:<err>
Parameters and Returns	**<RX1DRoffest>**, **<RX2DataRate>**, **<RX2Frequency>**: See the LoRaWAN protocol for details **<err>**: error code	
Example	AT+CRXP=1,1,471000000 OK	
Notice	Need to set it up before sending data. Do not set the default value.	

4.2.32 Set or read the latency of sending and receiving +CRX1DELAY

Test Command	AT+CRX1DELAY=?	+CRX1DELAY:“Delay” OK
Inquire Command	AT+CRX1DELAY?	+CRX1DELAY:<Delay > OK
Set Command	AT+CRX1DELAY=<Delay>	OK or+CME ERROR:<err>
Parameters and Returns	**<Delay>**: How long after sending to open the RX1 window, unit is s **<err>**: error code	
Example	AT+CRX1DELAY=2 OK	
Notice	Set how long to open the RX1 window after sending, before sending data. The value is the default value if this parameter is not set.	

4.2.33 Save the MAC parameter settings +CSAVE

Test Command	AT+CSAVE=?	+CSAVE OK
Set Command	AT+CSAVE	OK or+CME ERROR:<err>
Parameters and Returns	This command saves the configuration parameters to the EEPROM / FLASH, and after the restart, the module initializes and runs the networks using the new MAC configuration parameters. **<err>**: error code	
Example	AT+CSAVE OK	
Notice	It needs to be saved before sending the data.	

4.2.34 Restore Default MAC Address Parameters +CRESTORE

Test Command	AT+CRESTORE=?	+CRESTORE OK
Set Command	AT+CRESTORE	OK or+CME ERROR:<err>
Parameters and Returns	This command restores the default MAC configuration parameters to the EEPROM/FLASH. **<err>**: error code	
Example	AT+CRESTORE OK	
Notice		

4.2.35 PingS lotInfo Request +CPINGSLOTINFOREQ

Test Command	AT+CPINGSLOTINFOREQ=?	+CPINGSLOTINFOREQ:<periodicity > OK
Inquire Command	AT+CPINGSLOTINFOREQ?	+CPINGSLOTINFOREQ:<periodicity > OK
Set Command	AT+CPINGSLOTINFOREQ=<periodici ty>	OK or+CME ERROR:<err>
Parameters and Returns	**<periodicity>**: ping slot cicle **<err>**: error code	
Example	AT+CPINGSLOTINFOREQ=3 OK	
Notice	This command is a ClassB-specific command	

4.2.36 Adding Multicast Address +CADDMUTICAST

Test Command	AT+CADDMUTICAST=?	+CADDMUTICAST:"DevAddr","AppSKey" ,"NwkSKey","Periodicity","Datarate " OK
Set Command	AT+CADDMUTICAST=<DevAddr> ,< AppSKey>,<NwkSKey>,[Periodicity], [Datarate]	OK or+CME ERROR:<err>
Parameters and Returns	**<DevAddr>**：multicast address **<AppSKey>**：Multicast application session key **<NwkSKey>**：Multicast network session key **[Periodicity]**：ping slot Resource planning period profile **[Datarate]**：data rate **<err>**：error code	
Example	AT+CADDMUTICAST=67678d5e,5ac8eb2016f11f19ad19d7f530592c44,59543 06 9010279fa7317f85f47c46926, 2, 2 OK	
Notice	Please set up before JOIN.	

4.2.37 Delete the multicast address +CDELMUTICAST

Test Command	AT+CDELMUTICAST=?	+CDELMUTICAST:"DevAddr " OK
Set Command	AT+CDELMUTICAST=<DevAddr>	OK or+CME ERROR:<err>
Parameters and Returns	**<DevAddr>**：multicast address **<err>**：error code	
Example	AT+CDELMUTICAST=67678d5 e OK	

4.2.38 Querying the Number of Multicast Groups +CNUMMUTICAST

Test Command	AT+CNUMMUTICAST=?	+CNUMMUTICAST:"number " OK
Inquire Command	AT+CNUMMUTICAST?	+CNUMMUTICAST:<number > OK
Parameters and Returns	**<number>**: The number of multicast	
Example	AT+CNUMMUTICAST? +CNUMMUTICAST :0 OK	

3.4.1 Restart Module +IREBOOT

Test Command	AT+IREBOOT=?	+IREBOOT:"Mode" OK
Set Command	AT+IREBOOT=<mode>	OK or+CME ERROR:<err>
Parameters and Returns	**<mode>**: restart mode is defined as follows: • 0 : Restart the communication module immediately • 1 : Wait for the wireless frame currently being sent in the communication module to complete and then restart **<err>**: error code	
Example	AT+IREBOOT=1 OK	
Notice	After receiving the command, the communication module replies OK and restarts the communication module. No further AT commands are received until the restart is complete.	

4.2.39 Setting the Log Level +ILOGLVL

Test Command	AT+ILOGLVL=?	+ILOGLVL:“ level” OK
Inquire Command	AT+ILOGLVL?	+ILOGLVL:<level> OK
Set Command	AT+ILOGLVL=<level>	OK or+CME ERROR:<err>
Parameters and Returns	**<level>**: Log level, defined as follows: ● 0：Disabling Log Information ● 1~5 ： Enable log information. The larger the number, the more detailed the log information **<err>**: error code	
Example	AT+ILOGLVL=1 OK	

4.2.40 Encrypt Device Triple-tuple+CKEYSPROTECT

Test Command	AT+CKEYSPROTECT=?	+CKEYSPROTECT =<ProtectKey:length is 32> OK
Inquire Command	AT+CKEYSPROTECT?	+CKEYSPROTECT:<protected > OK
Set Command	AT+CKEYSPROTECT=<key >	OK or+CME ERROR:<err>
Parameters and Returns	**<key>**: Device node's protect key **<err>**: error code	
Example	AT+CKEYSPROTECT=AABBCCDD00112233AABBCCDD00112 233 OK	
Notice	After use the command, device’s triple-tuple will be encrypted in flash, user just can read the encrypted data but can’t change it anymore	