ASR6601

AT Command Set

Version 1.1.0

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About This Document

This document mainly introduces the AT command set for IoT LoRa module communication, including the configuration, operation, data transmission and reception of the LoRa module.

Intended Readers

This document is mainly for engineers who use this chip to develop their own platform and products, for instance:

- PCB Hardware Development Engineer
- Software Engineer
- Technical Support Engineer

Included Chip Models

The product models corresponding to this document are as follows.

Model	Flash	SRAM	Core	Package	Frequency
ASR6601SE	256 KB	64 KB	32-bit 48 MHz Arm China STAR-MC1 Processor	QFN68, 8*8 mm	150 ~ 960 MHz
ASR6601CB	128 KB	16 KB	32-bit 48 MHz Arm China STAR-MC1 Processor	QFN48, 6*6 mm	150 ~ 960 MHz
ASR6601SER	256 KB	64 KB	32-bit 48 MHz Arm China STAR-MC1 Processor	QFN68, 8*8 mm	150 ~ 960 MHz
ASR6601CBR	128 KB	16 KB	32-bit 48 MHz Arm China STAR-MC1 Processor	QFN48, 6*6 mm	150 ~ 960 MHz

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Revision History

Date	Version	Release Notes
2020.05	V0.1.0	First release.
2020.10	V0.2.0	Added Chapter 3: Demo Project.
2021.05	V1.1.0	Refine the structure of this document.

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1. Overview

This document mainly introduces the AT command set for IoT LoRa module communication, including the configuration, operation, data transmission and reception of the LoRa module.

1.1 Terms, Definitions and Abbreviations

1.1.1 Terms & Definitions

- **LoRa**

  LoRa is a type of LPWAN communication technology, it is an ultra-long distance wireless transmit solution based on spread spectrum technology used and promoted by Semtech.

  Features: low power consumption, long distance, low cost

- **LoRaWAN**

  LoRa Alliance® is an open and non-profit organization started by Semtech in March 2015. LoRa Alliance® released *LoRaWAN Specification*, which is a LPWAN standard based on open source MAC layer protocol.

  Network Topology: Star structure

  Network Composition: LoRa module, Gateway (base station), Server (includes network server, network control and application server)

  LoRaWAN divides LoRa modules into three classes: A/B/C

1.1.2 Abbreviations

The following abbreviations are used in this document.

Table 1-1 List of Abbreviations

Abbreviation	Full Name
MCU	Microcontroller Unit
MT	Mobile Terminal
TA	Terminal Agent
TE	Terminal Equipment

1.2 Functions

TE (Terminal Equipment) can send the AT commands referred to in this document to control MT (Mobile terminal) functions and related network services. TA (Terminal Agent) acts as the command and message adapter between TE and MT.

TE (Terminal Equipment), TA (Terminal Agent) and MT (Mobile terminal) can be physically implemented as so:

- TE, TA and MT are 3 independent entities
- TE is an independent entity, while TA is integrated in MT
- MT is an independent entity, while TA is integrated in TE
- TE, TA and MT are integrated into 1 entity

In this document, TE is the MCU of a IoT device, TA is integrated in MT. And the communication module refers to LoRa modules.

The system structure and connections between TE (Terminal Equipment), TA (Terminal Agent) & MT (Mobile terminal) are shown in Figure 1-1.

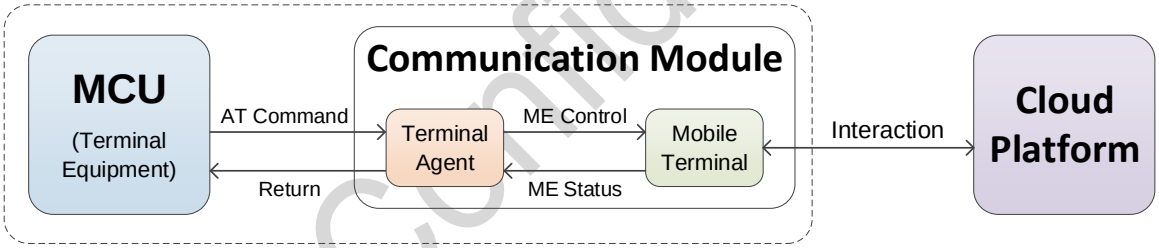

Figure 1-1 System Structure

According to Figure 1-1, MCU and the communication module are integraded into the IoT device. MCU communicates with TA through AT commands, so as to control MT (ME means mobile equipment) and realize the interaction between the IoT device and the cloud platform.

The interaction with the cloud platform is carried out through LoRa technology. In this document, the standard AT commands are extended to support LoRa commands in order to realize the communication between IoT devices and the cloud platform.

2. AT Command Syntax

AT commands use command lines based on ASCII, and the command format is as follows:

Request message format:

AT+<CMD>[OP][para-1,para-2,……para-n]<\r>

Table 2-1 AT Request Message Format

Area	Description
AT+	Command prefix
CMD	Command string
Op	Command operator, it can be the following: ● “=”: Set the parameters ● “?”: Query the current value of parameter ● “”: Executed comand ● “=?”: Query the parameters of the set command
para-1,para-2,……para-n	Parameter values or the parameter specified to be queried
\r	Enter, ASCII code: 0x0D

Response message format:

<\r\n>[+CMD:][para-1,para-2,……para-n]<\r\n>

or

<\r\n><STATUS><\r\n>

Or both of the above.

Table 2-2 AT Response Message Format

Area	Description
\r\n	Newline, ASCII code: 0x0A
+CMD	Corresponding command string
para-1,para-2,……para-n	Corresponding parameter string
STATUS	Command execution status, it can be the following: ● “OK”: the command was executed successfully ● “ERROR”: the command execution failed ● “+CME ERROR:<err>”: the command execution failed and returned the error code

Description:

(1) <>: the required contents

(2) []: optional contents

(3) \r: return, ASCII code: 0x0D

(4) \n: newline, ASCII code: 0x0A

For instance, to query the connection mode of MQTT, send the following command:

```
AT+IMQTTMODE?\r
```

And the response message is:

```
\r\n+IMQTTMODE:1\r\n

\r\nOK\r\n
```

In the following text, \r\n will be hidden for better readability.

(5) Parameter configuration of the serial port:

baud rate 115200, data bit 8, stop bit 1, parity 0.

(6) Current commands supports echo, but doesn't support BackSpace and history display for the time being.

3. Demo Project

3.1 Jumper Connection

The LORAWAN_AT project uses a low-power serial port for reception, so the jumper JP8 for serial port reception needs to be connected.

Table 3-1 Jumper Connection State

Jumper	Connection State
JP1	Connected
JP2	Connected
JP3	Connected
JP4	Connected
JP5	Connected
JP6 (only used in ASR6601CB development board)	Not connected
JP7	Connected
JP8	Connected

3.2 Code Location

LORAWAN_AT project is located in *projects\${DEMO-BOARD}\examples\lorawan\lorawan_at* directory of the SDK. ${DEMO-BOARD} is name of corresponding development board. Take ASR6601SE development board as an example, the directory will be: *projects\ASR6601SE-EVAL\examples\lorawan\lorawan_at*.

3.3 Serial Port Configuration

The serial port configuration information is as follows:

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


3.4 Brief Demonstration

Takes node A as an example to illustrate the steps of using AT commands to configure network access:

(1) **Node A information**

```
DEVEUI: 896E0FF00000240
APPEUI: D896E0E000005203
APPKEY: 077EE45C6E4564D96D76AE55AFD3AA89
Node type: ClassA
Gateway frequency group mask: 0001
```

(2) **Node 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 group mask setting**

Use AT+CFREQBANDMASK to configure the frequency group mask. Each bit of the mask represents 1 frequency group (8 frequency points), and it can represent up to 128 frequency points. For example, 0001 corresponds to 470.3-471.7 MHz. For further details, see *AT+CFREQBANDMASK* parameter description.

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

OK
```

(5) **Start connecting to the network**

```
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=1,2,3,112233

OK+SEND:03

OK+SENT:01
[1351754]receive data: rssi = -17, snr = 11, datarate = 3
[1351759]rx, ACK, index 1

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


4. LoRa AT Commands

4.1 LoRa AT Command Classification

Type	Description
General Command	Manufacturer ID, Module ID, Revision ID, Product seriel number ID
Network Related Parameters Config Command	Frequency group mask, Multicast address, Same/different frequency, Device DevEUI
Node Control and Status Command	Initiate join, Work mode, Class, Battery capacity, Module status
MAC Config Command	MAC command related to *LoRaWAN Specification*
Data Command	Send and receive data
Other Command	Set log level, Reboot the module, Restore the factory default settings
Manufacturer Private Command	LoRa manufacturer private commands

4.1.1 LoRaWAN General Commands

Command	Description	Comment
AT+CGMI	Read manufacturer identification	Optional
AT+CGMM	Read module identification	Optional
AT+CGMR	Read revision identification	Optional
AT+CGSN	Read product serial number identification	Optional
AT+CGBR	Set baud rate on UART interface	Optional

4.1.2 LoRaWAN Network Related Parameters Config Commands

Command	Description	Comment
AT+CJOINMODE	Set or read Join mode (OTAA or ABP)	Required
AT+CDEVEUI	Set or read DevEUI (based on OTAA)	Required
AT+CAPPEUI	Set or read AppEUI (based on OTAA)	Required
AT+CAPPKEY	Set or read AppKey (based on OTAA)	Required
AT+CDEVADDR	Set or read DevAddr (based on ABP)	Required
AT+CAPPSKEY	Set or read AppSkey (based on ABP)	Required
AT+CNWKSKEY	Set or read NwkSkey (based on ABP)	Required
AT+CFREQBANDMASK	Set or read frequency group mask (FreqBandMask)	Required
AT+CULDLMODE	Set or read Ul/Dl mode (same/different frequency)	Required
AT+CADDMUTICAST	Add the multicast address	Optional
AT+CDELMUTICAST	Delete the multicast address	Optional
AT+CNUMMUTICAST	Query the number of multicasts	Optional

4.1.3 LoRaWAN Node Control and Status Commands

Command	Description	Comment
AT+CWORKMODE	Set or read working mode (normal working mode)	Required
AT+CCLASS	Set or read class (Class A/B/C)	Required
AT+CBL	Read battery level	Optional
AT+CSTATUS	Read node status	Required
AT+CJOIN	Send OTAA Join request	Required
AT+CPINGSLOTINFOREQ	Send pingslot information request	Optional

4.1.4 LoRaWAN Data Commands

Command	Description	Comment
AT+DTRX	Send and receive data frames	Required
AT+DRX	Get the latest received data from Rx buffer and clear Rx buffer	Required

4.1.5 LoRaWAN MAC Config Commands

Command	Description	To apply
AT+CCONFIRM	Set or read the type of sent message (confirm or unconfirm)	Required
AT+CAPPPORT	Set or read application layer port	Required
AT+CDATARATE	Set or read data rate	Required
AT+CRSSI	Get the channel RSSI	Required
AT+CNBTRIALS	Set or read NbTrans parameters	Required
AT+CRM	Set or read report mode	Required
AT+CTXP	Set or read transmit power	Required
AT+CLINKCHECK	Enable link check	Required
AT+CADR	Enable or disable ADR	Required
AT+CRXP	Set or read the parameters of receive window	Required
AT+CRX1DELAY	Set or read the delay of TX and RX1	Required
AT+CSAVE	Save the configuration	Required
AT+CRESTORE	Restore default configuration	Required

4.1.6 Other Commands

Command	Description	To apply
AT+IREBOOT	Reboot the communication module	Optional
AT+ILOGLVL	Set log level	Optional

4.1.7 Manufacturer Private Commands

Command	Description	To apply
AT+CKEYSPROTECT	Device key encryption command	Optional

4.2 AT Commands Descriptions

4.2.1 Read Manufacturer ID: +CGMI

Query Command and Response	AT+CGMI?	+CGMI=<manufacturer> OK
Parameters and Returned Values	**<manufacturer>**: Manufacturer ID	
Example	AT+CGMI? +CGMI=ASR OK	

4.2.2 Read Module ID: +CGMM

Query Command and Response	AT+CGMM?	+CGMM=<model> OK
Parameters and Returned Values	**<model>**: Module ID	
Example	AT+CGMM? +CGMM=6601 OK	

4.2.3 Read Version Information: +CGMR

Query Command and Response	AT+CGMR?	+CGMR=<revision> OK
Parameters and Returned Values	**<revision>**: Version information	
Example	AT+CGMR? +CGMR=v1.1.0 OK	

4.2.4 Read the Product Serial Number: +CGSN

Query Command and Response	AT+CGSN?	+CGMR=<sn> OK
Parameters and Returned Values	**<sn>**: Product serial number	
Example	AT+CGSN? +CGSN=0539349E00032523 OK	

4.2.5 Set the Baud Rate: +CGBR

Query Command and Response	AT+CGBR?	+CGBR=<baud> OK
Set Command and Response	AT+CGBR=<baud>	OK
Parameters and Returned Values	**<baud>**: Baud rate	
Example	AT+CGBR=9600 OK	
Note	Because LPUART is used, the baud rate cannot exceed 9600	

4.2.6 Set or Read Join Method: +CJoinMODE

Test Command and Response	AT+CJoinMODE=?	+CJoinMODE:“mode” OK
Query Command and Response	AT+CJoinMODE?	+CJoinMODE:<mode> OK
Execute Command and Response	AT+CJoinMODE=<mode>	OK or +CME ERROR:<err>
Parameters and Returned Values	**<mode>**: The node Join method is as follows: ● 0: OTAA ● 1: ABP **<err>**: Error code	
Example	AT+CJoinMODE=0 OK	
Note	OTAA method is used by default. If you need to use ABP network access, please set it via this command before sending data.	

4.2.7 Set or Read DevEUI: +CDEVEUI

Test Command and Response	AT+CDEVEUI=?	+CDEVEUI=<DevEUI:length is 16>
Query Command and Response	AT+CDEVEUI?	+CDEVEUI:<value> OK
Execute Command and Response	AT+CDEVEUI=<value>	OK or +CME ERROR:<err>
Parameters and Returned Values	**<value>**: Node DevEUI	
Example	AT+CDEVEUI? +CDEVEUI=AABBCCDD00112233 OK	
Note	Set or read DevEUI, return Y1Y2...Y8, in hex format, 8 Bytes	

4.2.8 Set or Read AppEUI: +CAPPEUI

Test Command and Response	AT+CAPPEUI=?	+CAPPEUI=<AppEUI:length is 16>
Query Command and Response	AT+CAPPEUI?	+CAPPEUI:<value> OK
Execute Command and Response	AT+CAPPEUI=<value>	OK or +CME ERROR:<err>
Parameters and Returned Values	**<value>**: Node AppEUI **<err>**: Error code	
Example	AT+CAPPEUI=AABBCCDD00112233 OK	
Note	Used in OTAA, set or read AppEUI, return Y1Y2...Y8, in hex format, 8 Bytes	

4.2.9 Set or Read AppKey: +CAPPKEY

Test Command and Response	AT+CAPPKEY=?	+CAPPKEY=<AppKey:length is 32>
Query Command and Response	AT+CAPPKEY?	+CAPPKEY:<value> OK
Execute Command and Response	AT+CAPPKEY=<value>	OK or +CME ERROR:<err>
Parameters and Returned Values	**<value>**: Node AppKey **<err>**: Error code	
Example	AT+CAPPKEY=AABBCCDD00112233AABBCCDD00112233 OK	
Note	Used in OTAA, set or read AppKey, return Y1Y2...Y16, in hex format, 16 Bytes	

4.2.10 Set or Read DevAddr: +CDEVADDR

Test Command and Response	AT+CDEVADDR=?	+CDEVADDR=<DevAddr:length is 8, Device address of ABP mode>
Query Command and Response	AT+CDEVADDR?	+CDEVADDR:<value> OK
Execute Command and Response	AT+CDEVADDR=<value>	OK or +CME ERROR:<err>
Parameters and Returned Values	**<value>**: Node DevAddr **<err>**: Error code	
Example	AT+CDEVADDR=00112233 OK	
Note	Used in ABP, set or read DevAddr, return Y1Y2...Y4, in hex format, 4 Bytes	

4.2.11 Set or Read AppSKey: +CAPPSKEY

Test Command and Response	AT+CAPPSKEY=?	+CAPPSKEY=<AppSKey:length is 32>
Query Command and Response	AT+CAPPSKEY?	+CAPPSKEY:<value> OK
Execute Command and Response	AT+CAPPSKEY=<value>	OK or +CME ERROR:<err>
Parameters and Returned Values	**<value>**: Node AppSKey **<err>**: Error code	
Example	AT+CAPPSKEY=AABBCCDD00112233AABBCCDD00112233 OK	
Note	Used in ABP, set or read AppSKey, return Y1Y2...Y16, in hex format, 16 Bytes	

4.2.12 Set or Read NwkSKey: +CNWKSKEY

Test Command and Response	AT+CNWKSKEY=?	+CNWKSKEY =<NwkSKey:length is 32>
Query Command and Response	AT+CNWKSKEY?	+CNWKSKEY:<value> OK
Execute Command and Response	AT+CNWKSKEY=<value>	OK or +CME ERROR:<err>
Parameters and Returned Values	**<value>**: Node NwkSKey **<err>**: Error code	
Example	AT+CNWKSKEY=AABBCCDD00112233AABBCCDD00112233 OK	
Note	Used in ABP, set or read NwkSKey, return Y1Y2...Y16, in hex format, 16 Bytes	

4.2.13 Set or Read Frequency Group Mask: +CFREQBANDMASK

Test Command and Response	AT+CFREQBANDMASK=?	+CFREQBANDMASK:“mask” OK
Query Command and Response	AT+CFREQBANDMASK?	+CFREQBANDMASK:<mask> OK
Execute Command and Response	AT+CFREQBANDMASK=<mask>	OK or +CME ERROR:<err>
Parameters and Returned Values	**<mask>**: The frequency group mask that the network may work on. 16 bits correspond to 16 frequency groups. For details, please refer to *LoRaWAN Specification*. A brief example is given below. For example: the mask for channels 0-7 is 0001, the mask for channels 8-15 is 0002, and so on. Check *LoRaWAN Regional Parameters* to get the frequency corresponding to the specific channel. For instance, channels 0-7 corresponds to: 470.3, 470.5, 470.7, 470.9, 471.1, 471.3, 471.5, 471.7 (unit: MHz) under CN470 protocol. **<err>**: Error code	
Example	AT+CFREQBANDMASK=0001 OK	
Note	Set frequency group mask before Join.	

4.2.14 Set or Read Same/Different Frequency in Uplink/Downlink: +CULDLMODE

Test Command and Response	AT+CULDLMODE=?	+CULDLMODE:“mode” OK
Query Command and Response	AT+CULDLMODE?	+CULDLMODE:<mode> OK
Execute Command and Response	AT+CULDLMODE=<mode>	OK or +CME ERROR:<err>
Parameters and Returned Values	**<mode>**: ● 1: Same frequency mode ● 2: Different frequency mode **<err>**: Error code	
Example	AT+CULDLMODE=2 OK	
Note	Set same/different frequency in uplink/downlink before Join.	

4.2.15 Set or Read the Working Mode: +CWORKMODE

Test Command and Response	AT+CWORKMODE=?	+CWORKMODE:“mode” OK
Query Command and Response	AT+CWORKMODE?	+CWORKMODE:<mode> OK
Execute Command and Response	AT+CWORKMODE=<mode>	OK or +CME ERROR:<err>
Parameters and Returned Values	**<mode>**: ● 2: Normal working mode **<err>**: Error code	
Example	AT+CWORKMODE=2 OK	
Note	Set the working mode before Join, and the default is normal working mode. Currently, only normal working mode is supported.	

4.2.16 Set or Read the Class: +CCLASS

Test Command and Response	AT+CCLASS=?	+CCLASS:“class”,“branch”,“para1”,“para2”,“para3” ,“para4” OK
Query Command and Response	AT+CCLASS?	+CCLASS:<class> OK
Execute Command and Response	AT+CCLASS=<class>,[branch],[para1],[para2],[para3] , [para4]	OK or +CME ERROR:<err>
Parameters and Returned Values	**<class>**: ● 0: classA ● 1: classB ● 2: classC According to different device types, following parameters are avalible as an option: ● If <class>=1, and [branch]=0, then: There is only [para1], which is used to set the Ping slot periodicity, ranging from 0 to 7, and the corresponding cycle time is 0.96*2^ periodicity seconds. ● If <class>=1, and [branch]=1, then: [para1] is used to set the frequency of beacon (unit: Hz) [para2] is used to set beacon DataRate [para3] is used to set ping frequency (unit: Hz) [para4] is used to set ping DataRate For the value range of each parameter, see *LORAWAN Specification*. **<err>**: Error code	
Example	AT+CCLASS=2 OK	
Note	Set class before Join, and the default is ClassA.	

4.2.17 Query the Power Level of the Device: +CBL

Test Command and Response	AT+CBL=?	+CBL:“value” OK
Query Command and Response	AT+CBL?	+CBL:<value> OK
Parameters and Returned Values	**<value>**: Node power level, see *LoRaWAN Specification* for detailed definition.	
Example	AT+CBL? +CBL=0 OK	
Note	Query the power level of the device.	

4.2.18 Query the Status of the Device: +CSTATUS

Test Command and Response	AT+CSTATUS=?	+CSTATUS:”status” OK
Query Command and Response	AT+CSTATUS?	+CSTATUS:<status> OK
Parameters and Returned Values	**<status>**: The current uplink result is defined as follows: ● 00: No operation ● 01: Sending data ● 02: Failed to send data ● 03: Sent data successfully ● 04: Join is successful (only appears in the first Join process) ● 05: Join failed (only appeared in the first Join process) ● 06: Network may be abnormal (link check result) ● 07: Sent data successfully, no downlink ● 08: Sent data successfully, there is downlink data	
Example	AT+CSTATUS? +CSTATUS=03 OK	
Note	Query the current status of the device	

4.2.19 Set Join: +CJoin

Test Command and Response	AT+CJoin=?	+CJoin:<ParaTag1>,[ParaTag2],…[ParaTag4] OK
Query Command and Response	AT+CJoin?	+CJoin:<ParaValue1>,[ParaValue2],…[ParaValue4] OK
Execute Command and Response	AT+CJoin =<ParaValue1>,[ParaValue2], …[ParaValue4]	OK or +CME ERROR:<err> If the input is valid, the device will first return “OK”, then start automatic authentication, and return the authentication result: +CJoin:OK Authentication succeeded +CJoin:FAIL Authentication failed
Parameters and Returned Values	**<ParaTag1>**, **[ParaTag2]**, ……**[ParaTag4]**: Names of authentication parameters 1, 2, ...4. **<ParaValue1>**, **[ParaValue2]**, ……**[ParaValue4]**: Values of authentication parameters 1, 2, ...4. **<ParaTag1>**: execute Join related operations: ● 0: Stop Join ● 1: Start Join or restart the Join process. For modules with hot start enabled, executing this operation will clear the saved Join context parameters. **[ParaTag2]**: Defines whether to enable automatic Join. The factory default setting is 1. ● 0: Disable automatic Join ● 1: Enable Automatic Join. After the module enters the transparent transmission mode, Join is automatically started. **[ParaTag3]**: Join cycle, range: 7~255 (unit: s). The factory default setting is 8. **[ParaTag4]**: The maximum trial number to Join, range: 1~256. See *LoRaWAN Specification* for details. **<err>**: Error code	
Example	AT+CJoin=1,0,10,8 (Set Join parameters: turn off automatic Join; the Join cycle is 10s, and the maximum number of attempts is 8) OK +CJoin:OK	
Note		

4.2.20 Send and Receive Data: +DTRX

Test Command and Response	AT+DTRX=?	+DTRX:[confirm],[nbtrials],<Length>,<Payload> OK
Execute Command and Response	AT+DTRX=[confirm],[nbtrials],<Length>,<Payload>	OK+SEND:TX_LEN OK+SENT:TX_CNT OK+RECV:TYPE,PORT,LEN,DATA or ERR+SEND:ERR_NUM ERR+SENT:TX_CNT or +CME ERROR:<err>
Parameters and Returned Values	**[confirm]** and **[nbtrials]** are only valid for this transmission and are optional. **<Length>**: Indicates the number of strings, see *LoRaWAN Specification* for the maximum value. The length of bytes allowed to be transmitted at different rates is different (see *LoRaWan Specification* for details). 0 means sending empty data packets. **<Payload>**: Hex format (2 characters represent 1 number) **Returned Values Q&A**: 1. How to judge whether the data is sent successfully? ● For Confirmed Message: Every time a frame of data is sent, there will be a corresponding response. When the module does not receive a response and time is out, it will try again until the maximum number of attempts is reached. During this time, if it doesn't receive the downlink message, the data transmission is failed and the device will output "ERR+SENT"; if the transmission ends after receiving a response, which means it is successful, and the device will output "OK+SEND", "OK+SENT" and "OK+RECV". ● For Unconfirmed Message: After sending data, no downlink response will be requested. And it will return "OK+SEND" and "OK+SENT" at the end of each transmission. If a downlink response is received, the device will also output "OK+RECV". 2. What are the reminders of the data sending status: ● ***OK+SEND:TX_LEN*** means that the data sending request is successful. TX_LEN: 1 Byte, indicating the length of the data sent. ● ***OK+SENT:TX_CNT*** means that the data was sent successfully. TX_CNT: 1 Byte, indicating the number of data transmissions. ● ***ERR+SEND:ERR_NUM*** means that the data sending request failed. The reason is indicated by ERR_NUM. ERR_NUM: 1 Byte, the meaning of the error code is as follows:	

	◆ 0: Unjoined ◆ 1: The communication is busy and the sending request failed. ◆ 2: The data length exceeds the specified length. Only the MAC command can be sent. ● ***ERR+SENT:TX_CNT*** means that the data transmission failed and the number of transmissions has reached the maximum. TX_CNT: 1 Byte, indicating the number of data transmissions. ● ***OK+RECV:TYPE,PORT,LEN,DATA*** means that the data is successfully received (received a response message or downlink data). ◆ TYPE: 1 Byte, downlink message type ◆ Bit0: – 0: Unconfirm – 1: Confirm ◆ Bit1: – 0: Not ACK – 1: ACK ◆ Bit2: – 0: No LINK command response – 1: The LINK command response is carried in the downlink data ◆ Bit3: – 0: Not carried – 1: The TIME command response is carried in the downlink data. Only when this bit is set to 1, it means that the time synchronization is successful. ◆ Bit4~Bit7: Reserved, and the default is 0 ◆ PORT: 1 Byte, downlink transmission port ◆ LEN: 1 Byte, downlink data length ◆ DATA: n Bytes, downlink data, when LEN=0, this field does not exist. **<err>**: Error code
Example	AT+DTRX=1,2,5,0123456789 OK+SEND:05 OK+SENT:01 OK+RECV:02,01,00 This example indicates that the Confirm Data is sent successfully, the valid data received by the server should be: 0x01 0x23 0x45 0x67 0x89, and the downlink confirmation is received.
Note	First Join, then send data.

4.2.21 Receive Data: +DRX

Test Command and Response	AT+DRX=?	+DRX:<Length>,<Payload> OK
Query Command and Response	AT+DRX?	+DRX:<Length>,<Payload> OK or +CME ERROR:<err>
Parameters and Returned Values	**<Length>**: 0 means empty data packet **<Payload>**: Hexadecimal string data **OK**: Receive data packets normally **<err>**: Error code	
Example	AT+DRX? OK	
Note	Receive data packets from the receive buffer and clear the receive buffer.	

4.2.22 Set or Read the Type of Uplink Message: +CCONFIRM

Test Command and Response	AT+CCONFIRM=?	+CCONFIRM:“value” OK
Query Command and Response	AT+CCONFIRM?	+CCONFIRM:<value> OK
Execute Command and Response	AT+CCONFIRM =<value>	OK or +CME ERROR:<err>
Parameters and Returned Values	**<value>**: ● 0: Need to confirm the uplink message ● 1: No need to confirm the uplink message **<err>**: Error code	
Example	AT+CCONFIRM=1 OK	
Note		

4.2.23 Set or Read the Uplink Data Port Number: +CAPPPORT

Test Command and Response	AT+CAPPPORT=?	+CAPPPORT:“value” OK
Query Command and Response	AT+CAPPPORT?	+CAPPPORT:<value> OK
Execute Command and Response	AT+CAPPPORT=<value>	OK or +CME ERROR:<err>
Parameters and Returned Values	**<value>**: The data format of the port used by applications is decimal, range: 1~223, and the factory default setting is 10. *Note: Port:0x00 is the LoRaWAN MAC command.* **<err>**: Error code	
Example	AT+CAPPPORT=10 OK	
Note	Set the uplink data port number before sending data.	

4.2.24 Set or Read the Data Rate: +CDATARATE

Test Command and Response	AT+CDATARATE=?	+CDATARATE:“value” OK
Query Command and Response	AT+CDATARATE?	+CDATARATE:<value> OK
Execute Command and Response	AT+CDATARATE=<value>	OK or +CME ERROR:<err>
Parameters and Returned Values	**<value>**: Rate value. The factory default setting is 3, and the value range is as follows: ● 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	
Note	Set the data rate before sending data. If ADR is enabled, DATARATE cannot be changed. If you need to change DATARATE, please execute command *AT+CADR=0* first.	

4.2.25 Query Channel Signal Strength: +CRSSI

Test Command and Response	AT+CRSSI=?	+CRSSI OK
Query Command and Response	AT+CRSSI FREQBANDIDX?	+CRSSI: 0:<Channel 0 rssi> 1:<Channel 1 rssi> … 7:<Channel 8 rssi> OK
Parameters and Returned Values	**<FREQBANDIDX>**: The number of the frequency band, starting from 0, the 1A2 group number is 1. Returns the RSSI of 8 channels in a frequency band.	
Example	AT+CRSSI 1? +CRSSI: 0:-157 1:-157 2:-157 3:-157 4:-157 5:-157 6:-157 7:-157 OK	
Note	This command only supports CN470A.	

4.2.26 Set or Read the Maximum Trials of Data Transmission: +CNBTRIALS

Test Command and Response	AT+CNBTRIALS=?	+CNBTRIALS: “MType”,“value” OK
Query Command and Response	AT+CNBTRIALS?	+CNBTRIALS:<MType>,<value> OK
Execute Command and Response	AT+CNBTRIALS=<MType>,<value>	OK or +CME ERROR:<err>
Parameters and Returned Values	**<MType>**: ● 0: Unconfirm package ● 1: Confirm package **<value>**: The maximum trials of data transmission, range: 1~15 **<err>**: Error code	
Example	AT+CNBTRIALS=1,2 OK	
Note	Set the maximum trials of data transmission before sending data.	

4.2.27 Set or Read the Report Mode: +CRM

Test Command and Response	AT+CRM=?	+CRM:“reportMode”,”reportInterval” OK
Query Command and Response	AT+CRM?	+CTXP:<reportMode>,[reportInterval] OK
Execute Command and Response	AT+CTXP=<reportMode>,[reportInterval]	OK or +CME ERROR:<err>
Parameters and Returned Values	This command is mainly used in testing. **<reportMode>**: ● 0: Report data aperiodically ● 1: Report data periodically **<reportInterval>**: This parameter is only available when reporting data periodically. The interval of reporting data periodically is in seconds. For different DRs, the minimum allowable period is different: **<err>**: Error code	
Example	AT+CRM=1,10 OK	
Note	Set the data report mode before sending data.	

4.2.28 Set or Read the Transmit Power: +CTXP

Test Command and Response	AT+CTXP=?	+CTXP:“value” OK
Query Command and Response	AT+CTXP?	+CTXP:<value> OK
Execute Command and Response	AT+CTXP=<value>	OK or +CME ERROR:<err>
Parameters and Returned Values	**<value>**: transmission power, the factory value is 0, and the actual value range is related to the final product. In the frequency band specified by CN470A, the value range is as follows: ● 0: 17 dBm ● 1: 15 dBm ● 2: 13 dBm ● 3: 11 dBm ● 4: 9 dBm ● 5: 7 dBm ● 6: 5 dBm ● 7: 3 dBm **<err>**: Error code	
Example	AT+CTXP=1 OK	
Note	Set transmit power before sending data.	

4.2.29 Verify Network Connection: +CLINKCHECK

Test Command and Response	AT+CLINKCHECK=?	+CLINKCHECK:“value” OK
Execute Command and Response	AT+CLINKCHECK=<value>	OK +CLINKCHECK: <Y0>, <Y1>, <Y3>, <Y4> or +CME ERROR:<err>
Parameters and Returned Values	**<value>**: Link check enable control, it is defined as follows: ● 0: Disable link check ● 1: Perform link check once ● 2: The module automatically carries the linkcheck command in each uplink data packet If the device returns “OK”, the setting is successful. If <value>=1, after waiting for a period of time, the second response message will be returned in below format: *+CLINKCHECK: <Y0>, <Y1>, <Y3>, <Y4>* ● Y0 is the link check result: ◆ 0: Network connection is ok ◆ Non-0: No network connection ● Y1 is DemodMargin ● Y2 is NbGateways ● Y3 is RSSI for this downlink ● Y4 is SNR for this downlink **<err>**: Error code	
Example	AT+CLINKCHECK=1 OK +CLINKCHECK: 0, 0, 1, -68, 8	
Note	Set link check before sending data.	

4.2.30 Enable/Disable ADR: +CADR

Test Command and Response	AT+CADR=?	+CADR:“value” OK
Query Command and Response	AT+CADR?	+CADR:<value> OK
Execute Command and Response	AT+CADR=<value>	OK or +CME ERROR:<err>
Parameters and Returned Values	**<value>**: ADR enable control and the factory default setting is 1. ● 0: Disable ADR ● 1: Enable ADR **<err>**: Error code	
Example	AT+CADR=1 OK	
Note	Set it before sending data. ADR is enabled by default.	

4.2.31 Set or Read the Parameters of Receiving Window: +CRXP

Test Command and Response	AT+CRXP=?	+CRXP:“RX1DRoffest”,”RX2DataRate”, ”RX2Frequency” OK
Query Command and Response	AT+CRXP?	+CRXP:<RX1DRoffest>,<RX2DataRate>,<RX2Frequency> OK
Execute Command and Response	AT+CRXP=<RX1DRoffest>,<RX2DataRate>,<RX2Frequency>	OK or +CME ERROR:<err>
Parameters and Returned Values	**<RX1DRoffest>**, **<RX2DataRate>**, **<RX2Frequency>**: Please refer to *LoRaWAN Specification* for details. **<err>**: Error code	
Example	AT+CRXP=1,1,471000000 OK	
Note	Set it before sending data. If it is not set, the default value will be used.	

4.2.32 Set or Read the Delay of Sending and Receiving: +CRX1DELAY

Test Command and Response	AT+CRX1DELAY=?	+CRX1DELAY:“Delay” OK
Query Command and Response	AT+CRX1DELAY?	+CRX1DELAY:<Delay> OK
Execute Command and Response	AT+CRX1DELAY=<Delay>	OK or +CME ERROR:<err>
Parameters and Returned Values	**<Delay>**: This parameter is used to configure for how long to open the RX1 window after sending data (unit: s). **<err>**: Error code	
Example	AT+CRX1DELAY=2 OK	
Note	Set it before sending data. If it is not set, the default value will be used.	

4.2.33 Save the MAC Parameter Settings: +CSAVE

Test Command and Response	AT+CSAVE=?	+CSAVE OK
Execute Command and Response	AT+CSAVE	OK or +CME ERROR:<err>
Parameters and Returned Values	This command saves the MAC configuration parameters to EEPROM/FLASH. After reboot, the module will use the saved MAC configuration parameters for network initialization and operation. **<err>**: Error code	
Example	AT+CSAVE OK	
Note	Save the MAC parameter settings before sending data.	

4.2.34 Restore the Default MAC Configuration Parameters: +CRESTORE

Test Command and Response	AT+CRESTORE=?	+CRESTORE OK
Execute Command and Response	AT+CRESTORE	OK or +CME ERROR:<err>
Parameters and Returned Values	This command restores the default MAC configuration parameters to EEPROM/ FLASH. **<err>**: Error code	
Example	AT+CRESTORE OK	
Note		

4.2.35 PingSlotInfo Request: + CPINGSLOTINFOREQ

Test Command and Response	AT+CPINGSLOTINFOREQ=?	+CPINGSLOTINFOREQ:<periodicity> OK
Query Command and Response	AT+CPINGSLOTINFOREQ?	+CPINGSLOTINFOREQ:<periodicity> OK
Execute Command and Response	AT+CPINGSLOTINFOREQ=<periodicity>	OK or +CME ERROR:<err>
Parameters and Returned Values	**<periodicity>**: Ping slot period **<err>**: Error code	
Example	AT+CPINGSLOTINFOREQ=3 OK	
Note	This command is dedicated for ClassB.	

4.2.36 Add Multicast Address: +CADDMUTICAST

Test Command and Response	AT+CADDMUTICAST=?	+CADDMUTICAST:"DevAddr","AppSKey","NwkSKey","Periodicity","Datarate" OK
Execute Command and Response	AT+CADDMUTICAST=<DevAddr>,<AppSKey>,<NwkSKey>,[Periodicity],[Datarate]	OK or +CME ERROR:<err>
Parameters and Returned Values	**<DevAddr>**: Multicast address **<AppSKey>**: Multicast application session key **<NwkSKey>**: Multicast network session key **[Periodicity]**: Ping slot period **[Datarate]**: Data rate **<err>**: Error code	
Example	AT+CADDMUTICAST=67678d5e,5ac8eb2016f11f19ad19d7f530592c44,59543069010279fa7317f85f47c46926, 2, 2 OK	
Note	Add multicast address before Join.	

4.2.37 Delete Multicast Address: +CDELMUTICAST

Test Command and Response	AT+CDELMUTICAST=?	+CDELMUTICAST:"DevAddr" OK
Execute Command and Response	AT+CDELMUTICAST=<DevAddr>	OK or +CME ERROR:<err>
Parameters and Returned Values	**<DevAddr>**: Multicast address **<err>**: Error code	
Example	AT+CDELMUTICAST=67678d5e OK	

4.2.38 Query the Number of Multicasts: +CNUMMUTICAST

Test Command and Response	AT+CNUMMUTICAST=?	+CNUMMUTICAST:"number" OK
Query Command and Response	AT+CNUMMUTICAST?	+CNUMMUTICAST:<number> OK
Parameters and Returned Values	**<number>**: The number of multicasts	
Example	AT+CNUMMUTICAST? +CNUMMUTICAST:0 OK	

4.2.39 Reboot the Module: +IREBOOT

Test Command and Response	AT+IREBOOT=?	+IREBOOT:"Mode" OK
Execute Command and Response	AT+IREBOOT=<mode>	OK or +CME ERROR:<err>
Parameters and Returned Values	**<mode>**: Reboot mode, it is defined as follows: ● 0: Reboot the module immediately ● 1: Reboot after the current transmission is completeted **<err>**: Error code	
Example	AT+IREBOOT=1 OK	
Note	After the module receives this command, it will return “OK” and reboot itself. Before the reboot is completed, no subsequent AT commands will be received.	

4.2.40 Set the Log Level: +ILOGLVL

Test Command and Response	AT+ILOGLVL=?	+ILOGLVL:“level” OK
Query Command and Response	AT+ILOGLVL?	+ILOGLVL:<level> OK
Execute Command and Response	AT+ILOGLVL=<level>	OK or +CME ERROR:<err>
Parameters and Returned Values	**<level>**: Log level, it is defined as follows: ● 0: Disable 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	

4.2.41 Encrypt Device Keys: +CKEYSPROTECT

Test Command and Response	AT+CKEYSPROTECT=?	+CKEYSPROTECT =<ProtectKey:length is 32> OK
Query Command and Response	AT+CKEYSPROTECT?	+CKEYSPROTECT:<protected> OK
Execute Command and Response	AT+CKEYSPROTECT=<key>	OK or +CME ERROR:<err>
Parameters and Returned Values	**<key>**: Node protection key **<err>**: Error code	
Example	AT+CKEYSPROTECT=AABBCCDD00112233AABBCCDD00112233 OK	
Note	After using this command, the device information will be stored encrypted. The cipher text can only be read and cannot be modified.	

