RAK3172 Module AT Command Manual

Introduction

RAK3172 WisDuo module is based on STM32WLE5CC chip and it is designed to simplify LoRaWAN and LoRa point to point (P2P) communication. To integrate LoRa technology into your projects, RAK3172 implemented easy to use UART communication interface where you can send AT commands. Through these AT commands, you can set the parameters needed for LoRa P2P and LoRaWAN communication. You can also use any microcontroller with UART interface to control the RAK3172 module.

The UART serial communication is exposed on the UART2 (also identified as **LPUART1 port**), through **Pin 2 (TX2)** and **Pin 1 (RX2)**. The default parameters of the UART2 communication are **9600 / 8-N-1**. The firmware upgrade is also possible through this port. To get familiar with the pin distribution of this module and find a schematic circuit of a reference application, refer to the RAK3172 Module Datasheet.

Links to Quick Start Guide

For AT commands example usage, you can check these sections of quick start guide:

- RAK3172 TTN OTAA Guide - How to add OTAA device on TTN and what AT commands to use on RAK3172 OTAA activation.
- RAK3172 TTN ABP Guide - How to add ABP device on TTN and what AT commands to use on RAK3172 ABP activation.
- RAK3172 Chirpstack OTAA Guide - How to add OTAA device to Chirpstack and what AT commands to use on RAK3172 OTAA activation.
- RAK3172 Chirpstack ABP Guide - How to add ABP device on Chirpstack and what AT commands to use on RAK3172 ABP activation.
- LoRa P2P - Point to point communication between two RAK3172 modules.

AT Command Syntax

The AT command is based on ASCII characters. In general, the AT Command starts with the prefix `AT` and ends with `<CR><LF>` (i.e. \r\n). For the rest of the document, the `\r\n` part is omitted for the sake of clarity.

The AT commands have the standard format “AT+XXX”, with XXX denoting the command.

There are four available command formats:

AT COMMAND FORMAT	Description
AT+XXX?	Provides a short description of the given command
AT+XXX=?	Reading the current value on the command
AT+XXX= `<input parameter>`	Writing configuration on the command
AT+XXX	Used to run a command

The output of the commands is returned via UART.

The format of the reply is divided into two parts: returned value and the status return code.

> 📝 **NOTE:**
>
> `<CR>` stands for “carriage return” and `<LF>` stands for “line feed”

1. **`<value><CR><LF>`** is the first reply when (**AT+XXX?**) command description or (**AT+XXX=?**) reading value is executed then it will be followed by the status return code. The formats with no return value like (**AT+XXX= `<input parameter>`) writing configuration command and (**AT+XXX**) run command will just reply the status return code.

2. **`<CR><LF><STATUS><CR><LF>`** is the second part of the reply which is the status return code.

The possible status are:

STATUS RETURN CODE	Description
`OK`	Command executed correctly without error.
`AT_ERROR`	Generic error or input is not supported.
`AT_PARAM_ERROR`	The input parameter of the command is wrong.
`AT_BUSY_ERROR`	The network is busy so the command is not completed.
`AT_TEST_PARAM_OVERFLOW`	The parameter is too long.
`AT_NO_NETWORK_JOINED`	Module is not yet joined to a network.
`AT_RX_ERROR`	Error detected during the reception of the command
`AT_DUTYCYLE_RESTRICTED`	Duty cycle limited and cannot send data

More details on each command description and examples are given in the remainder of this section.

> 📝 **NOTE ON EXAMPLES:**
>
> On the examples of AT Commands on this document, ATE is active therefore each input AT Command is printed before the return values and status return code. It is preceded by **>** symbol to quickly identify it.

General Commands

This section describes the generic commands related to “attention” help list, link control and CPU AT_Slave reset.

AT

Description: Attention

This command is used to check that the UART communication link is working properly.

Command	Input Parameter	Return Value	Return Code
AT	-	-	`OK`

ATZ

Description: MCU reset

This command is used to trigger an MCU reset.

Command	Input Parameter	Return Value	Return Code
ATZ?	-	`ATZ Trig a MCU reset`	`OK`
ATZ	-	*No return. MCU resets.*	`OK`

ATR

Description: Restore default parameters

This command restores all parameters to the initial default values of the module.

Command	Input Parameter	Return Value	Return Code
ATR?	-	-	`OK`
ATR	-	-	`OK`

ATE

Description: Set command echo

This command allows the user to see the AT command input on the Serial Terminal.

Command	Input Parameter	Return Value	Return Code
ATE?	-	`ATE Set command echo`	`OK`
ATE	-	-	`OK`

AT+SN

Description: Serial number

This command can read the device serial number.

Command	Input Parameter	Return Value	Return Code
AT+SN?	-	`AT+SN read the device serial number`	`OK`
AT+SN=?	-	`0080E11500004CF6`	`OK`

Keys, IDs and EUIs management

This section describes the commands related to the activation of the end device. EUI's and Keys are **MSB first**.

AT+DEVEUI

Description: Device EUI or DEVEUI

This command allows the user to access and configure the device EUI or DEVEUI.

Command	Input Parameter	Return Value	Return Code
AT+DEVEUI?	-	`AT+DEVEUI=<XXXXXXXXXXXXXXXX><CR>. Get or Set the Device EUI`	`OK`
AT+DEVEUI=?	-	*< 8 hex >*	`OK`
AT+DEVEUI= `<Input Parameter>`	*< 8 hex >*	-	`OK` or `AT_PARAM_ERROR`

Examples:

```
> AT+DEVEUI?
AT+DEVEUI=<XXXXXXXXXXXXXXXX><CR>. Get or Set the Device EUI

OK
> AT+DEVEUI=1122334455667788

OK
> AT+DEVEUI=?
1122334455667788

OK
> AT+DEVEUI=112233445566778800

AT_PARAM_ERROR
```

AT+APPEUI

Description: Application unique identifier

This command allows the user to access and configure the APPEUI.

Command	Input Parameter	Return Value	Return Code
AT+APPEUI?	-	`AT+APPEUI=<XXXXXXXXXXXXXXXX><CR>. Get or Set the App Eui`	`OK`
AT+APPEUI=?	-	*< 8 hex >*	`OK`
AT+APPEUI= `<Input Parameter>`	*< 8 hex >*	-	`OK` or `AT_PARAM_ERROR`

Examples:

```
> AT+APPEUI?
AT+APPEUI=<XXXXXXXXXXXXXXXX><CR>. Get or Set the App Eui

OK
> AT+APPEUI=0080E11500004CF6

OK
> AT+APPEUI=?
0080e11500004cf6

OK
> AT+APPEUI=0080E11500004CF61234

AT_PARAM_ERROR
```

AT+APPKEY

Description: Application key

This command allows the user to access and configure the APPKEY.

Command	Input Parameter	Return Value	Return Code
AT+APPKEY?	-	`AT+APPKEY=<XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX><CR>. Get or Set the Application Key`	`OK`
AT+APPKEY=?	-	*< 16 hex >*	`OK`
AT+APPKEY= `<Input Parameter>`	*< 16 hex >*	-	`OK` or `AT_PARAM_ERROR`

Examples:

```
> AT+APPKEY?
AT+APPKEY=<XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX><CR>. Get or Set the Application Key

OK
> AT+APPKEY=01020AFBA1CD4D20010230405A6B7F88

OK
> AT+APPKEY=?
01020afba1cd4d20010230405a6b7f88

OK
> AT+APPKEY=01020AFBA1CD4D20010230405A6B7F

AT_PARAM_ERROR
```

AT+DEVADDR

Description: Device address or DEVADDR

This command allows the user to access and configure the device address or DEVADDR.

Command	Input Parameter	Return Value	Return Code
AT+DEVADDR?	-	`AT+DEVADDR=<XXXXXXXX><CR>. Get or Set the Device address`	`OK`
AT+DEVADDR=?	-	*< 4 hex >*	`OK`
AT+DEVADDR= `<Input Parameter>`	*< 4 hex >*	-	`OK` or `AT_PARAM_ERROR`

Examples:

```
> AT+DEVADDR?
AT+DEVADDR=<XXXXXXXXXXXXXXXX><CR>. Get or Set the Device EUI

OK
> AT+DEVADDR=01020A0B

OK
> AT+DEVADDR=?
01020a0b

OK
> AT+DEVADDR=01020A0BCC

AT_PARAM_ERROR
```

AT+APPSKEY

Description: Application session key

This command allows the user to access and configure the application session key or APPSKEY.

Command	Input Parameter	Return Value	Return Code
AT+APPSKEY?	-	`AT+APPSKEY=<XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX><CR>. Get or Set the Application Session Key`	`OK`
AT+APPSKEY=?	-	*< 16 hex >*	`OK`
AT+APPSKEY= `<Input Parameter>`	*< 16 hex >*	-	`OK` or `AT_PARAM_ERROR`

Examples:

```
> AT+APPSKEY?
AT+APPSKEY=<XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX><CR>. Get or Set the Application Session Key

OK
> AT+APPSKEY=01020AFBA1CD4D20010230405A6B7F88

OK
> AT+APPSKEY=?
01020afba1cd4d20010230405a6b7f88

OK
> AT+APPSKEY=01020AFBA1CD4D20010230405A6B7F

AT_PARAM_ERROR
```

AT+NWKSKEY

Description: Network session keys

This command allows the user to access and configure the network session keys or NWKSKEY.

Command	Input Parameter	Return Value	Return Code
AT+NWKSKEY?	-	`AT+APPSKEY= <XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX> <CR>. Get or Set the Application Session Key`	`OK`
AT+NWKSKEY=?	-	*< 16 hex >*	`OK`
AT+NWKSKEY= `<Input Parameter>`	*< 16 hex >*	-	`OK` or `AT_PARAM_ERROR`

Examples:

```
> AT+NWKSKEY?
AT+NWKSKEY=<XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX><CR>. Get or Set the Network Session Key

OK
> AT+NWKSKEY=01020AFBA1CD4D20010230405A6B7F88

OK
> AT+NWKSKEY=?
01020afba1cd4d20010230405a6b7f88

OK
> AT+NWKSKEY=01020AFBA1CD4D20010230405A6B7F

AT_PARAM_ERROR
```

Joining and Sending Data to LoRaWAN® network

This section describes the commands related to the joining process of the device to the LoRaWAN® newtork.

AT+NJM

Description: LoRaWAN® network join mode

This command allows the user to access and configure the activation method of the device either OTAA or ABP.

Command	Input Parameter	Return Value	Return Code
AT+NJM?	-	`AT+NJM Get or set the network join mode (0 = ABP, 1 = OTAA)`	`OK`
AT+NJM=?	-	`0` or `1`	`OK`
AT+NJM= `<Input Parameter>`	`0` or `1`	-	`OK` or `AT_PARAM_ERROR`

Examples:

```
> AT+NJM?
AT+NJM Get or set the network join mode (0 = ABP, 1 = OTAA)

OK
> AT+NJM=1

OK
> AT+NJM=?
1

OK
> AT+NJM=2

AT_PARAM_ERROR
```

AT+CFM

Description: Confirmed payload mode

This command allows the user to access and configure type of payload of the device.

Command	Input Parameter	Return Value	Return Code
AT+CFM?	-	AT+CFM: get or set the confirm mode (0-1)	OK
AT+CFM=?	-	0 *(if Unconfirmed) or* 1 *(if confirmed)*	OK
AT+CFM= `<Input Parameter>`	0 or 1	-	OK *or* AT_PARAM_ERROR

AT+JOIN

Description: Join LoRaWAN® network

This command allows the user to join a LoRaWAN® network.

Command	Input Parameter	Return Value	Return Code
AT+JOIN?	-	AT+JOIN: join network	OK
AT+JOIN=?	-	*Param1, Param2, Param3, Param4*	OK *or* AT_BUSY_ERROR
AT+JOIN= `<Input Parameter>`	*Param1:Param2:Param3:Param4*	-	OK
	Param1 = **Join command**: 1 for joining the network , 0 for stop joining		
	Param2 = **Auto-Join config**: 1 for Auto-join on power up) , 0 for no auto-join. (0 is default)		
	Param3 = **Reattempt interval**: 7 - 255 seconds (8 is default)		
	Param4 = **No. of join attempts**: 0 - 255 (0 is default)		

> 📝 **NOTE:**
>
> This is an asynchronous command. OK means that the device is joining. The completion of the JOIN can be verified with AT+NJS=? command.

AT+NJS

Description: Network join status

This command allows the user to check the status of the devices if it is connected to a LoRaWAN® network.

Command	Input Parameter	Return Value	Return Code
AT+NJS?	-	AT+NJS: get the join status	OK
AT+NJS=?	-	0 *(not joined) or* 1 *(joined)*	OK

AT+SEND

Description: Send payload data

This command allows the user to send LoRaWAN® payload on specific port.

Command	Input Parameter	Return Value	Return Code
AT+SEND?	-	AT+SEND: send data along with the application port	OK
AT+SEND= `<Input Parameter>`	**port**:**payload**	-	OK , AT_NO_NETOWRK_JOINED , AT_PARAM_ERROR *or* AT_BUSY_ERROR

AT+CFS

Description: Confirm status

This command allows the user to access the status of the last “SEND” command

Command	Input Parameter	Return Value	Return Code
AT+CFS?	-	AT+CFS: get the confirmation status of the last AT+SEND (0-1)	OK
AT+CFS=?	-	0 *or* 1	OK

AT+RECV

Description: Last received data

This command allows the user to get the last received data in hex format.

Command	Input Parameter	Return Value	Return Code
AT+RECV?	-	AT+RECV: print the last received data in hex format	OK
AT+RECV=?	-	**port:payload** (in HEX)	OK

> 📝 **NOTE:**
>
> When called twice, without new data received between the calls, the second AT+RECV=? returns an empty value
>
> `0:<CR><LF>`
> `<CR><LF>OK<CR><LF>`

LoRaWAN® device configuration

This section describes the commands related to the configuration of the LoRaWAN® device.

AT+ADR

Description: Adaptive data rate

This command allows the user to access and configure the adaptive data rate of the module.

Command	Input Parameter	Return Value	Return Code
AT+ADR?	-	AT+ADR= `<ADR><CR>`. Get or Set the Adaptive Data Rate setting ADR=[0:off, 1:on]	OK
AT+ADR=?	-	0 *(ADR off) or* 1 *(ARD on)*	OK
AT+ADR= `<Input Parameter>`	0 or 1	-	OK *or* AT_PARAM_ERROR

AT+CLASS

Description: LoRaWAN® class

This command allows the user to access and configure the the LoRaWAN® class of the module.

Command	Input Parameter	Return Value	Return Code
AT+CLASS?	-	AT+CLASS= `<Class><CR>`. Get or Set the Device Class=[A, B, C]	OK
AT+CLASS=?	-	A, B or C	OK
AT+CLASS= `<Input Parameter>`	A, B or C	-	OK *or* AT_PARAM_ERROR

> 📝 **NOTE:**
>
> This FW of the device supports the LoRaWAN® V1.0.3 stack

AT+DCS

Description: Duty cycle settings

This command allows the user to access and configure duty cycle settings.

Command	Input Parameter	Return Value	Return Code
AT+DCS?	-	AT+DCS= `<DutyCycle><CR>`. Get or Set the ETSI DutyCycle=[0:disable, 1:enable]	OK
AT+DCS=?	-	0 *(disabled) or* 1 *(enabled)*	OK
AT+DCS= `<Input Parameter>`	0 or 1	-	OK *or* AT_PARAM_ERROR

AT+DUTYTIME

Description: Get the duty cycle time

This command allows the user to get the duty cycle time (in seconds). The command is only used in the EU868, RU864 and EU433 frequency bands. Other frequency band query will return 0.

Command	Input Parameter	Return Value	Return Code
AT+DUTYTIME?	-	AT+DUTYTIME:Get the duty cycle time (s).	OK
AT+DUTYTIME=?	-	`<time is in seconds>`	OK

AT+DR

Description: Data rate settings

This command allows the user to access and configure data rate settings.

Command	Input Parameter	Return Value	Return Code
AT+DR?	-	`AT+DR=<DataRate><CR>. Get or Set the Tx DataRate= [0..7]`	`OK`
AT+DR=?	-	`0`, `1`, `2`, `3`, `4`, `5`, `6`, `7`	OK
AT+DR= `<Input Parameter>`	`0`, `1`, `2`, `3`, `4`, `5`, `6`, `7`	-	OK *or* AT_PARAM_ER

AT+JN1DL

Description: Join delay on RX1 window

This command allows the user to access and configure the join delay on RX1 window.

Command	Input Parameter	Return Value	Return Code
AT+JN1DL?	-	`AT+JN1Dl: get or set the joint accept delay between the end of the Tx and the join Rx window 1 in ms`	`OK`
AT+JN1DL=?	-	< *integer* >	`OK` or `AT_BUSY_ERROR`
AT+JN1DL= `<Input Parameter>`	< *integer* >	-	`OK`, `AT+BUSY_ERROR` or `AT_PARAM_ERROR`

AT+JN2DL

Description: Join delay on RX2 window

This command allows the user to access and configure the join delay on RX2 window.

Command	Input Parameter	Return Value	Return Code
AT+JN2DL?	-	`AT+JN2Dl: get or set the joint accept delay between the end of the Tx and the join Rx window 2 in ms`	`OK`
AT+JN2DL=?	-	*< integer >*	`OK` or `AT_BUSY_ERROR`
AT+JN2DL= `<Input Parameter>`	*< integer >*	-	`OK` , `AT+AT_BUSY_ERROR` or `AT_PARAM_ERROR`

AT+RX1DL

Description: Delay on RX1 window

This command allows the user to access and configure the delay on RX1 window.

Command	Input Parameter	Return Value	Return Code
AT+RX1DL?	-	`AT+RX1DL: get or set the delay between the end of the Tx and the Rx window 1 in ms`	`OK`
AT+RX1DL=?	-	*< integer >*	`OK` or `AT_BUSY_ERROR`
AT+RX1DL= `<Input Parameter>`	*< integer >*	-	`OK` , `AT_BUSY_ERROR` or `AT_PARAM_ERROR`

AT+RX2DL

Description: Delay on RX2 window

This command allows the user to access and configure the delay on RX2 window.

Command	Input Parameter	Return Value	Return Code
AT+RX2DL?	-	`AT+RX2DL: get or set the delay between the end of the Tx and the Rx window 2 in ms`	`OK`
AT+RX2DL=?	-	*< integer >*	`OK` or `AT_BUSY_ERROR`
AT+RX2DL= `<Input Parameter>`	*< integer >*	-	`OK` , `AT_BUSY_ERROR` or `AT_PARAM_ERROR`

AT+RX2DR

Description: Data Rate on RX2 window

This command allows the user to access and configure the data rate of the RX2 window.

Command	Input Parameter	Return Value	Return Code
AT+RX2DR?	-	`AT+RX2DR: get or set the Rx2 window data rate (0-7) corresponding to DR_X`	`OK`
AT+RX2DR=?	-	`0` , `1` , `2` , `3` , `4` , `5` , `6` , `7`	`OK` or `AT_BUSY_ERROR`
AT+RX2DR= `<Input Parameter>`	0,1,2,3,4,5,6,7	-	`OK` , `AT_BUSY_ERROR` or `AT_PARAM_ERROR`

AT+RX2FQ

Description: Frequency of the RX2 window

This command allows the user to access and configure the frequency of the RX2 window.

Command	Input Parameter	Return Value	Return Code
AT+RX2FQ?	-	`AT+RX2FQ: get or set the Rx2 window frequency`	`OK`
AT+RX2FQ=?	-	*< Frequency in Hz >*	`OK` or `AT_BUSY_ERROR`
AT+RX2FQ= `<Input Parameter>`	*< Frequency in Hz >*	-	`OK` , `AT_BUSY_ERROR` or `AT_PARAM_ERROR`

AT+TXP

Description: Transmit Power

This command allows the user to access and configure the transmit power.

Command	Input Parameter	Return Value	Return Code
AT+TXP?	-	`AT+TXP: Get or set the transmit power`	`OK`
AT+TXP=?	-	*< value >*	`OK` or `AT+PARAM_ERROR`
AT+TXP= `<Input Parameter>`	*< value >*	-	`OK` or `AT_PARAM_ERROR`

Check Appendix II Section **TXPower** for the input parameter depending on the frequency band selected.

For example, at EU868, a value of 2 represents **MaxEIRP - 4 dB** where MaxEIRP = +16 dBm.

AT+RETY

Description: Confirmed payload retransmission

This command allows the user to access and configure the number of retransmission for confirmed payload.

Command	Input Parameter	Return Value	Return Code
AT+RETY?	-	`AT+RETY: set the number of retransmissions of Confirm packet data`	`OK`
AT+RETY=?	-	`0` , `1` , `2` , `3` , `4` , `5` , `6` , `7`	`OK`
AT+RETY= `<Input Parameter>`	0,1,2,3,4,5,6,7	-	`OK` or `AT+PARAM_ERROR`

AT+MASK

Description: Setting masked channels

This command allows the user to access and configure masked channels.

Command	Input Parameter	Return Value	Return Code
AT+MASK?	-	`AT+MASK:Set the channel mask, close or open the channel,Only for US915,AU915,CN470`	`OK`
AT+MASK=?	-	< *mask* >	`OK`
AT+MASK= `<Input Parameter>`	*Channels (hex)*	-	`OK` or `AT+PARAM_ERROR`

AT+MASK Input Parameter Options

Sub-Band	Channels (hex)	US915	AU915	CN470
ALL	0000	All Enabled	All Enabled	All enabled
1	0001	0-7	0-7	0-7
2	0002	8-15	8-15	8-15
3	0004	16-23	16-23	16-23
4	0008	24-31	24-31	24-31
5	0010	32-39	32-39	32-39
6	0020	40-47	40-47	40-47
7	0040	48-55	48-55	48-55
8	0080	56-63	56-63	56-63
9	0100	-	-	64-71
10	0200	-	-	72-79
11	0400	-	-	80-87
12	0800	-	-	88-95

AT+BAND

Description: Regional frequency band

This command allows the user to access and configure the regional frequency band.

Command	Input Parameter	Return Value	Return Code
AT+BAND?	-	`AT+BAND: Set number corresponding to active regions (0: EU433 1: CN470 2: RU864 3: IN865 4: EU868 5: US915 6: AU915 7: KR920 8: AS923)`	`OK`
AT+BAND=?	-	`0` , `1` , `2` , `3` , `4` , `5` , `6` , `7` , `8`	`OK`
AT+BAND= `<Input Parameter>`	*< 0 to 8 >*	-	`OK` or `AT_PARAM_ERROR`

List of Band Parameter Options

Code	Regional Band
0	EU433
1	CN470
2	RU864
3	IN865
4	EU868
5	US915
6	AU915
7	KR920
8	AS923

AT+LPSEND

Description: Long data payload

This command allows the user to long data payload.

Command	Input Parameter	Return Value	Return Code
AT+LPSEND?	-	`AT+LPSEND: Send long packet data (Maximum is 1024 bytes)`	`OK`
AT+LPSEND= `<Input Parameter>`	**port**:**ack**:**payload**	-	`OK` or `AT_PARAM_ERROR`

ack: 0-unconfirmed, 1-confirmed

AT+LINKCHECK

Description: Network link status

This command allows the user to access and configure device network link status.

Command	Input Parameter	Return Value	Return Code
AT+LINKCHECK?	-	`AT+LINKCHECK: Verify Network Link Status`	`OK`
AT+LINKCHECK=?	-	`0` , `1` , `2`	`OK`
AT+LINKCHECK= `<Input Parameter>`	0 , 1 , 2	-	`OK` or `AT_PARAM_ERROR`

Input parameter details: 0 - Disable Link Check 1 - Execute Link Check just once on the next payload uplink. 2 - Module will automatically execute one time Link Check after every payload uplink.

Reply format:

`+EVT:LINKCHECK:Y0,Y1,Y2,Y3,Y4`

- `**Y0**` represent the result of Link Check.
  - 0 – represent the Link Check execute success.
  - Non-0 – represent the Link Check execute fail.
- `**Y1**` represent the DemodMargin.
- `**Y2**` represent the GwCnt (Number of Gateways that received link check command).
- `**Y3**` represent the RSSI.
- `**Y4**` represent the SNR.

AT+USEND

Description: Unified Send Data

This command allows the user to send unified data on a dedicated port number.

Command	Input Parameter	Return Value	Return Code
AT+USEND?	-	`AT+USEND: Unified SEND data along with the application port`	`OK`
AT+USEND= `<Input Parameter>`	**port** : **confirm** : **nbtrials** : **payload**	-	`OK` , `AT_PARAM_ERROR` , `AT_BUSY_ERROR` or `AT_NO_NETWORK_JOINED`

Input parameter details:

- **port**: value (1 to 223)
- **confirm**:value (0/confirm or 1/unconfirm)
- **nbtrials**: set the number of retransmissions, value (0 to 7)
- **payload**: data to be transmitted

Class B Mode

This section describes the commands related to Class B mode.

AT+PGSLOT

Description: Unified Send Data

This command allows the user to access and configure unicast ping slot periodicity.

Command	Input Parameter	Return Value	Return Code
AT+PGSLOT?	-	`PS: Get or set Periodicity`	`OK`
AT+PGSLOT=?	-	`PS: 0` *up to* `PS: 7`	`OK`
AT+PGSLOT= `<Input Parameter>`	*< 0 to 7 >*	-	`OK` or `AT_PARAM_ERROR`

AT+BFREQ

Description: Unified Send Data

This command allows the user to get the current beacon (default broadcast) frequency.

Command	Input Parameter	Return Value	Return Code
AT+BFREQ?	-	`AT+BFREQ: “Get the Beacon frequency`	`OK`
AT+BFREQ=?	-	*<DRx, psfreq>*	`OK`

AT+LTIME

Description: Unified Send Data

This command allows the user to get the current beacon (default broadcast) frequency.

Command	Input Parameter	Return Value	Return Code
AT+LTIME?	-	`AT+LTIME: Get the local time in UTC format`	`OK`
AT+LTIME=?	-	`LTIME:` *<hms on MM/DD/YYYY>*	`OK`

Device information

This section describes the commands on getting device information.

AT+RSSI

Description: Receive signal strength indicator

This command allows the user to get RSSI value of the last packet received.

Command	Input Parameter	Return Value	Return Code
AT+RSSI?	-	`AT+RSSI: Get the RSSI of the last received packet`	`OK`
AT+RSSI=?	-	*< integer > in dBm*	`OK`

AT+SNR

Description: Signal to Noise Ratio

This command allows the user to get SNR value of the last packet received.

Command	Input Parameter	Return Value	Return Code
AT+SNR?	-	`AT+SNR: Get the SNR of the last received packet`	`OK`
AT+SNR=?	-	< *integer* >	`OK`

AT+VER

Description: Version of the firmware

This command allows the user to get firmware version installed on the device.

Command	Input Parameter	Return Value	Return Code
AT+VER?	-	`AT+VER: Get the version of the firmware`	`OK`
AT+VER=?	-	< *V.x.y* >	`OK`

RF Test

Description: Radio frequency test management

This section describes the commands related to RF test management.

AT+TRSSI

Description: Receive Signal Strength Indicator

This command allows the user to get RF RSSI tone test of the device.

Command	Input Parameter	Return Value	Return Code
AT+TRSSI?	-	`AT+TRSSI: Start RF RSSI tone test`	`OK`
AT+TRSSI= `<Input Parameter>`	-	< *integer* > *in dBm*	`OK`

AT+TTONE

Description: Start radio frequency tone test

This command allows the user to get RF RSSI tone test of the device.

Command	Input Parameter	Return Value	Return Code
AT+TTONE?	-	`AT+TTONE: Start RF tone test`	`OK`
AT+TTONE= `<Input Parameter>`	-	*< integer > in dBm*	`OK` or `AT_BUSY_ERROR`

AT+TTX

Description: Start RF Tx LoRa® test

This command allows the user to set the number of packets to be sent for a PER RF TX test.

Command	Input Parameter	Return Value	Return Code
AT+TTX?	-	`AT+TTX: Set number of® packets sent with RF LoRa test`	`OK`
AT+TTX= `<Input Parameter>`	*< 0 < Integer < 64 >*	-	`OK` or `AT_PARAM_ERROR`

AT+TRX

Description: Start RF Tx LoRa® test

This command allows the user to set the number of packets to be received for a PER RF TX test.

Command	Input Parameter	Return Value	Return Code
AT+TRX?	-	`AT+TRX: Set number of packets received with RF LoRa® test`	`OK`
AT+TRX= `<Input Parameter>`	*< 0 < Integer < 64 >*	-	`OK` or `AT_PARAM_ERROR`

AT+TCONF

Description: Config LoRa® RF test

This command allows the user to access and set LoRa® configuration test.

Command	Input Parameter	Return Value	Return Code
AT+TCONF?	-	`AT+TCONF: Configure LoRa® RF test`	`OK`
AT+TCONF=?	-	-	`OK` or `AT_ERROR`
AT+TCONF= `<Input Parameter>`	-	-	`OK` or `AT_PARAM_ERROR`

AT+TTH

Description: RF Tx hopping test

This command allows the user to access and configure RF Tx hopping test.

Command	Input Parameter	Return Value	Return Code
AT+TTH?	-	`AT+TTH: Starts RF Tx hopping test from Fstart to Fstop, with Fdelta steps.`	`OK`
AT+TTH=< *`F start>, <Fstop>, <FDelta>,<PacketNb`* >	-	-	`OK`

AT+TOFF

Description: Stop ongoing radio frequency test

This command allows the user to stop the ongoing RF test.

Command	Input Parameter	Return Value	Return Code
AT+TOFF?	-	`AT+TOFF: Stop ongoing RF test`	`OK`
AT+TOFF	-	-	`OK`

AT+CERTIF

Description: Set the module in LoRaWAN® Certification mode

This command allows the user to start the RF Rx LoRa test.

Command	Input Parameter	Return Value	Return Code
AT+CERTIF?	-	`AT+CERTIF: Set the module in LoraWAN® Certification mode`	`OK`
AT+CERTIF	-	-	`OK` or `AT_BUSY_ERROR`

P2P Mode

This section describes the commands related to LoRa point to point functionality.

AT+NWM

Description: LoRa® network work mode (LoRaWAN or P2P)

This command allows the user to switch to LoRaWAN or (P2P)point-to-point mode.

Command	Input Parameter	Return Value	Return Code
AT+NWM?	-	`AT+NWM: Get or set the network work NWM (0 = P2P, 1 = LoRaWAN)`	`OK`
AT+NWM=?	-	-	`OK`
AT+NWM= `<Input Parameter>`	`0` *P2P or* `1` *LoRaWAN*	-	`OK` or `AT_PARAM_ERROR`

AT+PFREQ

Description: P2P mode frequency

This command allows the user to access and configure P2P mode frequency.

Command	Input Parameter	Return Value	Return Code
AT+PFREQ?	-	`AT+PFREQ: Configure P2P frequency`	`OK`
AT+PFREQ=?	-	*< frequency > in Hz*	`OK`
AT+PFREQ= `<Input Parameter>`	*< frequency > in Hz*	-	`OK` or `AT_PARAM_ERROR`

AT+PSF

Description: P2P mode spreading factor

This command allows the user to access and configure P2P mode spreading factor.

Command	Input Parameter	Return Value	Return Code
AT+PSF?	-	`AT+PSF: Configure P2P SpreadingFactor (6,7, 8, 9, 10, 11, 12)`	`OK`
AT+PSF=?	-	`6` , `7` , `8` , `9` , `10` , `11` , `12`	`OK`
AT+PSF= `<Input Parameter>`	*< 6 to 12 >*	-	`OK` or `AT_PARAM_ERROR`

AT+PBW

Description: P2P mode bandwidth

This command allows the user to access and configure P2P mode bandwidth.

Command	Input Parameter	Return Value	Return Code
AT+PBW?	-	`AT+PBW: Configure P2P Bandwidth(125, 250, 500)`	`OK`
AT+PBW=?	-	`125` , `250` or `500`	`OK`
AT+PBW= `<Input Parameter>`	`125` , `250` or `500`	-	`OK` or `AT_PARAM_ERROR`

AT+PCR

Description: P2P mode coding rate

This command allows the user to access and configure P2P mode coding rate.

Command	Input Parameter	Return Value	Return Code
AT+PCR?	-	`AT+PCR: Configure P2P code rate(4/5=0, 4/6=1, 4/7=2,4/8=3)`	`OK`
AT+PCR=?	-	`0` , `1` , `2` or `3`	`OK`
AT+PCR= `<Input Parameter>`	`0` , `1` , `2` or `3`	-	`OK` or `AT_PARAM_ERROR`

AT+PPL

Description: P2P mode preamble length

This command allows the user to access and configure P2P mode preamble length.

Command	Input Parameter	Return Value	Return Code
AT+PPL?	-	`AT+PPL: Configure P2P Preamble Length(2-65535)`	`OK`
AT+PPL=?	-	`2` *up to* `65535`	`OK`
AT+PPL= `<Input Parameter>`	`2` *up to* `65535`	-	`OK` or `AT_PARAM_ERROR`

AT+PTP

Description: P2P mode TX power

This command allows the user to access and configure P2P mode TX power.

Command	Input Parameter	Return Value	Return Code
AT+PTP?	-	`AT+TP: Configure P2P Power(5-22)`	`OK`
AT+PTP=?	-	`5` *up to* `22`	`OK`
AT+PTP= `<Input Parameter>`	`5` *up to* `22`	-	`OK` or `AT_PARAM_ERROR`

AT+P2P

Description: P2P configuration settings

This command allows the user to access and configure all P2P mode settings.

Command	Input Parameter	Return Value	Return Code
AT+P2P?	-	`AT+P2P: Configure P2P all parameters`	`OK`
AT+P2P=?	-	*`<Freq>,<SF>,<Bandwidth>,<CR>,<Preamble>,<Power>`*	`OK` or `AT_ERROR`
AT+P2P= `<Input Parameter>`	*`<Freq>,<SF>,<Bandwidth>,<CR>,<Preamble>,<Power>`*	-	`OK` or `AT_PARAM_ERROR`

Input parameter details:

- SF: 5 to 12
- Bandwidth: 125, 250 or 500
- CR: 0=4/5, 1=4/6, 2=4/7, 3=4/8
- Power: in dBm. If the value is 14, it means 14 dBm.

AT+PSEND

Description: P2P send data

This command allows the user to send P2P data.

Command	Input Parameter	Return Value	Return Code
AT+PSEND?	-	`AT+PSEND: P2P send data`	`OK`
AT+PSEND= `<Input Parameter>`	< *`Payload`* >	-	`OK` or `AT_PARAM_ERROR`

AT+PRECV

Description: P2P receive data window

This command allows the user to configure timeout period for P2P window reception.

Command	Input Parameter	Return Value	Return Code
AT+PRECV?	-	`AT+PRECV: Set the timeout period for P2P window reception (0-65535) ms`	`OK`
AT+PRECV=?	-	< *`Time in mSec`* >	`OK`
AT+PRECV= `<Input Parameter>`	< *`Time in mSec`* >	-	`OK` or `AT_PARAM_ERROR`

Input parameter details:

- If the value is set to 65535, the device will constantly listen to P2P TX without a timeout. This is the same as setting the device in RX mode.
- If the value is 0, the device will stop listening to P2P TX data. The device is in TX mode.

Multicast Group

This section describes the commands related to multicast group functionality.

AT+ADDMULC

Description: Add multicast group

This command allows the user to add new multicast group and multicat parameters.

Command	Input Parameter	Return Value	Return Code
AT+ADDMULC?	-	`AT+ADDMULC: Add a new multicast group`	`OK`
AT+ADDMULC= `<Input Parameter>`	*`[Class]:[DevAddr]:[NwkSKey]:[AppSKey]:[Frequency]:[Datarate]:[Periodicity]`*	-	`OK` or `AT_PARAM_ERROR`

Input parameter details:

If Class is C, periodicity parameter is removed.

Examples:

For class B,

```
> AT+ADDMULC=B:11223344:11223344556677881122334455667788:11223344556677881122334455667788:8680000

OK
```

For class C,

```
> AT+ADDMULC=C:11223344:11223344556677881122334455667788:11223344556677881122334455667788:8680000

OK
```

AT+RMVMULC

Description: Remove multicast group

This command allows the user to remove the configured multicat group.

Command	Input Parameter	Return Value	Return Code
AT+RMVMULC?	-	`AT+RMVMULC: Delete multicast group`	`OK`
AT+RMVMULC= `<Input Parameter>`	*`<DevAddr>`*	-	`OK`

AT+LSTMULC

Description: Multicast list

This command allows the get to information about the configured multicat group.

Command	Input Parameter	Return Value	Return Code
AT+LSTMULC?	-	`AT+RMVMULC:Get multicast group information`	`OK`
AT+LSTMULC=?	-	`MC1:[Class]:[DevAddr]:[NwkSK ey]:[AppSKey]:[Frequency]:[Dat arate]`	`OK`

Data Transparent Tranmission

This section describes the commands related to transparent data transmission in UART.

ATD

Description: Set transparent transmission mode

This command allows the user to set the transparent transmission mode.

Command	Input Parameter	Return Value	Return Code
ATD?	-	`ATD: Enter data transparent transmission mode`	`OK`
ATD	-	-	`OK`

+++

Description: Stop transparent transmission mode

This command allows the user to stop the transparent transmission mode.

Command	Input Parameter	Return Value	Return Code
+++?	-	`+++: Exit transparent transmission mode`	`OK`
+++	-	-	`OK`

Appendix

Appendix I： Data Rate by Region

EU433/EU868/RU864/AS923

Data Rate	Configuration	Indicative Physical Bit 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	Indicative Physical Bit 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	Indicative Physical Bit 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	

AU915

Data Rate	Configuration	Indicative Physical Bit 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

IN865

Data Rate	Configuration	Indicative Physical Bit 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

Appendix II： TX Power by Region

EU868

By default, MaxEIRP is considered to be +16 dBm.

TXPower	Configuration (EIRP)
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

US915

TXPower	Configuration (Conducted Power)
0	30 dBm - 2*TXpower
1	28 dBm
2	26 dBm
3 ~ 9	-
10	10 dBm
11 ~ 15	RFU

AU915

By default, MaxEIRP is considered to be +30 dBm.

TXPower	Configuration (EIRP)
0	MaxEIRP
1 ~ 10	MaxEIRP - 2*TXPower
11 ~ 10	RFU

KR920

By default, MaxEIRP is considered to be +14 dBm.

TXPower	Configuration (EIRP)
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

AS923

By default, Max EIRP isconsidered to be 16 dBm.

TXPower	Configuration (EIRP)
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, MaxEIRP is considered to be 30 dBm.

TXPower	Configuration (EIRP)
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

RU864

By default, MaxEIRP is considered to be +16 dBm.

TXPower	Configuration (EIRP)
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

CN470

By default, MaxEIRP is considered to be +19.15 dBm.

TXPower	Configuration (EIRP)
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

EU433

By default, MAxEIRP is considered to be +12.15 dBm.

TXPower	Configuration (EIRP)
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

Appendix III： Maximum Transmission Load by Region

> 📝 **NOTE:**
>
> M in the following list is the length with MAC header, N is the maximum usable payload size for the user data 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	Not Defined	Not Defined

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
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 Payload Size (M)		Downlink MAC Payload Size (M)	
	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	Not Defined	Not Defined

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	Not Defined	Not Defined

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	Not Defined	Not Defined

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	Not Defined	Not Defined

Appendix IV: Asynchronous Events

This section describes the output from UART lines of RAK3172 that can occur at any point in time while the device is operational.

Event	UART output	Status description
Beacon acquisition process	`+BC:` < *status* >	`FAILED` = beacon sync failed
		`DONE` = Switch to classB mode
		`LOST` = No Beacon received for 2 hours, switch to classA
		`LOCKED` = Receive Beacon
Pingslot process	`+PS:` < *status* >	`DONE` = At this time, ping slots will be opened periodically. The modem is now in Class B mode.
Class B/C downlink	`+EVT:` < *status* >	`RX3/RXC, RSSI -110, SNR 5` = indicates that data has been received on pingslot received window.
		`PortNumber:12345678` = received binary data on PortNumber.
		`UNICAST` = lets host know that the Rx is in unicast Class B mode.
		`MULCAST MC1` = Data received in multicast group 1
Class A downlink	`+EVT:` < *status* >	`RX1/RX2, RSSI -110, SNR 5`
		`PortNumber:12345678` = received binary data on PortNumber.
Join	`+EVT:` < *status* >	`JOIN FAILED`
		`JOINED`
Confirm	`+EVT:` < *status* >	`SEND CONFIRMED OK`
		`SEND CONFIRMED FAILED`
P2P	`+EVT:` < *status* >	`00112233` = received binary data format data
		`RXP2P, RSSI -110, SNR 5` = indicates that data has been received on P2P received window.
Link Check	`+EVT:` < *status* >	`LINKCHECK:Y0,Y1,Y2,Y3,Y4`
		Y0 = represent link status (1:links success, 2: link fail)
		Y1 = represent the DemodMargin
		Y2 = represent the NbGateways

Event	UART output	Status description
		Y3 = represent the RSSI of the command's dowmload
		Y4 = represent the SNR of the command's download

Last Updated: 7/28/2021, 5:13:12 AM