

AT Command Manual

Introduction

The purpose of this section is to demonstrate on how to configure the RAK7205 LPWAN Tracker thru the use of AT Commands via a Serial Port Tool running in your Windows PC. The list below shows the AT Commands available for use:

AT Command Syntax

The AT command is based on ASCII characters. In general, the AT Command starts with the prefix `AT` or `at` and ends with `<CR><LF>` (i.e. `\r\n`). The maximum length is **255 characters** which includes the `<CR><LF>` characters at the end of the command. For the rest of the document, the "`\r\n`" part is omitted for the sake of clarity.

The AT commands can be classified in the following groups:

- **Read Command:** Reads the current configuration or status of the module. The command name and the list of parameters are separated by `=` character. The `<m>` parameter is separated with its associated value `<n>` by the `:` character.

```
at+get_config=<m>:<n>
```

- **Write Command:** Writes/Modifies the current configuration of the module. The command name and the list of parameters are separated by `=` character. The `<m>` parameter is separated with its associated value `<n>` by the `:` character.

```
at+set_config=<m>:<n>
```

- **Operational Commands:** There are also commands that are neither read nor write commands. The purpose is to execute an action, for example:

```
at+send=lora:<m>:<n> // Sends data through the LoRa transceiver.
```

- **Special Command:** The RAK7205 UART port has two operational modes: **configuration mode** and **data transmission mode**. When switching from data transmission mode to configuration mode the command to be entered is `+++` and does not contain terminators such as `\r` and `\n`.

After executing the command, a response is sent back to the external MCU. The usual reply has the following format:

```
OK [information]\r\n
```

 **NOTE:**

Only the read commands have information in the replied message, while Write commands do not have an informative description.

After sending a successful command to the module, the firmware developed, running in the external MCU, will expect at a minimum string of `ok\r\n`. On the other hand, when the command is not successfully executed by the module, you will receive a response with the following format:

```
ERROR: [ErrCode]\r\n
```

Error Code Table

Error Code Table

Error Code	Description
1	The last command received is an unsupported AT command.
2	Invalid parameter in the AT command.
3	There is an error when reading or writing the flash memory.
4	There is an error when reading or writing through IIC bus.
5	There is an error when sending data through the UART port.
80	The LoRa transceiver is busy, could not process a new command.
81	LoRa service is unknown. Unknown MAC command received by node. Execute commands that are not supported in the current state, such as sending <code>at+join</code> command in P2P mode.
82	The LoRa parameters are invalid.
83	The LoRa parameters are invalid.
84	The LoRa data rate (DR) is invalid.
85	The LoRa frequency and data rate are invalid.
86	The device has not joined into a LoRa network.
87	The length of the packet exceeded that maximum allowed by the LoRa protocol.
88	Service is closed by the server. Due to the limitation of duty cycle, the server will send "SRV_MAC_DUTY_CYCLE_REQ" MAC command to close the service.
89	This is an unsupported region code.
90	Duty cycle is restricted. Due to duty cycle, data cannot be sent at this time until the time limit is removed.
91	No valid LoRa channel could be found.
92	No available LoRa channel could be found.
93	Status is error. Generally, the internal state of the protocol stack is wrong.
94	Time out reached while sending the packet through the LoRa transceiver.
95	Time out reached while waiting for a packet in the LoRa RX1 window.
96	Time out reached while waiting for a packet in the LoRa RX2 window.
97	There is an error while receiving a packet during the LoRa RX1 window.

Error Code	Description
98	There is an error while receiving a packet during the LoRa RX2 window.
99	Failed to join into a LoRa network.
100	Duplicated downlink message is detected. A message with an invalid downlink count is received.
101	Payload size is not valid for the current data rate (DR).
102	Many downlink packets are lost.
103	Address fail. The address of the received packet does not match the address of the current node.
104	Invalid MIC is detected in the LoRa message.

General AT Command

1. at+version

This command is used to get the current firmware version number.

Operation	Command	Response
Read	<code>at+version</code>	<code>OK <version number></code>

Parameter: NONE

Example:

```
at+version\r\n
OK V3.0.0.14.H
```

2. at+help

This command is used to obtain all AT commands supported by the current firmware.

Operation	Command	Response
Read	<code>at+help</code>	<code>OK <all AT commands></code>

Parameter: NONE

Example:

```
at+help\r\n
```

OK Device AT commands:

```
at+version
at+help
at+set_config=device:restart
at+set_config=device:sleep:X
at+get_config=device:status
at+set_config=device:uart:X:Y
at+set_config=device:uart_mode:X:Y
at+send=uart:X:YYY
at+set_config=device:gpio:X:Y
at+get_config=device:gpio:X
at+get_config=device:adc:X
```

LoRaWAN AT commands:

```
at+set_config=lora:default_parameters
at+join
at+send=lora:X:YYY
at+set_config=lora:region:XXX
at+get_config=lora:channel
at+set_config=lora:dev_eui:XXXX
at+set_config=lora:app_eui:XXXX
at+set_config=lora:app_key:XXXX
at+set_config=lora:dev_addr:XXXX
at+set_config=lora:apps_key:XXXX
at+set_config=lora:nwks_key:XXXX
at+set_config=lora:multicastenable:X
at+set_config=lora:multicast_dev_addr:XXXX
at+set_config=lora:multicast_apps_key:XXXX
at+set_config=lora:multicast_nwks_key:XXXX
at+set_config=lora:join_mode:X
at+set_config=lora:work_mode:X
at+set_config=lora:ch_mask:X:Y
at+set_config=lora:class:X
at+set_config=lora:confirm:X
at+set_config=lora:dr:X
at+set_config=lora:tx_power:X
at+set_config=lora:adr:X
at+get_config=lora:status
at+set_config=lora:dutycycle_enable:X
at+set_config=lora:send_repeat_cnt:X
```

LoRaP2P AT commands:

```
at+set_config=lorap2p:XXX:Y:Z:A:B:C
at+set_config=lorap2p:transfer_mode:X
at+send=lorap2p:XXX
```

3. `at+set_config=device:restart`

This command is used to restart the device.

Parameter: None

Example:

```
at+get_config=device:status\r\n
OK Board Core:RAK7205
MCU:STM32L151CUB6A
LoRa chip:SX1276
```

Interface Type AT Command

1. at+set_config=device:uart: <index>:<baud_rate>

This command is used to configure the baud rate for a UART port.

 **NOTE:**

There will be no reply after executing this configuration if a different baud rate is set. To make your UART serial communication work again, configure the UART baud rate setting of the Serial Port Tool based on the new baud rate.

Operation	Command	Response
Write	at+set_config=device:uart:<index>:<baud_rate>	OK

Parameter:

index	UART Number: 1 or 3. Two UART ports are currently supported starting FW V3.0.0.14.H - UART1 and UART3
baud_rate	UART Baud rate : 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200

Example:

```
at+set_config=device:uartx:1:115200\r\n
```

2. at+set_config=device:uart_mode: <index>:<mode>

This command is used to switch the UART operation between the AT configuration mode and the data transmission mode.

Operation	Command	Response
Write	at+set_config=device:uart_mode:<index>:<mode>	OK

Parameter:

index	UART Number: 1 or 3. Two UART ports are currently supported starting FW V3.0.0.14.H - UART1 and UART3
mode	UART Mode : Only 1 can be selected, which means the UART is set to data transmission mode

 **NOTE:**

To switch from data transmission mode to configuration mode, use `+++` (`+++` without `\r\n`).

Example:

```
at+set_config=device:uart_mode:1:1\r\n
OK

+++
OK
```

3. at+send=uart: <index>:<data>

This command is used to send data over a UART port.

Operation	Command	Response
Write	<code>at+send=uart:<index>:<data></code>	<code>OK</code>

Parameter:

index	UART Port Number. Currently, the RAK7205 only supports UART1.
mode	The data you want to send. The maximum length of data is 250 characters , equivalent to 255 — the length of <code>at+...</code> — the length of <code>\r\n</code> .

Example:

```
at+send=uart:1:12345\r\n
OK
```

4. at+get_config=device:gpio: <pin_num>

This command is used to obtain the voltage level status of a pin on a module.

Operation	Command	Response
Read	<code>at+get_config=device:gpio:<pin_num></code>	<code>OK<status></code>

Parameter:

pin_num	Pin index of the module
status (Return Value)	0: Low voltage level 1: High voltage level

Example:

```
at+get_config=device:gpio:2\r\n
OK 1
```

5. at+set_config=device:gpio: <pin_num>:<status>

This command is used to set the voltage level state (high or low) of a pin on a module.

Operation	Command	Response
Write	<code>at+set_config=device:gpio:<pin_num>:<status></code>	<code>OK</code>

Parameter:

pin_num	Pin index of the module
status	0: Low voltage level 1: High voltage level

Example:

```
at+set_config=device:gpio:2:0\r\n
OK
```

6. at+get_config=device:adc: <pin_num>

This command is used to obtain the voltage level of an ADC pin of the board.

Operation	Command	Response
Read	<code>at+get_config=device:adc:<pin_num></code>	<code>OK<voltage></code>

Parameter:

pin_num	ADC pin index of the module
Voltage (Return Value)	Voltage, Unit: mV

Example:

```
at+get_config=device:adc:2\r\n
OK 1663mV
```

LoRaWAN Type AT Command

1. at+join

This command is used to join a LoRaWAN network.

Operation	Command	Response
	at+join	OK Join Success

Parameter: NONE

Example:

```
at+join\r\n
OK Join Success
```

2. at+send=lora: <port>:<data>

This command is used to send data via LoRaWAN.

Operation	Command	Response
	at+send=lora:<port>:<data>	OK

Parameter:

port	Sending port of LoRa. The value range is 1-223.
data	The sending data format is in hexadecimal format. The possible values are between 00-FF . The module will internally cast every two characters into a byte before sending it to the LoRa transceiver. The maximum length varies depending on the band frequency and DR (LoRaWAN standard). Refer to Appendix III .

Example:

When sending data as unconfirmed uplink:

```
at+send=lora:1:5A00\r\n
OK
```

When sending data as confirmed uplink:

```
at+send=lora:1:5A00\r\n
OK
at+recv=0, -105, -12, 0
```

 **NOTE:**

When sending a confirmed message, you will receive an ACK response, i.e. `at+recv=...`. The `0, -105, -12, 0` stands for:

- `0` : For the LoRa port;
- `-105` : For the RSSI;
- `-12` : For the SNR;
- `0` : For the length of the data (no valid data in ACK).

3. `at+set_config=lora:region: <region>`

This command is used to set the appropriate working frequency band.

Operation	Command	Response
Write	<code>at+set_config=lora:region:<region></code>	<code>OK</code>

Parameter:

region EU433, CN470, IN865, EU868, US915, AU915, KR920, AS923. The default is EU868.

Example:

```
at+set_config=lora:region:EU868\r\n
OK
```

 **NOTE:**

In the AS923 frequency band, the supported frequency plan is "as2" and dwell is set to 1.

4. `at+get_config=lora:channel`

This command is used to read all the LoRa channel information for the device's current region.

Operation	Command	Response
Read	<code>at+get_config=lora:channel</code>	<code>OK <channel information></code>

Parameter: NONE

Example:

- EU868 region

```
at+get_config=lora:channel\r\n
OK *0,on,868100000,0,5; *1,on,868300000,0,5; *2,on,868500000,0,5; 3,off,0,0,0; 4,off,0,0,0; 5,off,0,0,0
```

 **NOTE:**

With `*0,on,868100000,0,5` as an example, the following is the channel parameter analysis:

- `*` at the beginning if the channel is open;
- `0` is the channel ID;
- `on` indicates the current status of the channel;
- `868100000` is the actual frequency of the channel, unit is Hz;
- `0,5` indicates the DR of the channel, DR0~DR5.

5. `at+set_config=lora:ch_mask:<channel_number>:<status>`

This command is used to switch a channel (turn on or off) in the current region.

Operation	Command	Response
Write	<code>at+set_config=lora:ch_mask:<channel_number>:<status></code>	<code>OK</code>

Parameter:

channel_number	Channel number
status	0: off 1: on

Example:

```
at+set_config=lora:ch_mask:0:0\r\n
OK
```


11. `at+set_config=lora:nwks_key: <nwks_key>`

This command is used to set the Network Session Key parameter for the LoRaWAN ABP mode.

Operation	Command	Response
Read	<code>at+set_config=lora:nwks_key:<nwks_key></code>	OK

Parameter:

`nwks_key` Network Session Key

Example:

```
at+set_config=lora:nwks_key:69AF20AEA26C01B243945A28C9172B42\r\n
OK
```

12. `at+set_config=lora:multicastenable: <IsEnable>`

This commands is used to enable multicasting.

Operation	Command	Respo
Write	<code>at+set_config=lora:multicastenable:<IsEnable></code>	OK

Parameter:

`IsEnable`
 0: disable
 1: enable
 The default is disable.

Example:

```
at+set_config=lora:multicastenable:1\r\n
OK
```

13. `at+set_config=lora:multicast_dev_addr: <multicast_dev_addr>`

This command is used to set the Device Address for the multicast feature.

Example:

```
at+set_config=lora:multicast_nwks_key:1D1991F5377C675879C39B6908D437A6\r\n
OK
```

16. at+set_config=lora:join_mode: <mode>

This command is used to switch the LoRaWAN access mode between the OTAA and the ABP mode.

Operation	Command	Response
Write	at+set_config=lora:join_mode:<mode>	OK

Parameter:

mode Activation mode
 0: OTAA
 1: ABP
 The default is OTAA.

Example:

```
at+set_config=lora:join_mode:1\r\n
OK
```

17. at+set_config=lora:class: <class>

This command is used to set the LoRaWAN class to Class A, Class B, or Class C.

Operation	Command	Response
Write	at+set_config=lora:class:<class>	OK

Parameter:

class 0: Class A
 1: Class B (Not supported at this time)
 2: Class C
 The default is Class A.

Example:

```
at+set_config=lora:class:0\r\n
OK
```

18. `at+set_config=lora:confirm: <type>`

This command is used to set the type messages to be sent: Confirmed/Unconfirmed.

Operation	Command	Response
Write	<code>at+set_config=lora:confirm:<type></code>	OK

Parameter:

type

- 0: unconfirm type
- 1: confirm type

The default is unconfirm type.

Example:

```
at+set_config=lora:confirm:0\r\n
OK
```

19. `at+set_config=lora:dr: <dr>`

This command is used to set the data rate (DR) of LoRa.

Operation	Command	Response
Write	<code>at+set_config=lora:dr:<dr></code>	OK

Parameter:

dr The data rate of LoRa is related to the current region. In most of the LoRa areas, it is common to use 0 to 5. Detailed reference can be made to LoRaWAN 1.0.2 specification.

20. `at+set_config=lora:tx_power: <tx_power>`

This command is used to set the RF transmission power level of the LoRa transceiver. The unit is in dBm.

Operation	Command	Response
Write	<code>at+set_config=lora:tx_power:<tx_power></code>	OK

Parameter:

`tx_power` LoRa transmit power level varies depending on frequency band and DR. Refer to the LoRaWAN 1.0.2 specification or Appendix II for details. The default is 0.

Example:

```
at+set_config=lora:tx_power:0\r\n
OK
```

21. `at+set_config=lora:adr:<status>`

This command is used to turn on/off the ADR feature of the LoRa communication.

Operation	Command	Response
Write	<code>at+set_config=lora:adr:<status></code>	OK

Parameter:

`status` 0: Turn off
 1: Turn on
 The default is on.

Example:

```
at+set_config=lora:adr:0\r\n
OK
```

22. `at+get_config=lora:status`

This command is used to get all the information related to the current LoRa status, except the channel information.

Operation	Command	Response
Read	<code>at+get_config=lora:status</code>	OK <lora status detail>

Parameter: NONE

Example:

```

at+get_config=lora:status\r\n
OK Work Mode: LoRaWAN
Region: EU868
Send_interval: 600s
Auto send status: false.
MulticastEnable: true.
Multi_Dev_Addr: 260111FD
Multi_Apps_Key: F13DDFA2619B10411F02F042E1C0F356
Multi_Nwks_Key: 1D1991F5377C675879C39B6908D437A6
Join_mode: OTAA
DevEui: 00000000000000888
AppEui: 00000000000000888
AppKey: 000000000000008880000000000000888
Class: C
Joined Network:false
IsConfirm: unconfirm
AdrEnable: true
EnableRepeaterSupport: false
RX2_CHANNEL_FREQUENCY: 869525000, RX2_CHANNEL_DR:0
RX_WINDOW_DURATION: 3000ms
RECEIVE_DELAY_1: 1000ms
RECEIVE_DELAY_2: 2000ms
JOIN_ACCEPT_DELAY_1: 5000ms
JOIN_ACCEPT_DELAY_2: 6000ms
Current Datarate: 4
Primeval Datarate: 4
ChannelsTxPower: 0
UpLinkCounter: 0
DownLinkCounter: 0

```

23. `at+set_config=lora:dutycycle_enable: <status>`

This command is used to enable or disable the Duty Cycle feature.

Operation	Command	Response
Write	<code>at+set_config=lora:dutycycle_enable:<status></code>	OK

Parameter:

status

- 0: disable
- 1: enable

The default is disable.

Example:

```

at+set_config=lora:dutycycle_enable:1\r\n
OK

```

24. `at+set_config=lora:send_repeat_cnt: <num>`

This command is used to sent the number attempts for retransmitting an uplink message. When activated, the module will resend a message if its corresponding ACK (down link) is not received after sending a confirmed uplink message. The default value is 0, which means that the module will not resend any message by default.

Operation	Command	Response
Write	<code>at+set_config=lora:send_repeat_cnt:<num></code>	OK

Parameter:

num Number of retries, up to 8.
The default is 0.

Example:

```
at+set_config=lora: send_repeat_cnt:1\r\n
OK
```

25. `set_config=lora:default_parameters`

This command is used to restore the factory setting.

Operation	Command	Response
Write	<code>at+set_config=lora:default_parameters</code>	OK

Parameter: NONE

Example:

```
at+set_config=lora:default_parameters\r\n
OK
```

26. `at+set_config=lora:send_interval: <status>:<interval>`

This command is used to set the time interval for sending data.

Operation	Command	Response
Write	<code>at+set_config=lora:send_interval:<status>:<interval></code>	OK

Parameter:

status Enable/disable the mechanism for sending data in intervals.
 0: the device will not send data automatically.
 1: the device will send data every 'interval' seconds.

interval Time in seconds. This parameter is only valid if 'status' is set to 1.

Example:

```
at+set_config=lora:send_interval:1:120\r\n
OK
```

27. `set_config=lora:periodic_rst_interval:<time>`

This command is used to set a periodic restart.

Operation	Command	Response
Write	<code>at+set_config=lora:periodic_rst_interval:<time></code>	OK

Parameter:

time Time in seconds.

Example:

```
at+set_config=lora:periodic_rst_interval:864000\r\n
interval_time=864000
OK
```

LoRa P2P Type AT Command

1. `at+set_config=lora:work_mode: <mode>`

This command is used to switch the LoRa transmission mode between the LoRaWAN and the LoRAP2p mode. This command will cause the module to restart once applied.

Operation	Command	Response
Write	<code>at+set_config=lora:work_mode:<mode></code>	

Parameter:

mode Work mode of LoRa
 0: LoRaWAN
 1: LoRa P2P

The default is LoRaWAN mode

Example :

```
at+set_config=lora:work_mode:1\r\n
UART1 work mode: RUI_UART_NORMAL
Current work_mode:P2P
Initialization OK
```

2. at+set_config=lorap2p: <frequency>:<spreadfact>:<bandwidth>:<codingrate>:<preamlen>:<power>

This command is used to set the relevant parameters of LoRAP2p mode and is only valid when the LoRa mode was switched to LoRaP2P before.

Operation	Command	Response
Write	at+set_config=lorap2p:<frequency>:<spreadfact>:<bandwidth>:<codingrate>:<preamlen>:<power>	OK

Parameter:

frequency	Frequency, the unit is Hz The default is 869525000 Hz.
spreadfact	Spreading factor The default is 12.
bandwidth	0: 125 KHz 1: 250 KHz 2: 500 KHz The default is 0.
codeingrate	1: 4/5 2: 4/6 3: 4/7 4: 4/8 The default is 1.
preamble	Preamble Length. 5~65535 The default is 8.
power	TX power. The unit is in dBm. 5~20 The default is 20.

Example :

```
at+set_config=lorap2p:869525000:12:0:1:8:20\r\n
OK
```

3. `at+set_config=lorap2p:transfer_mode: <mode>`

This command is used to switch the state of the LoRa transceiver between sending and receiving state, and it's only valid when the LoRa mode was set to LoRaP2P before.

Operation	Command	Response
Write	<code>at+set_config=lorap2p: transfer_mode:<mode></code>	OK

Parameter :

mode

- 1: receiver mode
- 2: sender mode

The default is sender mode.

Example :

```
at+set_config=lorap2p:transfer_mode:1\r\n
OK
```

4. `at+send=lorap2p: <data>`

This command is used for sending data through LoRaP2P, and only valid when the LoRa work mode was set to LoRaP2P before.

Operation	Command	Response
Send	<code>at+send=lorap2p:<data></code>	OK

Parameter :

mode

- 1: receiver mode
- 2: sender mode

The default is sender mode.

Example :

```
at+send=lorap2p:1234\r\n
OK
```

In LoRa P2P mode, the receiving node receives the data and outputs the data in the following format:

```
at+recv=<RSSI>,<SNR>,< Data Length >:< Data >
```


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 shall 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

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 length without MAC header, and the maximum sending data length is N.

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

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

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