

# CubeCell™ Series

## AT command user manual

## Release notes

| Edition | Modification item   | Modification time |
|---------|---|-------------------|
| V0.1    | - First public release  | 2019.10.21        |
| V0.2    | - Add user AT command;<br>- Correction of clerical and presentation errors.   | 2019.12.16        |
| V0.3    | - AT command version update to V0.9;<br>- Add node-to-node communication parameter configuration commands;<br>- Add copyright disable command;<br>- Add set channel mask command. | 2020.6.29         |
| V0.4    | - AT command version update to V1.0;<br>- Spreading factor support to 5~12 in node-to-node communication mode;<br>- SNR will be print in node-to-node communication mode.         | 2020.7.9          |
| V0.5    | - Add automatic low-power disable command   | 2020.08.04        |

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## 3. AT command syntax

### 3.1 Syntax overview

- All AT command lines must start with "AT+".
- **There is no ending character. Do not send a carriage return or a new line as the end.**
- **After reset, CubeCell will enter deep sleep mode after printing initial information and send "AT + XXX" wake-up device.**
- The return response usually follows the command:
  - Successful execution return "+OK";
  - If the execution fails or the syntax format is wrong, return "+ERROR" and the corresponding prompt content at the same time.

## 3.2 AT command list

### Basic control commands

#### Wake device

| Command     | Response   |
|-------------|--|
| AT+XXX      | ASR is Waked, LowPower Mode Stopped  |
| Description | After resetting, the device is in sleep state, and wakes up the device through the serial port interrupt. In theory, sending any data through the serial port can trigger the interrupt and wake up the device. For example "ABC". |

#### Sleep device

| Command     | Response                        |
|-------------|---------------------------------|
| AT+LPM=1    | +OK<br>LowPower Mode Stared.    |
| Description | Put the device into sleep mode. |

#### Reset

| Command     | Response                            |
|-------------|-------------------------------------|
| AT+RESET=1  | Print power-on / reset information. |
| Description | Device reset                        |

#### Restore factory settings

| Command         | Response  |
|-----------------|---|
| AT+DefaultSet=1 | Print power-on / reset information..  |
| Description     | After restoring the factory settings, the parameters will enter the sleep mode after the response ends. |

### Disable copyright information print

| Command               | Response  |
|-----------------------|---|
| <b>AT+Copyright=1</b> | Enable/Disable copyright information print when boot loader mode begin. Default Enable. |
| <b>Description</b>    | <b>Boot loader version higher than V1.0 (include V1.0) support this command.</b>        |

### Disable automatic low-power

| Command             | Response  |
|---------------------|---|
| <b>AT+AutoLPM=0</b> | +OK<br>+AutoLMP=0   |
| <b>Description</b>  | AT+AutoLPM=0 Disable automatic low-power,<br>AT+AutoLPM=1 Enable automatic low-power. |

### Query the chip's Unique ID

| Command            | Response   |
|--------------------|--|
| <b>AT+ChipID=?</b> | +OK<br>+ChipID:13A*****622   |
| <b>Description</b> | Read the unique number of the chip, which can be used to query the corresponding serial number ( <a href="#">Query address</a> ) |

### Enter serial number to activate Arduino support

| Command  | Response             |  |
|--|----------------------|--|
| <b>AT+CDKEY=A8<br/>5****93****D<br/>DC3*****1F0<br/>23EDE6</b> | System activated     | +The board is activated, don't need to active again                  |
|  | System not activated | Activation successful:+The board is activated, Arduino is supported! |
|  |                      | Activation failed:+ERROR: please input correct                       |



|                    |  |
|--------------------|--|
|                    | CDKEY.   |
| <b>Description</b> | <p>The content sent is not 32-bit capital characters, the character content is limited to 0 to F.</p> <ul style="list-style-type: none"> <li>- The development board is activated by default all the factory;</li> <li>- Module is activated by default, but an inactive version can be provided and can be activated with this command if Arduino support is required at a later stage.</li> </ul> <p>The serial number slyly queried from the <a href="#">website</a> is as follows:<br/>0x9CF2E059,0xFC613F26,0x174F6BAA,0xDC70F73B</p> <p>All "0x" and "Commas" need to be removed when using as an activation code.</p> |

#### LoRaWAN mode / normal LoRa mode switching

| Command             | Response   |
|---------------------|--|
| <b>AT+LORAWAN=?</b> | <p>+OK</p> <p>+LORAWAN=0</p> <p>+OK</p> <p>+LORAWAN=1</p>  |
| <b>Description</b>  | <p>Find current LoRaWAN support:</p> <ul style="list-style-type: none"> <li>- The return value is 0, normal LoRa mode;</li> <li>- Return value is 1, LoRaWAN protocol mode .</li> <li>- The AT command supports the LoRaWAN protocol by default. You can switch the LoRaWAN protocol or the normal LoRa sending and receiving mode by changing the variables of this command.</li> </ul> |
| <b>AT+LORAWAN=0</b> | <p>1. +OK</p> <p>2. +LORAWAN=0</p> <p>3. Copyright @ 2019 Heltec Automation. All rights reserved</p>   |

|                     |  |
|---------------------|--|
|                     | 4.<br>5. +LORAWAN=0<br>6.<br>7. +FREQ=470000000<br>8. +SF=7<br>9. +TxPower=10  |
| <b>Description</b>  | <p>When the response is complete, the system goes into hibernation.</p> <p>In this mode, the radio signal is transmitted via the SX1262 chip, and the operation of the pure hardware layer does not run any protocol stack and can be used for spectral debugging or simple transceiver testing.</p> |
| <b>AT+LORAWAN=1</b> | Print power-up/reset information.  |
| <b>Description</b>  | <p>When the response is complete, the system goes into hibernation and the device supports the LoRaWAN protocol.</p>   |

## User AT Command

Users may need special commands. Here's an example of adding user commands to CubeCell. In this example, we added a test command: "AT-test-abcd", if sending "AT-test-abcd" to CubeCell via serial port, the CubeCell returns "abcd".

```

*LORAWAN=1
*KeepNet=0
*OTAA=1
*Class=C
*ADR=1
*IsTxConfirmed=1
*AppPort=2
*DutyCycle=15000
*ConfirmedNbTrials=8
*DevEui=2232330000888802 (For OTAA Mode)
*AppEui=0000000000000000 (For OTAA Mode)
*AppKey=88888888888888888888888888886601 (For OTAA Mode)
*NwkSKey=072C78758CDCCABF55EE4A778D16EF67 (For ABP Mode)
*AppSKey=15B1D0EFA463DFBE3D11181E1EC7DA85 (For ABP Mode)
*DevAddr=007E6AE1 (For ABP Mode)

LoRaWan ClassC start!
joining...
ASR is Waked, LowPower Mode Stopped
hello
joined
confirmed uplink sending ...
receive data: rssi = -31, snr = -1, datarate = 0
hello

```

单条发送 多条发送 协议传输 帮助

AT+test=hello

User-owned AT commands can be modified in the examples above.

### User AT command execution logic

When the system receives each AT instruction, it prioritizes comparisons with user-defined fields within the AT\_user\_check function. If the return value of the function is **true**, the user-defined program within the function is executed. If the return value is **false**, the function is skipped to match the system's default AT commands.

### "LoRa Normal Mode" Proprietary Command

#### Set LoRa listening/sending parameter

| Command                  | Response                                       |       |    |    |           |                 |     |           |               |
|--------------------------|--|-------|----|----|-----------|-----------------|-----|-----------|---------------|
| AT+LoraSet=?             | +OK<br>+LoraPara:868000000,18,12,0,1,8,1,0,0   |       |    |    |           |                 |     |           |               |
| Description <sup>1</sup> | The parameters sequence (0 – FALSE; 1 -- TRUE) |       |    |    |           |                 |     |           |               |
|                          | frequency                                      | power | SF | BW | Code rate | Preamble length | CRC | IQ Invert | Save to FLASH |
|                          | 868MHz   | 18dBm | 12 | 0  | 1         | 8               | 1   | 0         | 0             |

<sup>1</sup> LoRa node-to-node communication parameters description:

- Frequency: Set LoRa listening/sending frequency in Hz.
- Power: LoRa signal output power in dBm;
- SF: Spreading factor, from 5~12
- BW: Bandwidth 0 – 125K, 1 – 250K, 2 – 500K;
- Code rate: 1 – 4/5, 2 – 4/6, 3 – 4/7, 4 – 4/8;
- Preamble Length: Preamble Length from 8~65535 bit;
- CRC check: 0 – disable CRC check, 1 – enable CRC check;
- IQ Invert: 0 -- not inverted, 1 – inverted;
- Save to FLASH: Save parameters to FLASH, 0 – not save, 1 – save.

|   |   |
|---|---|
| <b>AT+LoraSet=868000000,18,12,0,1,8,1,0,0</b> | +OK<br>+LoraPara:868000000,18,12,0,1,8,1,0      |
| <b>Description</b>                            | Set LoRa node-to-node communication parameters. |

#### Receive mode

| Command            | Response   |
|--------------------|--|
| <b>AT+RX=0</b>     | +OK<br>+RX=0   |
| <b>Description</b> | The device is in receive mode with no timeout;<br>Keep the device in a listening state, the listening frequency, the spread factor and the emission parameters are the same until the data is received and the listening state ends. To receive data again, you need to go from new to listening mode. |
| <b>AT+RX=1000</b>  | +OK<br>+RX=1000  |
| <b>Description</b> | The device is in receive mode, timeout 1000ms;<br>If no data is received within 1000ms, "RX Timeout" is output.  |

#### Receive data output mode selection

| Command               | Response  |
|-----------------------|---|
| <b>AT+PrintMode=?</b> | +OK<br>+PrintMode=0   |
| <b>Description</b>    | Query the current received data output mode:<br><ul style="list-style-type: none"><li>- Return value 0: string output;</li><li>- Return value 1:hex output.</li></ul> |
| <b>AT+PrintMode=1</b> | +OK   |

|                    |   |
|--------------------|---|
|                    | +PrintMode=1  |
| <b>Description</b> | Set the device to hexadecimal output format, the data received in RX mode will be printed in hexadecimal form.<br><br>The parameters are only 0 or 1. |

## LoRaWAN mode proprietary commands

### Set DevEui

| Command                           | Response  |
|-----------------------------------|---|
| <b>AT+DevEui=?</b>                | +OK<br>+DevEui=2232330000888802(For OTAA Mode)  |
| <b>Description</b>                | Output DevEui in the current system, for OTAA mode;   |
| <b>AT+DevEui=8888888888888888</b> | +OK<br>+DevEui=8888888888888888(For OTAA Mode)  |
| <b>Description</b>                | Set DevEui to 8888888888888888;<br><br>16-bit length, parastatal hexadecimal characters from 0 to F only. |

### Set AppEui

| Command                           | Response  |
|-----------------------------------|---|
| <b>AT+AppEui=?</b>                | +OK<br>+AppEui=0000000000000000(For OTAA Mode)  |
| <b>Description</b>                | Output AppEui in the current system for OTAA mode;  |
| <b>AT+AppEui=8888888888888888</b> | +OK<br>+AppEui=8888888888888888(For OTAA Mode)  |
| <b>Description</b>                | Set AppEui to 8888888888888888;<br><br>16-bit length, parastatal hexadecimal characters from 0 to F only. |

### Set AppKey

| Command   | Response  |
|---|---|
| <b>AT+AppKey=?</b>                                | +OK<br>+AppKey=88888888888888888888888888886601(For OTAA Mode)  |
| <b>Description</b>                                | Output the AppKey in the current system for OTAA mode;  |
| <b>AT+AppKey=88888888888888888888888888888888</b> | +OK<br>+AppKey=88888888888888888888888888888888(For OTAA Mode)  |
| <b>Description</b>                                | Set AppKey to:<br>88888888888888888888888888888888;<br>Length 32-bit, parastatal hexadecimal characters from 0 to F only. |

### Set NwkSKey

| Command  | Response  |
|--|---|
| <b>AT+NwkSKey=?</b>                                | +OK<br>+NwkSKey=D72C7****DCCA****EE4A7****6EF67(For ABP Mode)   |
| <b>Description</b>                                 | Output snout in the current system for NwkSKeyfor ABP mode;   |
| <b>AT+NwkSKey=88888888888888888888888888888888</b> | +OK<br>+NwkSKey=88888888888888888888888888888888(For ABP Mode)  |
| <b>Description</b>                                 | Set NwkSKey to:<br>88888888888888888888888888888888;<br>Length 32-bit, parastatal hexadecimal characters from 0 |

|  |            |
|--|------------|
|  | to F only. |
|--|------------|

### Set AppSKey

| Command   | Response   |
|---|--|
| <b>AT+AppSKey=?</b>                                 | +OK<br>+AppSKey=15B1D****463D****D1118****C7DA85(For ABP Mode)   |
| <b>Description</b>                                  | Output AppSKey in the current system for ABP mode;   |
| <b>AT+AppSKey=88888888<br/>88888888888888888888</b> | +OK<br>+AppSKey=88888888888888888888888888888888(For ABP Mode)   |
| <b>Description</b>                                  | Set AppSKey to:<br>88888888888888888888888888888888;<br>Length 32-bit, parastatal hexadecimal characters from 0 to F only. |

### Set DevAddr

| Command                    | Response   |
|----------------------------|--|
| <b>AT+DevAddr=?</b>        | +OK<br>+DevAddr=007E6AE1(For ABP Mode)   |
| <b>Description</b>         | Output DevAddr in the current system for ABP mode;   |
| <b>AT+DevAddr=88888888</b> | +OK<br>+DevAddr=88888888(For ABP Mode)   |
| <b>Description</b>         | Set DevAddr to:88888888;<br>Length 32-bit, parastatal hexadecimal characters from 0 to F only. |

### Set OTAA / ABP mode

| Command | Response |
|---------|----------|
|---------|----------|

|                    |   |
|--------------------|---|
| <b>AT+OTAA=?</b>   | +OK<br>+OTAA=1  |
|                    | +OK<br>+OTAA=0  |
| <b>Description</b> | Return value 1 (default): OTAA mode.<br>Return value 0: ABP mode. |
| <b>AT+OTAA=0</b>   | +OK<br>+OTAA=0  |
| <b>Description</b> | Switch to ABP mode with only 0 or 1 parameters.                   |

#### Configure ADR

| Command            | Response   |
|--------------------|--|
| <b>AT+ADR=?</b>    | +OK<br>+ADR=1  |
|                    | +OK<br>+ADR=0  |
| <b>Description</b> | Return value 1 (default): ADR function is on;<br>Return value 0: ADR function is disabled. |
| <b>AT+ADR=0</b>    | +OK<br>+ADR=0  |
| <b>Description</b> | Disable the ADR function, the parameter is only 0 or 1.                                    |

#### Configure LoRaWAN channel masks

About LoRaWAN channel masks, this document may makes sense to you:

<https://heltec-automation->

[docs.readthedocs.io/en/latest/general/sub\\_band\\_usage.html](https://heltec-automation-docs.readthedocs.io/en/latest/general/sub_band_usage.html)



| Command                                | Response  |
|--|---|
| AT+ChMask=?                            | +OK<br>+ChMask=00000000000000000000FF   |
| Description                            | Current LoRaWAN working channels are 0~7.   |
| AT+ChMask=00000000<br>000000000000FF00 | +OK<br>+ChMask=00000000000000000000FF00   |
| Description                            | This command had set LoRaWAN working channels to 8~15.<br><br>If this command running before join, must reset hardware. If the device already joined, it will effective in next send. |

#### Trigger OTAA access

| Command     | Response   |                         |
|-------------|--|-------------------------|
| AT+Join=1   | Start getting into the net   | +OK<br>joining...       |
|             | Successful access to the network   | +OK<br>joining...joined |
| Description | After the equipment is powered off or reset, a new network is required from the new. |                         |

#### Set communication cycle DutyCycle

| Command | Response |
|---------|----------|
|---------|----------|

|                           |   |
|---------------------------|---|
| <b>AT+DutyCycle=?</b>     | +OK<br>+DutyCycle=15000   |
| <b>Description</b>        | Return values in milliseconds, in this case, communication with the gateway every 15 seconds.   |
| <b>AT+DutyCycle=60000</b> | +OK<br>+DutyCycle=60000   |
| <b>Description</b>        | In this example, set the communication period to 60 seconds.<br><br>You can set a maximum of 65535000, per millisecond, and after setting it, it will take effect the next time the data is sent. |

#### Set communication mode Class A / C

| Command            | Response  |
|--------------------|---|
| <b>AT+Class=?</b>  | +OK<br>+Class=A   |
| <b>Description</b> | The return value is Class A or Class C, which represents the corresponding working mode.                              |
| <b>AT+Class=C</b>  | +OK<br>+Class=C   |
| <b>Description</b> | Only AT + Class = A or AT + Class = C is valid.<br><br>After setting up, the next time the data is sent takes effect. |

#### Turn ACK on / off

| Command | Response |
|---------|----------|
|---------|----------|

|                           |  |
|---------------------------|--|
| <b>AT+IsTxConfirmed=?</b> | +OK<br>+IsTxConfirmed=1  |
| <b>Description</b>        | The ACK receipt (communication confirmation) feature is turned on by default. After receiving the uplink, the gateway sends a Downlink to inform the node that the data has been received. |
| <b>AT+IsTxConfirmed=0</b> | +OK<br>+IsTxConfirmed=0  |
| <b>Description</b>        | Turn off ACK receipt.<br>Because of the ADR feature, there will still be Downlink data printing in this mode if parameters such as the node's rate are automatically adjusted.             |
| <b>AT+IsTxConfirmed=1</b> | +OK<br>+IsTxConfirmed=1  |
| <b>Description</b>        | Turn on the ACK receipt. After setting, it will take effect when the next data is sent.  |

#### Configure fport

| Command             | Response  |
|---------------------|---|
| <b>AT+AppPort=?</b> | +OK<br>+AppPort=2   |
| <b>Description</b>  | Query the current upstream data port.   |
| <b>AT+AppPort=5</b> | +OK<br>+AppPort=5   |
| <b>Description</b>  | Set fport to 5, and the parameter range is 0 ~ 255.<br>After setting up, the next time the data is sent takes |

|  |         |
|--|---------|
|  | effect. |
|--|---------|

**Set the number of retransmissions (if the transmission fails)**

| Command                        | Response   |
|--------------------------------|--|
| <b>AT+ ConfirmedNbTrials=?</b> | +OK<br>+ConfirmedNbTrials=8  |
| <b>Description</b>             | If communication fails, the system retransmits data to the gateway 8 times by default, changing the rate every 2 times to try to optimally transfer. |
| <b>AT+ ConfirmedNbTrials=3</b> | +OK<br>+ConfirmedNbTrials=3  |
| <b>Description</b>             | Set the number of retransmissions to 3 and the parameter range is 3 ~ 8.<br>After setting, it will take effect the next time data is sent.           |

## Send data

The following commands can be used in "LoRa Normal Mode" and "LoRaWAN Mode".

- LoRa Normal Mode: Data will be sent directly;
- LoRa mode: The data is encapsulated in a format that conforms to the LoRaWAN protocol before being sent out.

## Send Hex Data

| Command                          | Response   |  |
|----------------------------------|--|--|
| <b>AT+SendHex=AABBCCDD012345</b> | LoRaWAN Mode   | +OK<br><br>+Send Hex Data:AABBCCDD012345<br><br>confirmed uplink sending ...<br><br><i>The node communicates successfully with the gateway and receives the ACK issued by the gateway, which prints.</i><br><br>receive data: rssi = -xx, snr = -x, datarate = x |
|                                  | LoRa Normal mode   | +OK<br><br>+Send Hex Data:AABBCCDD012345<br><br>TX done  |
| <b>Description</b>               | Send out hex strings,"0xAA, 0xBB, 0xCC, 0xDD, 0x01, 0x23, 0x45".<br><br><b>Hex characters only 0 to F, must be even digits, two bits as one byte, and a maximum of 64 bytes.</b> |  |

## Send string

| Command                       | Response  |  |
|-------------------------------|---|--|
| <b>AT+SendStr=abcdefghijk</b> | LoRaWAN mode  | +OK<br><br>+Send String:abcdefghijk<br><br>confirmed uplink sending ...<br><br><i>The node communicates successfully with the gateway and receives the ACK issued by the gateway, which prints</i><br><br>receive data: rssi = -47, snr = -1, datarate = 0 |
|                               | LoRa Normal mode  | +OK<br><br>+Send String:abcdefghijk<br><br>TX done   |
| <b>Description</b>            | Send the string, "abcdefghijk".<br><br>ASCII characters only, up to 64 bytes. |  |

## 4. Application examples

### 4.1 Sending data through LoRa normal mode

- 1) Power on CubeCell (HTCC-AM0x module needs external low level to trigger reset);
- 2) Wake up the device: **AT + XXX**
- 3) Disable LoRaWAN protocol: **AT + LORAWAN = 0**
- 4) Set the working frequency to 470MHz: **AT + FREQ = 470000000**
- 5) [Spread](#) factor, [transmit power](#) to maintain default;
- 6) Send data: **AT+SendStr=abcdefghijkl**

### 4.2 Sending data through LoRaWAN mode

This mode needs to work with the [LoRa gateway](#).

- 1) Power on CubeCell (HTCC-AM0x module needs external low level to trigger reset);
- 2) Wake up the device: **AT + XXX**
- 3) Turn on LoRaWAN protocol support: **AT + LORAWAN = 1**
- 4) Switch to OTAA working mode: **AT + OTAA = 1**
- 5) [Parameters such as DevEui](#), [AppKey](#), etc. can remain default, but you need to ensure that they correspond to the parameters registered on the server;
- 6) Connect to the network (if the gateway is not powered off, connect to the network only once): **AT + Join = 1**
- 7) Send data after successful access to the internet, e.g. **AT-SendHex-AABBCCDD012345**
- 8) After sending the data, go into sleep mode if necessary: **AT-LPM=1**
- 9) If the device is woken up in the next cycle, the data can be sent directly without the need to access the network again.

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