

# 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; - Correction of clerical and presentation errors.	2019.12.16
V0.3	- AT command version update to V0.9; - Add node-to-node communication parameter configuration commands; - Add copyright disable command; - Add set channel mask command.	2020.6.29
V0.4	- AT command version update to V1.0; - Spreading factor support to 5~12 in node-to-node communication mode; - SNR will be print in node-to-node communication mode.	2020.7.9
V0.5	- Add automatic low-power disable command	2020.08.04
V0.6	- AT command version update to V1.3; - Add adjust DR command under non-ADR command; - Add query sending status command.	2021.01.14

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

### Query the chip's Unique ID

Command	Response
<b>AT+ChipID=?</b>	+OK +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 5****93****D DC3*****1F0 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: 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. 5. +LORAWAN=0 6. 7. +FREQ=470000000 8. +SF=7 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=8888888888888888888888888888886601 (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 +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, range 0~22(±1) 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 +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 +RX=0
<b>Description</b>	The device is in receive mode with no timeout; 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 +RX=1000
<b>Description</b>	The device is in receive mode, timeout 1000ms; If no data is received within 1000ms, "RX Timeout" is output.

#### Receive data output mode selection

Command	Response
<b>AT+PrintMode=?</b>	+OK +PrintMode=0
<b>Description</b>	Query the current received data output mode: <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.  The parameters are only 0 or 1.

## LoRaWAN mode proprietary commands

### Set DevEui

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

### Set AppEui

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

### Set AppKey

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

### Set NwkSKey

Command	Response
<b>AT+NwkSKey=?</b>	+OK +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 +NwkSKey=88888888888888888888888888888888(For ABP Mode)
<b>Description</b>	Set NwkSKey to: 88888888888888888888888888888888; Length 32-bit, parastatal hexadecimal characters from 0

	to F only.
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### Set AppSKey

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

### Set DevAddr

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

### Set OTAA / ABP mode

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

### Configure ADR

Command	Response
<b>AT+ADR=?</b>	+OK +ADR=1
	+OK +ADR=0
<b>Description</b>	Return value 1 (default): ADR function is on; Return value 0: ADR function is disabled.
<b>AT+ADR=0</b>	+OK +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 +ChMask=00000000000000000000FF
Description	Current LoRaWAN working channels are 0~7.
AT+ChMask=00000000 000000000000FF00	+OK +ChMask=00000000000000000000FF00
Description	This command had set LoRaWAN working channels to 8~15.  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 joining...
	Successful access to the network	+OK 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
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<b>AT+DutyCycle=?</b>	+OK +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 +DutyCycle=60000
<b>Description</b>	In this example, set the communication period to 60 seconds.  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 +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 +Class=C
<b>Description</b>	Only AT + Class = A or AT + Class = C is valid.  After setting up, the next time the data is sent takes effect.

#### Turn ACK on / off

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

	effect.
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#### Set the number of retransmissions (if the transmission fails)

Command	Response
<b>AT+ ConfirmedNbTrials=?</b>	+OK +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 +ConfirmedNbTrials=3
<b>Description</b>	Set the number of retransmissions to 3 and the parameter range is 3 ~ 8.  After setting, it will take effect the next time data is sent.

#### Adjust DR under non-ADR

Command	Response
<b>AT+SetDR =2</b>	+OK +SetDR=2
<b>Description</b>	The DR range of different regions may be different.  If the adjusted DR value is wrong, a correct range will be returned. Such as:  +ERROR: DR should be 2 – 7

### Query sending status

Command	Response
AT+Busy=?	+OK +Busy=1
	+OK +Busy=0
Description	Check if the message can be sent now. If feedback "+Busy=1", it can't, if feedback "+Busy=0", it can.

### 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	
AT+SendHex=AABBCCDD012345	LoRaWAN Mode	+OK  +Send Hex Data:AABBCCDD012345  confirmed uplink sending ...  <i>The node communicates successfully with the gateway and receives the ACK issued by the gateway, which prints.</i>  receive data: rssi = -xx, snr = -x, datarate = x

	LoRa  Normal  mode	+OK  +Send Hex Data:AABBCCDD012345  TX done
<b>Description</b>	Send out hex strings,"0xAA, 0xBB, 0xCC, 0xDD, 0x01, 0x23, 0x45".  <b>Hex characters only 0 toF, 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  +Send String:abcdefghijk  confirmed uplink sending ...  <i>The node communicates successfully with the gateway and receives the ACK issued by the gateway, which prints</i>  receive data: rssi = -47, snr = -1, datarate = 0
	LoRa Normal mode	+OK  +Send String:abcdefghijk  TX done
<b>Description</b>	Send the string, "abcdefghijk".  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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