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泰芯半导体
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Taixin **AH** Module **AT** Command Development Guide

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Revision History

date	Version	describe	Revised by
2023-5-23	V4.3 Modified the description of JOINGROUP;		WE
2023-4-7	V4.2 Modify the description of the destination address of TXDATA;		WE
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2021-4-29	V1.10 Added AT+DSLEEP command instructions		YOU

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2021-4-19	V1.9	Add broadcast mode instructions: at+mode=group at+joingroup	YOU
2021-3-6	V1.7 adds AT+BEACON_INT/AT+DTIM commands		YOU
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2020-11-18	V1.4 Added AT+PAIR/AT+CONN_STATE commands		YOU
2020-11-10	V1.3 Added AT+RSSI usage instructions		YOU
2020-10-24	V1.2 Added AT command terminator description and serial port tool setting description		YOU
2020-9-22	V1.1 Added AT+KEYMGMT/AT+AGGCNT commands		YOU
2020-09-16	V1.0First version		YOU

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1 Overview

The Taixin AH module supports AT command working mode. AT commands can be sent through uart or network port.

Number settings, data communication.

2 Interface Description

2.1 Serial port settings

The serial port configuration is as shown below.

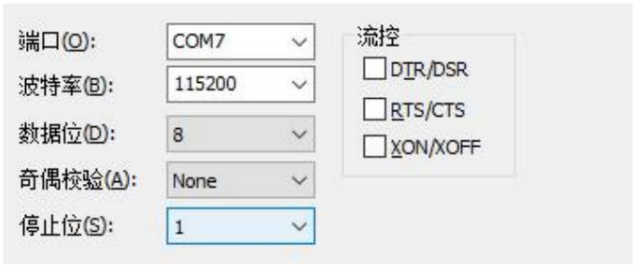

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Figure 2-1 Serial port parameter configuration

In addition, please note that the new line mode is selected. Take SecureCRT as an example:

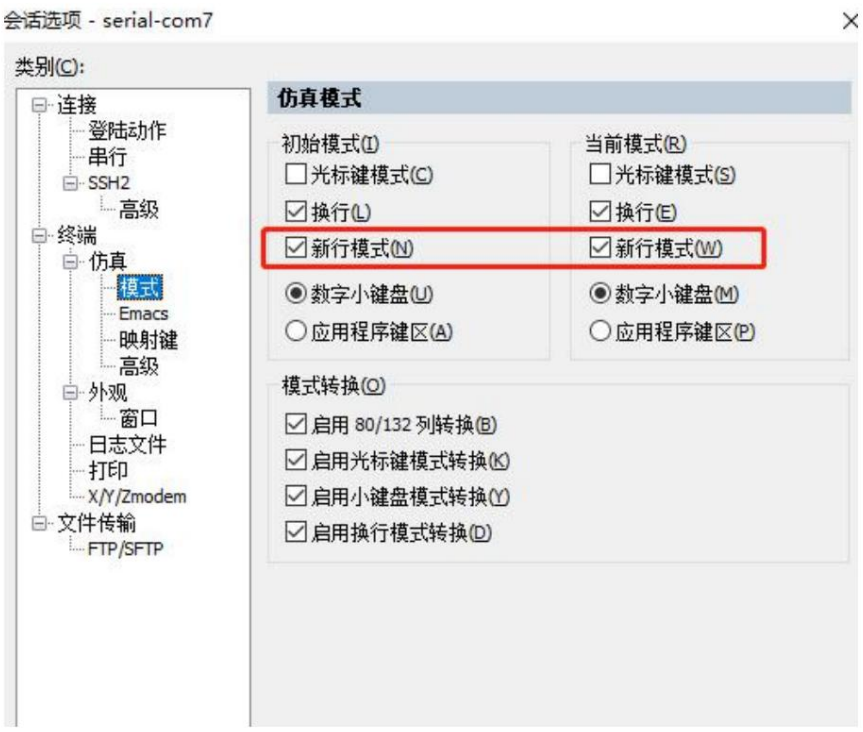

Figure 2-2 Selecting the new line mode

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To test whether the serial port is normal, enter AT+, and it will print as shown below:

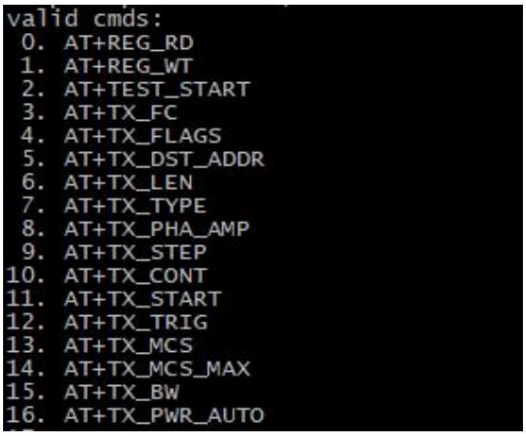

Figure 2-3 Echo after inputting AT+

If this is not printed, it means that the serial port input is incorrect and you need to contact our FAE.

2.2 Network Port

For scenarios where serial ports are inconvenient to use, Tysin provides two network port-based tools to facilitate customers to configure parameters.

Configuration (netat.exe) and log viewing (netlog.exe). Note that both tools will only work after the bridge firmware version 12954. The following are

instructions for use.

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2.2.1 **Netat.exe**

When you need to use AT+ commands to configure the bridge parameters, you can use netat.exe. Use a network

cable to connect the bridge device and the PC. Double-click to run, enter the IP address of the PC, and the mac of the connected device will be

displayed. If

only one device is connected, it will automatically select device 1.

Figure 2-4 Netat selects only one device

If several devices are connected via a switch, you can select the device by entering a number

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Figure 2-5 Netat selects multiple devices

After selecting the device, enter the AT command to execute the AT command. The usage is consistent with the serial port.

2.2.2 **Netlog.exe**

When you need to use a network cable to view the debug log of the bridge, you can use netlog.exe. Use a network cable to connect the bridge device and the PC. Double-click to run netlog.exe, enter the IP address of the PC, and the log will be automatically printed. Only the log of the device connected by the network cable will be displayed. When using it, be careful not to use a switch to connect multiple devices.

3 **AT** command instructions

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3.1 Basic Networking Commands

3.1.1AT+MODE: Set working mode

Execute Instructions	Query: AT+MODE?	Setting: AT+MODE=ap/sta
response	+MODE:ap/sta OK	Success: OK Failed: ERROR
Parameter Description		Support 4 modes: ap/sta/group/apsta
Example		ÿ at+mode=ap: AP mode ÿ at+mode=sta: sta mode ÿ at+mode=group: broadcast mode ÿ at+mode=apsta: relay mode, the relay mode settings The device can be used as both a STA to connect to the upper AP level and an AP Provide connection service for other STAs. Use at+r_ssid And at+r_psk set the connection parameters of the upper-level AP.

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3.1.2AT+SSID: Set SSID

Execute Instructions	Query: AT+SSID?	Setting: AT+SSID=ssid_char
response	+SSID:hgic_ah_test OK	Success: OK Failed: ERROR
Parameter Description		ssid_char length is less than 32 characters
Example		at+ssid=hgic_ah_test

3.1.3AT+KEYMGMT: Set encryption mode

Execute Instructions	Query: AT+KEYMGMT?	Setting: AT+KEYMGMT=WPA-PSK/NONE
response	+KEYMGMT:WPA-PSK OK	Success: OK Failed: ERROR
Parameter Description		WPA-PSK: Enable encryption NONE: Disable encryption
Example		at+keymgmt=WPA-PSK at+keymgmt=NONE

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3.1.4AT+PSK: Set encryption password

Execute Instructions	Query: AT+PSK?	Setting: AT+PSK=psk_char
response	+PSK:baa58569a9edd7c3a55e4 46bc658ef76a7173d023d25678 6832474d737756a82 OK	Success: OK Failed: ERROR
Parameter Description		psk_char must be 64 hex characters.
Example		at+psk=baa58569a9edd7c3a55e446bc6 58ef76a7173d023d256786832474d7377 56a82

3.1.5AT+PAIR: Pairing control

Execute Instructions	Query: AT+PAIR=0/1

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response	OK
Parameter Description	This command can be used to quickly pair the network when the SSID is not set. When pairing is started: 1. The AP is configured with SSID and password, but the STA is not configured: During the pairing process, the STA will obtain The SSID and password of the AP. 2. Neither the AP nor the STA is configured with an SSID and password: During the pairing process, the AP will Generate a random password. After pairing is successful, a PAIR SUCCESS message will be generated, but pairing will not be automatically terminated. Run AT+PAIR=0 to stop pairing. The connection will be automatically established after pairing stops. If both AP and STA have set SSID and other parameters, there is no need to start PAIR. Parameters are automatically connected.
Example	AT+PAIR=1 //Start pairing AT+PAIR=0 //Stop pairing

3.1.6AT+BSS_BW: Set BSS bandwidth

Execute Instructions	Query: AT+BSS_BW?	Setting: AT+BSS_BW=bss_bw
response	+BSS_BW:8MHz OK	Success: OK Failed: ERROR
Parameter Description		bss_bw selects only the following 4 values: 1 : 1MHz 2 : 2MHz 4 : 4MHz 8 : 8MHz
Example		at+bss_bw=4

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3.1.7AT+FREQ_RANGE: Set the operating frequency range

Execute Instructions	Query: AT+FREQ_RANGE?	Setting: AT+FREQ_RANGE=start,end
response	+FREQ_RANGE:9080-9240 OK	Success: OK Failed: ERROR
Parameter Description		ÿThis command is used to set the frequency for continuous use Range, specify the start center frequency and end center The AH module will automatically calculate the frequency point sequence

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		surface. ÿ The values of start and end are the center frequency*10.
Example		at+freq_range=9080,9240 set up start freq=908MHz end freq=924MHz The generated channel list is 908M. 916M,924M Note that if AT+CHAN_LIST is set at the same time, The parameters set in CHAN_LIST take precedence.

3.1.8AT+CHAN_LIST: Set the working frequency list

Execute Instructions	Query: AT+CHAN_LIST?	Setting: AT+CHAN_LIST=freq1,freq2
response	+CHAN_LIST:9080,9240 OK	Success: OK Failed: ERROR
Parameter Description		ÿThis command is used to set a non-continuous frequency point sequence surface. ÿ The specified frequency value is the center frequency*10. ÿ Supports up to 16 frequency points, separated by commas
Example		at+chan_list=9080,9240 Set 2 frequencies: 908MHz, 924MHz

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3.2 Status query command

3.2.1AT+RSSI: Check the device signal quality RSSI

Execute Instructions	Query: AT+RSSI?
response	+RSSI:-30 OK
Parameter Description	AT+RSSI=index/mac_addr

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	index: specifies the device index to be queried, starting from 1. mac_addr: specifies the mac address of the device to be queried.
Example	AT+RSSI //If no parameters are specified, query the RSSI of the first device AT+RSSI=1 //Specify the rssi of the first device to query AT+RSSI=f4:de:09:68:6c:20 //Specify RSSI query based on MAC address

3.2.2AT+CONN_STATE: Check the connection status

Execute Instructions	Query: AT+CONN_STATE
response	+CONNECTED //Connected +DISCONNECT //Not connected
Parameter Description	
Example	AT+CONN_STATE

3.2.3AT+WNBCFG: View device parameter information

Execute Instructions	AT+WNBCFG
response	
illustrate	View device parameter information

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3.2.4AT+STA_INFO: View STA information

Execute Instructions	AT+STA_INFO=ID
response	STA1: f6:de:09:79:6c:50 tx1: mcs=*0 bw=2MHz snr=86 cnt=7 agg=1 data=0KB(0kbps) dur=4ms dut=32% txq=0 cca=28 ack=0KB(7) drop=0KB(0) per=0% est_rate=450kbps rx1: mcs=0 bw=2MHz evm(avg:std)=0:0 rssi=0 agc=0 cnt=10 agg=1 data=0KB(2kbps) dur=9ms dut=67% fcsErr=0, freqDev=595Hz adv_bw=0:0:0:0 sta_cnt=1
illustrate	View the LMAC statistics of the STA with the corresponding ID, including RSSI, EVM and other information; AP can use this command, but STA does not need this command; ID is the serial number of the STA, starting from 1; When using this command, you can first turn off the default LMAC printing: AT+SYSDBG=LMAC,0

3.2.5AT+SCAN_AP: Scan surrounding AP information

Execute Instructions	AT+SCAN_AP
response	OK
illustrate	Execute this command in STA mode to scan surrounding AP information.

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3.2.6AT+BSSLIST: Get the scanned AP list

Execute Instructions	Query: AT+BSSLIST
response	[508727]BSS List: [508727]ah_1, freq:7720, signal:-14, en:0, bssid:fa:de:09:83:84:38, repeater:0 [508734]ah_2, freq:7800, signal:-17, en:0, bssid:f6:de:09:6e:5a:50, repeater:0
illustrate	After executing the scan_ap command, you can use this command to obtain the scanned AP list (AP is set ssid can be scanned)

3.3 Advanced Networking Commands

3.3.1AT+TXPOWER: Set the maximum transmit power

Execute Instructions	Query: AT+TXPOWER?	Setting: AT+TXPOWER=txpower
response	+TXPOWER:20dbm OK	Success: OK Failed: ERROR
Parameter Description		This command is used to manually set the maximum transmit power. The range is 6~20, 1db step.
Example		at+txpower=20 Set the maximum transmit power to 20dbm

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3.3.2AT+ACKTMO: Set ACK TIMEOUT time

Execute Instructions	Query: AT+ACKTMO?	Setting: AT+ACKTMO=0
response	+ACKTMO:0 OK	Success: OK Failed: ERROR
Parameter Description	Default value, no additional ACK timeout time;	Set and add AH module WiFi protocol parameter ack timeout value in microseconds, default is 0. This setting is only required when communicating over 1km. This parameter is calculated as 10*(distance in kilometers) -1), for example, for 2km, set acktmo=10. Modified value is saved after power off;
Example		AT+ACKTMO=100 Increase 100us ACK packet timeout

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3.3.3AT+TX_MCS: set tx mcs

Execute Instructions	Query: AT+TX_MCS?	Setting: AT+TX_MCS=255
response	+TX_MCS:255 OK	Success: OK Failed: ERROR
Parameter Description		Set tx mcs, the range is 0~7 or 1M mode 10 means fixed to a certain mcs, other values mean mcs auto-adjust; This command will be saved after power off;
Example		AT+TX_MCS=2 The MCS of fixed transmission is 2

3.3.4AT+HEART_INT: Set the heartbeat packet interval

Execute Instructions	Query: AT+HEART_INT?	Setting: AT+HEART_INT=500
response	+HEART_INT:500 OK	Success: OK Failed: ERROR
Parameter Description		Set the heartbeat packet interval, unit: mS, minimum setting The more STAs there are, the higher the recommended heart rate is. The larger the heartbeat interval, the more appropriate the heartbeat packet length. The length is STA_count*50; Earlier software versions required AP and STA to be set up similarly. The same heartbeat packet interval, otherwise the connection will have problems; This command will be saved when power is off; starting from V1.6.2, only You only need to set the AP's heartbeat packet interval, and the AP will automatically This command is invalid for STA. .
Example		AT+HEART_INT=2000 Set the heartbeat packet interval to 2S

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3.3.5AT+UNPAIR: Set to unpair the specified STA

Execute Instructions	Query: AT+UNPAIR?	Setting: AT+UNPAIR=mac_addr
response	No response	Success: unpair sta:mac_addr Failed: sta:mac_addr is not exist
Parameter Description		mac_addr is the other party's mac address
Example		at+unpair=f6:de:09:75:a3:61

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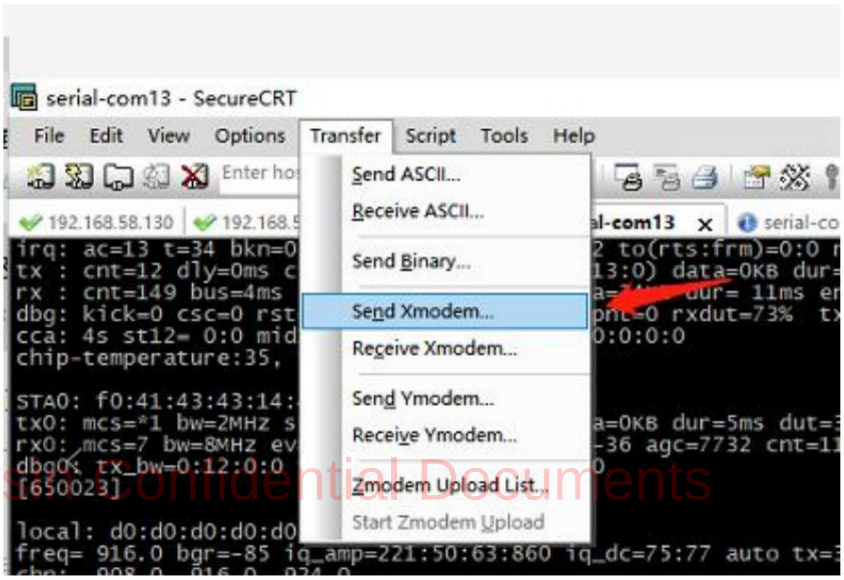
3.4 Debug Commands

3.4.1AT+FWUPG: Serial port firmware upgrade

Execute Instructions	AT+FWUPG
response	After successful execution, the serial port prints: CCCCCCCCCC Indicates that the module has entered the upgrade mode and can use the xmodem protocol to download the firmware.
illustrate	Serial port tools that support the xmodem protocol include: secureCRT, xshell 

3.4.2AT+LOADDEF: Restore factory settings

Execute Instructions	AT+LOADDEF=1
response	
illustrate	Restore factory settings

3.4.3AT+SYSDBG: Set to print debug information

Execute Instructions	Query: Not supported	Setting: AT+SYSDBG=XXX,VALE
response		Success: OK
Parameter Description		XXX can select LMAC (air interface statistics), WNB (network layer statistics); VALE=0 means turn off the corresponding printing, =1 means turn on the corresponding printing.

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		Open the corresponding print. LMAC statistics are turned on by default, many of them, such as It can be closed if necessary; WNB statistics are disabled by default.
Example		AT+SYSDBG=LMAC,0 Disable LMAC printing

3.4.4AT+BAUDRATE: Set the baud rate of UART-BUS

Execute Instructions	Query: AT+BAUDRATE=?	Setting: AT+BAUDRATE=VALUE
response	VALUE	Success: OK
Parameter Description		Note that this command selects UART BUS When installing the firmware, set UART0 (A10/A11) The baud rate through UART1 (A12/A13) To set; The VALUE range is 9600-400K. The UART-BUS may not work properly;
Example		AT+BAUDRATE=115200

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3.5 Multicast Related Commands

3.5.1AT+JOINGROUP: Joining a multicast network

After setting the working mode of the WiFi module to group, you can use this command to set the WiFi module to join a multicast network.

After joining the multicast network, the WiFi module will only receive data in the multicast network. All data communications are in multicast mode.

If the working mode is set to group, but no multicast network is added, all data communication

All are sent and received in broadcast form.

Note that the JOINGROUP command can only be set after the GROUP mode is set.

Execute Instructions	AT+JOING ROUP=ÿ	Setting: AT+JOINGROUP=11:22:33:44:55:66,3
response	fail: ERROR	Success: OK Failed: ERROR
Parameter Description	Not supported Inquiry	AT+JOINGROUP=group_addr,AID group_addr: The address of the multicast network to join AID: The AID of the device in the multicast network. AID valid values: 1~N (N is a fixed value).

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		The AID of each device in the network should be unique. one. ÿ Set effective AID: The WiFi module will periodically send heartbeats in the multicast network. Jump to announce its presence to other WiFi modules. ÿ Set invalid AID: The WiFi module will not send heartbeats and will not notify other WiFi module. If all devices set AID to 0, they will not be affected. The firmware supports a maximum limit on the number of STAs.
Example		AT+JOINGROUP=11:22:33:44:55:66,3 Join multicast address:11:22:33:44:55:66 AID is set to 3

3.6 Relay related setting commands

3.6.1AT+R_SSID: Set the relay SSID

Execute Instructions	Query: AT+R_SSID?	Setting: AT+R_SSID=repeater_ssid
response	+R_SSID:repeater_ssid OK	Success: OK Failed: ERROR
Parameter Description		Set the SSID of the relay connection to the upper AP.
Example		

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3.6.2AT+R_PSK: Set the encryption password for the relay

Execute Instructions	Query: AT+R_PSK?	Setting: AT+R_PSK=psk_char
response	+R_PSK:baa58569a9edd7c3a55 e446bc658ef76a7173d023d256 786832474d737756a82 OK	Success: OK Failed: ERROR
Parameter Description		The password for the relay to connect to the upper AP. psk_char Must be 64 hex characters.
Example		

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3.7 Roaming related setting commands

3.7.1AT+ROAM: Enable roaming

Execute Instructions	Query: AT+ROAM?	Setting: AT+ROAM=0/1
response	OK	Success: OK Failed: ERROR
Parameter Description	Roaming needs to be enabled only on the STA side. The SSID of the AP in the roaming network can be set by full word matching or fuzzy matching. Full word match: All APs' SSIDs are set to the same SSID. The length of the SSID is unlimited and does not exceed The SSID should be more than 32 characters. STAs are also set to this SSID. Fuzzy matching: The last three characters of the SSID of different APs are different. The total length of the SSID must be greater than 8 characters. Characters, consisting of a common string (at the beginning of the SSID) and a 3-character ID (at the end of the string) For example, if the common string is HUGE_IC_AH, then you can set the SSID of AP1 to HUGE_IC_AH001, AP2's SSID is HUGE_IC_AH002, and so on. STA's SSID It should be set to be consistent with the SSID of one of the APs.	
Example		AT+ROAM=1

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3.8 Hibernation related commands

3.8.1AT+PS_MODE: Set STA sleep mode

Execute Instructions	Query: AT+PS_MODE?	Setting: AT+PS_MODE=0/1/2/3/4
response	+PS_MODE:0 OK	Success: OK Failed: ERROR
Parameter Description		PS_MODE can take the following values: 0: No sleep mode is set, the effect is the same as mode 3 Same. 1: When the module enters sleep mode, it maintains communication with the server. Keep alive (the module itself and the server are kept alive). 2: When the module enters sleep mode, it maintains a state of communication with the server. Active (AP replaces the module and the server to keep active, the power consumption is the lowest Low). 3: When the module enters sleep mode, it only maintains communication with the AP.

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		Connection, any unicast packet can wake up the module. 4: The module enters sleep mode and only keeps alive with the AP. Only through AP input: at+wakeup wake up Awake.
Example		AT+PS_MODE=4

3.8.2AT+DTIM: Set the sleep DTIM time

Execute Instructions	Query: AT+DTIM?	Setting: AT+DTIM=1000/2000/3000 etc.
response	+DTIM:1000 OK	Success: OK Failed: ERROR
Parameter Description		The following values are available for DTIM: 1000: 1S to receive DTIM packets 2000: 2S wake up to receive DTIM packet 3000: 3S to receive DTIM packets ...
Example		AT+DTIM=1000

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3.8.3AT+DSLEEP: Set to enter sleep mode

Execute Instructions	Query: AT+DSLEEP?	Setting: AT+DSLEEP=1/120 or other values
response	+DSLEEP:awake OK	Success: OK Failed: undef DEEP_SLEEP
Parameter Description	Cannot read after hibernation	In the connected state, set = 1 to make the device enter the rest state. Sleep and keep alive state; In the non-connected state, set a non-zero value X to indicate that the device Go to sleep for X seconds and then wake up. If the STA retains the AP connection information, wake up The STA will then reconnect to the AP. If the reconnection timeout occurs, the Enter sleep mode, then wake up and connect again. Then go to sleep (ps-connect status). If you want the unconnected device to not To hibernate again, you need to change ps-mode to 0;
Example		AT+DSLEEP=1

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3.8.4AT+WAKEUP: Set remote wakeup

Execute Instructions	Query: AT+WAKEUP?	Setting: AT+WAKEUP=mac_addr
response	invalid	Success: OK Failed: ERROR
Parameter Description		Enter this command on the AP to wake up the sleeping STA
Example		AT+WAKEUP=11:22:33:44:55:66

3.8.5AT+PS_CONNECT: Set PS Connect behavior

Execute Instructions	Query: AT+PS_CONNECT?	AT+PS_CONNECT=60,3
response	+PS_CONNECT=60,3 OK	Success: OK Failed: ERROR
Parameter Description	Set the sleep interval of ps connect (unit S), and the maximum number of increments. STA's WiFi module is in sleep mode After disconnection, it will wake up and reconnect AP. If the connection fails, the WiFi module will Will enter PS Connect mode: loop sleep/wake up/reconnect. Sleep is to prevent reconnection. It consumes too much. If the maximum increment number is set to 1, Indicates no increment.	The first connection failed, sleep for 1 minute, the second The first connection failed and then sleep for 2 minutes. The third connection Failed to sleep for 3 minutes. The sleep time increases by 3 After that, it goes back to the first interval and repeats in a regular pattern. cycle.
Example		AT+PS_CONNECT=60,3

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3.9 **IoT** project related commands

3.9.1AT+TCPTEST: Test TCP traffic

Execute Instructions	AT+TCPTEST=ip_addr,port,tcpmode
response	
Parameter Description	ip_addr: the other party's IP address port: port number

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	tcpmode: The default is for the client to send, "s" for the server to receive
Example	As the sender: AT+TCPTEST=10.10.10.3,5002 As the receiving end: AT+TCPTEST=10.10.10.3,5002,s

3.9.2AT+IP: query or set IP address

Execute Instructions	Query: AT+IP=?	Setting: AT+IP=ip_addr
response	+IP:10.10.10.3 (successfully assigned ipÿ +IP:0.0.0.0 (unsuccessfully allocated ipÿ	Success: OK Failed: ERROR
Parameter Description		Enter this command to set the IP address
Example		AT+IP=10.10.10.3

3.9.3AT+PING: ping function

Execute Instructions	AT+PING=ip_domain,send_times,pktsize
response	Pinging 10.10.10.201 with 1024 bytes of data: [57969]qs_end [57981]Reply from 10.10.10.201: bytes=1024 time:13ms TTL=255 [58977][02:40:49:81:69:70] is expired, del it (1000) [58996]Reply from 10.10.10.201: bytes=1024 time:11ms TTL=255 [60008]Reply from 10.10.10.201: bytes=1024 time:8ms TTL=255
Parameter Description	"ip_domain" can be an IP address or a domain name; pktsize: ping packet data size, the default is 32 bytes; Note that you cannot enter other at commands while pinging.
Example	AT+PING=10.10.10.201,5,1024

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3.10 Other Commands

3.10.1 AT+TXDATA: Send data command

Execute Instructions	Query: Not supported: AT+TXDATA=length,txbw,txmcs,priority	
response		Success: OK Failed: ERROR
Parameter Description		This command is used to send data through the serial port in UART non-transparent mode.

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		deliver. Execution steps: 1. Execute the AT+TXDATA command first to set the parameters for data transmission, such as: length: the length of the data to be sent [required] txbw: specifies the tx bandwidth of the data [optional] txmcs: specify the tx mcs of the data [optional] priority: specifies the priority of the data, 0~7 [optional] 2. After executing the at+txdata command and it returns OK, start sending data. The length of the sent data must meet the length specified by the parameter. ÿ In 1-to-1 mode, AT+TXDATA can directly send the original data. according to. ÿ In 1-to-many mode, AT+TXDATA cannot directly send raw data. It is necessary to add a 14-byte Ethernet frame header before the original data before sending it. Setting length should also include the Ethernet frame header length. The 1-to-1 mode or 1-to-many mode is set when the firmware is compiled. The MAX_STA is determined by MAX_STA. MAX_STA=1 means 1 to 1 mode. MAX_STA>1, it is 1 to many mode, which can be adjusted according to actual application requirements The default firmware is 1 to many mode.
Example		ÿ 1 to 1 mode: at+txdata=10 //need to send 10 bytes of data OK 1234567890 //10byte original data is sent directly ÿ 1 to many mode: at+txdata=24 //need to send 10 bytes of data OK 222222222222888888888888999991234567890 The first 14 bytes are filled with the Ethernet frame header (written in hexadecimal). The last 10 bytes are the original data (written in the form of visible characters, which should actually be This is written in hexadecimal format). ÿ 2222222222222: Ethernet destination address ÿ 888888888888: Ethernet source address

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ÿ 9999: Ethernet protocol type

Ethernet frame header filling instructions:

ÿ Source address: can be filled with 0

ÿ Protocol type: can be filled with 0

ÿ Destination address: The filling rules for ap and sta are as follows:

ÿ The AP end uart master needs to manage the STA device, remember

Record the MAC address of each STA device, maintain the device ID and

The mac address mapping table is checked before sending data.

Data can only be sent after the MAC address of the device is found.

If it is a broadcast, the destination address is filled with

0xFFÿ

ÿ The UART master at the STA end does not need to maintain the mapping table.

Just fill in 1.

If you use SecureCrt to test this serial command, you need to note

Note that the first 14 bytes of the Ethernet frame header are in hexadecimal format.

The destination address can be entered in visible characters.

111111, the source address can use visible characters 000000, Ethernet protocol

The type can be visible with the character 00, and the final input becomes:

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111111000000001234567890. The source address displayed on the receiving end is

and Ethernet protocol types are garbled because the sender automatically replaces them

The device source address and protocol type are converted into hexadecimal, which is generally not

See the characters, so it becomes garbled.

If you use other serial port tools that support hexadecimal input, you can set

Any MAC address, then note that all characters including payload are

Hexadecimal input.

An example of the AP mapping table is as follows:

Device ID	MAC address
1001	00:1A:2B:3C:4D:5 AND

ÿ Receive data:

After the AH module receives the data, it will output the data on the serial port in the following format:

1. 1 to 1:

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		+RXDATA:10\r\n 1234567890 10 bytes of data received. 2. 1 to many: +RXDATA:24\r\n 222222222228888888888899991234567890 Receive 24 bytes of data, of which the first 14 bytes are the Ethernet frame header Data (written in hexadecimal format), starting from byte 15 Real data (written in visible character form, should actually be written uniformly as 16 hexadecimal characters). ÿ The UART master on the AP side can save the source address of the Ethernet frame header. Associate with the device ID and update the mapping table. ÿ The UART master at the STA end does not need to maintain the mapping table and ignores the Ethernet Network frame header, just receive the real data. After the uart master receives +RXDATA, please parse it according to the above format Receive data.

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4 **AT** command usage examples

4.1 Basic instructions for module connection establishment

When using AT commands to initialize the AH module, you mainly need to set the frequency, bandwidth, SSID and password. Code and other parameters. The simple initialization AT command list is as follows:

```
AT+CHAN_LIST=9080,9160,9240 #Set 3 frequencies #Set 8M bandwidth
AT+BSS_BW=8 #Set
AT+SSID=hgic_ah_test #SSID
AT+KEYMGMT=WPA-PSK # Enable encryption
AT+PSK=baa58569a9edd7c3a55e446bc658ef76a7173d023d256786832474d737756a82
AT+MODE=ap #Set to AP mode
```


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4.2 Configure relay network instructions

4.2.1AP Module

1. Configure the AP's ssid. Each AP should have a different configuration. You can consider increasing it by ssid1 and ssid2. For example:

   at+ssid=ssid1

2. Configure no encryption (to simplify the configuration, temporarily use no encryption as

   an example) at+keymgmt=none

4.2.2 Relay Module

1. Configure the relay role

   at+mode=apsta 2.

Configure no encryption

   at+keymgmt=none 3.

Configure the relay's r_ssid, which is used to connect the relay to the AP. It should be consistent with the ssid of the AP you want to connect to, for example:

   at+r_ssid=ssid1

4. Configure the relay's ssid, which is used to connect the relay to the sta. For ease of management, you can consider making the ssid consistent

with the ap's ssid in the front and adding a suffix at the end, such as ssid1_r1, ssid1_r2, ssid2_r1, etc. For example:

   at+ssid=ssid1_r1

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4.2.3STA module

1. Configure the STA's SSID to connect to the relay. It should be consistent with the SSID of the relay you want to connect to, for example:

   at+ssid=ssid1_r1 2,

configure without encryption

   at+keymgmt=none

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