AH Module AT Command Development Guide

Document Version: V3.0
Confidentiality Level: A

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1. Overview

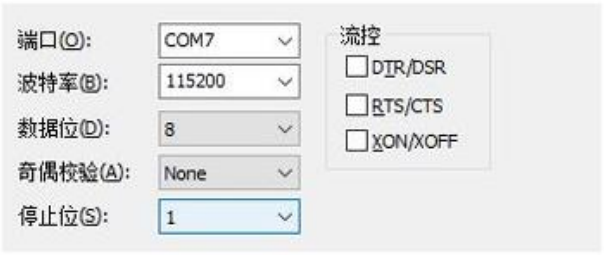
The AH module supports AT command working mode, allowing AT commands to be sent via UART or Ethernet interface for parameter configuration and data communication.

2. Interface Description

2.1 Serial Port Settings

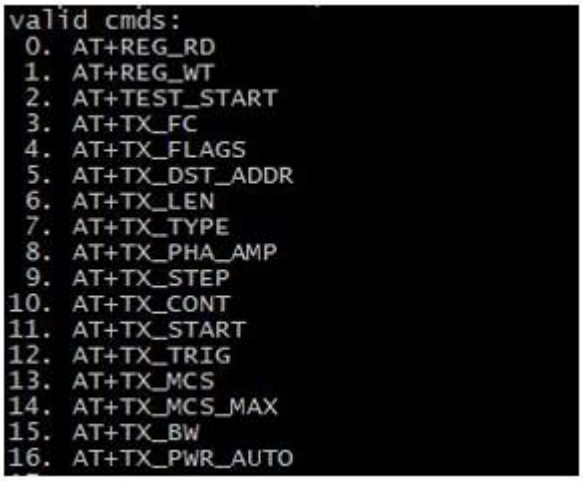
Configure the serial port according to the following parameters:

- **Baud Rate:** 115200
- **Data Bits:** 8
- **Stop Bits:** 1
- **Parity:** None
- **Flow Control:** None



Important: Please select newline mode. For SecureCRT example, ensure proper line ending configuration.

To test if the serial port is working properly, input AT+. It should print a response. If there's no response, contact our FAE for support.



2.2 Ethernet Interface

For scenarios where serial port usage is inconvenient, we provide two Ethernet-based tools for customer parameter configuration (netat.exe) and log viewing (netlog.exe). Note that both tools require bridge firmware version 12954 or later.

2.2.1 Netat.exe

Use netat.exe when you need to configure bridge parameters with AT+ commands.

1. Connect the bridge device and PC with an Ethernet cable
2. Double-click to run, input the PC's IP address
3. The connected device's MAC will be displayed
4. If only one device is connected, it will auto-select device 1

5. If multiple devices are connected through a switch, select the device by inputting a number

After selecting the device, input AT commands to execute them, with the same usage as serial port.

2.2.2 Netlog.exe

Use netlog.exe when you need to view bridge debug logs via Ethernet.

1. Connect the bridge device and PC with an Ethernet cable
2. Double-click to run netlog.exe, input the PC's IP address
3. Logs will be automatically printed
4. Only logs from the Ethernet-connected device will be displayed
5. Note: Do not use a switch to connect multiple devices when using this tool

3. AT Command Usage Instructions

3.1 Basic Networking Commands

3.1.1 AT+MODE: Set Working Mode

Command	Query: AT+MODE?	Set: AT+MODE=ap/sta
Response	+MODE:ap/sta OK	Success: OK Failure: ERROR
Parameters	Supports 4 modes: ap/sta/group/apsta	
Examples	at+mode=ap - AP mode at+mode=sta - STA mode at+mode=group – Broadcast mode at+mode=apsta - Relay mode (device acts as both STA connecting to upstream AP and AP providing connection service for other STAs. Use at+r_ssid and at+r_psk to set upstream AP connection parameters)	

3.1.2 AT+SSID: Set SSID

Command	Query: AT+SSID?	Set: AT+SSID=ssid_char
Response	+SSID:hgic_ah_test OK	Success: OK Failure: ERROR
Parameters	ssid_char length must be less than 32 characters	
Example	at+ssid=hgic_ah_test	

3.1.3 AT+KEYMGMT: Set Encryption Mode

Command	Query: AT+KEYMGMT?	Set: AT+KEYMGMT=WPA-PSK/NONE
Response	+KEYM_GMT:WPA-PSK OK	Success: OK Failure: ERROR
Parameters	WPA-PSK: Enable encryption NONE: Disable encryption	
Examples	at+keymgmt=WPA-PSK at+keymgmt=NONE	

3.1.4 AT+PSK: Set Encryption Password

Command	Query: AT+PSK?	Set: AT+PSK=psk_char
Response	+PSK:baa58569a9edd7c3a55e446bc658ef76a7173d023d256786832474d737756a82 OK	Success: OK Failure: ERROR
Parameters	psk_char must be 64 hex characters	
Example	at+psk=baa58569a9edd7c3a55e446bc658ef76a7173d023d256786832474d737756a82	

3.1.5 AT+PAIR: Pairing Control

Command	Set: AT+PAIR=0/1
Response	OK
Parameters	This command enables quick pairing for networking. When pairing is started: 1. If AP has configured SSID and password: STA will acquire AP's SSID and password during pairing 2. If AP hasn't configured SSID and password: AP will generate random passwords for each STA during pairing After successful pairing, a "PAIR SUCCESS" message will be generated. Execute AT+PAIR=0 to stop pairing. Connection will be established automatically after pairing stops.
Examples	AT+PAIR=1 // Start pairing AT+PAIR=0 // Stop pairing

3.1.6 AT+BSS_BW: Set BSS Bandwidth

Command	Query: AT+BSS_BW?	Set: AT+BSS_BW=bss_bw
Response	+BSS_BW:8MHz OK	Success: OK Failure: ERROR
Parameters	bss_bw options: 1: 1MHz 2: 2MHz 4: 4MHz	

Command	Query: AT+BSS_BW?	Set: AT+BSS_BW=bss_bw
	8: 8MHz	
Example	at+bss_bw=4	

3.1.7 AT+FREQ_RANGE: Set Working Frequency Range

Command	Query: AT+FREQ_RANGE?	Set: AT+FREQ_RANGE=start,end
Response	+FREQ_RANGE:9080-9240 OK	Success: OK Failure: ERROR
Parameters	• This command sets continuous frequency range by specifying start and end center frequencies. AH module automatically calculates frequency list • start and end values are center frequency × 10	
Example	at+freq_range=9080,9240 Sets start freq=908MHz, end freq=924MHz Generated channel list: 908M, 916M, 924M **Note:** If AT+CHAN_LIST is also set, CHAN_LIST parameters take priority	

3.1.8 AT+CHAN_LIST: Set Working Frequency List

Command	Query: AT+CHAN_LIST?	Set: AT+CHAN_LIST=freq1,freq2
Response	+CHAN_LIST:9080,9240 OK	Success: OK Failure: ERROR
Parameters	• This command sets non-continuous frequency list • Specified frequency values are center frequency × 10 • Supports up to 16 frequencies, separated by commas	

Command	Query: AT+CHAN_LIST?	Set: AT+CHAN_LIST=freq1,freq2
Example	at+chan_list=9080,9240 Sets 2 frequencies: 908MHz, 924MHz	

3.2 Status Query Commands

3.2.1 AT+RSSI: View Device Signal Quality RSSI

Command	Query: AT+RSSI?
Response	+RSSI:-30 OK
Parameters	AT+RSSI=index/mac_addr index: Specify device index to query, starting from 1 mac_addr: Specify device MAC address to query
Examples	AT+RSSI // Query 1st device RSSI (no parameter specified) AT+RSSI=1 // Query 1st device RSSI AT+RSSI=f4:de:09:68:6c:20 // Query RSSI by MAC address

3.2.2 AT+CONN_STATE: View Connection Status

Command	Query: AT+CONN_STATE
Response	+CONNECTED // Connected +DISCONNECT // Disconnected
Example	AT+CONN_STATE

3.2.3 AT+WNBCFG: View Device Parameter Information

Command	AT+WNBCFG
Description	View device parameter information

3.3 Advanced Networking Commands

3.3.1 AT+TXPOWER: Set Maximum Transmit Power

Command	Query: AT+TXPOWER?	Set: AT+TXPOWER=txpower
Response	+TXPOWER:20dbm OK	Success: OK Failure: ERROR
Parameters	This command manually sets maximum transmit power Range: 6~20, 1dB steps	
Example	at+txpower=20 Sets maximum transmit power to 20dBm	

3.3.2 AT+ACKTMO: Set ACK TIMEOUT Time

Command	Query: AT+ACKTMO?	Set: AT+ACKTMO=0
Response	+ACKTMO:0 OK	Success: OK Failure: ERROR
Parameters	Default value: no additional ACK timeout For communication distances over 3km, add 20us ACK timeout for every additional 3km Modified values are saved through power cycles	
Example	AT+ACKTMO=100 Adds 100us ACK packet timeout	

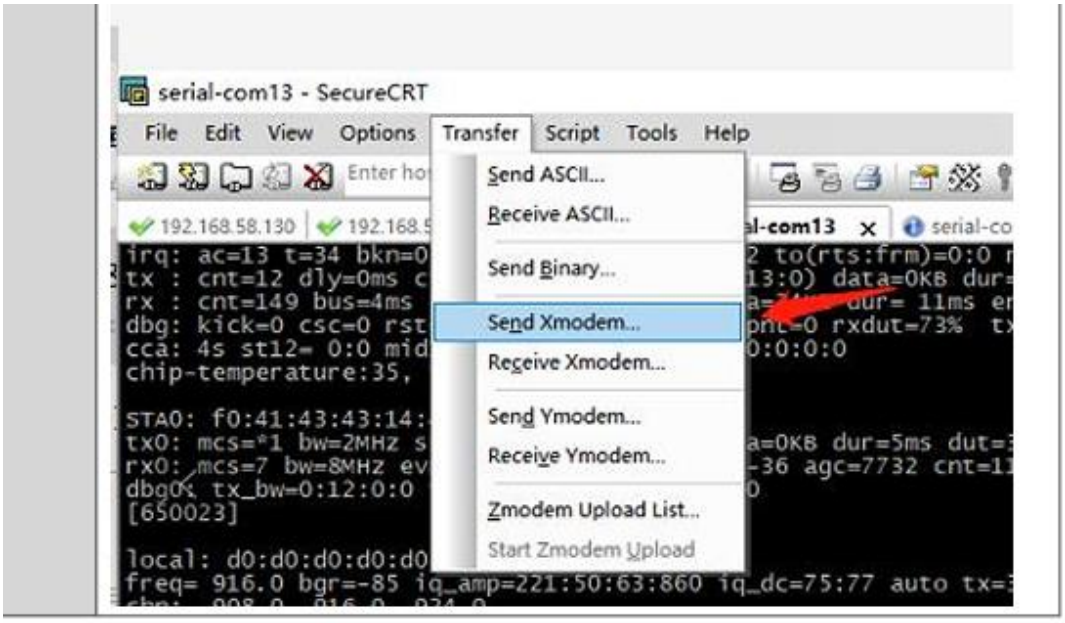
3.3.3 AT+TX_MCS: Set TX MCS

Command	Query: AT+TX_MCS?	Set: AT+TX_MCS=255
Response	+TX_MCS:255 OK	Success: OK Failure: ERROR
Parameters	Set TX MCS, range 0~7 or 10 in 1M mode indicates fixed MCS, other values indicate automatic MCS adjustment This command is saved through power cycles	
Example	AT+TX_MCS=2 Fixes transmission MCS to 2	

3.4 Debug Commands

3.4.1 AT+FWUPG: Serial Port Firmware Upgrade

Command	AT+FWUPG
Response	After successful execution, serial port prints: CCCCCCCCCC Indicates module has entered upgrade mode, can use xmodem protocol to download firmware
Description	Serial tools supporting xmodem protocol: SecureCRT, Xshell



3.4.2 AT+LOADDEF: Restore Factory Settings

Command	AT+LOADDEF=1
Description	Restore factory settings

3.5 Multicast Related Commands

3.5.1 AT+JOINGROUP: Join Multicast Network

After setting WiFi module working mode to group, use this command to set WiFi module to join a specific multicast network. After joining, the module will only receive data from that multicast network. All data communication uses multicast addresses. If working mode is set to group but no multicast network is joined, all data communication is broadcast.

Command	Set: AT+JOINGROUP=11:22:33:44:55:66,3
Response	Success: OK Failure: ERROR
Parameters	AT+JOINGROUP=group_addr,AID group_addr: Multicast network address to join AID: Device AID in multicast network, valid values: 1~255. Each device's AID should be unique in the network • Valid AID: WiFi module sends periodic heartbeats in multicast network to announce its presence • Invalid AID: WiFi module doesn't send heartbeats or notify other modules
Example	AT+JOINGROUP=11:22:33:44:55:66,3 Join multicast address: 11:22:33:44:55:66 Set AID to 3

3.6 Relay Related Setting Commands

3.6.1 AT+R_SSID: Set Relay SSID

Command	Query: AT+R_SSID?	Set: AT+R_SSID=repeater_ssid
Response	+R_SSID:repeater_ssid OK	Success: OK Failure: ERROR
Parameters	Set SSID for relay to connect to upstream AP	

3.6.2 AT+R_PSK: Set Relay Encryption Password

Command	Query: AT+R_PSK?	Set: AT+R_PSK=psk_char
Response	+R_PSK:baa58569a9edd7c3a55e446bc658ef76a7173d023d256786832474d737756a82 OK	Success: OK Failure: ERROR
Parameters	Password for relay to connect to upstream AP. psk_char must be 64 hex characters	

3.7 Roaming Related Setting Commands

3.7.1 AT+ROAM: Set Roaming Enable

Command	Query: AT+ROAM?	Set: AT+ROAM=0/1
Response	OK	Success: OK Failure: ERROR
Parameters	Roaming enable only needs to be set on STA side. **Roaming network AP SSID matching:** • **Exact match:** All APs set to same SSID (up to 32 characters). STAs also set to this SSID • **Fuzzy match:** Different APs have different last 3 characters in SSID. Total SSID length > 8 characters, composed of common string (at SSID beginning) + 3-character ID (at end). Example: common string "HUGE_IC_AH", AP1 SSID "HUGE_IC_AH001", AP2 SSID "HUGE_IC_AH002", etc. STA SSID should match one of the AP SSIDs	
Example	AT+ROAM=1	

3.8 Other Commands

3.8.1 AT+TXDATA: Send Data Command

Command	Query: Not supported	Set: AT+TXDATA=length,txbw,txmcs,priority
Response	Success: OK Failure: ERROR	
Parameters	This command is used for data transmission via serial port in UART non-transparent mode. **Execution steps:** 1. Execute AT+TXDATA command first, set data transmission parameters:	

Command	Query: Not supported	Set: AT+TXDATA=length,txbw,txmcs,priority
	• length: Data length to send [Required] • txbw: Specify TX bandwidth for this data [Optional] • txmcs: Specify TX MCS for this data [Optional] • priority: Specify data priority, 0~7 [Optional] 2. After AT+TXDATA command returns OK, start sending data. Data length must match specified length parameter • **1-to-1 mode:** AT+TXDATA can directly send raw data • **1-to-many mode:** AT+TXDATA cannot directly send raw data, must add raw data + 14-byte Ethernet frame header before sending. Length setting should include Ethernet frame header length 1-to-1 or 1-to-many mode is determined at firmware compile time based on actual application requirements. Default	

Command	Query: Not supported	Set: AT+TXDATA=length,txbw,txmcs,priority
	firmware is 1-to-many mode.	

Examples:

1-to-1 mode:

at+txdata=10 // Send 10 bytes of data
OK
1234567890 // 10 bytes raw data sent directly

1-to-many mode:

at+txdata=24 // Send 10 bytes of data
OK
222222222228888888888899991234567890
// First 14 bytes are filled Ethernet frame header, last 10 bytes are raw data

• 222222222222: Ethernet destination address
• 888888888888: Ethernet source address
• 9999: Ethernet protocol type

Ethernet Frame Header Filling Instructions:

- **Source address:** Can fill with all 0s
- **Protocol type:** Can fill with all 0s
- **Destination address:** AP and STA filling rules:
  - **AP side:** UART host controller needs to manage STA devices, record each STA device's MAC address, maintain device ID and MAC address mapping table. Look up device's MAC address before sending data. For broadcast sending, fill destination address with all 0xFF
  - **STA side:** UART host controller doesn't need to maintain mapping table, fill with all 0s

AP Side Mapping Table Example:

Device ID	MAC Address
1001	00:1A:2B:3C:4D:5E

Receiving Data: After AH module receives data, it outputs data on serial port in the following format:

1-to-1:

+RXDATA:10\r\n
1234567890
// Received 10 bytes of data

1-to-many:

+RXDATA:24\r\n
222222222228888888888899991234567890
// Received 24 bytes of data, first 14 bytes are Ethernet frame header, starting from 15th byte is real data

- **AP side:** UART host controller can save source address from Ethernet frame header, associate with device ID, update mapping table
- **STA side:** UART host controller doesn't need to maintain mapping table, ignore Ethernet frame header, receive real data only

UART host controller should parse received data according to above format after receiving +RXDATA.

4. AT Command Usage Examples

4.1 Module Connection Basic Commands

When using AT commands to initialize AH module settings, mainly configure frequency, bandwidth, SSID and password parameters. Simple initialization AT command list:

```
AT+CHAN_LIST=9080,9160,9240        # Set 3 frequencies
AT+BSS_BW=8                        # Set 8M bandwidth
AT+SSID=hgic_ah_test               # Set SSID
AT+KEY_MGMT=WPA-PSK                # Enable encryption
```

AT+PSK=baa58569a9edd7c3a55e446bc658ef76a7173d023d256786832474d737756a82

AT+MODE=ap # Set to AP mode

4.2 Relay Network Configuration Commands

4.2.1 AP Module

1. Configure AP SSID, each AP should have different SSID, consider incremental like ssid1, ssid2:

at+ssid=ssid1

2. Configure no encryption (for simplified configuration, using no encryption as example):

at+keymgmt=none

4.2.2 Relay Module

1. Configure relay role:

at+mode=apsta

2. Configure no encryption:

at+keymgmt=none

3. Configure relay r_ssid for relay to connect to AP, should match target AP's SSID:

at+r_ssid=ssid1

4. Configure relay SSID for relay to connect to STA. For easy management, consider keeping AP SSID prefix and adding suffix like ssid1_r1, ssid1_r2, ssid2_r1:

at+ssid=ssid1_r1

4.2.3 STA Module

1. Configure STA SSID for STA to connect to relay, should match target relay's SSID:

at+ssid=ssid1_r1

2. Configure no encryption:

at+keymgmt=none