ESP32

AT Instruction Set and Examples

Version 1.2

Espressif Systems

About This Guide

This document introduces the ESP32 AT commands, explains how to use them and provides examples of several common AT commands.

Release Notes

Date	Version	Release notes
2017.11	V1.0	Initial release.
2018.06	V1.1	Updated Section 4.2.15, 5.2.8, 5.2.15, 6.2.5, 6.2.11 and Chapter 8. Added Section 5.2.9, 6.2.29, 6.2.30, 9.5.2.2.
2018.12	V1.2	Update Chapter 1 and Section 5.2.3.

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Table of Contents

1. Overview

This document introduces the ESP32 AT commands, and explains how to use them.

The AT command set is divided into different categories: Basic AT commands, Wi-Fi AT commands, TCP/IP AT commands, etc.

Please note that the AT commands marked with * are beta versions that have not been fully tested.

> 📖 ***Note:***
>
> *For codes related to ESP32 AT instruction set, please refer to https://github.com/espressif/esp32-at.*

1.1. User-Defined AT Commands

Please use only English letters or an underscore (_), when naming user-defined AT commands. The AT command name must NOT contain characters or numbers.

AT firmware is based on the Espressif IoT Development Framework (ESP-IDF). Espressif Systems' AT commands are provided in ***libat_core.a***, which is included in the AT BIN firmware. Examples of customized, user-defined AT commands are provided in ***esp-at***.

The structure, `at_cmd_struct`, is used to define four types of a command. Examples of implementing user-defined AT commands are provided in ***/esp32-at/main/interface/uart/at_uart_task.c***.

1.2. Downloading AT Firmware into Flash

Please use Espressif's official Flash Download Tools to download the firmware. Make sure you select the corresponding flash size.

Espressif's official Flash Download Tools: http://espressif.com/en/support/download/other-tools?keys=&field_type_tid%5B%5D=13.

Download **ESP32_AT_BIN**: http://www.espressif.com/en/support/download/at.

The flashing addresses are in ***/ESP32_AT_BIN/download.config***.

Please note that there are several binaries for some specific functions, they are listed as below:

- ***at_customize.bin*** is to provide a user partition table, which lists different partitions for the ***ble_data.bin***, SSL certificates, and ***factory_param_XXX.bin***. Furthermore, users can add their own users partitions, and read/write the user partitions with the command ***AT+FS*** and ***AT+SYSFLASH***.
- ***factory_param_XXX.bin*** indicates the hardware configurations for different ESP modules. Please make sure the correct bin is used for your specific module. If users design their own module, they can configure it with reference to the *esp32-at/docs/ESP32_AT_Factory_Parameter_Bin.md*, and the binaries will be automatically

generated after compilation. When users flash the firmware into the module, the ***customized_partitions/factory_param.bin*** in the ***download.config*** should be replaced with the actual module-specific ***customized_partitions/factory_param_XXX.bin***.

Modules	UART Pins（TX, RX, CTS, RTS）	Bin
ESP32-WROOM-32 Series (Default Value)	GPIO17, GPIO16, GPIO15, GPIO14	customized_partitions/factory_param_WROOM-32.bin
ESP32-WROVER Series	GPIO22, GPIO19, GPIO15, GPIO14	customized_partitions/factory_param_WROVER-32.bin
ESP32-PICO Series	GPIO22, GPIO19, GPIO15, GPIO14	customized_partitions/factory_param_PICO-D4.bin
ESP32-SOLO Series	GPIO17, GPIO16, GPIO15, GPIO14	customized_partitions/factory_param_SOLO-1.bin

📖 ***Note:***

UART CTS and RTS are optional pins, not compulsive.

- ***ble_data.bin*** is to provide BLE services when the ESP32 works as a BLE server;
- ***server_cert.bin***, ***server_key.bin*** and ***server_ca.bin*** are examples of SSL server's certificate;

If some of the functions are not used, then the corresponding binaries need not to be downloaded into flash.

If all functions are needed, then those binaries have to be downloaded into flash. In this case, there is a CombineBin button on the ESP Flash Download Tool to combine multiple binaries into one, to make the downloading easier. Please note that the downloading addresses of binaries and other flash configurations have to be set correctly while combining.

📖 ***Note:***

- *If the ESP32-AT bin fails to boot, and prints log "ota data partition invalid", please erase all flash or download the blank.bin into the address labeled as "otadata" in esp32-at/partitions_at.csv.*
- *Users can change to use another UART for AT communication. For example, if you want to use UART0 for AT communication, you need to:*
  - *make menuconfig -> component config -> AT -> "AT UART settings" to set it to use UART 0*
  - *The debug log will output through UART0 by default, but users can disable it in menuconfig, as: make menuconfig --> Component config --> ESP32-specific --> UART for console output*
- *ESP32_AT_Bin/factory stores the ESP AT factory binaries for different ESP official modules.*

If users compile esp32-at by themselves, they can call command '`make print_flash_cmd`' and print the download addresses, following the steps below:

- Call `rm sdkconfig` to remove the old configuration.
- Call `make defconfig` to set the latest default configuration.
- Call make `print_flash_cmd` to print the download addresses.

2. Command Description

Each command set contains four types of AT commands.

Type	Command Format	Description
Test Command	AT+<x>=?	Queries the Set Commands' internal parameters and their range of values.
Query Command	AT+<x>?	Returns the current value of parameters.
Set Command	AT+<x>=<…>	Sets the value of user-defined parameters in commands, and runs these commands.
Execute Command	AT+<x>	Runs commands with no user-defined parameters.

⚠ ***Notice:***

- *Not all AT commands support all four variations mentioned above.*
- *Square brackets [ ] designate the default value; it is either not required or may not appear.*
- *String values need to be included in double quotation marks, for example:* `AT+CWSAP="ESP756290","21030826",1,4`.
- *The default baud rate of AT command is 115200.*
- *AT commands are ended with a new-line (CR-LF), so the serial tool should be set into "New Line Mode".*
- *Definitions of AT command error codes are in esp32-at/components/at/include/esp_at.h.*

3. Basic AT Commands

3.1. Overview

Commands	Description
AT	Tests AT startup.
AT+RST	Restarts a module.
AT+GMR	Checks version information.
AT+GSLP	Enters Deep-sleep mode.
ATE	Configures echoing of AT commands.
AT+RESTORE	Restores the factory default settings of the module.
AT+UART_CUR	Current UART configuration.
AT+UART_DEF	Default UART configuration, saved in flash.
AT+SLEEP	Sets the sleep mode.
AT+SYSRAM	Checks the remaining space of RAM.
AT+SYSFLASH	Sets user partitions in flash
AT+SYSFS	File systems operations
AT+RFPOWER	Sets RF TX power

3.2. Commands

3.2.1. AT—Tests AT Startup

Execute Command	AT
Response	OK
Parameters	-

3.2.2. AT+RST—Restarts the Module

Execute Command	AT+RST
Response	OK
Parameters	-

Note	When the command is capitalized, it can be used to force restart. When system is in a "busy" state, user can call "AT+RST" to force restart. The system will prompt message "will force to restart!!!" before restarts.

3.2.3. AT+GMR—Checks Version Information

Execute Command	`AT+GMR`

Response	`<AT version info>`
	`<SDK version info>`
	`<compile time>`
	
	`OK`

Parameters	• `<AT version info>`: information about the AT version. • `<SDK version info>`: information about the SDK version. • `<compile time>`: the duration of time for compiling the BIN.

3.2.4. AT+GSLP—Enters Deep-sleep Mode

Set Command	`AT+GSLP=<time>`
Response	`<time>` `OK`
Parameters	`<time>`: the duration of ESP32's sleep. Unit: ms. ESP32 will wake up after Deep-sleep for as many milliseconds (ms) as `<time>` indicates.

3.2.5. ATE—AT Commands Echoing

Execute Command	`ATE`
Response	`OK`
Parameters	• `ATE0`: Switches echo off. • `ATE1`: Switches echo on.

3.2.6. AT+RESTORE—Restores the Factory Default Settings

Execute Command	`AT+RESTORE`
Response	`OK`

Note	The execution of this command will reset all parameters saved in flash, and restore the factory default settings of the module. The chip will be restarted when this command is executed.

3.2.7. AT+UART_CUR—Current UART Configuration, Not Saved in Flash

Command	Query Command: `AT+UART_CUR?`	Set Command: `AT+UART_CUR=<baudrate>,<databits>,<stopbits>,<parity>,<flow control>`

Response	`+UART_CUR:<baudrate>,<databits>,<stopbits>,<parity>,<flow control>`
	`OK`
	Command `AT+UART_CUR?` will return the actual value of UART configuration parameters, which may have allowable errors compared with the set value because of the clock division.
		`OK`

Parameters	• `<baudrate>`: UART baud rate • `<databits>`: data bits ▸ `5`: 5-bit data ▸ `6`: 6-bit data ▸ `7`: 7-bit data ▸ `8`: 8-bit data • `<stopbits>`: stop bits ▸ `1`: 1-bit stop bit ▸ `2`: 1.5-bit stop bit ▸ `3`: 2-bit stop bit • `<parity>`: parity bit ▸ `0`: None ▸ `1`: Odd ▸ `2`: Even • `<flow control>`: flow control ▸ `0`: flow control is not enabled ▸ `1`: enable RTS ▸ `2`: enable CTS ▸ `3`: enable both RTS and CTS	
Notes	1. The configuration changes will **NOT** be saved in flash. 2. The use of flow control requires the support of hardware: ▸ IO15 is UART0 CTS ▸ IO14 is UART0 RTS 3. The range of baud rates supported: 80 ~ 5000000.	
Example	`AT+UART_CUR=115200,8,1,0,3`	

3.2.8. AT+UART_DEF—Default UART Configuration, Saved in Flash

Command	Query Command: `AT+UART_DEF?` Function: Read the UART configuration from flash.	Set Command: `AT+UART_DEF=<baudrate>,<databits>,<stop bits>,<parity>,<flow control>`
Response	`+UART_DEF:<baudrate>,<databits>,<stopbits>,<parity>,<flow control>` `OK`	`OK`
Parameters	• `<baudrate>`: UART baud rate • `<databits>`: data bits ▸ `5`: 5-bit data ▸ `6`: 6-bit data ▸ `7`: 7-bit data ▸ `8`: 8-bit data • `<stopbits>`: stop bits ▸ `1`: 1-bit stop bit ▸ `2`: 1.5-bit stop bit ▸ `3`: 2-bit stop bit • `<parity>`: parity bit ▸ `0`: None ▸ `1`: Odd ▸ `2`: Even • `<flow control>`: flow control ▸ `0`: flow control is not enabled ▸ `1`: enable RTS ▸ `2`: enable CTS ▸ `3`: enable both RTS and CTS	
Notes	1. The configuration changes will be saved in the NVS area, and will still be valid when the chip is powered on again. 2. The use of flow control requires the support of hardware: ▸ IO15 is UART0 CTS ▸ IO14 is UART0 RTS 3. The range of baud rates supported: 80 ~ 5000000.	
Example	`AT+UART_DEF=115200,8,1,0,3`	

3.2.9. AT+SLEEP—Sets the Sleep Mode

Set Command	AT+SLEEP=<sleep mode>
Response	OK
Parameters	<sleep mode>: ▸ 0: disable the sleep mode. ▸ 1: Modem-sleep mode.
Example	AT+SLEEP=0

3.2.10. AT+SYSRAM—Checks the Remaining Space of RAM

Query Command	AT+SYSRAM?
Response	+SYSRAM:<remaining RAM size> OK
Parameters	<remaining RAM size>: remaining space of RAM, unit: byte
Example	AT+SYSRAM? +SYSRAM:148408 OK

3.2.11. AT+SYSFLASH—Set User Partitions in Flash *

Command	Query Command: AT+SYSFLASH? Function: Check the user partitions in flash.	Set Command: AT+SYSFLASH=<operation>,<partition>,<offset>,<length>
Response	+SYSFLASH:<partition>,<type>,<subtype>,<addr>,<size> OK	+SYSFLASH:<length>,<data> OK
Parameters	<partition>: name of user partition <type>: type of user partition <subtype>: subtype of user partition <addr>: address of user partition <size>: size of user partition	<operation>: ▸ 0: erase sector ▸ 1: write data into the user partition ▸ 2: read data from the user partition <partition>: name of user partition <offset>: offset of user partition <length>: data length

Notes	• at_customize.bin has to be downloaded, so that the relevant commands can be used. For more details about at_customize.bin please refer to the *ESP32_Customize_Partitions*. • Important things to note when erasing user partitions: ▸ When erasing the targeted user partition in its entirety, parameters `<offset>` and `<length>` can be omitted. For example, command `AT+SYSFLASH=0,"ble_data"` can erase the entire "ble_data" user partition. ▸ If parameters `<offset>` and `<length>` are not omitted when erasing the user partition, they have to be 4KB-aligned. • The introduction to partitions is in *ESP-IDF Partition Tables*.

Example	// read 100 bytes from the "ble_data" partition offset 0.
	`AT+SYSFLASH=2,"ble_data",0,100`
	// write 10 bytes to the "ble_data" partition offset 100.
	`AT+SYSFLASH=1,"ble_data",100,10`
	// erase 8192 bytes from the "ble_data" partition offset 4096.
	`AT+SYSFLASH=0,"ble_data",4096,8192`

3.2.12. AT+FS—Filesystem Operations *

Command	Set Command: `AT+FS=<type>,<operation>,<filename>,<offset>,<length>`
Response	OK
Parameters	`<type>`: only FATFS is currently supported ▸ `0`: FATFS `<operation>`: ▸ `0`: delete file ▸ `1`: write file ▸ `2`: read file ▸ `3`: query the size of the file ▸ `4`: list files in a specific directory, only root directory is currently supported `<offset>`: offset, for writing and reading operations only `<length>`: data length, for writing and reading operations only
Notes	• This function is disabled by default. User needs to set configuration by "make menuconfig" to enable it, and re-compile the ESP32 AT firmware. • at_customize.bin has to be downloaded, so that the relevant commands can be used. The definitions of user partitions are in *esp32-at/at_customize.csv*. Please refer to the *ESP32_Customize_Partitions* for more details.

Example	// delete a file.
	`AT+FS=0,0,"filename"`
	// write 10 bytes to offset 100 of a file.
	`AT+FS=0,1,"filename",100,10`
	// read 100 bytes from offset 0 of a file.
	`AT+FS=0,2,"filename",0,100`
	// list all files in the root directory.
	`AT+FS=0,4,"."`

3.2.13. AT+RFPOWER—Set RF TX Power *

Command	Set Command: `AT+RFPOWER=<wifi_power>[,<ble_adv_power>,<ble_scan_power>,<ble_conn_power>]`
Response	`OK`

Parameters	`<wifi_power>`: range [0, 11]
	▸ `0`:level 0. Refer to the 44th byte of phy_init_data.bin, the default value is 19.5 dBm
	▸ `1`:level 1. Refer to the 45th byte of phy_init_data.bin, the default value is 19 dBm
	▸ `2`:level 2. Refer to the 46th byte of phy_init_data.bin, the default value is 18.5 dBm
	▸ `3`:level 3. Refer to the 47th byte of phy_init_data.bin, the default value is 17 dBm
	▸ `4`:level 4. Refer to the 48th byte of phy_init_data.bin, the default value is 15 dBm
	▸ `5`:level 5. Refer to the 49th byte of phy_init_data.bin, the default value is 13 dBm
	▸ `6`:level 5 - 2 dBm. For example, if level 5 is 13 dBm, level 6 will be 11 dBm
	▸ `7`:level 5 - 4.5 dBm
	▸ `8`:level 5 - 6 dBm
	▸ `9`:level 5 - 8 dBm
	▸ `10`:level 5 - 11 dBm
	▸ `11`:level 5 - 14 dBm
	`<ble_adv_power>`: RF TX Power of BLE advertising, range: [0, 7]
	▸ `0`:7dBm
	▸ `1`:4dBm
	▸ `2`:1dBm
	▸ `3`:-2 dBm
	▸ `4`:-5 dBm
	▸ `5`:-8 dBm
	▸ `6`:-11 dBm
	▸ `7`:-14 dBm
	`<ble_scan_power>`: RF TX Power of BLE scanning, range: [0, 7], the same as `<ble_adv_power>`
	`<ble_conn_power>`: RF TX Power of BLE connecting, range: [0, 7], the same as `<ble_adv_power>`

Notes	• The RF TX power may not be very precise, it is normal that the actual RF TX power is different from the setting value. • The last three parameters,`[<ble_adv_power>,<ble_scan_power>,<ble_conn_power>]`, should be set or be omitted altogether.

Example	`AT+RFPOWER=0`
	Or
	`AT+RFPOWER=0,0,0,0`

4. Wi-Fi AT Commands

4.1. Overview

Commands	Description
AT+CWMODE	Sets the Wi-Fi mode (STA/AP/STA+AP).
AT+CWJAP	Connects to an AP.
AT+CWLAPOPT	Sets the configuration of command AT+CWLAP.
AT+CWLAP	Lists available APs.
AT+CWQAP	Disconnects from the AP.
AT+CWSAP	Sets the configuration of the ESP32 SoftAP.
AT+CWLIF	Gets the Station IP to which the ESP32 SoftAP is connected.
AT+CWDHCP	Enables/disables DHCP.
AT+CWDHCPS	Sets the IP range of the ESP32 SoftAP DHCP server. Saves the setting in flash.
AT+CWAUTOCONN	Connects to the AP automatically on power-up.
AT+CWSTARTSMART	Starts SmartConfig.
AT+CWSTOPSMART	Stops SmartConfig.
AT+WPS	Enables the WPS function.
AT+CWHOSTNAME	Configure the host name of ESP32 station.
AT+MDNS	MDNS function

4.2. Commands

4.2.1. AT+CWMODE—Sets the Wi-Fi Mode (Station/SoftAP/Station+SoftAP)

Commands	Test Command: AT+CWMODE=?	Query Command: AT+CWMODE? Function: to query the Wi-Fi mode of ESP32.	Set Command: AT+CWMODE=<mode> Function: to set the Wi-Fi mode of ESP32.
Response	+CWMODE:<mode> OK	+CWMODE:<mode> OK	OK

Parameters	<mode>: ▸ 0: Null mode, Wi-Fi RF will be disabled * ▸ 1: Station mode ▸ 2: SoftAP mode ▸ 3: SoftAP+Station mode
Note	The configuration changes will be saved in the NVS area.
Example	AT+CWMODE=3

4.2.2. AT+CWJAP—Connects to an AP

Commands	Query Command: `AT+CWJAP?` Function: to query the AP to which the ESP32 Station is already connected.	Set Command: `AT+CWJAP=<ssid>,<pwd>[,<bssid>]` Function: to set the AP to which the ESP32 Station needs to be connected.

Response	`+CWJAP:<ssid>,<bssid>,<channel>,<rssi>`
	`OK`
		`OK`
		or
		`+CWJAP:<error code>`
		`ERROR`

Parameters	• `<ssid>`: a string parameter showing the SSID of the AP. • `<bssid>`: the AP's MAC address. • `<channel>`: channel • `<rssi>`: signal strength	• `<ssid>`: the SSID of the target AP. • `<pwd>`: password, MAX: 64-byte ASCII. • `[<bssid>]`(optional parameter): the target AP's MAC address, used when multiple APs have the same SSID. • `<error code>`: (for reference only) ▸ 1: connection timeout. ▸ 2: wrong password. ▸ 3: cannot find the target AP. ▸ 4: connection failed. ▸ others: unknown error occurred. Escape character syntax is needed if SSID or password contains any special characters, such as, or " or \.

Messages	// If ESP32 station connects to an AP, it will prompt messages:
	WIFI CONNECTED
	WIFI GOT IP
	// If the WiFi connection ends, it will prompt messages:
	WIFI DISCONNECT	

Note	• The configuration changes will be saved in the NVS area. • This command requires Station mode to be active.	

Examples	`AT+CWJAP="abc","0123456789"`
	For example, if the target AP's SSID is `"ab\,c"` and the password is `"0123456789"\"`, the command is as follows:
	`AT+CWJAP="ab\\\,c","0123456789\"\\"`
	If multiple APs have the same SSID as `"abc"`, the target AP can be found by BSSID:
	`AT+CWJAP="abc","0123456789","ca:d7:19:d8:a6:44"`	

4.2.3. AT+CWLAPOPT—Sets the Configuration for the Command AT+CWLAP

Set Command	`AT+CWLAPOPT=<sort_enable>,<mask>`
Response	`OK`
Parameters	• `<sort_enable>`: determines whether the result of command `AT+CWLAP` will be listed according to RSSI: ▸ `0`: the result is ordered according to RSSI. ▸ `1`: the result is not ordered according to RSSI. • `<mask>`: determines the parameters shown in the result of `AT+CWLAP`; 0 means not showing the parameter corresponding to the bit, and 1 means showing it. ▸ `bit 0`: determines whether `<ecn>` will be shown in the result of AT+CWLAP. ▸ `bit 1`: determines whether `<ssid>` will be shown in the result of AT+CWLAP. ▸ `bit 2`: determines whether `<rssi>` will be shown in the result of AT+CWLAP. ▸ `bit 3`: determines whether `<mac>` will be shown in the result of AT+CWLAP. ▸ `bit 4`: determines whether `<channel>` will be shown in the result of AT+CWLAP.
Example	`AT+CWLAPOPT=1,31` The first parameter is 1, meaning that the result of the command `AT+CWLAP` will be ordered according to RSSI; The second parameter is `31`, namely `0x1F`, meaning that the corresponding bits of `<mask>` are set to 1. All parameters will be shown in the result of `AT+CWLAP`.

4.2.4. AT+CWLAP—Lists the Available APs

Commands	Set Command: `AT+CWLAP=<ssid>[,<mac>,<channel>]` Function: to query the APs with specific SSID and MAC on a specific channel.	Execute Command: `AT+CWLAP` Function: to list all available APs.
Response	`+CWLAP:<ecn>,<ssid>,<rssi>,<mac>,<channel>` `OK`	`+CWLAP:<ecn>,<ssid>,<rssi>,<mac>,<channel>` `OK`
Parameters	• `<ecn>`: encryption method. ▸ `0`: OPEN ▸ `1`: WEP ▸ `2`: WPA_PSK ▸ `3`: WPA2_PSK ▸ `4`: WPA_WPA2_PSK ▸ `5`: WPA2_Enterprise (AT can NOT connect to WPA2_Enterprise AP for now.) • `<ssid>`: string parameter, SSID of the AP. • `<rssi>`: signal strength. • `<mac>`: string parameter, MAC address of the AP.	

Examples	`AT+CWLAP="Wi-Fi","ca:d7:19:d8:a6:44",6`
	or search for APs with a designated SSID:
	`AT+CWLAP="Wi-Fi"`	

4.2.5. AT+CWQAP—Disconnects from the AP

Execute Command	`AT+CWQAP`
Response	`OK`
Parameters	-

4.2.6. AT+CWSAP—Configuration of the ESP32 SoftAP

Commands	Query Command: `AT+CWSAP?` Function: to obtain the configuration parameters of the ESP32 SoftAP.	Set Command: `AT+CWSAP=<ssid>,<pwd>,<chl>,<ecn>[,<max conn>][,<ssid hidden>]` Function: to set the configuration of the ESP32 SoftAP.
Response	`+CWSAP:<ssid>,<pwd>,<channel>,<ecn>,<max conn>,<ssid hidden>` `OK`	`OK`

Parameters	• `<ssid>`: string parameter, SSID of AP.
	• `<pwd>`: string parameter, length of password: 8 ~ 64 bytes ASCII.
	• `<channel>`: channel ID.
	• `<ecn>`: encryption method; WEP is not supported.
	  ▸ `0`: OPEN
	  ▸ `2`: WPA_PSK
	  ▸ `3`: WPA2_PSK
	  ▸ `4`: WPA_WPA2_PSK
	• `[<max conn>]`(optional parameter): maximum number of Stations to which ESP32 SoftAP can be connected; within the range of [1, 10].
	• `[<ssid hidden>]`(optional parameter):
	  ▸ `0`: SSID is broadcast. (the default setting)
	  ▸ `1`: SSID is not broadcast.
		The same as above.
		⚠ ***Notice:***
		This command is only available when SoftAP is active.

Note	The configuration changes will be saved in the NVS area.	
Example	`AT+CWSAP="ESP32","1234567890",5,3`	

4.2.7. AT+CWLIF—IP of Stations to Which the ESP32 SoftAP is Connected

Execute Command	`AT+CWLIF`
Response	`+CWLIF:<ip addr>,<mac>` `OK`
Parameters	• `<ip addr>`: IP address of Stations to which ESP32 SoftAP is connected. • `<mac>`: MAC address of Stations to which ESP32 SoftAP is connected.
Note	This command cannot get a static IP. It only works when both DHCPs of the ESP32 SoftAP, and of the Station to which ESP32 is connected, are enabled.

4.2.8. AT+CWDHCP—Enables/Disables DHCP

Commands	Query Command: `AT+CWDHCP?`	Set Command: `AT+CWDHCP=<operate>,<mode>` Function: to enable/disable DHCP.
Response	`+CWDHCP:<enable>` `OK`	`OK`

Parameters	`<enable>`: DHCP disabled or enabled now?
	• `Bit0`:
	  ▸ `0`: Station DHCP is disabled.
	  ▸ `1`: Station DHCP is enabled.
	• `Bit1`:
	  ▸ `0`: SoftAP DHCP is disabled.
	  ▸ `1`: SoftAP DHCP is enabled.
		• `<operate>`:
		  ▸ `0`: disable
		  ▸ `1`: enable
		• `<mode>`:
		  ▸ `Bit0`: Station DHCP
		  ▸ `Bit1`: SoftAP DHCP

Notes	• The configuration changes will be stored in the NVS area.
	• This set command interacts with static-IP-related AT commands (`AT+CIPSTA`-related and `AT+CIPAP`-related commands):
	  ▸ If DHCP is enabled, static IP will be disabled;
	  ▸ If static IP is enabled, DHCP will be disabled;
	  ▸ Whether it is DHCP or static IP that is enabled depends on the last configuration.	

Examples	`AT+CWDHCP=1,1`
	Enable Station DHCP. If the last DHCP mode is 2, then the current DHCP mode will be 3.
	`AT+CWDHCP=0,2`
	Disable SoftAP DHCP. If the last DHCP mode is 3, then the current DHCP mode will be 1.	

4.2.9. AT+CWDHCPS—Sets the IP Address Allocated by ESP32 SoftAP DHCP (The configuration is saved in Flash.)

Commands	Query Command: `AT+CWDHCPS?`	Set Command: `AT+CWDHCPS=<enable>,<lease time>,<start IP>,<end IP>` Function: sets the IP address range of the ESP32 SoftAP DHCP server.
Response	`+CWDHCPS:<lease time>,<start IP>,<end IP>` `OK`	`OK`

Parameters	• `<enable>`:
	  ▸ `0`: Disable the settings and use the default IP range.
	  ▸ `1`: Enable setting the IP range, and the parameters below have to be set.
	• `<lease time>`: lease time, unit: minute, range [1, 2880].
	• `<start IP>`: start IP of the IP range that can be obtained from ESP32 SoftAP DHCP server.
	• `<end IP>`: end IP of the IP range that can be obtained from ESP32 SoftAP DHCP server.	

Notes	• The configuration changes will be saved in the NVS area. • This AT command can only be called when ESP32 runs as SoftAP, and when DHCP is enabled. The IP address should be in the same network segment as the IP address of ESP32 SoftAP.	

Examples	`AT+CWDHCPS=1,3,"192.168.4.10","192.168.4.15"`
	or
	`AT+CWDHCPS=0 //Disable the settings and use the default IP range.`	

4.2.10. AT+CWAUTOCONN—Auto-Connects to the AP or Not

Set Command	`AT+CWAUTOCONN=<enable>`
Response	`OK`
Parameters	`<enable>`: ▸ `0`: does NOT auto-connect to AP on power-up. ▸ `1`: connects to AP automatically on power-up. The ESP32 Station connects to the AP automatically on power-up by default.
Note	The configuration changes will be saved in the NVS area.
Example	`AT+CWAUTOCONN=1`

4.2.11. AT+CWSTARTSMART—Starts SmartConfig

Commands	Set Command: `AT+CWSTARTSMART=<type>` Function: to start SmartConfig of a designated type.	Set Command: `AT+CWSTARTSMART` Function: enable ESP-TOUCH+AirKiss SmartConfig.
Response	`OK`	`OK`
Parameters	`<type>`: ▸ 1: ESP-TOUCH ▸ 2: AirKiss ▸ 3: ESP-TOUCH+AirKiss	none
Messages	When smartconfig starts, it will prompt messages as below: smartconfig type: <type> // AIRKISS, ESPTOUCH or UNKNOWN Smart get wifi info // got SSID and password ssid:<AP's SSID> password:<AP's password> // ESP32 will try to connect to the AP WIFI CONNECTED WIFI GOT IP smartconfig connected wifi // if the connection failed, it will prompt "smartconfig connect fail"	
Notes	• For details on SmartConfig please see *ESP-TOUCH User Guide*. • SmartConfig is only available in the ESP32 Station mode. • The message `Smart get wifi info` means that SmartConfig has successfully acquired the AP information. ESP32 will try to connect to the target AP. • Message `smartconfig connected wifi` is printed if the connection is successful. • Use command `AT+CWSTOPSMART` to stop SmartConfig before running other commands. Please make sure that you do not execute other commands during SmartConfig.	
Example	`AT+CWMODE=1` `AT+CWSTARTSMART=3`	

4.2.12. AT+CWSTOPSMART—Stops SmartConfig

Execute Command	`AT+CWSTOPSMART`
Response	`OK`
Parameters	-
Note	Irrespective of whether SmartConfig succeeds or not, before executing any other AT commands, please always call `AT+CWSTOPSMART` to release the internal memory taken up by SmartConfig.
Example	`AT+CWSTOPSMART`

4.2.13. AT+WPS—Enables the WPS Function

Set Command	`AT+WPS=<enable>`

Response	`OK`
	or
	`ERROR`

Parameters	`<enable>`: ▸ `1`: enable WPS/Wi-Fi Protected Setup (implemented by PBC/Push Button Configuration). ▸ `0`: disable WPS (implemented by PBC).
Notes	• WPS must be used when the ESP32 Station is enabled. • WPS does not support WEP/Wired-Equivalent Privacy encryption.
Example	`AT+CWMODE=1` `AT+WPS=1`

4.2.14. AT+CWHOSTNAME—Configures the Host Name of ESP32 Station *

Commands	Query Command: `AT+CWHOSTNAME?` Function: Checks the host name of ESP32 Station.	Set Command: `AT+CWHOSTNAME=<hostname>` Function: Sets the host name of ESP32 Station.

Response	`+CWHOSTNAME:<host name>`
	`OK`
	If the station mode is not enabled, the command will return:
	`+CWHOSTNAME:<null>`
	`OK`
		`OK`
		If the station mode is not enabled, the command will return:
		`ERROR`

Parameters	`<hostname>`: the host name of the ESP32 Station, maximum length: 32 bytes	
Notes	• The configuration changes are not saved in the flash. • The default host name of the ESP32 Station is ESP_XXXXXX; XXXXXX is the lower 3 bytes of the MAC address, for example, `+CWHOSTNAME:<ESP_A378DA>`.	
Example	`AT+CWMODE=3` `AT+CWHOSTNAME="my_test"`	

4.2.15. AT+MDNS—Configures the MDNS Function *

Set Command	`AT+MDNS=<enable>[,<hostname>,<service_name>,<port>]`
Response	`OK`

Parameters	• <enable>:
	  ▸ 1: enables the MDNS function; the following three parameters need to be set.
	  ▸ 0: disables the MDNS function; the following three parameters need not to be set.
	• <hostname>: MDNS host name
	• <service_name>: MDNS service name, it should start with "_"
	• <port>: MDNS port

Notes	• Please do not use other special characters (such as .) for <hostname> and <service_name>.
Example	AT+MDNS=1,"espressif","_iot",8080 Or AT+MDNS=0

5. TCP/IP-Related AT Commands

5.1. Overview

Commands	Description
AT+CIPSTATUS	Gets the connection status.
AT+CIPDOMAIN	DNS function.
AT+CIPDNS	Sets user-defined DNS server.
AT+CIPSTAMAC	Sets the MAC address of ESP32 Station.
AT+CIPAPMAC	Sets the MAC address of ESP32 SoftAP.
AT+CIPSTA	Sets the IP address of ESP32 Station.
AT+CIPAP	Sets the IP address of ESP32 SoftAP.
AT+CIPSTART	Establishes TCP connection, UDP transmission or SSL connection.
AT+CIPSSLCCONF	Sets configuration of SSL client
AT+CIPSEND	Sends data.
AT+CIPSENDEX	Sends data when length of data is <length>, or when \0 appears in the data.
AT+CIPCLOSE	Closes TCP/UDP/SSL connection.
AT+CIFSR	Gets the local IP address.
AT+CIPMUX	Configures the multiple connections mode.
AT+CIPSERVER	Deletes/Creates TCP or SSL server.
AT+CIPSERVERMAXCONN	Set the maximum connections that server allows
AT+CIPMODE	Configures the transmission mode.
AT+SAVETRANSLINK	Saves the transparent transmission link in flash.
AT+CIPSTO	Sets timeout when ESP32 runs as a TCP server.
AT+CIUPDATE	Updates the software through Wi-Fi.
AT+CIPDINFO	Shows remote IP and remote port with +IPD.
AT+CIPSNTPCFG	Configures the time domain and SNTP server.
AT+CIPSNTPTIME	Queries the SNTP time.
AT+PING	Ping packets

5.2. Commands

5.2.1. AT+CIPSTATUS—Gets the Connection Status

Execute Command	AT+CIPSTATUS
Response	STATUS:<stat> +CIPSTATUS:<link ID>,<type>,<remote IP>,<remote port>,<local port>,<tetype>
Parameters	• <stat>: status of the ESP32 Station interface. ▸ 2: The ESP32 Station is connected to an AP and its IP is obtained. ▸ 3: The ESP32 Station has created a TCP or UDP transmission. ▸ 4: The TCP or UDP transmission of ESP32 Station is disconnected. ▸ 5: The ESP32 Station does NOT connect to an AP. • <link ID>: ID of the connection (0~4), used for multiple connections. • <type>: string parameter, "TCP" or "UDP". • <remote IP>: string parameter indicating the remote IP address. • <remote port>: the remote port number. • <local port>: ESP32 local port number. • <tetype>: ▸ 0: ESP32 runs as a client. ▸ 1: ESP32 runs as a server.

5.2.2. AT+CIPDOMAIN—DNS Function

Execute Command	AT+CIPDOMAIN=<domain name>
Response	+CIPDOMAIN:<IP address>
Parameter	<domain name>: the domain name.
Example	AT+CWMODE=1 // set Station mode AT+CWJAP="SSID","password" // access to the internet AT+CIPDOMAIN="iot.espressif.cn" // DNS function

5.2.3. AT+CIPDNS—Sets User-defined DNS Servers; Configuration Saved in the Flash

Commands	Query Command: AT+CIPDNS? Function: Get the user-defined DNS servers which saved in flash.	Set Command: AT+CIPDNS=<enable>[,<DNS server0>,<DNS server1>] Function: Set user-defined DNS servers.
Response	+CIPDNS:<DNS server0> [+CIPDNS:<DNS server1>] OK	OK

Parameters	• <enable>: ▸ 0: disable to use a user-defined DNS server; ▸ 1: enable to use a user-defined DNS server. • <DNS server0>: optional parameter indicating the first DNS server; • <DNS server1>: optional parameter indicating the second DNS serve.
Example	AT+CIPDNS=1,"208.67.220.220"
Note	• This configuration will be saved in flash. • For command: AT+CIPDNS=0 (disable to use user-defined DNS servers), "208.67.222.222" will be used as DNS server by default. And the DNS server may change according to the configuration of the router which the chip connected to. • For command: AT+CIPDNS=1 (enable to use user-defined DNS servers, but the <DNS server> parameters are not set), servers "208.67.222.222" will be used as DNS server by default. • If users set two DNS servers with this command, please note that these two DNS servers should not be the same.

5.2.4. AT+CIPSTAMAC—Sets the MAC Address of the ESP32 Station

Commands	Query Command: AT+CIPSTAMAC? Function: to obtain the MAC address of the ESP32 Station.	Set Command: AT+CIPSTAMAC=<mac> Function: to set the MAC address of the ESP32 Station.
Response	+CIPSTAMAC:<mac> OK	OK
Parameters	<mac>: string parameter, MAC address of the ESP Station.	
Notes	• The configuration changes will be saved in the NVS area. • The MAC address of ESP32 SoftAP is different from that of the ESP32 Station. Please make sure that you do not set the same MAC address for both of them. • Bit 0 of the ESP32 MAC address CANNOT be 1. For example, a MAC address can be "1a:…" but not "15:…". • FF:FF:FF:FF:FF:FF and 00:00:00:00:00:00 are invalid MAC and cannot be set.	
Example	AT+CIPSTAMAC="1a:fe:35:98:d3:7b"	

5.2.5. AT+CIPAPMAC—Sets the MAC Address of the ESP32 SoftAP

Commands	Query Command: AT+CIPAPMAC? Function: to obtain the MAC address of the ESP32 SoftAP.	Set Command: AT+CIPAPMAC=<mac> Function: to set the MAC address of the ESP32 SoftAP.
Response	+CIPAPMAC:<mac> OK	OK

Parameters	<mac>: string parameter, MAC address of ESP32 SoftAP.
Notes	• The configuration changes will be saved in the NVS area. • The MAC address of ESP32 SoftAP is different from that of the ESP32 Station. Please make sure you do not set the same MAC address for both of them. • Bit 0 of the ESP32 MAC address CANNOT be 1. For example, a MAC address can be "18:…" but not "15:…". • FF:FF:FF:FF:FF:FF and 00:00:00:00:00:00 are invalid MAC and cannot be set.
Example	AT+CIPAPMAC="18:fe:36:97:d5:7b"

5.2.6. AT+CIPSTA—Sets the IP Address of the ESP32 Station

Commands	Query Command: AT+CIPSTA? Function: to obtain the IP address of the ESP32 Station.	Set Command: AT+CIPSTA=<ip>[,<gateway>,<netmask>] Function: to set the IP address of the ESP32 Station.
Response	+CIPSTA:<ip> OK	OK
Parameters	⚠ ***Notice:*** Only when the ESP32 Station is connected to an AP can its IP address be queried.	• <ip>: string parameter, the IP address of the ESP32 Station. • [<gateway>]: gateway. • [<netmask>]: netmask.
Notes	• The configuration changes will be saved in the NVS area. • The set command interacts with DHCP-related AT commands (AT+CWDHCP-related commands): ▸ If static IP is enabled, DHCP will be disabled; ▸ If DHCP is enabled, static IP will be disabled; ▸ Whether it is DHCP or static IP that is enabled depends on the last configuration.	
Example	AT+CIPSTA="192.168.6.100","192.168.6.1","255.255.255.0"	

5.2.7. AT+CIPAP—Sets the IP Address of the ESP32 SoftAP

Commands	Query Command: AT+CIPAP? Function: to obtain the IP address of the ESP32 SoftAP.	Set Command: AT+CIPAP=<ip>[,<gateway>,<netmask>] Function: to set the IP address of the ESP32 SoftAP.
Response	+CIPAP:<ip>,<gateway>,<netmask> OK	OK
Parameters	• <ip>: string parameter, the IP address of the ESP32 SoftAP. • [<gateway>]: gateway. • [<netmask>]: netmask.	

Notes	• The configuration changes will be saved in the NVS area. • Currently, ESP32 only supports class C IP addresses. • The set command interacts with DHCP-related AT commands (`AT+CWDHCP`-related commands): ▸ If static IP is enabled, DHCP will be disabled; ▸ If DHCP is enabled, static IP will be disabled; ▸ Whether it is DHCP or static IP that is enabled depends on the last configuration.
Example	`AT+CIPAP="192.168.5.1","192.168.5.1","255.255.255.0"`

5.2.8. AT+CIPSTART—Establishes TCP Connection, UDP Transmission or SSL Connection

Establish TCP Connection

Set Command	Single TCP connection (`AT+CIPMUX=0`): `AT+CIPSTART=<type>,<remote IP>,<remote port>[,<TCP keep alive>]`	Multiple TCP Connections (`AT+CIPMUX=1`): `AT+CIPSTART=<link ID>,<type>,<remote IP>,<remote port>[,<TCP keep alive>]`
Response	`OK`	
Parameters	• `<link ID>`: ID of network connection (0~4), used for multiple connections. • `<type>`: string parameter indicating the connection type: `"TCP"`, `"UDP"` or `"SSL"`. • `<remote IP>`: string parameter indicating the remote IP address. • `<remote port>`: remote port number. • `[<TCP keep alive>]` (optional parameter): detection time interval when TCP is kept alive. This function is disabled by default. Users are recommended to enable this function when establishing a TCP connection. ▸ `0`: disable TCP keep-alive. ▸ `1 ~ 7200`: detection time interval, unit: second(s).	

Messages	// If the TCP connection is established, a message appears as below:
	[<link ID>,] CONNECT
	// If the TCP connection ends, a message appears as below:
	[<link ID>,] CLOSED	

Note	Users are recommended to enable this function when establishing a TCP connection.	

Examples	`AT+CIPSTART="TCP","iot.espressif.cn",8000`
	`AT+CIPSTART="TCP","192.168.101.110",1000`
	For more information please see Chapter 9: ***AT Command Examples.***	

Establish UDP Transmission

Set Command	Single connection (`AT+CIPMUX=0`): `AT+CIPSTART=<type>,<remote IP>,<remote port>[,<UDP local port>,<UDP mode>]`	Multiple connections (`AT+CIPMUX=1`): `AT+CIPSTART=<link ID>,<type>,<remote IP>,<remote port>[,<UDP local port>,<UDP mode>]`

Response	OK
Parameters	• <link ID>: ID of network connection (0~4), used for multiple connections. • <type>: string parameter indicating the connection type: "TCP", "UDP" or "SSL". • <remote IP>: string parameter indicating the remote IP address. • <remote port>: remote port number. • [<UDP local port>]: optional. It is the UDP port of ESP32. • [<UDP mode>] (optional parameter): the entity of UDP transmission. For UDP transparent transmission, the value of this parameter has to be 0. ▸ 0: the destination peer entity of UDP will not change; this is the default setting. ▸ 1: the destination peer entity of UDP will change once. ▸ 2: the destination peer entity of UDP is allowed to change. ⚠ ***Notice:*** *To use* <UDP mode> *,* <UDP local port> *must be set first.*

Messages	// If the UDP transmission is established, a message appears as below
	[<link ID>,] CONNECT
	// If the UDP transmission ends, a message appears as below
	[<link ID>,] CLOSED

Example	AT+CIPSTART="UDP","192.168.101.110",1000,1002,2 For more information please see Chapter 9: ***AT Command Examples.***

Establish SSL Connection

Set Command	AT+CIPSTART=[<link ID>,]<type>,<remote IP>,<remote port>[,<TCP keep alive>]
Response	OK
Parameters	• <link ID>: ID of network connection (0~4), used for multiple connections. • <type>: string parameter indicating the connection type: "TCP", "UDP" or "SSL". • <remote IP>: string parameter indicating the remote IP address. • <remote port>: the remote port number. • [<TCP keep alive>] (optional parameter): detection time interval when TCP is kept alive. This function is disabled by default. Users are recommended to enable this function when establishing a TCP ▸ 0: disable the TCP keep-alive function. ▸ 1 ~ 7200: detection time interval, unit: second (s).

Messages	// If the SSL connection is established, a message appears as below
	[<link ID>,] CONNECT
	// If the SSL connection ends, a message appears as below
	[<link ID>,] CLOSED

Notes	• SSL connection needs much memory. Lack of available memory may cause system reboot. • Users are recommended to enable this function when establishing a TCP connection.
Example	`AT+CIPSTART="SSL","iot.espressif.cn",8443`

5.2.9. AT+CIPSSLCCONF—Set Configuration of SSL Client *

Set Command	1. For single connection: (`AT+CIPMUX=0`)
	`AT+CIPSSLCCONF=<type>,<cert_key_ID>,<CA_ID>`
	2. For multiple connections: (`AT+CIPMUX=1`)
	`AT+CIPSSLCCONF=<link ID>,<type>,<cert_key_ID>,<CA_ID>`

Response	`OK`
Parameters	• `[<link_id>]`: ID of the connection (0~4) for multiple connections. If it is omitted in multi-connections mode, then the configuration will take effect on all connections. • `<type>`: ▸ `0`: no authentication ▸ `1`: loading cert and private key for the authentication server may request ▸ `2`: loading CA to authenticate server ▸ `3`: bi-directional authentication, both SSL server and client will authenticate certificate of each other • `<cert_key_ID>`: The ID of the certificate, starting from 0. ESP32 AT supports multiple certificates. On how to generate the bin file, please refer to *PKI Bin* in *esp32-at/tools/readme.md*. • `<CA_ID>`: The CA ID that starts from 0. ESP32 AT supports multiple certificates. On how to generate the bin file, please refer to *PKI Bin* in *esp32-at/tools/readme.md*.
Note	• Please call this command before establishing the SSL connection, if it is needed. • This configuration will be saved in the NVS area of flash. And if a SSL connection is saved in flash by command `AT+SAVETRANSLINK`, the SSL connection will be established according to this configuration in next start-up.
Example	`AT+CIPMUX=1` // enable multiple connections `AT+CIPSSLCCONF=1,3,0,0` // to set the NO.1 link, loading certificates (with ID 0) for authentication.

5.2.10. AT+CIPSEND—Sends Data

Commands	Set Command:
	1. For single connection: (`AT+CIPMUX=0`)
	`AT+CIPSEND=<length>`
	2. For multiple connections: (`AT+CIPMUX=1`)
	`AT+CIPSEND=<link ID>,<length>`
	3. Remote IP and ports can be set in UDP transmission:
	`AT+CIPSEND=[<link ID>,]<length>[,<remote IP>,<remote port>]`
	Function: to configure the data length in normal transmission mode.
		Execute Command:
		`AT+CIPSEND`
		Function: to start sending data in transparent transmission mode.

Response	Send data of designated length.
	Wrap return > after the set command. Begin receiving serial data. When the requirement of data length is met, the transmission of data starts.
	If the connection cannot be established or gets disrupted during data transmission, the system returns:
	`ERROR`
	If data is transmitted successfully, the system returns:
	`SEND OK`
	Otherwise, the system returns:
	`SEND FAIL`
		Wrap return > after executing this command.
		After entering the transparent transmission, the data will be sent every 2048 bytes or every 20ms.
		When a single packet containing +++ is received, ESP32 returns to normal command mode. Please wait for at least one second before sending the next AT command.
		This command can only be used in transparent transmission mode which requires single connection.
		For UDP transparent transmission, the value of `<UDP mode>` has to be `0` when using `AT+CIPSTART`.

Parameters	• `<link ID>`: ID of the connection (0~4), for multiple connections. • `<length>`: data length, MAX: 2048 bytes. • `[<remote IP>]`: remote IP can be set in UDP transmission. • `[<remote port>]`: remote port can be set in UDP transmission.	-
Example	For more information please see ***Chapter 9: AT Command Examples.***	

5.2.11. AT+CIPSENDEX—Sends Data

Commands	Set Command:
	1. Single connection: (+CIPMUX=0)
	`AT+CIPSENDEX=<length>`
	2. Multiple connections: (+CIPMUX=1)
	`AT+CIPSENDEX=<link ID>,<length>`
	3. Remote IP and ports can be set in UDP transmission:
	`AT+CIPSENDEX=[<link ID>,]<length>[,<remote IP>,<remote port>]`
	Function: to configure the data length in normal transmission mode.

Response	Send data of designated length.
	Wrap return > after the set command. Begin receiving serial data. When the requirement of data length, determined by <length>, is met, or when \0 appears in the data, the transmission starts.
	If connection cannot be established or gets disconnected during transmission, the system returns:
	`ERROR`
	If data are successfully transmitted, the system returns:
	`SEND OK`
	Otherwise, the system returns:
	`SEND FAIL`

Parameters	• <link ID>: ID of the connection (0~4), for multiple connections. • <length>: data length, MAX: 2048 bytes. • When the requirement of data length, determined by <length>, is met, or when \0 appears, the transmission of data starts. Go back to the normal command mode and wait for the next AT command. • When sending \0, please send it as \\0.

5.2.12. AT+CIPCLOSE—Closes TCP/UDP/SSL Connection

Commands	Set Command (for multiple connections): `AT+CIPCLOSE=<link ID>` Function: to close TCP/UDP connection.	Execute Command (for single connection): `AT+CIPCLOSE`
Response	OK	
Parameters	<link ID>: ID number of connections to be closed; when ID=5, all connections will be closed.	-
Messages	// When connection ends, it will prompt message as below [<link ID>,] CLOSED	

5.2.13. AT+CIFSR—Gets the Local IP Address

Execute Command	AT+CIFSR
Response	+CIFSR:APIP,<SoftAP IP address> +CIFSR:APMAC,<SoftAP MAC address> +CIFSR:STAIP,<Station IP address> +CIFSR:STAMAC,<Station MAC address> OK
Parameters	<IP address>: IP address of the ESP32 SoftAP; IP address of the ESP32 Station. <MAC address>: MAC address of the ESP32 SoftAP; MAC address of the ESP32 Station.
Notes	Only when the ESP32 Station is connected to an AP can the Station IP be queried.

5.2.14. AT+CIPMUX—Enables/Disables Multiple Connections

Commands	Query Command: AT+CIPMUX?	Set Command: AT+CIPMUX=<mode> Function: to set the connection type.
Response	+CIPMUX:<mode> OK	OK
Parameters	<mode>: ▸ 0: single connection ▸ 1: multiple connections	
Notes	• The default mode is single connection mode. • Multiple connections can only be set when transparent transmission is disabled (AT+CIPMODE=0). • This mode can only be changed after all connections are disconnected. • If the TCP server is running, it must be deleted (AT+CIPSERVER=0) before the single connection mode is activated.	
Example	AT+CIPMUX=1	

5.2.15. AT+CIPSERVER—Deletes/Creates TCP or SSL Server *

Command	Query Command: `AT+CIPSERVER?` Function: to obtain information about the server mode.	Set Command: `AT+CIPSERVER=<mode>[,<port>][,<SSL>,<SSL CA enable>]` Function: to set a TCP or SSL server.
Response	`+CIPSERVER:<mode>,<port>,<SSL>,<SSL CA enable>` `OK`	`OK`
Parameters	`<mode>`: ▸ `0`: delete server. ▸ `1`: create server. `<port>` (optional parameter): port number; 333 by default. `[<SSL>]` (optional parameter): string "SSL", to set an SSL server `[<SSL CA enable>]` (optional parameter): ▸ `0`: disable CA. ▸ `1`: enable CA.	
Notes	• A server can only be created when multiple connections are activated (`AT+CIPMUX=1`). • Only one server is allowed to be created. • A server monitor will be automatically created when the server is created. • Connecting of a client to the ESP server will take up one connection. The connection will be assigned an ID.	

Messages	// If a connection is established, a message appears as below:
	[<link ID>,] CONNECT
	// If a connection ends, a message appears as below:
	[<link ID>,] CLOSED	

Example	• To create a TCP server:
	`AT+CIPMUX=1`
	`AT+CIPSERVER=1,80`
	• To create an SSL server:
	`AT+CIPMUX=1`
	`AT+CIPSERVER=1,443,"SSL",1`	

5.2.16. AT+CIPSERVERMAXCONN—Set the Maximum Connections Allowed by Server *

Commands	Query Command: `AT+CIPSERVERMAXCONN?` Function: obtain the maximum number of clients allowed to connect to the TCP or SSL server.	Set Command: `AT+CIPSERVERMAXCONN=<num>` Function: set the maximum number of clients allowed to connect to the TCP or SSL server.

Response	`+CIPSERVERMAXCONN:<num>` `OK`	`OK`
Parameters	`<num>`: the maximum number of clients allowed to connect to the TCP or SSL server, range: [1, 5]	
Notes	To set this configuration, you should call the command `AT+CIPSERVERMAXCONN=<num>` before creating a server.	

Example	`AT+CIPMUX=1`
	`AT+CIPSERVERMAXCONN=2`
	`AT+CIPSERVER=1,80`	

5.2.17. AT+CIPMODE—Configures the Transmission Mode

Commands	Query Command: `AT+CIPMODE?` Function: to obtain information about transmission mode.	Set Command: `AT+CIPMODE=<mode>` Function: to set the transmission mode.
Response	`+CIPMODE:<mode>` `OK`	`OK`
Parameters	`<mode>`: ▸ `0`: normal transmission mode. ▸ `1`: UART-Wi-Fi passthrough mode (transparent transmission), which can only be enabled in TCP/SSL single connection mode or in UDP mode when the remote IP and port do not change.	
Notes	• The configuration changes will NOT be saved in flash. • During the UART-Wi-Fi passthrough transmission, if the TCP connection breaks, ESP32 will keep trying to reconnect until +++ is input to exit the transmission. If it is a normal TCP transmission and the TCP connection breaks, ESP32 will give a prompt and will not attempt to reconnect. • The UART-Wi-Fi passthrough mode and the BLE commands cannot be used together, so before enabling UART-WiFi passthrough mode, please ensure that the BLE commands are not enabled (`AT+BLEINIT=0`).	
Example	`AT+CIPMODE=1`	

5.2.18. AT+SAVETRANSLINK—Saves the Transparent Transmission Link in Flash

Save TCP Single Connection in Flash

Set Command	`AT+SAVETRANSLINK=<mode>,<remote IP or domain name>,<remote port>[,<type>,<TCP keep alive>]`
Response	`OK`
Parameters	• `<mode>`: ▸ `0`: normal mode, ESP32 will NOT enter UART-Wi-Fi passthrough mode on power-up. ▸ `1`: ESP32 will enter UART-Wi-Fi passthrough mode on power-up. • `<remote IP>`: remote IP or domain name. • `<remote port>`: remote port. • `[<type>]` (optional): `TCP`, `SSL` or `UDP`, `TCP` by default. • `[<TCP keep alive>]` (optional): TCP is kept alive. This function is disabled by default. ▸ `0`: disables the TCP keep-alive function. ▸ `1 ~ 7200`: keep-alive detection time interval, unit: second (s).
Notes	• This command will save the UART-Wi-Fi passthrough mode and its link in the NVS area. ESP32 will enter the UART-Wi-Fi passthrough mode on any subsequent power cycles. • As long as the remote IP (or domain name) and port are valid, the configuration will be saved in flash.
Example	`AT+SAVETRANSLINK=1,"192.168.6.110",1002,"TCP"`

Save UDP Transmission in Flash

Set Command	`AT+SAVETRANSLINK=<mode>,<remote IP>,<remote port>,<type>[,<UDP local port>]`
Response	`OK`
Parameters	• `<mode>`: ▸ `0`: normal mode; ESP32 will NOT enter UART-Wi-Fi passthrough mode on power-up. ▸ `1`: ESP32 enters UART-Wi-Fi passthrough mode on power-up. • `<remote IP>`: remote IP or domain name. • `<remote port>`: remote port. • `[<type>]` (optional): `UDP`, `TCP` by default. • `[<UDP local port>]` (optional): local port when UDP transparent transmission is enabled on power-up.
Notes	• This command will save the UART-Wi-Fi passthrough mode and its link in the NVS area. ESP32 will enter the UART-Wi-Fi passthrough mode on any subsequent power cycles. • As long as the remote IP (or domain name) and port are valid, the configuration will be saved in flash.
Example	`AT+SAVETRANSLINK=1,"192.168.6.110",1002,"UDP",1005`

Save SSL Single Connection in Flash

Set Command	`AT+SAVETRANSLINK=<mode>,<remote IP or domain name>,<remote port>[,<type>,<TCP keep alive>]`
Response	`OK`

Parameters	• `<mode>`:
	  ▸ `0`: normal mode, ESP32 will NOT enter UART-Wi-Fi passthrough mode on power-up.
	  ▸ `1`: ESP32 will enter UART-Wi-Fi passthrough mode on power-up.
	• `<remote IP>`: remote IP or domain name.
	• `<remote port>`: remote port.
	• `[<type>]` (optional): `SSL`, `TCP` by default.
	• `[<TCP keep alive>]` (optional): TCP is kept alive. This function is disabled by default.
	  ▸ `0`: disables the TCP keep-alive function.
	  ▸ `1 ~ 7200`: keep-alive detection time interval, unit: second (s).

Notes	• This command will save the UART-Wi-Fi passthrough mode and its link in the NVS area. ESP32 will enter the UART-Wi-Fi passthrough mode on any subsequent power cycles. • As long as the remote IP (or domain name) and port are valid, the configuration will be saved in flash.
Example	`AT+SAVETRANSLINK=1,"192.168.6.110",443,"SSL"`

5.2.19. AT+CIPSTO—Sets the TCP Server Timeout

Commands	Query Command: `AT+CIPSTO?` Function: to check the TCP server timeout.	Set Command: `AT+CIPSTO=<time>` Function: to set the TCP server timeout.
Response	`+CIPSTO:<time>` `OK`	`OK`
Parameter	`<time>`: TCP server timeout within the range of 0 ~ 7200s.	
Notes	• ESP32 configured as a TCP server will disconnect from the TCP client that does not communicate with it until timeout. • If `AT+CIPSTO=0`, the connection will never time out. This configuration is not recommended.	

Example	`AT+CIPMUX=1`
	`AT+CIPSERVER=1,1001`
	`AT+CIPSTO=10`	

5.2.20. AT+CIPSNTPCFG—Sets the Time Zone and the SNTP Server

Commands	Query Command: `AT+CIPSNTPCFG?`	Set Command: `AT+CIPSNTPCFG=<enable>[,<timezone>][,<SNTP server0>,<SNTP server1>,<SNTP server2>]`
Response	`+CIPSNTPCFG:<enable>,<timezone>,<SNTP server1>[,<SNTP server2>,<SNTP server3>]` `OK`	`OK`

Parameters	• `<enable>`:
	  ▸ `0`: SNTP is disabled;
	  ▸ `1`: SNTP is enabled.
	• `<timezone>`: time zone; range: [-11,13]; if SNTP is enabled, the <timezone> has to be set;
	• `<SNTP server0>`: optional parameter indicating the first SNTP server;
	• `<SNTP server1>`: optional parameter indicating the second SNTP server;
	• `<SNTP server2>`: optional parameter indicating the third SNTP server.	

Example	`AT+CIPSNTPCFG=1,8,"cn.ntp.org.cn","ntp.sjtu.edu.cn","us.pool.ntp.org"`	
Note	If the <SNTP server> parameters are not set, servers `"cn.ntp.org.cn","ntp.sjtu.edu.cn","us.pool.ntp.org"` will be used by default.	

5.2.21. AT+CIPSNTPTIME—Queries the SNTP Time

Query Command	`AT+CIPSNTPTIME?`
Response	`+CIPSNTPTIME:SNTP time` `OK`
Parameters	-

Example	`AT+CIPSNTPCFG=1,8,"cn.ntp.org.cn","ntp.sjtu.edu.cn"`
	`OK`
	`AT+CIPSNTPTIME?`
	`+CIPSNTPTIME:Mon Dec 12 02:33:32 2016`
	`OK`

5.2.22. AT+CIUPDATE—Updates the Software Through Wi-Fi

Command	Execute Command: `AT+CIUPDATE` Function: normal FOTA.	Set Command: `AT+CIUPDATE=<ota_mode>[,<version>]` Function: set FOTA mode and upgrade to a specific version.

Response	`+CIPUPDATE:<n>`
	`OK`
	//<n> means the FOTA steps:
	▸ 1: find the server.
	▸ 2: check software version from server, this step will be skipped if upgrading to a specific version
	▸ 3: get the software version, this step will be skipped if upgrading to a specific version
	▸ 4: start updating.	

Parameters	none	`<ota_mode>` : ▸ `0`: normal FOTA ▸ `1`: SSL FOTA `[<version>]` : optional parameter, to set a specific version for upgrading. If it is not set, the default version will be downloaded for upgrading.
Notes	• The speed of the upgrade is susceptible to the connectivity of the network. • ERROR will be returned if the upgrade fails due to unfavourable network conditions. Please wait for some time before retrying.	
Notice	• If using Espressif's AT BIN (***/esp-idf/bin/at***), `AT+CIUPDATE` will download a new AT BIN from the Espressif Cloud. • If using a user-compiled AT BIN, users need to make their own `AT+CIUPDATE` upgrade. Espressif provides a demo as a reference for local upgrade (***/esp-idf/example/at)***. • User can enable SSL OTA in the menuconfig, more details are in the ***Chapter OTA Function.*** • It is suggested that users call `AT+RESTORE` to restore the factory default settings after upgrading the AT firmware.	

5.2.23. AT+CIPDINFO—Shows the Remote IP and Port with "+IPD"

Set Command	`AT+CIPDINFO=<mode>`
Response	`OK`
Parameters	`<mode>`: ▸ `0`: does not show the remote IP and port with "+IPD". ▸ 1: shows the remote IP and port with "+IPD".
Example	`AT+CIPDINFO=1`

5.2.24. +IPD—Receives Network Data

Command	Single connection: `(+CIPMUX=0)+IPD,<len>[,<remote IP>,<remote port>]:<data>`	multiple connections: `(+CIPMUX=1)+IPD,<link ID>,<len>[,<remote IP>,<remote port>]:<data>`

Parameters	The command is valid in normal command mode. When the module receives network data, it will send the data through the serial port using the `+IPD` command. • `[<remote IP>]`: remote IP, enabled by command `AT+CIPDINFO=1.` • `[<remote port>]`: remote port, enabled by command `AT+CIPDINFO=1.` • `<link ID>`: ID number of connection. • `<len>`: data length. • `<data>`: data received.

5.2.25. AT+PING—Ping Packets

Set Command	`AT+PING=<IP>` Function: Ping packets.

Response	`+PING:<time>`
	`OK`
	or
	`+PING:TIMEOUT`
	`ERROR`

Parameters	• `<IP>`: string; host IP or domain name • `<time>`: the response time of ping
Notes	`AT+PING="192.168.1.1"` `AT+PING="www.baidu.com"`

6. BLE-Related AT Commands

6.1. Overview

Commands	Description
AT+BLEINIT	Bluetooth Low Energy (BLE) initialization
AT+BLEADDR	Sets BLE device's address
AT+BLENAME	Sets BLE device's name
AT+BLESCANPARAM	Sets parameters of BLE scanning
AT+BLESCAN	Enables BLE scanning
AT+BLESCANRSPDATA	Sets BLE scan response
AT+BLEADVPARAM	Sets parameters of BLE advertising
AT+BLEADVDATA	Sets BLE advertising data
AT+BLEADVSTART	Starts BLE advertising
AT+BLEADVSTOP	Stops BLE advertising
AT+BLECONN	Establishes BLE connection
AT+BLECONNPARAM	Updates parameters of BLE connection
AT+BLEDISCONN	Ends BLE connection
AT+BLEDATALEN	Sets BLE data length
AT+BLECFGMTU	Sets BLE MTU length
AT+BLEGATTSSRVCRE	Generic Attributes Server (GATTS) creates services
AT+BLEGATTSSRVSTART	GATTS starts services
AT+BLEGATTSSRVSTOP	GATTS stops services
AT+BLEGATTSSRV	GATTS discovers services
AT+BLEGATTSCHAR	GATTS discovers characteristics
AT+BLEGATTSNTFY	GATTS notifies of characteristics
AT+BLEGATTSIND	GATTS indicates characteristics
AT+BLEGATTSSETATTR	GATTS sets attributes
AT+BLEGATTCPRIMSRV	Generic Attributes Client (GATTC) discovers primary services
AT+BLEGATTCINCLSRV	GATTC discovers included services

Commands	Description
AT+BLEGATTCCHAR	GATTC discovers characteristics
AT+BLEGATTCRD	GATTC reads characteristics
AT+BLEGATTCWR	GATTC writes characteristics
AT+BLESPPCFG	Configures BLE SPP (Serial Port Profile)
AT+BLESPP	Enables BLE SPP
AT+BLESECPARAM	Sets Parameters of BLE SMP (Security Manager Specification)
AT+BLEENC	Starts a Pairing Request
AT+BLEENCRSP	Sets a Pairing Response
AT+BLEKEYREPLY	Reply to a Pairing Key
AT+BLECONFREPLY	Reply to a Pairing Result
AT+BLEENCDEV	Lists All Devices that Bonded
AT+BLEENCCLEAR	Unbinds Device

⚠ ***Notice:***

- *Download BLE Spec (ESP32 supports Core Version 4.2): https://www.bluetooth.com/specifications/adopted-specifications*
- The BLE commands and the UART-Wi-Fi passthrough mode cannot be used together, so before BLE initialization, please ensure that the UART-Wi-Fi passthrough mode is not enabled (`AT+CIPMODE=0`).

6.2. Commands

6.2.1. AT+BLEINIT—BLE Initialization

Commands	Query Command: `AT+BLEINIT?` Function: to check the initialization status of BLE.	Set Command: `AT+BLEINIT=<init>` Function: to initialize the role of BLE.

Response	If BLE is not initialized, it will return:
	`+BLEINIT:0`
	`OK`
	If BLE is initialized, it will return:
	`+BLEINIT:<role>`
	`OK`
		`OK`

Parameter	`<init>`: ▸ `0`: de-init BLE, disable BLE RF * ▸ `1`: client role ▸ `2`: server role	
Notes	• Before using BLE AT commands, this command has to be called first to trigger the initialization process. • After being initialized, the BLE role cannot be changed directly. If the user wants to change the BLE role, `AT+RST` or `AT+BLEINIT=0` needs to be called first. • If using ESP32 as a BLE server, a service bin should be downloaded into Flash. ▸ at_customize.bin has to be downloaded, so that the relevant commands can be used. Please refer to the *ESP32_Customize_Partitions* for more details. ▸ To learn how to generate a service bin, please refer to *esp32-at/tools/readme.md*. ▸ The download address of the service bin is the "ble_data" address in *esp32-at/at_customize.csv*.	
Example	`AT+BLEINIT=1`	

6.2.2. AT+BLEADDR—Sets BLE Device's Address

Commands	Query Command: `AT+BLEADDR?` Function: to get the BLE public address.	Set Command: `AT+BLEADDR=<addr_type>,<random_addr>` Function: to set the BLE random address.
Response	`+BLEADDR:<BLE_public_addr>` `OK`	`OK`
Parameter	`<addr_type>`: ▸ `0`: public address ▸ `1`: random address	

Notes	• For the time being, only two actions are supported: getting the public address and setting the BLE random address. • The two most significant bits of the random address shall be equal to 1. More details are in the BLE spec.
Example	`AT+BLEADDR=1,"f8:7f:24:87:1c:f7"`

6.2.3. AT+BLENAME—Sets BLE Device's Name

Commands	Query Command: `AT+BLENAME?` Function: to get the BLE device name.	Set Command: `AT+BLENAME=<device_name>` Function: to set the BLE device name.
Response	`+BLENAME:<device_name>` `OK`	`OK`
Parameter	`<device_name>`: the BLE device name	
Notes	• The default BLE device name is "BLE_AT". • This configuration sets the device name characteristic of GAP service, it is the device name we can get after BLE connection is established, more details are in BLE core v4.2 vol.3 part C 12.1. • If user wants to set the device name while advertising, it is the command AT+BLEADVDATA that should be used.	
Example	`AT+BLENAME="esp_demo"`	

6.2.4. AT+BLESCANPARAM—Sets Parameters of BLE Scanning

Commands	Query Command: `AT+BLESCANPARAM?` Function: to get the parameters of BLE scanning.	Set Command: `AT+BLESCANPARAM=<scan_type>,<own_addr_type>,<filter_policy>,<scan_interval>,<scan_window>` Function: to set the parameters of BLE scanning.
Response	`+BLESCANPARAM:<scan_type>,<own_addr_type>,<filter_policy>,<scan_interval>,<scan_ window>` `OK`	`OK`

Parameters	<scan_type>: ▸ 0: passive scan ▸ 1: active scan <own_addr_type>: ▸ 0: public address ▸ 1: random address ▸ 2: RPA public address ▸ 3: RPA random address <filter_policy>: ▸ 0: BLE_SCAN_FILTER_ALLOW_ALL ▸ 1: BLE_SCAN_FILTER_ALLOW_ONLY_WLST ▸ 2: BLE_SCAN_FILTER_ALLOW_UND_RPA_DIR ▸ 3: BLE_SCAN_FILTER_ALLOW_WLIST_PRA_DIR <scan_interval>: scan interval <scan_window>: scan window
Notes	<scan_window> CANNOT be larger than <scan_interval>
Example	AT+BLEINIT=1 // role: client AT+BLESCANPARAM=0,0,0,100,50

6.2.5. AT+BLESCAN—Enables BLE Scanning

Commands	Set Command: AT+BLESCAN=<enable>[,<interval>] Function: to enable/disable scanning.
Response	+BLESCAN:<addr>,<rssi>,<adv_data>,<scan_rsp_data>,<addr_type> OK

Parameters	<enable>: ▸ 0: disable scanning ▸ 1: enable scanning [<interval>]: optional parameter, unit: second ▸ When disabling the scanning, this parameter should be omitted ▸ When enabling the scanning, - if the <interval> is 0 or omitted, it means that scanning is continuous - if the <interval> is NOT 0, for example, command AT+BLESCAN=1,3 , it means that scanning should last for 3 seconds and then stop automatically, so that the scanning results be returned. <addr>: BLE address <rssi>: signal strength <adv_data>: advertising data <scan_rsp_data>: scan response data <addr_type>: BLE address type ▸ 0: public address ▸ 1: random address ▸ 2: RPA (Resolvable Private Address) public ▸ 3: RPA (Resolvable Private Address) random
Example	AT+BLEINIT=1 // role: client AT+BLESCAN=1 // start scanning AT+BLESCAN=0 // stop scanning

6.2.6. AT+BLESCANRSPDATA—Sets BLE Scan Response

Commands	Set Command: AT+BLESCANRSPDATA=<scan_rsp_data> Function: to set scan response.
Response	OK
Parameter	<scan_rsp_data>: scan response data is a HEX string. For example, to set the response data as "0x11 0x22 0x33 0x44 0x55", the command should be AT+BLESCANRSPDATA="1122334455".
Note	The maximum length of the scan response is 31 bytes.
Example	AT+BLEINIT=2 // role: server AT+BLESCANRSPDATA="1122334455"

6.2.7. AT+BLEADVPARAM—Sets Parameters of Advertising

Commands	Query Command: `AT+BLEADVPARAM?` Function: to query the parameters of advertising.	Set Command: `AT+BLEADVPARAM=<adv_int_min>,<adv_int_max>,<adv_type>,<own_addr_type>,<channel_map>[,<adv_filter_policy>,<peer_addr_type>,<peer_addr>]` Function: to set the parameters of advertising.
Response	`+BLEADVPARAM:<adv_int_min>,<adv_int_max>,<adv_type>,<own_addr_type>,<channel_map>,<adv_filter_policy>,<peer_addr_type>,<peer_addr>` `OK`	OK
Parameters	`<adv_int_min>`: minimum value of advertising interval; range: 0x0020 ~ 0x4000 `<adv_int_max>`: maximum value of advertising interval; range: 0x0020 ~ 0x4000 `<adv_type>`: ▸ `0`: ADV_TYPE_IND ▸ `1`: ADV_TYPE_DIRECT_IND_HIGH ▸ `2`: ADV_TYPE_SCAN_IND ▸ `3`: ADV_TYPE_NONCONN_IND `<own_addr_type>`: own BLE address type ▸ `0`: BLE_ADDR_TYPE_PUBLIC ▸ `1`: BLE_ADDR_TYPE_RANDOM `<channel_map>`: channel of advertising ▸ `1`: ADV_CHNL_37 ▸ `2`: ADV_CHNL_38 ▸ `4`: ADV_CHNL_39 ▸ `7`: ADV_CHNL_ALL `[<adv_filter_policy>]`(optional parameter): filter policy of advertising ▸ `0`: ADV_FILTER_ALLOW_SCAN_ANY_CON_ANY ▸ `1`: ADV_FILTER_ALLOW_SCAN_WLST_CON_ANY ▸ `2`: ADV_FILTER_ALLOW_SCAN_ANY_CON_WLST ▸ `3`: ADV_FILTER_ALLOW_SCAN_WLST_CON_WLST `[<peer_addr_type>]`(optional parameter): remote BLE address type ▸ `0`: PUBLIC ▸ `1`: RANDOM `[<peer_addr>]`(optional parameter): remote BLE address	
Note	`<adv_filter_policy>,<peer_addr_type>,<peer_addr>` these three parameters should be set together, or be omitted together.	
Example	`AT+BLEINIT=2` // role: server `AT+BLEADVPARAM=50,50,0,0,4,0,0,"12:34:45:78:66:88"`	

6.2.8. AT+BLEADVDATA—Sets Advertising Data

Commands	Set Command: `AT+BLEADVDATA=<adv_data>` Function: to set advertising data.
Response	OK
Parameters	`<adv_data>`: advertising data; this is a HEX string. For example, to set the advertising data as "0x11 0x22 0x33 0x44 0x55", the command should be `AT+BLEADVDATA="1122334455"`.
Note	The maximum length of the advertising data is 31 bytes.
Example	`AT+BLEINIT=2` // role: server `AT+BLEADVDATA="1122334455"`

6.2.9. AT+BLEADVSTART—Starts Advertising

Commands	Execute Command: `AT+BLEADVSTART` Function: to start advertising.
Response	OK
Parameter	None
Notes	• If advertising parameters are NOT set by command `AT+BLEADVPARAM=<adv_parameter>`, the default parameters will be used. • If advertising data is NOT set by command `AT+BLEADVDATA=<adv_data>`, the all zeros data will be sent.
Example	`AT+BLEINIT=2` // role: server `AT+BLEADVSTART`

6.2.10. AT+BLEADVSTOP—Stops Advertising

Commands	Execute Command: `AT+BLEADVSTOP` Function: to stop advertising.
Response	OK
Parameter	None
Notes	After having started advertising, if the BLE connection is established successfully, it will stop advertising automatically. In such a case, this command does NOT need to be called.

Example	`AT+BLEINIT=2` // role: server
	`AT+BLEADVSTART`
	`AT+BLEADVSTOP`

6.2.11. AT+BLECONN—Establishes BLE connection

Commands	Query Command: `AT+BLECONN?` Function: to query the BLE connection.	Set Command: `AT+BLECONN=<conn_index>,<remote_address>[,<addr_type>]` Function: to establish the BLE connection.

Response	`+BLECONN:<conn_index>,<remote_address>`
	`OK`
	If the connection has not been established, there will NOT be `<conn_index>` and `<remote_address>`
		`OK`
		If the connection established successfully, it will prompt message
		`+BLECONN:<conn_index>,<remote_address>`
		It will prompt the message below, if NOT:
		`+BLECONN:<conn_index>,fail`

Parameters	`<conn_index>`: index of BLE connection; only 0 is supported for the single connection right now, but multiple BLE connections will be supported in the future. `<remote_address>`: remote BLE address `[<addr_type>]`: optional parameter, default type is public address ▸ `0`: public address ▸ `1`: random address ▸ `2`: RPA (Resolvable Private Address) public ▸ `3`: RPA (Resolvable Private Address) random	
Example	`AT+BLEINIT=1` // role: client `AT+BLECONN=0,"24:0a:c4:09:34:23"`	

6.2.12. AT+BLECONNPARAM—Updates parameters of BLE connection

Commands	Query Command: `AT+BLECONNPARAM?` Function: to query the parameters of BLE connection.	Set Command: `AT+BLECONNPARAM=<conn_index>,<min_interval>,<max_interval>,<latency>,<timeout>` Function: to update the parameters of BLE connection.
Response	`+BLECONNPARAM:<conn_index>,<min_interval>,<max_interval>,<cur_interval>,<latency>,<timeout>` `OK`	`OK` // command received If the setting failed, it will prompt message below: `+BLECONNPARAM : <conn_index>,-1`

Parameters	<conn_index>: index of BLE connection; only 0 is supported for the single connection right now, but multiple BLE connections will be supported in the future. <min_interval>: minimum value of connecting interval; range: 0x0006 ~ 0x0C80 <max_interval>: maximum value of connecting interval; range: 0x0006 ~ 0x0C80 <cur_interval>: current connecting interval value <latency>: latency; range: 0x0000 ~ 0x01F3 <timeout>: timeout; range: 0x000A ~ 0x0C80
Note	This commands supports the client only when updating its connection parameters. Of course, the connection has to be established first.
Example	AT+BLEINIT=1 // role: client AT+BLECONN=0,"24:0a:c4:09:34:23" AT+BLECONNPARAM=0,12,14,1,500

6.2.13. AT+BLEDISCONN—Ends BLE connection

Commands	Execute Command: AT+BLEDISCONN=<conn_index> Function: to end a BLE connection.
Response	OK If the connection ends, it will prompt message +BLEDISCONN:<conn_index>,<remote_address>
Parameter	<conn_index>: index of BLE connection; only 0 is supported for the single connection right now, but multiple BLE connections will be supported in the future. <remote_address>: remote BLE address
Example	AT+BLEINIT=1 // role: client AT+BLECONN=0,"24:0a:c4:09:34:23" AT+BLEDISCONN=0

6.2.14. AT+BLEDATALEN—Sets BLE Data Packet Length

Commands	Set Command: AT+BLEDATALEN=<conn_index>,<pkt_data_len> Function: to set the length of BLE data packet.
Response	OK
Parameter	<conn_index>: index of BLE connection; only 0 is supported for the single connection right now, but multiple BLE connections will be supported in the future. <pkt_data_len>: data packet's length; range: 0x001b ~ 0x00fb
Notes	The BLE connection has to be established before setting the packet length.

Example	AT+BLEINIT=1 // role: client AT+BLECONN=0,"24:0a:c4:09:34:23" AT+BLEDATALEN=0,30

6.2.15. AT+BLECFGMTU—Sets GATT MTU Length

Commands	Query Command: AT+BLECFGMTU? Function: to query the length of the maximum transmission unit (MTU).	Set Command: AT+BLECFGMTU=<conn_index>,<mtu_size> Function: to set the length of the maximum transmission unit (MTU).
Response	+BLECFGMTU:<conn_index>,<mtu_size> OK	OK // the command is received
Parameter	<conn_index>: index of BLE connection; only 0 is supported for the single connection right now, but multiple BLE connections will be supported in the future. <mtu_size>: MTU length	
Notes	• Only the client can call this command to set the length of MTU. However, the BLE connection has to be established first. • The actual length of MTU needs to be negotiated. The "OK" response only means that the MTU length must be set. So, the user should use command AT+BLECFGMTU? to query the actual MTU length.	
Example	AT+BLEINIT=1 // role: client AT+BLECONN=0,"24:0a:c4:09:34:23" AT+BLECFGMTU=0,300	

6.2.16. AT+BLEGATTSSRVCRE—GATTS Creates Services

Commands	Execute Command: AT+BLEGATTSSRVCRE Function: The Generic Attributes Server (GATTS) creates BLE services.
Response	OK
Parameter	None
Notes	• If using ESP32 as a BLE server, a service bin should be downloaded into Flash in order to provide services. ▸ To learn how to generate a service bin, please refer to esp32-at/tools/readme.md. ▸ The download address of the service bin is the "ble_data" address in esp32-at/at_customize.csv. • This command should be called immediately to create services, right after the BLE server is initialized. If a BLE connection is established first, the service creation will fail.
Example	AT+BLEINIT=2 // role: server AT+BLEGATTSSRVCRE

6.2.17. AT+BLEGATTSSRVSTART—GATTS Starts Services

Commands	Execute Command: `AT+BLEGATTSSTART` Function: GATTS starts all services.	Set Command: `AT+BLEGATTSSRVSTART=<srv_index>` Function: GATTS starts a specific service.
Response	OK	
Parameter	None	`<srv_index>`: service's index starting from 1

Example	`AT+BLEINIT=2` // role: server
	`AT+BLEGATTSSRVCRE`
	`AT+BLEGATTSSRVSTART`	

6.2.18. AT+BLEGATTSSRVSTOP—GATTS Stops Services

Commands	Execute Command: `AT+BLEGATTSSTOP` Function: GATTS stops all services.	Set Command: `AT+BLEGATTSSRVSTOP=<srv_index>` Function: GATTS stops a specific service.
Response	OK	
Parameter	None	`<srv_index>`: service's index starting from 1

Example	`AT+BLEINIT=2` // role: server
	`AT+BLEGATTSSRVCRE`
	`AT+BLEGATTSSRVSTART`
	`AT+BLEGATTSSRVSTOP`	

6.2.19. AT+BLEGATTSSRV—GATTS Discovers Services

Commands	Query Command: `AT+BLEGATTSSRV?` Function: GATTS services discovery.
Response	`+BLEGATTSSRV:<srv_index>,<start>,<srv_uuid>,<srv_type>` OK
Parameters	`<srv_index>`: service's index starting from 1 `<start>`: ▸ `0`: the service has not started ▸ `1`: the service has already started `<srv_uuid>`: service's UUID `<srv_type>`: service's type ▸ `0`: is not a primary service ▸ `1`: is a primary service

Example	AT+BLEINIT=2 // role: server AT+BLEGATTSSRVCRE AT+BLEGATTSSRV?

6.2.20. AT+BLEGATTSCHAR—GATTS Discovers Characteristics

Commands	Query Command: AT+BLEGATTSCHAR? Function: GATTS characteristics discovery.

Response	// when showing a characteristic, it will be as:
	+BLEGATTSCHAR:"char",<srv_index>,<char_index>,<char_uuid>,<char_prop>
	// when showing a descriptor, it will be as:
	+BLEGATTSCHAR:"desc",<srv_index>,<char_index>,<desc_index>
	OK

Parameters	<srv_index>: service's index starting from 1 <char_index>: characteristic's index starting from 1 <char_uuid>: characteristic's UUID <char_prop>: characteristic's properties <desc_index>: descriptor's index <desc_uuid>: descriptor's UUID
Example	AT+BLEINIT=2 // role: server AT+BLEGATTSSRVCRE AT+BLEGATTSSRVSTART AT+BLEGATTSCHAR?

6.2.21. AT+BLEGATTSNTFY—GATTS Notifies of Characteristics

Commands	Set Command: AT+BLEGATTSNTFY=<conn_index>,<srv_index>,<char_index>,<length> Function: GATTS notifies of its characteristics.
Response	wrap return > after the command. Begin receiving serial data. When the requirement of data length, determined by <length>, is met, the notification starts. If the data transmission is successful, the system returns: OK

Parameters	<conn_index>: index of BLE connection; only 0 is supported for the single connection right now, but multiple BLE connections will be supported in the future. <srv_index>: service's index; it can be fetched with command AT+BLEGATTSCHAR? <char_index>: characteristic's index; it can be fetched with command AT+BLEGATTSCHAR? <length>: data length

Example	A simple workflow is shown below. Users can refer to ***Section 9.5 BLE AT Examples*** for more details.
	AT+BLEINIT=2 // role: server
	AT+BLEGATTSSRVCRE
	AT+BLEGATTSSRVSTART
	AT+BLEADVSTART // starts advertising. After the client is connected, it must be configured to receive notifications.
	AT+BLEGATTSCHAR? // check which characteristic the client will be notified of
	// for example, to notify of 4 bytes of data using the 6th characteristic in the 3rd service, use the following command:
	AT+BLEGATTSNTFY=0,3,6,4
	// after > shows, inputs 4 bytes of data, such as "1234"; then, the data will be transmitted automatically

6.2.22. AT+BLEGATTSIND—GATTS Indicates Characteristics

Commands	Set Command: AT+BLEGATTSIND=<conn_index>,<srv_index>,<char_index>,<length> Function: GATTS indicates its characteristics.
Response	wrap return > after the command. Begin receiving serial data. When the requirement of data length, determined by <length>, is met, the indication starts. If the data transmission is successful, the system returns: OK
Parameters	<conn_index>: index of BLE connection; only 0 is supported for the single connection right now, but multiple BLE connections will be supported in the future. <srv_index>: service's index; it can be fetched with command AT+BLEGATTSCHAR? <char_index>: characteristic's index; it can be fetched with command AT+BLEGATTSCHAR? <length>: data length

Example	A simple workflow is shown below. Users can refer to ***Section 9.5 BLE AT Examples*** for more details.
	`AT+BLEINIT=2` // role: server
	`AT+BLEGATTSSRVCRE`
	`AT+BLEGATTSSRVSTART`
	`AT+BLEADVSTART` // starts advertising. After the client is connected, it must be configured to receive indications.
	`AT+BLEGATTSCHAR?` // check for which characteristic the client can receive indications
	// for example, to indicate 4 bytes of data using the 7th characteristic in the 3rd service, use the following command:
	`AT+BLEGATTSIND=0,3,7,4`
	// after > shows, inputs 4 bytes of data, such as "1234"; then, the data will be transmitted automatically

6.2.23. AT+BLEGATTSSETATTR—GATTS Sets Characteristic

Commands	Set Command: `AT+BLEGATTSSETATTR=<srv_index>,<char_index>[,<desc_index>],<length>` Function: GATTS sets its characteristic (descriptor).
Response	wrap return > after the command. Begin receiving serial data. When the requirement of data length, determined by `<length>`, is met, the setting starts. If the setting is successful, the system returns: `OK`

Parameters	`<srv_index>`: service's index; it can be fetched with command `AT+BLEGATTSCHAR?`
	`<char_index>`: characteristic's index; it can be fetched with command `AT+BLEGATTSCHAR?`
	`[<desc_index>]`(Optional parameter): descriptor's index. If it is set, this command is used to set the value of the descriptor; if it is not, this command is used to set the value of the characteristic.
	`<length>`: data length

Note	If the <length> is larger than the maximum length allowed, the setting will fail.

Example	A simple workflow is shown below. Users can refer to ***Section 9.5 BLE AT Examples*** for more details.
	`AT+BLEINIT=2` // role: server
	`AT+BLEGATTSSRVCRE`
	`AT+BLEGATTSSRVSTART`
	`AT+BLEGATTSCHAR?`
	// for example, to set 4 bytes of data of the 1st characteristic in the 1st service, use the following command:
	`AT+BLEGATTSSETATTR=1,1,,4`
	// after > shows, inputs 4 bytes of data, such as "1234"; then, the setting starts

6.2.24. AT+BLEGATTCPRIMSRV—GATTC Discovers Primary Services

Commands	Query Command: `AT+BLEGATTCPRIMSRV=<conn_index>` Function: GATTC discovers primary services.
Response	`+BLEGATTCPRIMSRV:<conn_index>,<srv_index>,<srv_uuid>,<srv_type>` OK
Parameters	`<conn_index>`: index of BLE connection; only 0 is supported for the single connection right now, but multiple BLE connections will be supported in the future. `<srv_index>`: service's index starting from 1 `<srv_uuid>`: service's UUID `<srv_type>`: service's type ▸ `0`: is not a primary service ▸ `1`: is a primary service
Note	The BLE connection has to be established first.

Example	`AT+BLEINIT=1` // role: client
	`AT+BLECONN=0,"24:12:5f:9d:91:98"`
	`AT+BLEGATTCPRIMSRV=0`

6.2.25. AT+BLEGATTCINCLSRV—GATTC Discovers Included Services

Commands	Set Command: `AT+BLEGATTCINCLSRV=<conn_index>,<srv_index>` Function: GATTC discovers included services.
Response	`+BLEGATTCINCLSRV:<conn_index>,<srv_index>,<srv_uuid>,<srv_type>,<included_srv_uuid>,<included_srv_type>` OK
Parameters	`<conn_index>`: index of BLE connection; only 0 is supported for the single connection right now, but multiple BLE connections will be supported in the future. `<srv_index>`: service's index; it can be fetched with command `AT+BLEGATTCPRIMSRV=<conn_index>` `<srv_uuid>`: service's UUID `<srv_type>`: service's type ▸ `0`: is not a primary service ▸ `1`: is a primary service `<included_srv_uuid>`: included service's UUID `<included_srv_type>`: included service's type ▸ `0`: is not a primary service ▸ `1`: is a primary service
Note	The BLE connection has to be established first.

Example	AT+BLEINIT=1 // role: client AT+BLECONN=0,"24:12:5f:9d:91:98" AT+BLEGATTCPRIMSRV=0 AT+BLEGATTCINCLSRV=0,1 // set a specific index according to the result of the previous command

6.2.26. AT+BLEGATTCCHAR—GATTC Discovers Characteristics

Commands	Set Command: AT+BLEGATTCCHAR=<conn_index>,<srv_index> Function: GATTC discovers characteristics.

Response	// when showing a characteristic, it will be as:
	+BLEGATTCCHAR:"char",<conn_index>,<srv_index>,<char_index>,<char_uuid>,<char_prop>
	// when showing a descriptor, it will be as:
	+BLEGATTCCHAR:"desc",<conn_index>,<srv_index>,<char_index>,<desc_index>,<desc_uuid>
	OK

Parameters	<conn_index>: index of BLE connection; only 0 is supported for the single connection right now, but multiple BLE connections will be supported in the future. <srv_index>: service's index; it can be fetched with command AT+BLEGATTCPRIMSRV=<conn_index> <char_index>: characteristic's index starting from 1 <char_uuid>: characteristic's UUID <char_prop>: characteristic's properties <desc_index>: descriptor's index <desc_uuid>: descriptor's UUID
Note	The BLE connection has to be established first.
Example	AT+BLEINIT=1 // role: client AT+BLECONN=0,"24:12:5f:9d:91:98" AT+BLEGATTCPRIMSRV=0 AT+BLEGATTCCHAR=0,1 // set a specific index, according to the result of the previous command

6.2.27. AT+BLEGATTCRD—GATTC Reads a Characteristic

Commands	Set Command: AT+BLEGATTCRD=<conn_index>,<srv_index>,<char_index>[,<desc_index>] Function: GATTC to read a characteristic or descriptor.

Response	`+BLEGATTCRD:<conn_index>,<len>,<value>` `OK`

Parameters	`<conn_index>`: index of BLE connection; only 0 is supported for the single connection right now, but multiple BLE connections will be supported in the future.
	`<srv_index>`: service's index; it can be fetched with command `AT+BLEGATTCPRIMSRV=<conn_index>`
	`<char_index>`: characteristic's index; it can be fetched with command `AT+BLEGATTCCHAR=<conn_index>,<srv_index>`
	`[<desc_index>]`(Optional parameter): descriptor's index. If it is set, the value of the target descriptor will be read; if it is not set, the value of the target characteristic will be read.
	`<len>`: data length
	`<value>`: HEX string
	▸ Characteristic's value, read by command `AT+BLEGATTCRD=<conn_index>,<srv_index>, <char_index>`. For example, if the response is `"+BLEGATTCRD:0,1,30"`, it means that the value length is 1, and the content is `"0x30"`.
	▸ Descriptor's value, read by command `AT+BLEGATTCRD=<conn_index>,<srv_index>, <char_index>,<desc_index>`. For example, if the response is `"+BLEGATTCRD: 0,4,30313233"`, it means that the value length is 4, and the content is "0x30 0x31 0x32 0x33".

Note	• The BLE connection has to be established first. • If the target characteristic cannot be read, it will return "ERROR".

Example	`AT+BLEINIT=1` // role: client
	`AT+BLECONN=0,"24:12:5f:9d:91:98"`
	`AT+BLEGATTCPRIMSRV=0`
	`AT+BLEGATTCCHAR=0,3` // set a specific index, according to the result of the previous command
	// for example, to read 1st descriptor of the 2nd characteristic in the 3rd service, use the following command:
	`AT+BLEGATTCRD=0,3,2,1`

6.2.28. AT+BLEGATTCWR—GATTC Writes Characteristic

Commands	Set Command: `AT+BLEGATTCWR=<conn_index>,<srv_index>,<char_index>[,<desc_index>],<length>` Function: GATTC writes characteristics or descriptor.
Response	wrap return > after the command. Begin receiving serial data. When the requirement of data length, determined by `<length>`, is met, the writting starts. If the setting is successful, the system returns: `OK`

Parameters	<conn_index>: index of BLE connection; only 0 is supported for the single connection right now, but multiple BLE connections will be supported in the future. <srv_index>: service's index; it can be fetched with command AT+BLEGATTCPRIMSRV=<conn_index> <char_index>: characteristic's index; it can be fetched with command AT+BLEGATTCCHAR=<conn_index>,<srv_index> [<desc_index>] (optional parameter): descriptor's index. If it is set, the value of the target descriptor will be written; if it is not set, the value of the target characteristic will be written. <length>: data length
Note	• The BLE connection has to be established first. • If the target characteristic cannot be written, it will return "ERROR".

Example	AT+BLEINIT=1 // role: client
	AT+BLECONN=0,"24:12:5f:9d:91:98"
	AT+BLEGATTCPRIMSRV=0
	AT+BLEGATTCCHAR=0,3 // set a specific index, according to the result of the previous command
	// for example, to write 6 bytes of data to the 4th characteristic in the 3rd service, use the following command:
	AT+BLEGATTCWR=0,3,4,,6
	// after > shows, inputs 6 bytes of data, such as "123456"; then, the writing starts

6.2.29. AT+BLESPPCFG—Configures BLE SPP

Set Command	AT+BLESPPCFG=<cfg_enable>,<tx_srv_index>,<tx_char_index>,<rx_srv_index>,<rx_srv_index> Function: to configure BLE SPP (Serial Port Profile, UART-BLE passthrough mode). It will take two characteristics: one for sending data, the other for receiving data.
Response	OK

Parameters	<cfg_enable>: • 0: clears BLE SPP configuration, the following four parameters need not to be set. • 1: sets BLE SPP configuration, the following four parameters have to be set. <tx_srv_index>: the index of the service that contains the target characteristic for sending data. • If ESP runs as a BLE server, <tx_srv_index> will be a local service ID which can be obtained by using the command AT+BLEGATTSSRVCRE. • If ESP runs as a BLE client, <tx_srv_index> will be a remote service ID which can be obtained by using the command AT+BLEGATTCPRIMSRV=<conn_index>. <tx_char_index>: the index of the characteristic that is used for sending data. • If ESP runs as a BLE server, <tx_char_index> will be a local characteristic ID which can be obtained by using the command AT+BLEGATTSCHAR. The characteristic should support notification or indication. • If ESP runs as a BLE client, <tx_char_index> will be a remote characteristic ID which can be obtained by using the command AT+BLEGATTCCHAR=<conn_index>,<srv_index>. The characteristic should support writing access. <rx_srv_index>: the index of the service that contains the target characteristic for receiving data. • If ESP runs as a BLE server, <rx_srv_index> will be a local service ID which can be obtained by using the command AT+BLEGATTSSRVCRE. • If ESP runs as a BLE client, <rx_srv_index> will be a remote service ID which can be obtained by using the command AT+BLEGATTCPRIMSRV=<conn_index>. <rx_char_index>: the index of the characteristic that is used for receiving data. • If ESP runs as a BLE server, <rx_char_index> will be a local characteristic ID which can be obtained by using the command AT+BLEGATTSCHAR. The characteristic should support writing access. • If ESP runs as a BLE client, <rx_char_index> will be a remote characteristic ID which can be obtained by using the command AT+BLEGATTCCHAR=<conn_index>,<srv_index>. The characteristic should support notification or indication.
Note	• This command can be called after initializing BLE. • This command can be called multiple times, the final configuration depends on the last setting. • If the target characteristic cannot be written, it will return "ERROR". This configuration will not be saved in flash, and will be cleared after system reboot or BLE shutdown.

Example	`AT+BLEINIT=2` // role: server
	`AT+BLEGATTSSRVCRE`
	`AT+BLEGATTSSRVSTART`
	`AT+BLEGATTSCHAR?`
	`AT+BLEADVSTART` // start advertising
	// After a BLE client connects to the ESP server, the message `+BLECONN:0,<client MAC>` will appear.
	// For example, to configure the 7th characteristic in the 1st service as a TX channel for sending data; and configure the 5th characteristic in the 1st service as a RX channel for receiving data, use the following command:
	`AT+BLESPPCFG=1,1,7,1,5`
	// The client needs to listen to the notification/indication from TX channel which is the 7th characteristic in this example.

6.2.30. AT+BLESPP—Enables BLE SPP

Execute Command	`AT+BLESPP` Function: to enable BLE SPP (Serial Port Profile, UART-BLE passthrough mode).
Response	`OK` `>` // waiting for serial data The wrap return is > after this command is executed. Then, ESP32 enters UART-BLE passthrough mode. When a single packet containing +++ is received, ESP32 returns to normal command mode. Please wait for at least one second before sending the next AT command.
Note	• When calling this command to enable BLE SPP, the configuration set by `AT+BLESPPCFG` will be checked. If the configuration has not been set, cleared, or is invalid (for example, the characteristic fails to meet requirements), the command will return "ERROR". • If the UART-WiFi passthrough mode has been enabled, the command will return "ERROR". • If the BLE connection is not established, or the multiple connections mode is enabled, the command will return "ERROR". • If the BLE is advertising, the command will return "ERROR". However, the command will be enabled successfully if the advertising type is `ADV_TYPE_NONCONN_IND`. • If the BLE connection breaks unexpectedly in UART-BLE passthrough mode, the ESP will keep trying to restore the connection.

Example	AT+BLEINIT=2 // role: server
	AT+BLEGATTSSRVCRE
	AT+BLEGATTSSRVSTART
	AT+BLEGATTSCHAR?
	AT+BLEADVSTART // start advertising
	// After a BLE client connects to the ESP server, the message +BLECONN:0,<client MAC> will return.
	// For example, to configure the 7th characteristic in the 1st service as a TX channel for sending data; and configure the 5th characteristic in the 1st service as a RX channel for receiving data, use the following command:
	AT+BLESPPCFG=1,1,7,1,5
	// The client needs to listen to the notification/indication from TX channel which is the 7th characteristic in this example.
	AT+BLESPP // enable BLE SPP

6.2.31. AT+BLESECPARAM—Set Parameters of BLE SMP

Commands	Query Command: AT+BLESECPARAM? Function: to query parameters of BLE SMP (Security Manager Specification).	Set Command: AT+BLESECPARAM=<auth_req>,<iocap>,<key_size>,<init_key>,<rsp_key> Function: to set parameters of BLE SMP.
Response	+BLESECPARAM:<auth_req>,<iocap>,<key_size>,<init_key>,<rsp_key> OK	OK

Parameters	<auth_req>: authentication requirements ▸ 0: ESP_LE_AUTH_NO_BOND ▸ 1: ESP_LE_AUTH_BOND ▸ 2: ESP_LE_AUTH_REQ_MITM ▸ 4: ESP_LE_AUTH_REQ_SC_ONLY ▸ 5: ESP_LE_AUTH_REQ_SC_BOND ▸ 6: ESP_LE_AUTH_REQ_SC_MITM ▸ 7: ESP_LE_AUTH_REQ_SC_MITM_BOND <iocap>: IO capabilities ▸ 0: ESP_IO_CAP_OUT /*!< DisplayOnly */ ▸ 1: ESP_IO_CAP_IO /*!< DisplayYesNo */ ▸ 2: ESP_IO_CAP_IN /*!< KeyboardOnly */ ▸ 3: ESP_IO_CAP_NONE /*!< NoInputNoOutput */ ▸ 4: ESP_IO_CAP_KBDISP /*!< Keyboard display */ <key_size>: encryption key size, range : [7, 16] <init_key>: ▸ if bit0 is 1, it means ESP_BLE_ENC_KEY_MASK // exchange the encryption key ▸ if bit1 is 1, it means ESP_BLE_ID_KEY_MASK // exchange the IRK key ▸ if bit2 is 1, it means ESP_BLE_CSR_KEY_MASK // exchange the CSRK key ▸ if bit3 is 1, it means ESP_BLE_LINK_KEY_MASK // exchange the link key(this key is used only in the BLE & BR/EDR-coexist mode) <rsp_key>: response key ▸ if bit0 is 1, it means ESP_BLE_ENC_KEY_MASK // exchange the encryption key ▸ if bit1 is 1, it means ESP_BLE_ID_KEY_MASK // exchange the IRK key ▸ if bit2 is 1, it means ESP_BLE_CSR_KEY_MASK // exchange the CSRK key ▸ if bit3 is 1, it meansESP_BLE_LINK_KEY_MASK // exchange the link key(this key is used only in the BLE & BR/EDR-coexist mode)
Note	This configuration should be set before the BLE connection is established.
Example	AT+BLESECPARAM=1,4,16,3,3

6.2.32. AT+BLEENC—Starts a Pairing Request

Commands	Set Command: AT+BLEENC=<conn_index>,<sec_act> Function: to start a pairing request.
Response	OK
Parameters	<conn_index>: index of BLE connection; only 0 is supported for the single connection right now, but multiple BLE connections will be supported in the future. <sec_act>: ▸ 0: ESP_BLE_SEC_NONE ▸ 1: ESP_BLE_SEC_ENCRYPT ▸ 2: ESP_BLE_SEC_ENCRYPT_NO_MITM ▸ 3: ESP_BLE_SEC_ENCRYPT_MITM
Example	AT+BLESECPARAM=1,4,16,3,3 AT+BLEENC=0,3

6.2.33. AT+BLEENCRSP—Sets a Pairing Response

Commands	Set Command: `AT+BLEENCRSP=<conn_index>,<accept>` Function: to set a pairing response.
Response	`OK`
Parameters	`<conn_index>`: index of BLE connection; only 0 is supported for the single connection right now, but multiple BLE connections will be supported in the future. `<accept>`: ▸ `0: reject` ▸ `1: accept`
Example	`AT+BLEENCRSP=0,1`

6.2.34. AT+BLEKEYREPLY—Reply to a Pairing Key

Commands	Set Command: `AT+BLEKEYREPLY=<conn_index>,<key>` Function: to reply to a pairing key.
Response	`OK`
Parameters	`<conn_index>`: index of BLE connection; only 0 is supported for the single connection right now, but multiple BLE connections will be supported in the future. `<key>`: pairing key
Example	`AT+BLEKEYREPLY=0,649784`

6.2.35. AT+BLECONFREPLY—Reply to a Pairing Result

Commands	Set Command: `AT+BLECONFREPLY=<conn_index>,<confirm>` Function: to reply to a pairing result when the pairing key cannot be used.
Response	`OK`
Parameters	`<conn_index>`: index of BLE connection; only 0 is supported for the single connection right now, but multiple BLE connections will be supported in the future. `<confirm>`: ▸ `0: No` ▸ `1: Yes`
Example	// confirm that pairing succeeded `AT+BLECONFREPLY=0,1`

6.2.36. AT+BLEENCDEV—Lists All Devices that Bonded

Command	Query Command: `AT+BLEENCDEV?`
Response	`+BLEENCDEV:<enc_dev_index>,<mac_address>` `OK`
Parameters	`<enc_dev_index>`: index of bonded devices; only 0 is supported for the single connection right now, but multiple BLE connections will be supported in the future. `<mac_address>`: Mac address
Example	`AT+BLEENCDEV?`

6.2.37. AT+BLEENCCLEAR—Unbind Device

Commands	Set Command: `AT+BLEENCCLEAR=<enc_dev_index>` Function: unbind a device with a specific index.	Execute Command: `AT+BLEENCCLEAR` Function: unbind all devices.
Response	`OK`	
Parameters	`<enc_dev_index>`: index of bonded devices; only 0 is supported for the single connection right now, but multiple BLE connections will be supported in the future.	
Example	`AT+BLEENCCLEAR`	

7. AT Commands with Configuration Saved in the NVS Area

Commands	Examples
AT+UART	AT+UART=115200,8,1,0,3
AT+UART_DEF	AT+UART_DEF=115200,8,1,0,3
AT+CWDHCP	AT+CWDHCP=1,1
AT+CIPSTAMAC	AT+CIPSTAMAC="18:fe:35:98:d3:7b"
AT+CIPAPMAC	AT+CIPAPMAC="1a:fe:36:97:d5:7b"
AT+CIPSTA	AT+CIPSTA="192.168.6.100"
AT+CIPAP	AT+CIPAP="192.168.5.1"
AT+CWDHCPS	AT+CWDHCPS=1,3,"192.168.4.10","192.168.4.15"
AT+SAVETRANSLINK	AT+SAVETRANSLINK=1,"192.168.6.10",1001
AT+CWMODE	AT+CWMODE=3
AT+CWJAP	AT+CWJAP="abc","0123456789"
AT+CWSAP	AT+CWSAP="ESP32","12345678",5,3
AT+CWAUTOCONN	AT+CWAUTOCONN=1
AT+CIPSSLCCONF	AT+CIPSSLCCONF=1,3,0,0

⚠ ***Notice:***

NVS parameter area is 0xFA000 ~ 0x110000, and it is 88 KB in size.

8. AT Messages

Messages of ESP32 AT are as below:

Messages	Description
ready	The AT firmware is ready.
ERROR	AT command error, or error occurred during execution.
WIFI CONNECTED	ESP station connected to an AP.
WIFI GOT IP	ESP station got IP address.
WIFI DISCONNECT	ESP station disconnected from an AP.
busy p...	Busy processing. The system is in process of handling the previous command, cannot accept the newly input.
<conn_id>,CONNECT	A network connection of which ID is <conn_id> is established.
<conn_id>,CLOSED	A network connection of which ID is <conn_id> ends.
+IPD	Network data received.
+STA_CONNECTED:<sta_mac>	A station connects to the ESP softAP.
+DIST_STA_IP:<sta_mac>,<sta_ip>	ESP softAP distributes an IP address to the station connected.
+STA_DISCONNECTED:<sta_mac>	A station disconnects from the ESP softAP.
+BLECONN	A BLE connection established.
+BLEDISCONN	A BLE connection ends.
+READ	A read operation from BLE connection
+WRITE	A write operation from BLE connection
+NOTIFY	A notification from BLE connection
+INDICATE	An indication from BLE connection
+BLESECNTFYKEY	BLE SMP key
+BLEAUTHCMPL	BLE SMP pairing completed.

9. AT Commands Examples

Herein we introduce some examples of how to use Espressif's AT Commands.

9.1. ESP32 as a TCP Client in Single Connection

1. Set the Wi-Fi mode:

```
AT+CWMODE=3                                    // SoftAP+Station mode
```

Response:

```
OK
```

2. Connect to the router:

```
AT+CWJAP="SSID","password"                     // SSID and password of router
```

Response:

```
OK
```

3. Query the device's IP:

```
AT+CIFSR
```

Response:

```
192.168.3.106                                  // device got an IP from router
```

4. Connect the PC to the same router which ESP32 is connected to. Use a network tool on the PC to create a TCP server.
   - For example, the TCP server on PC is 192.168.3.116, port 8080.
5. ESP32 is connected to the TCP server as a client:

```
AT+CIPSTART="TCP","192.168.3.116",8080   // protocol、server IP & port
```

6. Send data:

```
AT+CIPSEND=4                                   // set date length which will be sent,  such as
4 bytes
>TEST                                          // enter the data, no CR
```

Response:

```
SEND OK
```

> ⚠ ***Notice:***
>
> - *If the number of bytes inputted are more than the size defined (n):*
>   - *the system will reply* `busy`*, and send the first n bytes.*
>   - *and after sending the first n bytes, the system will reply* `SEND OK`*.*

7. Receive data:

```
+IPD,n:xxxxxxxxxx                    // received n bytes, data=xxxxxxxxxx
```

9.2. UDP Transmission

UDP transmission is established via `AT+CIPSTART`. There is no such distinction between UDP server and UDP client.

1. Set the Wi-Fi mode:

```
AT+CWMODE=3                          // SoftAP+Station mode
```

Response:

```
OK
```

2. Connect to the router:

```
AT+CWJAP="SSID","password"           // SSID and password of router
```

Response:

```
OK
```

3. Query the device's IP:

```
AT+CIFSR
```

Response:

```
+CIFSR:STAIP,"192.168.101.104"       // IP address of ESP32 Station
```

4. Connect the PC to the same router which ESP32 is connected to. Use a network tool on the PC to create UDP transmission.
   - For example, the PC's IP address is 192.168.101.116 and the port is 8080.
5. Below are two examples of UDP transmission:

9.2.1. UDP (with Fixed Remote IP and Port)

In UDP transmission, whether the remote IP and port are fixed or not is determined by the last parameter of `AT+CIPSTART`, namely `0`. `0` means that the remote IP and port are fixed and cannot be changed. A specific ID is given to such a connection, ensuring that the data sender and receiver will not be replaced by other devices.

1. Enable multiple connections:

```
AT+CIPMUX=1
```

Response:

```
OK
```

2. Create a UDP transmission, with the ID being 4, for example.

```
AT+CIPSTART=4,"UDP","192.168.101.110",8080,1112,0
```

Response:

```
4,CONNECT
OK
```

> 📖 ***Notes:***
>
> - `"192.168.101.110"` *and* `8080` *are the remote IP and port of UDP transmission on the remote side, i.e., the UDP configuration set by PC.*
> - `1112` *is the local port number of ESP32. Users can define this port number. The value of this parameter will be random if it is not defined beforehand.*
> - `0` *means that the remote IP and port are fixed and cannot be changed. For example, if another PC also creates a UDP entity and sends data to ESP32 port 1112, ESP32 can receive the data sent from UDP port 1112. But when data are sent using AT command* `AT+CIPSEND=4,X`*, it will still be sent to the first PC end. If parameter* `0` *is not used, the data will be sent to the new PC.*

3. Send data:

```
AT+CIPSEND=4,7              // send 7 bytes to transmission NO.4
>UDPtest                     // enter the data, no CR
```

Response:

```
SEND OK
```

> ⚠️ ***Notice:***
>
> - *If the number of bytes inputted are more than the size defined (n):*
>   - *the system will reply* `busy`*, and send the first n bytes.*
>   - *and after sending the first n bytes, the system will reply* `SEND OK`*.*

4. Receive data:

```
+IPD,4,n:xxxxxxxxxx          // received n bytes, data=xxxxxxxxxx
```

5. Close UDP transmission No.4:

```
AT+CIPCLOSE=4
```

Response:

```
4,CLOSED
OK
```

9.2.2. UDP (with Changeable Remote IP and Port)

1. Create a UDP transmission with the last parameter being `2`.

```
AT+CIPSTART="UDP","192.168.101.110",8080,1112,2
```

Response:

```
CONNECT
OK
```

> 📖 ***Notes:***
>
> - `"192.168.101.110"` *and* `8080` *here refer to the IP and port of the remote UDP transmission terminal which is created on a PC in* ***Section 9.2.1.***
> - `1112` *is the local port of ESP32. Users can define this port. The value of this parameter will be random if it is not defined beforehand.*
> - `2` *means the means the opposite terminal of UDP transmission can be changed. The remote IP and port will be automatically changed to those of the last UDP connection to ESP32.*

2. Send data:

```
AT+CIPSEND=7                    // send 7 bytes
>UDPtest                        // enter the data, no CR
```

Response:

```
SEND OK
```

> ⚠ ***Notice:***
>
> - *If the number of bytes inputted are more than the size defined (n):*
>   - *the system will reply* `busy`*, and send the first n bytes.*
>   - *and after sending the first n bytes, the system will reply* `SEND OK`*.*

3. If you want to send data to any other UDP terminals, please designate the IP and port of the target terminal in the command.

```
AT+CIPSEND=6,"192.168.101.111",1000          // send six bytes
>abcdef                                       // enter the data, no CR
```

Response:

```
SEND OK
```

4. Receive data:

```
+IPD,n:xxxxxxxxxx                            // received n bytes, data=xxxxxxxxxx
```

5. Close UDP transmission:

```
AT+CIPCLOSE
```

Response:

```
CLOSED
OK
```

9.3. Transparent Transmission

AT Demo supports transparent transmission only when ESP32 works as a TCP client in single connection or UDP transmission.

9.3.1. ESP32 as a TCP Client in UART-Wi-Fi Passthrough (Single Connection Mode)

Here is an example of the ESP32 Station working as a TCP client in single connection mode of transparent transmission.

1. Set the Wi-Fi mode:

```
AT+CWMODE=3                                    // SoftAP+Station mode
```

Response:

```
OK
```

2. Connect to the router:

```
AT+CWJAP="SSID","password"                     // SSID and password of router
```

Response:

```
OK
```

3. Query the device's IP:

```
AT+CIFSR
```

Response:

```
192.168.101.105                                // device's IP that got from router
```

4. Connect the PC to the same router to which ESP32 is connected. Use a network tool on the PC to create a TCP server.
   - For example, the PC's IP address is 192.168.101.110 and the port is 8080.
5. Connect the device to the TCP server as a TCP client:

```
AT+CIPSTART="TCP","192.168.101.110",8080     // protocol, server IP & port
```

Response:

```
OK
```

6. Enable the transparent transmission mode:

```
AT+CIPMODE=1
```

Response:

```
OK
```

7. Send data:

```
AT+CIPSEND
```

Response:

```
>               // From now on, data received from UART will be transparent transmitted
to server
```

8. Stop sending data:

When receiving a packet that contains only "+++", the UART-WiFi passthrough transmission process will be stopped. Then please wait at least 1 second before sending next AT command.

Please be noted that if you input "+++" directly by typing, the "+++", may not be recognised as three consecutive "+" because of the Prolonged time when typing.

> ⚠ ***Notice:***
>
> *The aim of ending the packet with +++ is to exit transparent transmission and to accept normal AT commands, while TCP still remains connected. However, users can also deploy command* `AT+CIPSEND` *to go back into transparent transmission.*

9. Exit the transparent transmission mode:

```
AT+CIPMODE=0
```

Response:

```
OK
```

10. Close the TCP connection:

```
AT+CIPCLOSE
```

Response:

```
CLOSED
OK
```

9.3.2. UDP Transmission (UART-Wi-Fi PassthroughTransmission)

Here is an example of the ESP32 working as a SoftAP in UDP transparent transmission.

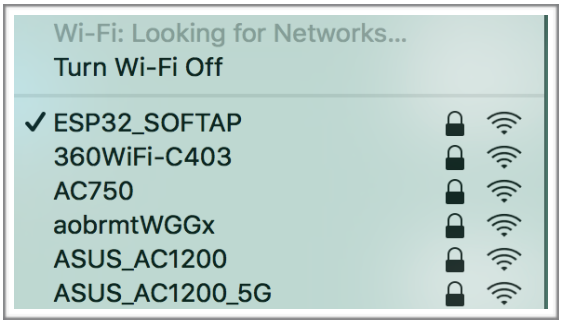
1. Set the Wi-Fi mode:

```
AT+CWMODE=3                                    // SoftAP+Station mode
```

Response:

```
OK
```

2. Connect the PC to the ESP32 SoftAP:



3. Use a network tool on PC to create a UDP.
   - For example, the PC's IP address is 192.168.4.2 and the port is 1001.

4. Create a UDP transmission between ESP32 and the PC with a fixed remote IP and port.

```
AT+CIPSTART="UDP","192.168.4.2",1001,2233,0
```

Response:

```
OK
```

5. Enable the transparent transmission mode:

```
AT+CIPMODE=1
```

Response:

```
OK
```

6. Send data:

```
AT+CIPSEND
```

Response:

```
>                // from now on, data received from UART will be transparent
transmitted to server
```

7. Stop sending data:

When receiving a packet that contains only "+++", the UART-WiFi passthrough transmission process will be stopped. Then please wait at least 1 second before sending next AT command.

Please be noted that if you input "+++" directly by typing, the "+++", may not be recognized as three consecutive "+" because of the Prolonged time when typing.

> ⚠ ***Notice:***
>
> *The aim of ending the packet with +++ is to exit transparent transmission and to accept normal AT commands, while TCP still remains connected. However, users can also use command* `AT+CIPSEND` *to go back into transparent transmission.*

9. Exit the transparent transmission mode:

```
AT+CIPMODE=0
```

Response:

```
OK
```

10. Close the UDP transmission:

```
AT+CIPCLOSE
```

Response:

```
CLOSED
OK
```

9.4. ESP32 as a TCP Server in Multiple Connections

When ESP32 works as a TCP server, multiple connections should be enabled; that is to say, there should be more than one client connecting to ESP32.

Below is an example showing how a TCP server is established when ESP32 works in the SoftAP mode. If ESP32 works as a Station, set up a server in the same way after connecting ESP32 to the router.

1. Set the Wi-Fi mode:

```
AT+CWMODE=3                                    // SoftAP+Station mode
```

Response:

```
OK
```

2. Enable multiple connections:

```
AT+CIPMUX=1
```

Response:

```
OK
```

3. Set up a TCP server:

```
AT+CIPSERVER=1                                 // default port = 333
```

Response:

```
OK
```

4. Connect the PC to the ESP32 SoftAP:

5. Using a network tool on PC to create a TCP client and connect to the TCP server that ESP created.

> ⚠ ***Notice:***
>
> *When ESP32 works as a TCP server, there is a timeout mechanism. If the TCP client is connected to the ESP32 TCP server, while there is no data transmission for a period of time, the server will disconnect from the client. To avoid such a problem, please set up a data transmission cycle every two seconds.*

6. Send data:

```
                                // ID number of connection is defaulted to be 0
AT+CIPSEND=0,4                  // send 4 bytes to connection NO.0
>TEST                          // enter the data, no CR
```

Response:

```
SEND OK
```

> ⚠ ***Notice:***
>
> - *If the number of bytes inputted are more than the size defined (n):*
>   - *the system will reply busy, and send the first n bytes.*
>   - *and after sending the first n bytes, the system will reply SEND OK.*

7. Receive data:

```
+IPD,0,n:xxxxxxxxxx         // received n bytes, data = xxxxxxxxxx
```

8. Close the TCP connection:

```
AT+CIPCLOSE=0               // delete NO.0 connection
```

Response:

```
0,CLOSED
OK
```

9.5. BLE AT Examples

9.5.1. iBeacon Examples

The following demonstrates two examples of iBeacon:

- ESP32 advertising iBeacons, which can be discovered by the “Shake Nearby” function of WeChat.
- ESP32 scanning iBeacons.

Table 9-1. iBeacon Frame

Type	Length (byte)	Description
iBeacon prefix	9	02 01 06 1A FF 4C 00 02 15
Proximity UUID	16	Used to identify vendor
Major	2	Used to identify store
Minor	2	Used to identify the location of a specific Beacon within a store
TX power	1	Used to calculate the distance between the ESP32 device and the phone

9.5.1.1. ESP32 Device Advertising iBeacons

1. Initialize the role of the ESP32 device as a BLE server:

```
AT+BLEINIT=2                                    // server role
```

Response:

```
OK
```

2. Start advertising.

Configure the parameters of the advertisement as Table 9-2 shows:

Table 9-2. iBeacon Advertisement Example

Type	Content
iBeacon prefix	02 01 06 1A FF 4C 00 02 15
Proximity UUID	FDA50693-A4E2-4FB1-AFCF-C6EB07647825
Major	27 B7
Minor	F2 06
TX power	C5

The AT command should be as below:

```
AT+BLEADVDATA="0201061aff4c000215fda50693a4e24fb1afcfc6eb0764782527b7f206c5"
```

Response:

```
OK
```

Start advertising:

```
AT+BLEADVSTART
```

Response:

```
OK
```

Open WeChat on your mobile phone and then select “Shake Nearby” to discover the ESP32 device that is advertising, as shown in Figure 9-1.

Figure 9-1. “Shake Nearby” on WeChat

9.5.1.2. ESP32 Device Scanning for iBeacons

Not only can the ESP32 device transmits iBeacons, but it can also work as a BLE client that scans for iBeacons and gets the advertisement data which can then be parsed by the host MCU.

> ⚠ ***Notice:***
>
> *If the ESP32 device has already been initialized as a BLE server, you need to call AT+BLEINIT=0 to de-init it first, and then re-init it as a BLE client.*

1. Initialize the role of the ESP32 device as a BLE client:

```
AT+BLEINIT=1                            // client role
```

Response:

```
OK
```

2. Enable a scanning for three seconds:

```
AT+BLESCAN=1,3
```

Response:

```
OK
```

You will get a scanning result that looks like:

```
+BLESCAN:
24:0a:c4:02:10:0e,-33,0201061aff4c000215fda50693a4e24fb1afcfc6eb0764782527b7f206c5,

+BLESCAN:24:0a:c4:01:4d:fe,-74,02010207097a4f68664b43020aeb051220004000,

+BLESCAN:
24:0a:c4:02:10:0e,-33,0201061aff4c000215fda50693a4e24fb1afcfc6eb0764782527b7f206c5,
```

The result shows the advertisement that has been configured in Section 9.5.1.1. Then, the host MCU can parse the data whose frame is shown in Table 9-1.

9.5.2. BLE Communication Examples

9.5.2.1. Basic Communication

Below is an example of using two ESP32 modules, one as a BLE server (hereafter named "ESP32 Server") and the other one as a BLE client (hereafter named "ESP32 Client"). The example shows how to use BLE functions with AT commands.

> ⚠ ***Notice:***
>
> *The ESP32 Server needs to download a "service bin" into Flash to provide BLE services.*
>
> - *To learn how to generate a "service bin", please refer to esp32-at/tools/readme.md.*
> - *The download address of the "service bin" is the address of "ble_data" in esp32-at/at_customize.csv.*

1. BLE initialization:

- ESP32 Server:

```
AT+BLEINIT=2                                // server role
```

Response:

```
OK
```

- Create services.

```
AT+BLEGATTSSRVCRE
```

Response:

```
OK
```

- Start services.

```
AT+BLEGATTSSRVSTART
```

Response:

```
OK
```

- ESP32 Client:

```
AT+BLEINIT=1                                    // client role
```

Response:

```
OK
```

2. Establish BLE connection:

- ESP32 Server:
  - Query the BLE address. For example, if the address is "24:0a:c4:03:f4:d6".

```
AT+BLEADDR?                                    // get server's BLE address
```

Response:

```
+BLEADDR:24:0a:c4:03:f4:d6
OK
```

  - Configure parameters of advertisements. This is optional, though. If you do not configure the parameters of advertisements, default parameters will be applied.

```
AT+BLEADVPARAM=32,64,0,0,7
```

Response:

```
OK
```

  - Configure advertisement data:

```
AT+BLEADVDATA="0201060B094573707265737369660303 02A0"

/*  The adv data is
 *  02 01 06  //<length>,<type>,<data>
 *  0A 09 457370726573736966 //<length>,<type>,<data>
 *  03 03 02A0  //<length>,<type>,<data>
*/
```

Response:

```
OK
```

If you do not configure the advertisement data, then the payload will be empty when scanned.

You can also configure the response data of the scanning (ScanRspData):

```
AT+BLESCANRSPDATA="0201060B094573707265737369660303 02A0"


OK
```

The ScanRspData can be discovered in an active scan.

  - Start advertising.

```
AT+BLEADVSTART
```

Response:

```
OK
```

- ESP32 Client:
  - Configure the scanning parameters. This is optional, though. For example, in the active-scan mode, the command is as follows:

```
AT+BLESCANPARAM=1,0,0,100,50
```

Response:

```
OK
```

  - Start scanning.

```
AT+BLESCAN=1,3
```

Response:

```
+BLESCAN:<BLE address>,<rssi>,<adv_data>,<scan_rsp_data>
OK
```

  - Establish the BLE connection, when the server is scanned successfully.

```
AT+BLECONN=0,"24:0a:c4:03:f4:d6"
```

Response:

```
OK
+BLECONN:0,"24:0a:c4:03:f4:d6"
```

> 📖 ***Notes:***
>
> - *If the BLE connection is established successfully, it will prompt* `+BLECONN:<conn_index>,<remote_BLE_address>`
> - *If the BLE connection is broken, it will prompt* `+BLEDISCONN:<conn_index>,<remote_BLE_address>`

  - Update the connection parameters:

```
AT+BLECONNPARAM=0,30,30,0,600


OK
```

You can also query the result:

```
AT+BLECONNPARAM?
+BLECONNPARAM:0,30,30,30,0,600


OK
```

  - Set the Maximum Transmission Unit (MTU)

The client can initiate an Exchange MTU Request after the connection has been established:

```
AT+BLECFGMTU=0,200


OK
```

You can also query the result:

```
AT+BLECFGMTU?
+BLECFGMTU:0,200


OK
```

3. Read/Write a characteristic:

- ESP32 Server:
  - Discover local services.

```
AT+BLEGATTSSRV?
```

Response:

```
+BLEGATTSSRV:1,1,0xA002,1


OK
```

  - Discover characteristics.

```
AT+BLEGATTSCHAR?
```

Response:

```
+BLEGATTSCHAR:"char",1,1,0xC300
+BLEGATTSCHAR:"desc",1,1,1
+BLEGATTSCHAR:"char",1,2,0xC301
+BLEGATTSCHAR:"desc",1,2,1
+BLEGATTSCHAR:"char",1,3,0xC302
+BLEGATTSCHAR:"desc",1,3,1

OK
```

- ESP32 Client:
  - Discover services:

```
AT+BLEGATTCPRIMSRV=0
```

Response:

```
+BLEGATTCPRIMSRV:0,1,0x1801,1
+BLEGATTCPRIMSRV:0,2,0x1800,1
+BLEGATTCPRIMSRV:0,3,0xA002,1

OK
```

> ⚠ ***Notice:***
>
> - *When discovering services, the ESP32 Client will get two more default services (UUID:0x1800 and 0x1801) than what the ESP32 Server will get.*
> - *So, for the same service, the <srv_index> received by the ESP32 Client equals the <srv_index> received by ESP32 Server + 2.*
> - *For example, the <srv_index> of the above-mentioned service, 0xA002, is 3 when the ESP32 Client is in the process of discovering services. But if the ESP32 Server tries to discover it with command* `AT+BLEGATTSSRV?`*, the <srv_index> will be 1.*

- Discover characteristics.

```
AT+BLEGATTCCHAR=0,3
```

Response:

```
+BLEGATTCCHAR:"char",0,3,1,0xC300,2
+BLEGATTCCHAR:"desc",0,3,1,1,0x2901
+BLEGATTCCHAR:"char",0,3,2,0xC301,2
+BLEGATTCCHAR:"desc",0,3,2,1,0x2901
+BLEGATTCCHAR:"char",0,3,3,0xC302,8
+BLEGATTCCHAR:"desc",0,3,3,1,0x2901
+BLEGATTCCHAR:"char",0,3,4,0xC303,4
+BLEGATTCCHAR:"desc",0,3,4,1,0x2901
+BLEGATTCCHAR:"char",0,3,5,0xC304,8
+BLEGATTCCHAR:"char",0,3,6,0xC305,16
+BLEGATTCCHAR:"desc",0,3,6,1,0x2902
+BLEGATTCCHAR:"char",0,3,7,0xC306,32
+BLEGATTCCHAR:"desc",0,3,7,1,0x2902

OK
```

- Read a characteristic. Please note that the target characteristic's properties have to include the read operation.

```
AT+BLEGATTCRD=0,3,1
```

Response:

```
+BLEGATTCRD:0,1,30

OK
```

> 📖 ***Note:***
>
> *If the ESP32 Client reads the characteristic successfully, message* `+READ:<conn_index>,<remote BLE address>` *will be prompted on the ESP32 Server side.*

- Write a characteristic. Please note that the target characteristic's properties have to include the write operation.

```
AT+BLEGATTCWR=0,3,3,,2
```

Response:

```
>           // waiting for data
OK
```

> 📖 ***Note:***
>
> *If the ESP32 Client writes the characteristic successfully, message* `+WRITE:<conn_index>,<srv_index>,<char_index>,[<desc_index>],<len>,<value>` *will be prompted on the ESP32 Server side.*

4. Notify of a characteristic:

- ESP32 Client:
  - Configure the characteristic's descriptor. Please note that the target characteristic's properties have to include notifications.

```
AT+BLEGATTCWR=0,3,6,1,2
```

Response:

```
>           // waiting for data, should input HEX string "01" here
OK
```

> 📖 ***Note:***
>
> *If the ESP32 Client writes the descriptor successfully, message* `+WRITE:<conn_index>,<srv_index>,<char_index>, <desc_index>,<len>,<value>` *will be prompted on the ESP32 Server side.*

- ESP32 Server:
  - Notify of a characteristic. Please note that the target characteristic's properties have to include notifications.

```
AT+BLEGATTSNTFY=0,1,6,3
```

Response:

```
>           // waiting for data
OK
```

> 📖 ***Note:***
>
> - *If the ESP32 Client receives the notification, it will prompt message* `+NOTIFY:<conn_index>,<srv_index>,<char_index>, <len>,<value>.`
> - *For the same service, the <srv_index> on the ESP32 Client side equals the <srv_index> on the ESP32 Server side + 2.*

5. Indicate a characteristic:

- ESP32 Client:

- Configure the characteristic's descriptor. Please note that the target characteristic's property has to support the indicate operation.

```
AT+BLEGATTCWR=0,3,7,1,2
```

Response:

```
>           // waiting for serial data, should input HEX string "02" here
OK
```

> 📖 ***Note:***
>
> *If the ESP32 Client writes the descriptor successfully, message* `+WRITE:<conn_index>,<srv_index>,<char_index>, <desc_index>,<len>,<value>` *will be prompted on the ESP32 Server side.*

- ESP32 Server:
  - Indicate characteristic. Please note that the target characteristic's property has to support the indicate operation.

```
AT+BLEGATTSIND=0,1,7,3
```

Response:

```
>           // waiting for serial data
OK
```

> 📖 ***Note:***
>
> - *If the ESP32 Client receives the indication, it will prompt message* `+INDICATE:<conn_index>,<srv_index>,<char_index>, <len>,<value>`
> - *For the same service, the <srv_index> on the ESP32 Client side equals the <srv_index> on the ESP32 Server side + 2.*

9.5.2.2. UART-BLE Passthrough Mode

Below is an example of using two ESP32 modules: one as a BLE server (hereafter named as "ESP32 Server") and the other one as a BLE client (hereafter named as "ESP32 Client"). The example shows how to build BLE SPP (Serial Port Profile, UART-BLE passthrough mode) with AT commands.

> ⚠ ***Notice:***
>
> *Download the service bin into the flash of the ESP32 Server.*
>
> - *On how to generate a service bin, please refer to esp32-at/tools/readme.md.*
> - *The download address of the "service bin" is the address of "ble_data" in esp32-at/at_customize.csv.*

1. BLE initialization:

- ESP32 Server:
  - BLE server initialization:

```
AT+BLEINIT=2                                // server role
```

Response:

```
OK
```

- Create services:

```
AT+BLEGATTSSRVCRE
```

Response:

```
OK
```

- Start services:

```
AT+BLEGATTSSRVSTART
```

Response:

```
OK
```

- ESP32 Client:

```
AT+BLEINIT=1                                    // client role
```

Response:

```
OK
```

2. Establish BLE connection:

- ESP32 Server:
  - Query the BLE address. The following section takes "24:0a:c4:03:f4:d6" as a example.

```
AT+BLEADDR?                                    // get server's BLE address
```

Response:

```
+BLEADDR:24:0a:c4:03:f4:d6
OK
```

  - Configure advertisement data (optional). Without the configuration, the payload of the broadcasting packet will be empty.

```
AT+BLEADVDATA="0201060B094573707265737366966030302A0"

/*  The adv data is
 *  02 01 06  //<length>,<type>,<data>
 *  0A 09 457370726573736966 //<length>,<type>,<data>
 *  03 03 02A0  //<length>,<type>,<data>
*/
```

Response:

```
OK
```

- Start advertising.

```
AT+BLEADVSTART
```

Response:

```
+BLEADDR:24:0a:c4:03:f4:d6
OK
```

- ESP32 Client:
  - Start scanning:

```
AT+BLESCAN=1,3
```

Response:

```
+BLESCAN:<BLE address>,<rssi>,<adv_data>,<scan_rsp_data>
OK
```

- Establish the BLE connection, after the server is scanned successfully.

```
AT+BLECONN=0,"24:0a:c4:03:f4:d6"
```

Response:

```
OK
+BLECONN:0,"24:0a:c4:03:f4:d6"
```

> 📖 ***Notes:***
>
> - *If the BLE connection is established successfully, the message* `+BLECONN:<conn_index>,<remote_BLE_address>` *will appear.*
> - *If the BLE connection is broken, the message* `+BLEDISCONN:<conn_index>,<remote_BLE_address>` *will appear.*

3. Discover Services:

- ESP32 Server:
  - Discover local services.

```
AT+BLEGATTSSRV?
```

Response:

```
+BLEGATTSSRV:1,1,0xA002,1


OK
```

- Discover characteristics:

```
AT+BLEGATTSCHAR?
```

Response:

```
+BLEGATTSCHAR:"char",1,1,0xC300
+BLEGATTSCHAR:"desc",1,1,1
+BLEGATTSCHAR:"char",1,2,0xC301
+BLEGATTSCHAR:"desc",1,2,1
+BLEGATTSCHAR:"char",1,3,0xC302
+BLEGATTSCHAR:"desc",1,3,1

OK
```

- ESP32 Client:
  - Discover services:

```
AT+BLEGATTCPRIMSRV=0
```

Response:

```
+BLEGATTCPRIMSRV:0,1,0x1801,1
+BLEGATTCPRIMSRV:0,2,0x1800,1
+BLEGATTCPRIMSRV:0,3,0xA002,1

OK
```

> ⚠ ***Notice:***
>
> - *When discovering services, the ESP32 Client will get two more default services (UUID:0x1800 and 0x1801) than what the ESP32 Server will get.*
> - *So, for the same service, the <srv_index> received by the ESP32 Client equals the <srv_index> received by ESP32 Server plus 2.*
> - *For example, the <srv_index> of the above-mentioned service, 0xA002, is 3 when the ESP32 Client is in the process of discovering services. But if the ESP32 Server tries to discover it with command* `AT+BLEGATTSSRV?`*, the <srv_index> will be 1.*

  - Discover characteristics.

```
AT+BLEGATTCCHAR=0,3
```

Response:

```
+BLEGATTCCHAR:"char",0,3,1,0xC300,2
+BLEGATTCCHAR:"desc",0,3,1,1,0x2901
+BLEGATTCCHAR:"char",0,3,2,0xC301,2
+BLEGATTCCHAR:"desc",0,3,2,1,0x2901
+BLEGATTCCHAR:"char",0,3,3,0xC302,8
+BLEGATTCCHAR:"desc",0,3,3,1,0x2901
+BLEGATTCCHAR:"char",0,3,4,0xC303,4
+BLEGATTCCHAR:"desc",0,3,4,1,0x2901
+BLEGATTCCHAR:"char",0,3,5,0xC304,8
+BLEGATTCCHAR:"char",0,3,6,0xC305,16
+BLEGATTCCHAR:"desc",0,3,6,1,0x2902
+BLEGATTCCHAR:"char",0,3,7,0xC306,32
+BLEGATTCCHAR:"desc",0,3,7,1,0x2902
```

```
OK
```

4. Configure BLE SPP:

- ESP32 Client:
  - Set a characteristic that enables writing permission to TX channel for sending data. Set another characteristic that supports notification or indication to RX channel for receiving data.

```
AT+BLESPPCFG=1,3,5,3,7
```

Response:

```
OK
```

  - Enable BLE SPP:

```
AT+BLESPP
```

Response:

```
OK
>                   // waiting for serial data
```

> 📖 ***Note:***
>
> *After ESP32 Client enabling BLE SPP, data received from serial port will be transmitted to the BLE server directly.*

- ESP32 Server:
  - Set a characteristic that supports notification or indication to TX channel for sending data. Set another characteristic that enables writing permission to RX channel for receiving data.

```
AT+BLESPPCFG=1,1,7,1,5
```

Response:

```
OK
```

  - Enable BLE SPP:

```
AT+BLESPP
```

Response:

```
OK
>                   // waiting for serial data
```

> 📖 ***Notes:***
>
> - *After ESP32 Server enables BLE SPP, the data received from serial port will be transmitted to the BLE client directly.*
> - *If the ESP32 Client does not enable BLE SPP first, or uses other device as BLE client, then the BLE client needs to listen to the notification or indication first. For example, if the ESP32 Client does not enable BLE SPP first, then it should enable listening with command AT+BLEGATTCWR=0,3,7,1,1 first for the ESP32 Server to transmit successfully.*
> - *For the same service, the <srv_index> on the ESP32 Client side equals the <srv_index> on the ESP32 Server side plus 2.*

9.5.2.3. Usage Scenarios

1. Bluetooth networking

BLE can be used to transfer the Wi-Fi SSID and Password in a Bluetooth network.

- Use `AT+BLEGATTCWR` for the client to pass on the SSID and password to the server.
- Use `AT+BLEGATTSNTFY` for the server to pass on the SSID and password to the client.

Details can be found in Section 9.5.2.1.

2. Transparent data transmission

The ESP32 AT does not support transparent data transmission over BLE for the time being. However, users can use that basic data-transmission method to simulate the transparent data transmission process where Host MCU can filter the data information.

- Call `AT+BLEGATTCWR` continuously for the client to transfer data to the server.
- Call `AT+BLEGATTSNTFY` continuously for the server to transfer data to the client.

Details can be found in Section 9.5.2.1.

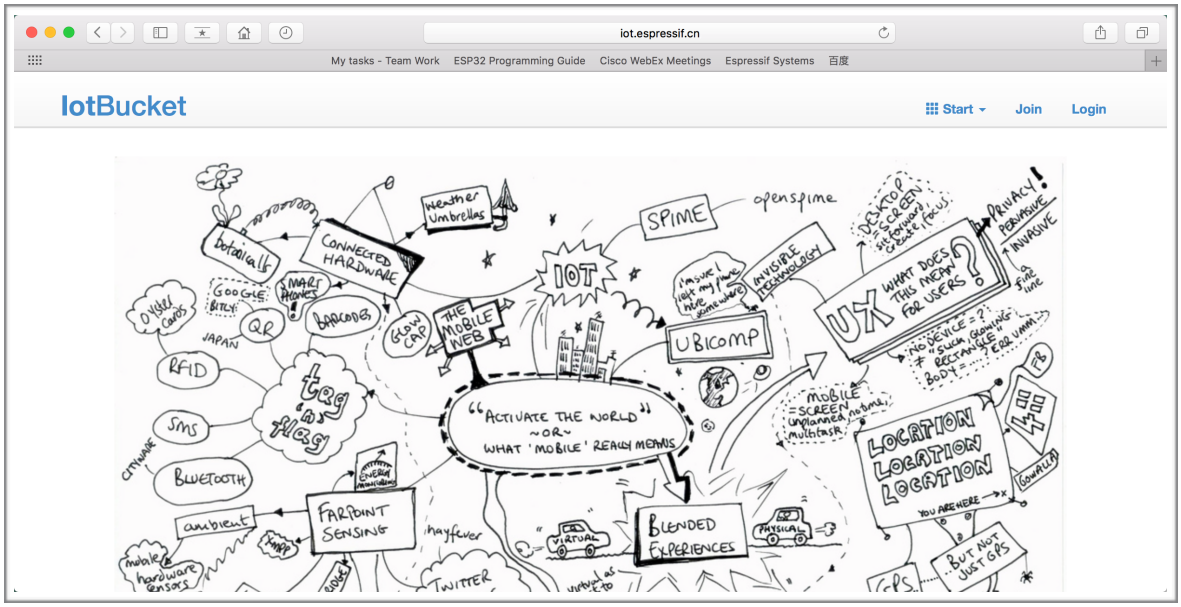
3. OTA firmware upgrade

OTA firmware upgrade can also be implemented over BLE.

10. OTA Update

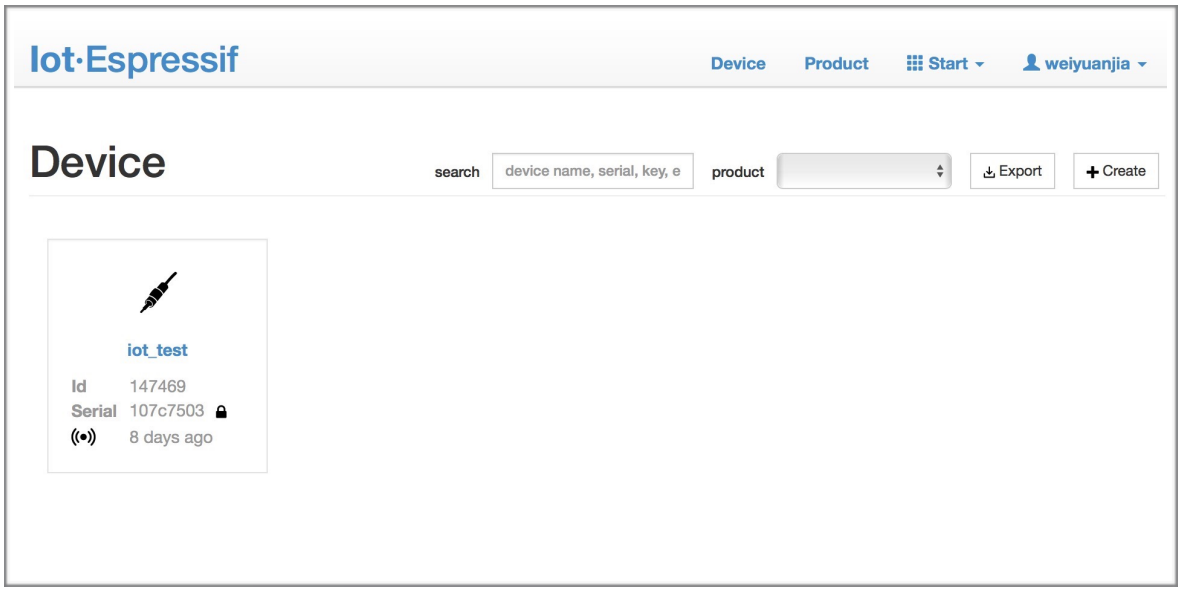
The following steps guide the users in creating a device on *iot.espressif.cn* and updating the OTA BIN on it.

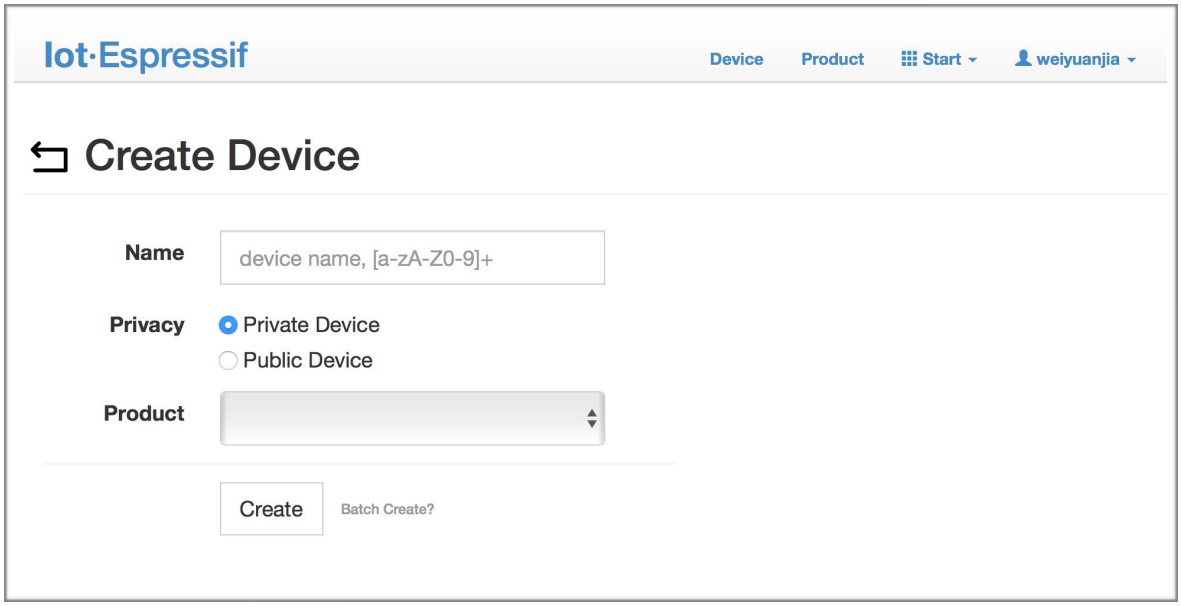
1. Open the website *iot.espressif.cn*. If using SSL OTA, it should be *https://iot.espressif.cn*.



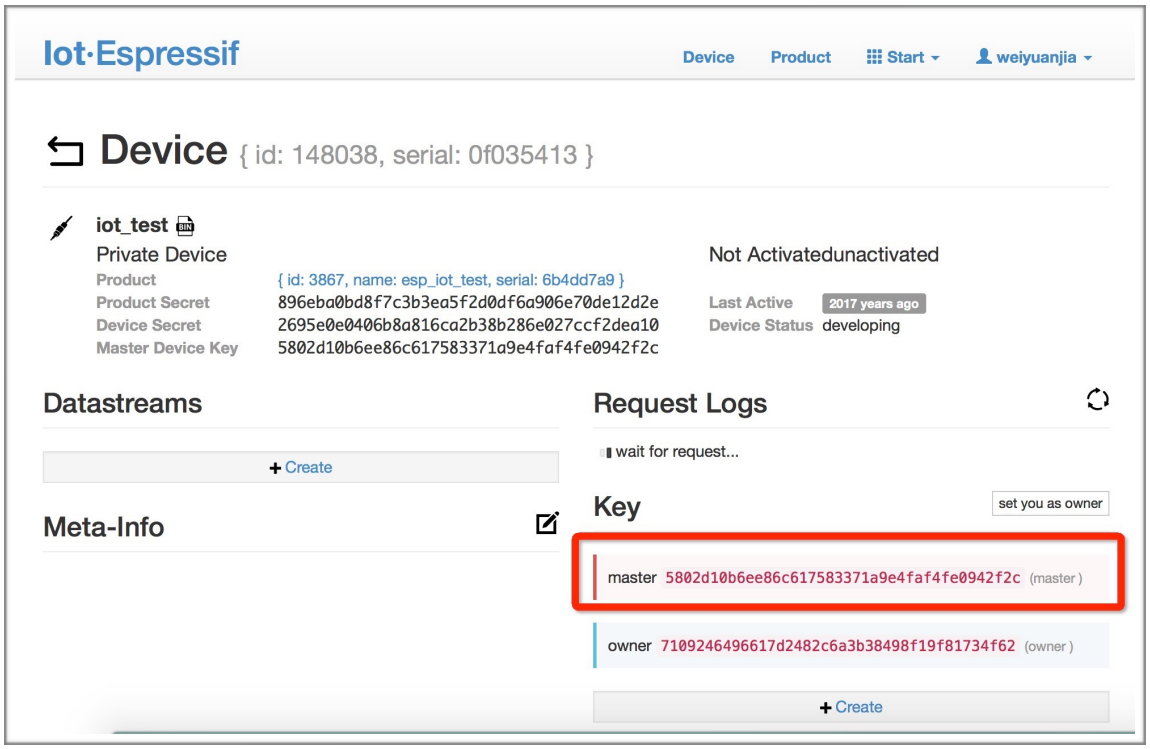
2. Click "Join" in the upper right corner of the webpage, and enter your name, email address, and password.

3. Click on "Device" in the upper right corner of the webpage, and click on "Create" to create a device.

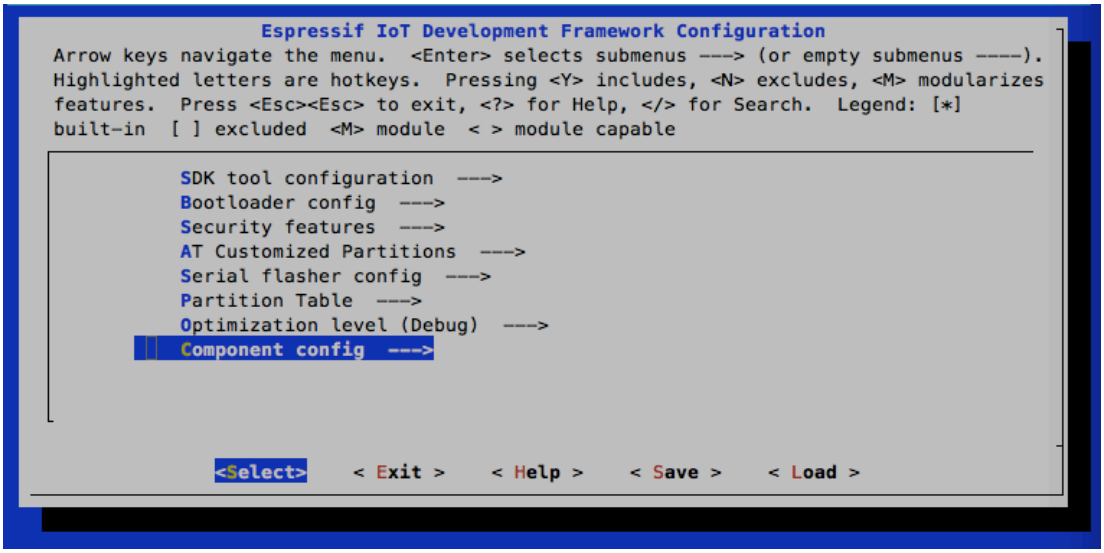


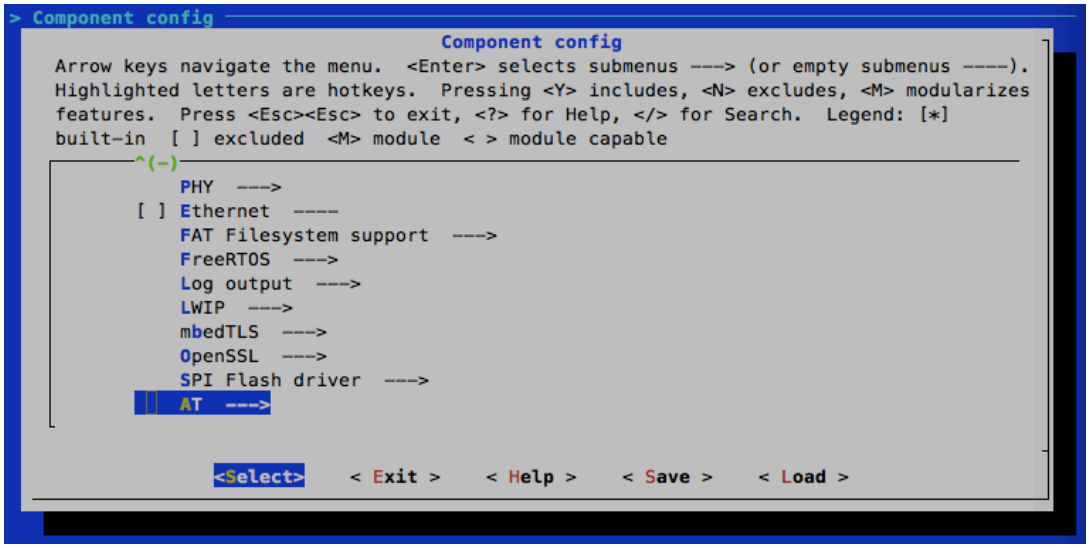


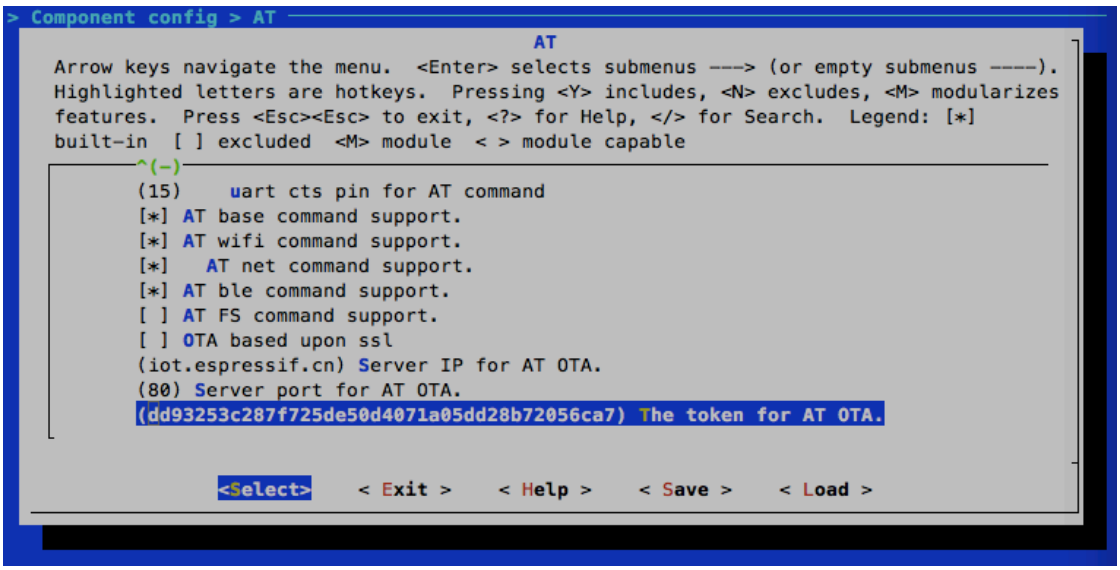
4. A key is generated when the device is successfully created, as the figure below shows.



5. Use the key to compile your own OTA BIN. The process of configuring the AT OTA token key is as follows:

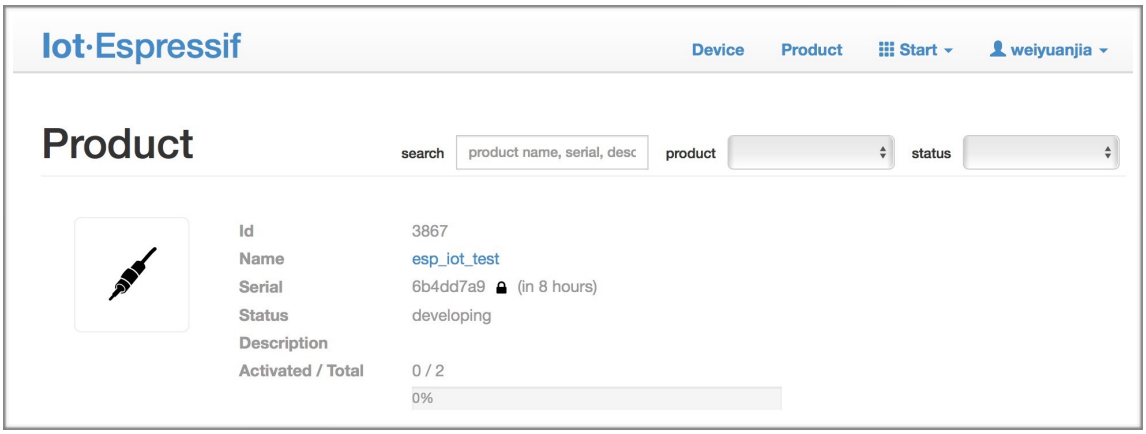


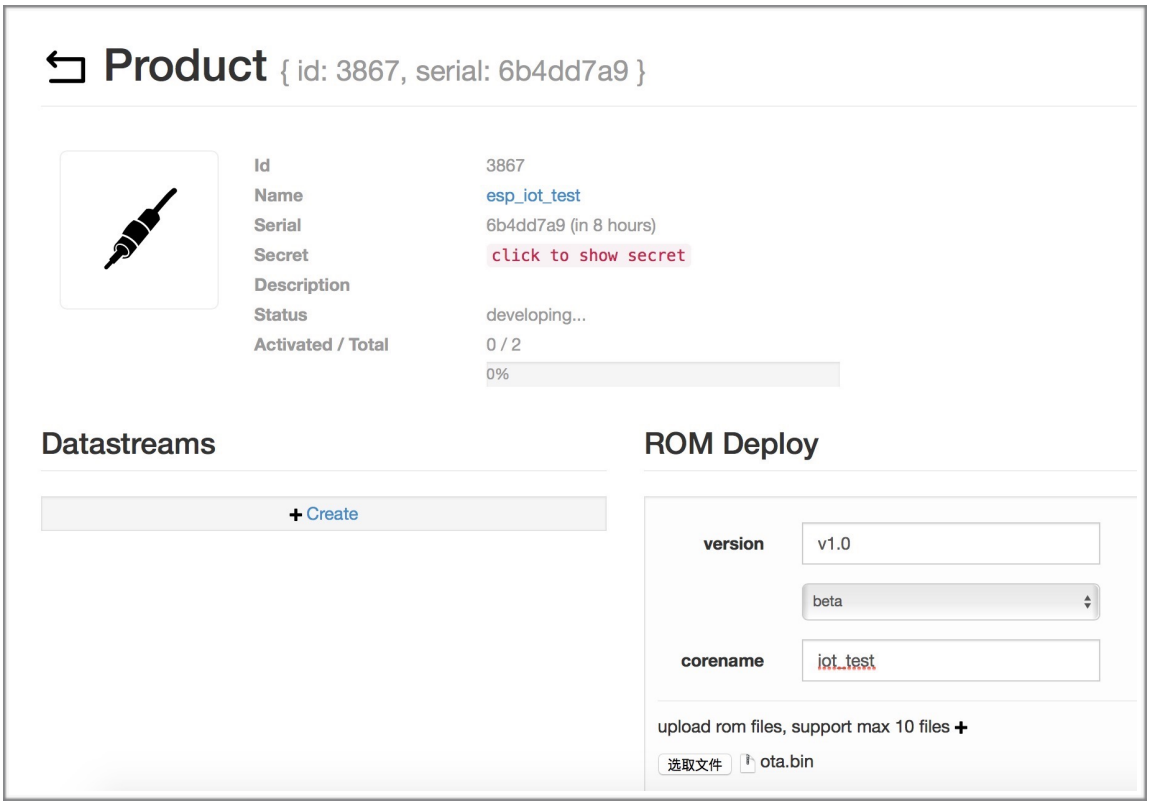




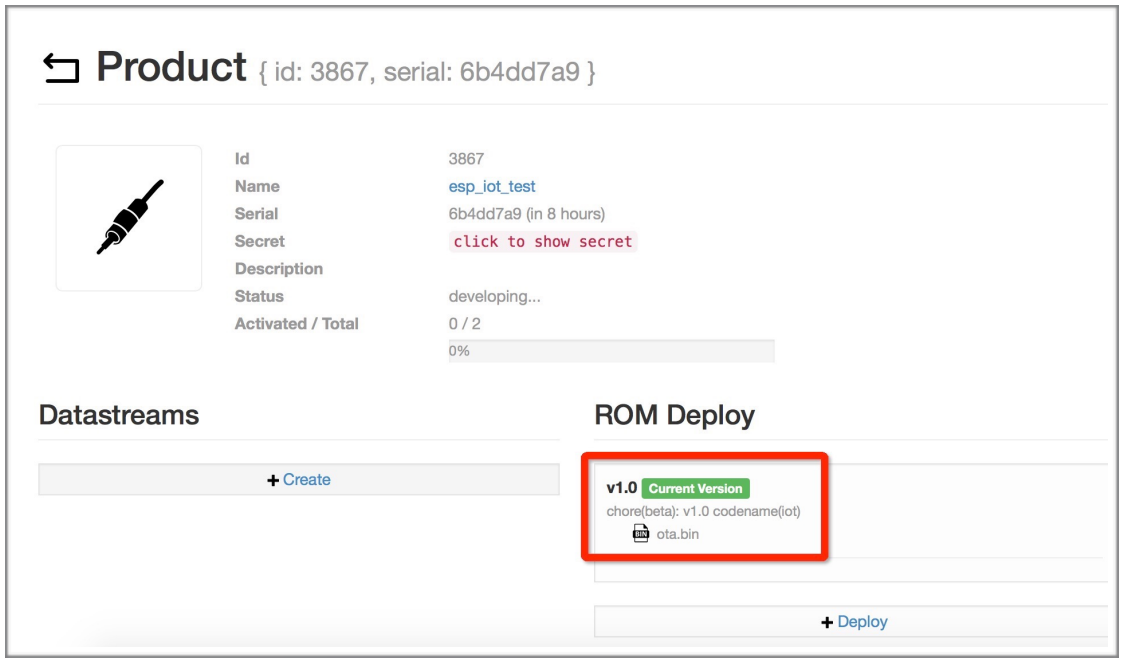
> ⚠ ***Notice:***
>
> *If using SSL OTA, the option "OTA based upon ssl" should be selected.*

6. Click on "Product" to enter the webpage, as shown below. Click on the device created. Enter version and corename under "ROM Deploy". Rename the BIN compiled in Step 5 as "ota.bin" and save the configuration.





7. Click on the ***ota.bin*** to save it as the current version.

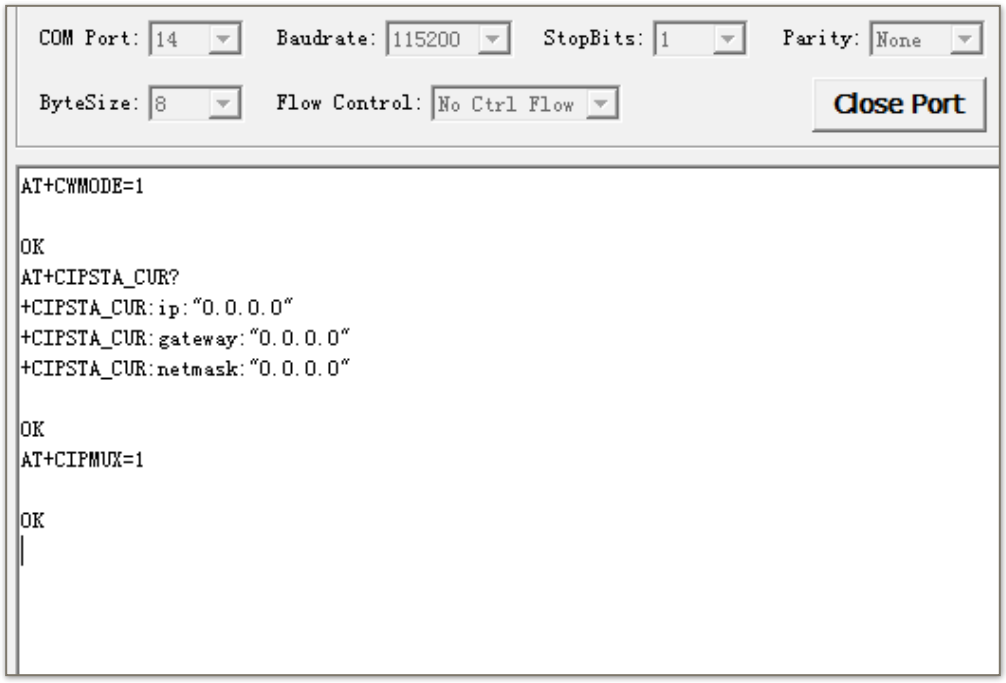


8. Run the command `AT+CIUPDATE`. If the network is connected, OTA update w.

11. Q & A

If you have any questions about the execution of AT commands, please contact us via *Espressif Technical Inquiries*. Please describe the issues that you might encounter, including any relevant details, as follows:

- AT Version information or AT Command: You can use command `AT+GMR` to acquire information on your current AT command version.
- Hardware Module information: for example, ESP-WROOM-32.
- Screenshot of the test steps, for example:



- If possible, please provide the printed log information, such as:

```
Guru Meditation Error of type StoreProhibited occurred on core   0. Exception was unhandled.
Register dump:
PC      :  40135735  PS      :  00060f30  A0      :  800f913b  A1      :  3ffd66c0
A2      :  00000000  A3      :  3ffd6828  A4      :  00000b68  A5      :  b33f0000
A6      :  b33fffff  A7      :  3ffb004c  A8      :  00000003  A9      :  3ffd66a0
A10     :  3ffd6828  A11     :  00000b69  A12     :  00060020  A13     :  3ffc2d30
A14     :  00000003  A15     :  00060023  SAR     :  00000000  EXCCAUSE:  0000001d
EXCVADDR:  00000038  LBEG    :  00000000  LEND    :  00000000  LCOUNT :  00000000
Rebooting...
```

Espressif IOT Team

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