RAK410-SPI Programming Manual

Version 2.2

Content

1. Overview

1.1 Module Introduction

RAK410 module is a Wi-Fi module that fully supports IEEE 802.11b/g/n wireless standards, with internally integrated TCP/IP protocol stack, supporting numerous protocols such as ARP, IP, ICMP, TCP, UDP, DHCP CLIENT, DHCP SERVER, HTTP, DNS, etc. The host communicates with module by AT commands via UART or SPI interface, facilitate user setting up network and sending/receiving data. Through SPI interface, the maximum transmission rate is up to 1.5Mbps. RAK410 also supports to store the parameters, automatically re-connection after reboot, reducing time consumption on networking. The RAK410module supports 5 power management modes, with power consumption as low as 0.5uA, completely realizing low-power design for customer.

1.2 Device Features

- Support IEEE 802.11b/g/n protocol
- Support UART/SPI Interface
- Maximum SPI clock requency:4MHZ
- Support AT commands
- Support Station Mode, Ad-hoc Mode and AP Mode
- Support DHCP SERVER/DHCP CLIENT
- Support OPEN, WEP, WPA-PSK, WPA2-PSK, WPS Encryptions
- Support TCP, UDP protocols, with maximum 8 UDP/TCP connections
- Support parameters store, automatically load parameters after reset
- Support parameters store in Deep Sleep State, with connection time as fastest as 300ms
- 5 kinds power working modes, with minimum power consumption as 0.5 uA
- Support webpage-based parameter configuration

2. SPI Interface

2.1. SPI Configuration

RAK410 as SPI Slave communicates with SPI Host; the maximum SPI clock frequency is up to 4MHZ. The configuration of SPI interface is as below:

CPOL (clock polarity) = 0----------SCK is idle in low level
CPHA (clock phase) = 0----------Data is latched on clock rising edge, while transmitted on clock falling edge

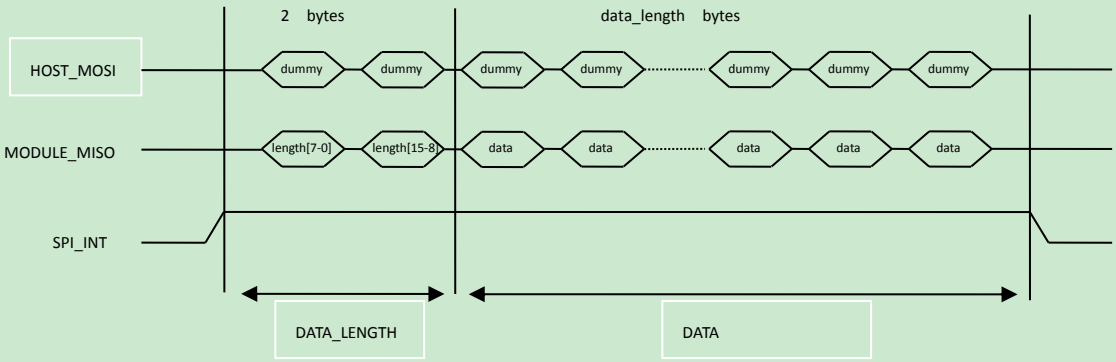
MSB_FIRST----------MSB is first sent
8 BIT MODE----------Data length is 8 bits
MODULE_CS----------Slave selective signal is active low

Hardware interface connections:

HOST_MOSI ---------->MODULE_MOSI
HOST_MISO <---------- MODULE_MISO
HOST_CS ---------->MODULE_CS
HOST_CLK ---------->MODULE_CLK
HOST_INT <---------- MODULE_INT

2.2. Interrupt Pin

Working as an extended pin of SPI interface, this pin is used to inform host that the module is sending data. After receiving this message by either interruption or reading the pin status, the host sends 2-byte blank data, meanwhile, the module returns 2-bytedata_length, then the host sends blank data in the length of data_length and gets the returned value, as shown in the following graph:

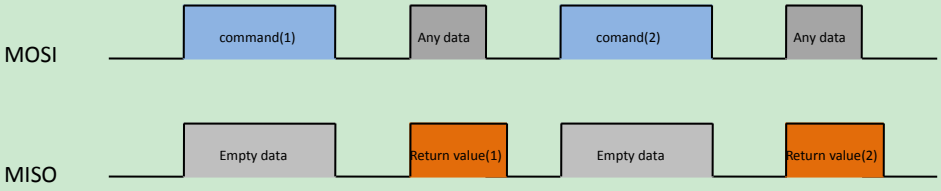


Data Format Sent

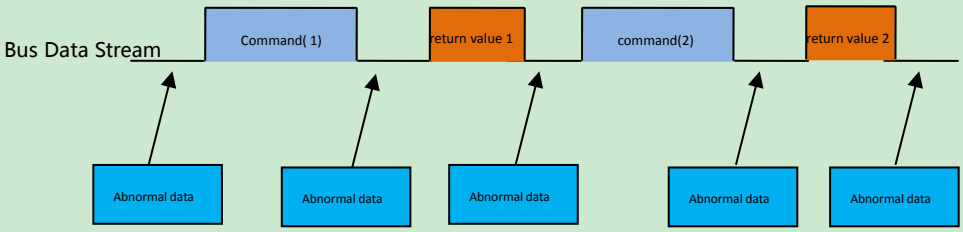
Data Length (2 bytes)	Data Block(data_length bytes)
data_length	data

2.3. Send and Receive Data

As a full-duplex interface, SPI bus can send and receive data simultaneously, while send commands and receive return value in simplex mode, in which way module receives commands without sending any valid data (all data is 0) and send the return value without receiving any data sent from the host, shown as the below figure:



If the module has otherabnormal data(wireless connection, disconnection,TCP disconnection, connection,wireless data,for more details, seeReceive Data) needs to be transmitted, the module will send abnormal datafirst, and thensend the return valuewhen it is receiving idleorhas receivedwaitcommand, shown as the below figure:



3. Initiate

The initiating time for RAK410 is about 210ms; if abnormal initiating occurs，the following output prompts:

ASCII------- Welcome to RAK410\r\n

HEX--------57 65 6C 63 6F 6D 65 20 74 6F 20 52 41 4B 34 31 30 0D 0A

4. Store Configuration Parameters

RAK410 supports storing user's parameters to Flash, including scanned information, passwords, IP addresses, and so on. After IP is configured, user can store these configurations by at+storeconfig.Whenat+storeenable=1, these parameters can be automatically loaded after module reboots.

Note:

If abnormal initiating occurs caused by parameter store error, user can enter BOOT mode by MCU_BOOT pin or by at+del_data command , then delete all parameters via command.

5. Power Management

5.1 Power Mode

RAK410 supports 5 power modes through configureat+pwrmode=<mode> as below:

Mode	Command	Parameter	Control part	Wireless part	Wake-Up Type	Min Power Consumption (AP)
0	at+pwrmode=	0	Normal_ Mode	Max_Perf	No need	100mA
1	at+pwrmode=	1	Sleep_Mo de	Power_Save	No need	20mA
2	at+pwrmode=	2	Sleep_Mo de	Shut_down	Command =at+wake _up	2mA
3	at+pwrmode=	3	Deep_Sle ep	Power_Save	Interrupt	3mA
4	at+pwrmode=	4	Deep_Sle ep	Shut_down	Interrupt	0.5uA

0)at+pwrmode=0----------Mode 0

Module works under the maximum performance, control part and wireless part are fully opened.

1)at+pwrmode=1----------Mode 1

Control part and wireless part can be switched into low consumption mode, module can however still receive and transmit data by command, yet lower module performance.

2)at+pwrmode=2----------Mode 2

In the current mode, module saves connection status to RAM, and shuts down the power of wireless part, then control part switches into low consumption. Module can receive commands, however, only *at+wake_up* is valid, any other command would cause fatal errors. If back to work, simply enters *at+wake_up*command to wake up module, then the module should switch into working mode rapidly.

3)at+pwrmode=3----------Mode 3

Control part enters into deep sleep, cannot respond to any command. However, wireless part keeps current connective status, and the module can be wakened up by either transmitting remote data or external interrupting pin (MCU_WAKE, rising edge is valid), then enters Mode 1, and works normally.

4)at+pwrmode=4----------Mode 4

When enters into this mode, module firstly saves current connective status to RAM, and shuts down the power of wireless part, then control part enters into deep state. In this state, module cannot respond to any command or wireless data, lowering consumption to minimum. The module can be wakened up by external interrupting pin (MCU_WAKE, rising edge is valid), and back to the power mode from sleep mode.

5.2 Power Mode Switch

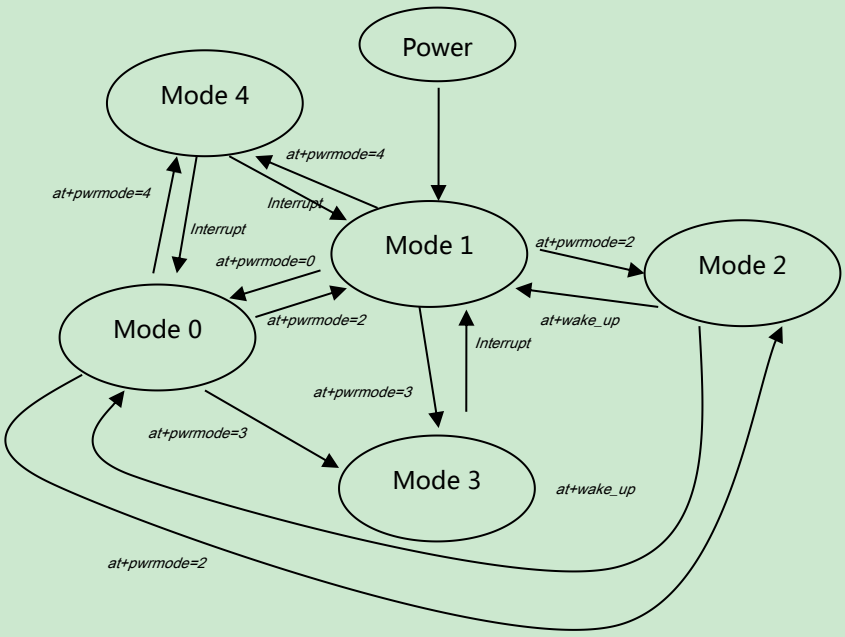
Mode 0---------Switch to any mode by enter corresponding command.

Mode 1--------- Switch to any mode by enter corresponding command.

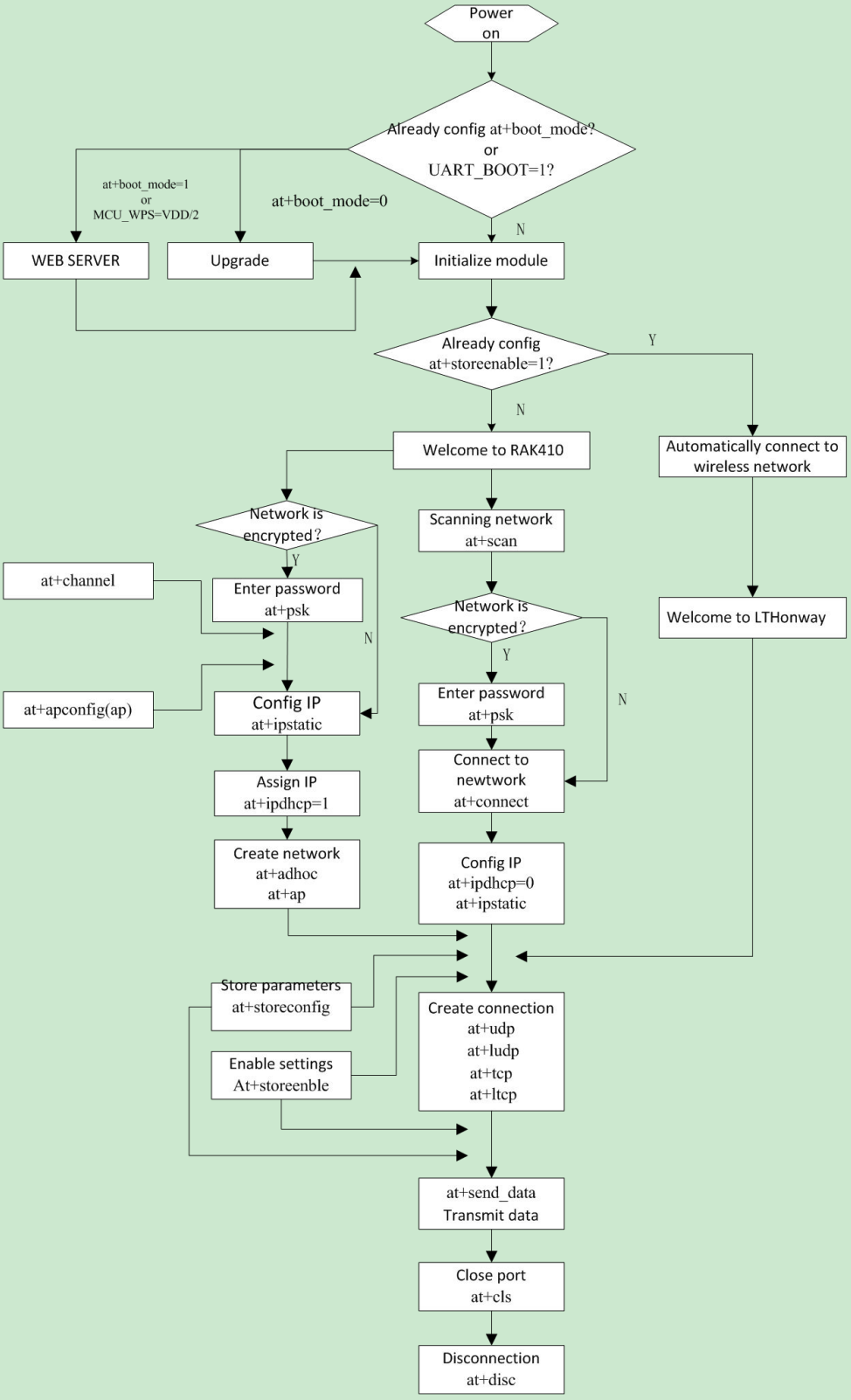
Mode 2--------Only *at+wake_up* command to wake up, then enter into the mode before

Mode 3--------Cannot enter any command, enter into Mode 1 by interrupt-way wakeup

Mode 4--------Cannot enter any command, enter into the mode before by interrupt-way wakeup



6. Module Commands Flow Chart



7. AT Command

RAK410 communicates with host through AT commands.

7.1. Command Format

Host to Module:
at+<command>=<parameter 1>,<parameter 2>,.....<paran>\r\n
All AT commands from host to module are ASICII, for example:
at+psk=lthonway\r\n
at+connect=LTHonway\r\n
After each command is executed, the module returns value to the host, the third byte of the return value is <code>, shown as below:

1) If executed successfully,
   0x00---------command is executed successfully
2) If data is received,
   0x01----------module received data successfully
   0x80----------TCP CLIENT is connected
   0x81----------TCP CLIENT is disconnected
3) If failed to executed, the returns
   <Error Code>------error code

AT Syntax description

1） AT command begins with “at+”(low case), and ends with \r\n”, maximum length is 80bytes, any other format is regard as error.
2） All parameters and commands returned are ASCII, and all the return value is hexadecimal.

Note:

All the AT syntax above is not applicable to data-receiving command at+send_data , for more information please refer to at+send_data.

7.2. Error Code

Code(HEX)	Description
-1	Input parameter error*(Parameter not recognized/Missing parameter/syntax is long/other illegal parameter)*
-2	Bad command error*(re-enter command)*
-10	System error*(re-enter command or reset module)*
-11	Fatal error*(Must reset module)*
Other	Refer to the specific command

7.3. Command Description

7.3.1. Scan Wireless Network

Command

at+scan=<channel>,<ssid>\r\n

Description

Scan wireless networks, capture wireless information, such as encrypted message, channel, signal intensity, BSSID, and so on.

Note:

If the network to be connected is encrypted, this command is mandatory; if the network is public, this command is optional.

Parameter description

The scan command contains two parameter, <channel> is the channel scanned, value range is 1-11, if value is set to 0, all channels are to be scanned, <ssid> is the assigned SSID, optional.

Note:

Specify the certain channel(s) can shorten scan time!

Parameter	Value	Description
<channel>	1-11	Scan the specified channel(s) (1-11), scan all channels if value is 0.
<ssid>	Service name	Specified SSID(optional)

Example:

at+scan=0 \r\n----------Scan all channels

at+scan=0,LTHonway\r\n----------Scan the service named "LTHonway" in all channels

at+scan=8,LTHonway\r\n----------Scan the service named "LTHonway" in channel 8

at+scan=6 \r\n----------Scan all the SSIDin channel 6

Return Value Description

If command executed successfully, OK is returned as well as the network number that scanned (maximum: 16). Use command at+get_scan to get network information.

Parameter	Format	Length(byte)	Description	
<Length[7:0]>	HEX	1	Length of 8-bit LSBs	
<Length[15:8]>	HEX	1	Length of 8-bit MSBs	
Command successful				
<Code>	HEX	1	=0	Network is scanned
<Scan Num>	HEX	1	Number of network scanned	
Command failed				
<Code>	HEX	1	0XFE=-2	1. cannot find available SSID

				2. cannot find specified SSID
Note				

7.3.2. Query Scanned Information

Command

at+get_scan=<scan_num>\r\n

Description

Get scanned information. Use this command afterat+scancommand.

Note:

1. *If no need to get wireless network information, this command can be omitted!*
2. *After all scanned information is got, if get again, error-2 will be returned , then command at+scan has to be execute!*

Parameter Description

<scan_num> scans the number of information scanned. If the value set is greater than the actual number of scanned information, then the actual number is returned.

Parameter	Value	Description
<scan_num>	> 0	Get the number of scanned information

Example:

at+get_scan=10\r\n----------Get 10 wireless network information

Return Value Description

Parameter	Format	Length (byte)	Description							
<Length[7:0]>	HEX	1	Length of 8-bit LSBs							
<Length[15:8]>	HEX	1	Length of 8-bit MSBs							
Command successful										
<Code>	HEX	1	=0	Get information correctly						
<SSID>	HEX	33	SSID							
<BSSID>	HEX	6	BSSID							
<CHANNEL>	HEX	1	Channel							
< RSSI>	HEX	1	Channel intensity (negative value)							
<Security Mode>	HEX	1	Way of encryption							
			bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
			WPA2	WPA	WEP	802.1X	PSK	WEP	TKIP	CCMP
Command failed										
<Code>	HEX	1	0XFE=-2				1. get all scanned information			

Note	*For <Security Mode>, bit=1 encryption is valid, bit=0 encryption is invalid. If multiple bits = 1 concurrently, hybrid encryption*

7.3.3. Set The Password

Command

at+psk=<passphrase>\r\n

Description

1.If module works in station mode, this command is used to enter network password. Module RAK410 supports WEP, WPA-PSK, WPA2-PSK and WPA-PSK+WPA2-PSK encryption methods, whereas WPA2-PSK and WPA2-PSK support TKIP, CCMP and TKIP+CCMP hybrid encryption method.

For WEP encryption, password must be either 5or 13ASCIIs, or 10 or 26 hexadecimals (0-9, a-f).

For WPA/WPA2 encryption, module RAK410 supports password types in ASCII with 8-63 characters long or 64 hexadecimals (0-9,a-f).

2.If module works in AP or Ad-hoc mode, this command is used to configure network password.

In AP mode, the encryption method is WAP2-PSK-CCMP by default, no other encryption is supported. Password type must be 8-63ASCIIs or 64 hexadecimals (0-9,a-f).

In Ad-hoc mode, the encryption method is WEP by default, no other encryption is supported. Password type must be 5 or 13ASCIIs, or 10 or 26 hexadecimals (0-9, a-f).

Note:

1. *If the network to be connected is OPEN, this command can be omitted!*
2. *Module RAK410 does not support comma (,) in the password.*

Parameter Description

Parameter	Value	Description
<passphrase>	Password	Enter or set password

Example:

at+psk=lthonway\r\n----------8-byte character password in WPA2 or WPA mode

at+psk=2a334e5d12\r\n---------10-byte hex password in WEP mode

Return Value Description

Parameter	Format	Length(byte)	Description	
<Length[7:0]>	HEX	1	Length of 8-bit LSBs	
<Length[15:8]>	HEX	1	Length of 8-bit MSBs	
Command successful				
<Code>	HEX	1	=0	Get information

				correctly
Command failed				
<Code>	HEX	1	See ERROR list	
Note				

7.3.4. Connect To The Wireless Network

Command

at+connect=<ssid>\r\n

Description

This command is used to connect to specified network. If the network password is not blank, only use this command after *at+scan* command and *at+psk* command. If the network password is blank, no *at+scan*command*and at+psk* command are needed.

Parameter Description

Maximum SSID is 32 bytes.

Parameter	Value	Description
<SSID>	SSID	The SSID to be connected is with maximum 32 in length

Example:

at+connect=LTHonway\r\n----------The network whose SSID is "LTHonway" isconnected

Return Value Description

Parameter	Format	Length(byte)	Description	
<Length[7:0]>	HEX	1	Length of 8-bit LSBs	
<Length[15:8]>	HEX	1	Length of 8-bit MSBs	
Command successful				
<Code>	HEX	1	=0	Connected to specified network
Command failed				
<Code>	HEX	1	0XFE=-2	No SSID is found
<Code>	HEX	1	0XFD=-3	Connection is failed
Note				

7.3.5. Connect To The Network by WPS

Command

at+wps=<mode>,<pin>\r\n

Description

This command is used to enable module WPS function by 3 ways:

1. Through WPS pin; If pin receives the failing edge, the WPS function is enabled, simultaneously the serial port outputs *at+wps=push\r\n*command, waiting module for pushing WPS. The maximum wait timeout is 2 minutes.
2. Enter *at+wps=push\r\n* command, waiting module for pushing WPS. The maximum wait timeout is 2 minutes.
3. Enter *at+wps=pin,<pin code>\r\n*command, enter < *pin code* >in the router configuration page to set connection. The maximum wait timeout is 2 minutes.

Note: it is only effective in Station mode.

Parameter Description

Parameter	Value	Description
<mode>	=push	Connection mode is push
	=pin	Enter PIN code to connect
<pin code>	8ASCII	PIN code (valid when <mode>=pin)

Return Value Description

Parameter	Format	Length(byte)	Description	
<Length[7:0]>	HEX	1	Length of 8-bit LSBs	
<Length[15:8]>	HEX	1	Length of 8-bit MSBs	
Command successful				
<Code>	HEX	1	=0	Wireless network is connected
<SSID>	HEX	33	SSID	
<Security Mode>	HEX	1	Way of encryption	
			bit7 bit6 bit5 bit4 bit3 bit2 bit1 bit0	
			WPA2 WPA WEP NONE	
<Password>	HEX	65	password	
\r\n	ASCII	2	End mark	
Command failed				
<CODE>	HEX	1	0XFD=-3	1.WPS waiting times out
			0XFC =-4	2.Invalid information
			0XFB =-5	3.Multiple PBC sessions
			0XFA =-6	4.Walktimer Timeout
			0XF9 =-7	5.M2D RCVD
			0XF8 =-8	6.Unknown error
Note	*For <Security Mode>, bit=1 encryption is valid; bit=0 encryption is invalid.*			

7.3.6. Query Wireless Network Connection Status

Command

at+con_status\r\n

Description

This command is used to get current wireless network status.

If the modules work in AP mode, this command is used to query the device's connection status.

Parameter Description

N/A

Return Value Description

Parameter	Format	Length(byte)	Description	
<Length[7:0]>	HEX	1	Length of 8-bit LSBs	
<Length[15:8]>	HEX	1	Length of 8-bit MSBs	
Command successful				
<Code>	HEX	1	=0	Wireless network is connected
Command failed				
<Code>	HEX	1	=-2	No wireless network
Note				

7.3.7. SetTheBeacon Frame Interval

Command

at+listen=<listen interval>\r\n

Description

This command is used to set beacon frame interval in Station mode.

Note:

In power saving mode, module can reduce power consumption by increase parameter value, however, a delay occurs when module receives wireless data!

Parameter Description

Parameter	Value	Description
<listen interval>	20-1000	For detailed parameters, see wireless router configuration.

Return Value Description

Parameter	Forma	Length(	Description

	t	byte)		
<Length[7:0]>	HEX	1	Length of 8-bit LSBs	
<Length[15:8]>	HEX	1	Length of 8-bit MSBs	
Command successful				
<Code>	HEX	1	=0	Set successfully
Command failed				
<Code>	HEX	1	see ERROR list	
Note				

7.3.8. QueryRSSI Value

Command

at+rssi\r\n

Description

This command is used to get signal strength of the Access Point or network that module connect to.

Parameter Description

N/A

Return Value Description

Parameter	Format	Length(byte)	Description	
<Length[7:0]>	HEX	1	Length of 8-bit LSBs	
<Length[15:8]>	HEX	1	Length of 8-bit MSBs	
Command successful				
<Code>	HEX	1	=0	Get information correctly
<RSSI>	HEX	1	Signal intensity (negative value)	
Command failed				
<CODE>	HEX	1	0XFE=-2 No wireless network is found	
Note				

7.3.9. Create The Wireless Access Point

Command

at+ap=<ssid>,<hidden>\r\n

Description

This command is used to create a wireless access point, allowing connections from other wireless devices to send/receive data.Before this command, user can configure other wireless parameters by commands at+apconfig, at+channel.

After the creation, module can automatically initiate DHCP SERVER. User must configure at+ipdhcp=1 after static IP is set by command (at+ipstatic), then module can automatically configure DHCP SERVER parameters, including IP address range and duration.

Parameter Description

Maximum SSID is 32 bytes.

Parameter	Value	Description
<SSID>	SSID	The SSID to be connected is with maximum 32 in length
<hidden>	0	Set network to visible (optional)
	1	Set network to hidden (optional)

Example:

at+ap=LTHonway,1\r\n----------Create a network whose SSID is "LTHonway"

Return Value Description

Parameter	Format	Length(byte)	Description	
<Length[7:0]>	HEX	1	Length of 8-bit LSBs	
<Length[15:8]>	HEX	1	Length of 8-bit MSBs	
Command successful				
<Code>	HEX	1	=0	Get information correctly
Command failed				
<CODE>	HEX	1	0XFE=-2	Failed to set up
<CODE>	HEX	1	0XFD=-3	Failed to create
Note				

7.3.10. Configure Parameter of Wireless Access Point

Command

at+apconfig=<contry code>,<inact time>,<beacon>,<dtim>\r\n

Description

This command is used to configure parameters of wireless access point, including country code, inactive time, beacon frame intervals and DTIM threshold.

Parameter Description

Parameter	Value	Description
<contry code >	Country	Country code, e.g. China (CN)

	code	
<inact time>	>0	Inactive time
< beacon>	100~1000	Configure beacon frame intervals, available value: 100 ~ 1000(ms), default: 100
<dtim>	1~255	Value range: 1 ~25, specifying the interval for delivery traffic indication message (DTIM). The unit is beacon interval, default is1, meaning the interval of DTIM is same as that of beacon frame.

Return Value Description

Parameter	Format	Length(byte)	Description	
<Length[7:0]>	HEX	1	Length of 8-bit LSBs	
<Length[15:8]>	HEX	1	Length of 8-bit MSBs	
Command successful				
<Code>	HEX	1	=0	Set successfully
Command failed				
<CODE>	HEX	1	see ERROR list	
Note				

7.3.11. Creat/JoinAd-hoc Network

Command

at+adhoc=<ssid>\r\n

Description

This command is used to create and/or join point-to-point network (Ad-hoc). For creating a network, firstly set/enter password and channel by commands at+psk, at+channel before using this command. In Ad-hoc mode, the network encryption is WEP by default, no other encryption is supported. The default network channel is 10 (2457MHZ).

Parameter Description

Parameter	Value	Description
<ssid>	ssid	Network identifier

Note:

In Ad-hoc mode, DHCP SERVER is not available.

Return Value Description

Parameter	Format	Length(byte)	Description
<Length[7:0]>	HEX	1	Length of 8-bit LSBs

<Length[15:8]>	HEX	1	Length of 8-bit MSBs	
Command successful				
<Code>	HEX	1	=0	Set successfully
Command failed				
<CODE>	HEX	1	0XFE=-2 creating/connecting failed	
Note				

7.3.12. Set The Channel

Command

at+channel=< channel >\r\n

Description

It is used to set network channels in Ad-hoc, AP modes. This parameter must be used before setting channel.

Parameter Description

Parameter	Value	Description
<channel>	0-11	Set channel

Return Value Description

Parameter	Form at	Length(byte)	Description	
<Length[7:0]>	HEX	1	Length of 8-bit LSBs	
<Length[15:8]>	HEX	1	Length of 8-bit MSBs	
Command successful				
<Code>	HEX	1	=0	Set successfully
Command failed				
<CODE>	HEX	1	see ERROR list	
Note				

7.3.13. Set TheDHCP Mode

Command

at+ipdhcp=<mode>\r\n

Description

This command is used to settheDHCP working mode.

Parameter Description

If <mode>=0, module works in DHCP CLIENT mode, and module gets data (IP address, etc.) from DHCP SERVER.
If <mode>=1, module automatically configures parameters for DHCP SERVER, including IP address range and duration. This parameter must be effective after command at+ipstatic, in AP mode.

Parameter	Value	Description
< mode >	0	=0 DHCP CLIENT
	1	=1 DHCP SERVER

Example:

at+ipdhcp=0\r\n ----------module works in DHCP CLIENT mode

at+ipdhcp=1\r\n ----------module works in DHCP SERVER mode

Return Value Description

Parameter	Format	Length(byte)	Description	
<Length[7:0]>	HEX	1	Length of 8-bit LSBs	
<Length[15:8]>	HEX	1	Length of 8-bit MSBs	
Command successful				
<Code>	HEX	1	=0	Command successful
<IP>	HEX	4	Module IP address (<mode>=0 valid)	
<NETMASK>	HEX	4	Module subnet mask(<mode>=0 valid)	
<GATEWAY>	HEX	4	Gateway(<mode>=0 valid)	
<DNS1>	HEX	4	DNS Server 1(<mode>=0 valid)	
<DNS2>	HEX	4	DNS Server 2 (<mode>=0 valid)	
Command failed				
<Code>	HEX	1	0XFE =-2	Getting address timeout is valid(<mode>=0 valid)
Note				

7.3.14. Configure The Static IP Address

Command

at+ipstatic=<ip>,<mask>,<gateway>,<dns server1 >,<dns server2>\r\n

Description

This command is used to assign static IP address for module.

Parameter Description

Parameter	Value	Description
<IP>	0.0.0.0-255.255.255.255	ConfigureIP address
<NETMASK>	0.0.0.0-255.255.255.255	Configure subnet mask
<GATEWAY>	0.0.0.0-255.255.255.255	Configure gateway

<DNS SERVER1>	0.0.0.0-255.255.255.255 (0 is valid)	Configure DNS Server 1
<DNS SERVER2>	0.0.0.0-255.255.255.255 (0 is valid)	Configure DNS Server 2

Example:

at+ipstatic=192.168.9.5,255.255.255.0,192.168.9.1,0,0\r\n----------Module IP=192.168.9.5
Subnet mask=255.255.255.0
Gateway=192.168.9.1
DNS Server 1=0
DNSServer2=0

Return Value Description

Parameter	Format	Length(byte)	Description	
<Length[7:0]>	HEX	1	Length of 8-bit LSBs	
<Length[15:8]>	HEX	1	Length of 8-bit MSBs	
Command successful				
<Code>	HEX	1	=0	ConfigIP address successfully
Command failed				
<Code>	HEX	1	=-2	IP address error
Note				

7.3.15. QueryTheIP Address

Command

at+ipconfig \r\n

Description

This command is used to get the current IP address of the module.

Parameter Description

N/A

Return Value Description

Parameter	Format	Length(byte)	Description	
<Length[7:0]>	HEX	1	Length of 8-bit LSBs	
<Length[15:8]>	HEX	1	Length of 8-bit MSBs	
Command successful				
<Code>	HEX	1	=0	Got IP address successfully
<MAC>	HEX	6	Module MAC address	
<IP>	HEX	4	Module IP address	

<NETMASK>	HEX	4	Module subnet mask	
<GATEWAY>	HEX	4	Gateway	
<DNS SERVER1>	HEX	4	DNS Server 1	
<DNS SERVER2>	HEX	4	DNS Server 2	
Command failed				
<Code>	HEX	1	0XFE =-2	Failed to get IP address
Note				

7.3.16. DNS

Command

at+dns=<domain>\r\n

Description

This command is used to convert domain name into the corresponding IP address with available DNS server address.

Parameter Description

N/A

Return Value Description

Parameter	Format	Length(byte)	Description	
<Length[7:0]>	HEX	1	Length of 8-bit LSBs	
<Length[15:8]>	HEX	1	Length of 8-bit MSBs	
Command successful				
OK	ASCII	2	Query successfully	
<Code>	HEX	1	=0	Query successfully
Command failed				
<CODE>	HEX	1	0XFE=-2 DNS send error	
<CODE>	HEX	1	0XFD=-3DNS receive error	
<CODE>	HEX	1	0XFC=-4 DNS request failed	
Note				

7.3.17. PING

Command

at+ping=<host>,<count>,<size>\r\n

Description

This command is used to test network connection status by ping command.

Parameter Description

Parameter	Description
<HOST>	Specify a host
<COUNT>	Number of data package, default is 1 (optional).
<SIZE>	Size of data package, maximum is 1400bytes, default is 64bytes(optional).

Example:

at+ping =192.168.9.5\r\n----------execute ping command

Return Value Description

Parameter	Format	Length(byte)	Description	
<Length[7:0]>	HEX	1	Length of 8-bit LSBs	
<Length[15:8]>	HEX	1	Length of 8-bit MSBs	
Command successful				
<Code>	HEX	1	=0	Network is connected
Command failed				
<Code>	HEX	1	=-2	Cannot access host
Note				

7.3.18. Create UDP Connection

Command

at+udp=<dest_ip>,<dest_port>,<local_port>\r\n

Description

This command is used to create a UDP port and configure remote IP address as well as port number. If created successfully, a hexadecimal value is returned for connection management. Maximum 8 connections can be created.

Parameter Description

Parameter	Value	Description
<destip>	0.0.0.0-255.255.255.255	Destination IP address
<dest port>	1-65535	Destination port
<local port>	1-65535	Local port

Example:

at+udp=192.168.9.5,25000,25001\r\n----------connect to destination port

Return Value Description

Parameter	Format	Length(byte)	Description	
<Length[7:0]>	HEX	1	Length of 8-bit LSBs	
<Length[15:8]>	HEX	1	Length of 8-bit MSBs	
Command successful				
<Code>	HEX	1	=0	Setting up successfully
<FLAG>	HEX	1	=0x00~0x07 port identifier for port management	
Command failed				
<Code>	HEX	1	0XFE= -2	Creating local port error
<Code>	HEX	1	0XFD= -3	Binding local pot error
<Code>	HEX	1	0XFC= -4	Connecting destination port error
Note				

7.3.19. CreateUDP SERVER

Command

at+ludp=<local port>\r\n

Description

This command is used to create a local port and wait data from remote port. If the remote port wants to connect to the local port, then the remote port sends data to the local port. However, the module just keeps the last connection of data transmitting, the other connections are invalid. If local port is created successfully, a hexadecimal value is returned for connection management. Maximum 8 connections can be created.

Parameter Description

Parameter	Value	Description
<local port>	1-65535	Creating local port

Example:

at+ludp =25000\r\n----------creating local port 25000

Return Value Description

Parameter	Format	Length(byte)	Description	
<Length[7:0]>	HEX	1	Length of 8-bit LSBs	
<Length[15:8]>	HEX	1	Length of 8-bit MSBs	
Command successful				
<Code>	HEX	1	=0	Setting up successfully
<Flag>	HEX	1	=0x00~0x07 port identifier for port management	

Command failed				
<Code>	HEX	1	0XFE= -2	Creating local port error
<Code>	HEX	1	0XFD= -3	Binding local pot error
Note				

7.3.20. CreateTCP CLIENT

Command

at+tcp=<dest_ip>,<dest_port>,<module_port>\r\n

Description

This command is used to create TCP CLIENT and connect the remote TCP SERVER. If create successfully, a hexadecimal value is returned for connection management. Maximum 8 connections can be created.

Parameter Description

Parameter	Value	Description
<destip>	0.0.0.-255.255.255.255	Destination IP address
<dest port>	1-65535	Destination port
<local port>	1-65535	Local port

Example:

at+tcp=192.168.9.5,25000,25001\r\n----------connect to destination port

Return Value Description

Parameter	Format	Length(byte)	Description	
<Length[7:0]>	HEX	1	Length of 8-bit LSBs	
<Length[15:8]>	HEX	1	Length of 8-bit MSBs	
Command successful				
<Code>	HEX	1	= 0	Connected successfully
<Flag>	HEX	1	port identifier for port management	
Command failed				
<Code>	HEX	1	0XFE= -2	Creating local port error
<Code>	HEX	1	0XFD= -3	Binding local pot error
<Code>	HEX	1	0XFC= -4	TCPSERVER connection error
Note				

7.3.21. CreateTCP SERVER

Command

at+ltcp=<local_port>\r\n

Description

The module works as TCP server and creates monitoring port If create successfully, a hexadecimal value is returned for connection management. Maximum 4 connections can be created.

Parameter Description

Parameter	Value	Description
<local_port>	1-65535	Creating local monitoring port

Example:

at+ltcp=25000 \r\n----------creating TCP SERVER

Return Value Description

Parameter	Format	Length(byte)	Description	
<Length[7:0]>	HEX	1	Length of 8-bit LSBs	
<Length[15:8]>	HEX	1	Length of 8-bit MSBs	
Command successful				
<Code>	HEX	1	=0	Created successfully
<Flag>	HEX	1	(0x08~0x0B)port identifier for port management	
Command failed				
<Code>	HEX	1	0XFE= -2	Creating local port error
			0XFD= -3	Binding local pot error
			0XFB= -5	Monitoring error
Note	Port identifier(0x08 ~ 0x0B)is only used to remove TCP Sever. The Port identifier(0x00 ~ 0x07) to sending data is the return port when TCP-Client connected to the TCP-Sever.			

7.3.22. CloseThe Connected Port

Command

at+cls=<socket_flag>\r\n

Description

This command is used to close up connection by its corresponding port identifier.

Parameter Description

Parameter	Description

<socket_flag>	Port identifier

Example:

at+cls=0\r\n----------close up the connection whose identifier is 0

Return Value Description

Parameter	Format	Length(byte)	Description	
<Length[7:0]>	HEX	1	Length of 8-bit LSBs	
<Length[15:8]>	HEX	1	Length of 8-bit MSBs	
Command successful				
<Code>	HEX	1	=0	Close successfully
Command failed				
<CODE>	HEX	1	0XFE= -2	Specified port does not exist
<CODE>	HEX	1	0XFD= -3	Close failed
Note				

7.3.23. Send Data

Command

at+send_data=<socket_flag>,<data_length><data_stream>\r\n

Description

This command is used to send data to target connection (port identifier) with maximum data length as 1400. Whereas, <data_stream> can be any format, meaning the module keeps the original data format without converting.

Parameter Description

Parameter	Value	Description
<socket_flag>	0-3	Connection identifier
<data_length>	1-1400	First byte is 8-bit LSB,Second byte is 8-bit MSB
<data_stream>	data	Data to be sent

Example:

at+send_data=0,<0x04><0x00>\r\nABCD

Sending 4 bytes data to the connection with identifier as 0; the data content is "ABCD" .

Return Value Description

Parameter	Format	Length (byte)	Description
<Length[7:0]>	HEX	1	Length of 8-bit LSBs
<Length[15:8]>	HEX	1	Length of 8-bit MSBs

Command successful				
<Code>	HEX	1	=0	Get information correctly
Command failed				
<Code>	HEX	1	0XFE=-2	Specified port does not exist
			0XFD=-3	Data send error
Note				

7.3.24. Receive Data

Command

N/A

Description

It is the data sent to host, including TCP/UDP, TCPclient connection and disconnection. Its type can be identified by <CODE>.

Parameter Description

N/A

Return Value Description

1. Receiving Data

Parameter	Format	Length(byte)	Description
<Length[7:0]>	HEX	1	Length of 8-bit LSBs
<Length[15:8]>	HEX	1	Length of 8-bit MSBs
Data Received Successfully			
<Code>	HEX	1	=0X01 TCP/UDP data
< flag>	HEX	1	=0X00-0X07 Port identifier
<dest_port>	HEX	2	Destination port
<dest_ip>	HEX	4	Destination IP
<data_length>	HEX	2	Data length
<data_stream>	HEX	<data_length>	Data
Data received Failed			
<CODE>	HEX	1	=0XFFdata receive error
Note			

2.TCPConnection Status

Parameter	Forma	Length(byte)	Description

	t		
<Length[7:0]>	HEX	1	Length of 8-bit LSBs
<Length[15:8]>	HEX	1	Length of 8-bit MSBs
TCP Connected			
<Code>	HEX	1	=0X80 TCPclient connected
< flag>	HEX	1	=0X00-0X07 Port identifier
<dest_port>	HEX	2	Destination port
<dest_ip>	HEX	4	Destination IP
TCP Disconnected			
<Code>	HEX	1	=0X81TCP Client disconnected
< flag>	HEX	1	=0X00-0X07 Port identifier
<dest_port>	HEX	2	Destination port
<dest_ip>	HEX	4	Destination IP
Note			

7.3.25. Disassociate

Command

at+disc\r\n

Description

This command is used to disconnect current wireless connection.

Parameter Description

N/A

Return Value Description

Parameter	Format	Length(byte)	Description	
<Length[7:0]>	HEX	1	Length of 8-bit LSBs	
<Length[15:8]>	HEX	1	Length of 8-bit MSBs	
Command successful				
<Code>	HEX	1	=0	Disconnect successfully
Command failed				
<Code>	HEX	1	=-2	Network is disconnected
Note				

7.3.26. Setting Power Working Mode

Command

at+pwrmode=<mode>\r\n

Description

This command is used to set power working mode for module.

Parameter Description

Parameter	Value	Description
< mode>	0	Set mode to 0
	1	Set mode to 1
	2	Set mode to 2
	3	Set mode to 3
	4	Set mode to 4

Return Value Description

Parameter	Format	Length(byte)	Description	
<Length[7:0]>	HEX	1	Length of 8-bit LSBs	
<Length[15:8]>	HEX	1	Length of 8-bit MSBs	
Command successful				
<Code>	HEX	1	=0	Set successfully
Command failed				
<Code>	HEX	1	see ERROR list	
Note				

7.3.27. Wake up

Command

at+wake_up\r\n

Description

If module is working in power mode 3, then wake up module by this command. Note that this command is used after at+pwrmode=2.

Parameter Description

N/A

Return Value Description

Parameter	Format	Length(byte)	Description
<Length[7:0]>	HEX	1	Length of 8-bit LSBs
<Length[15:8]>	HEX	1	Length of 8-bit MSBs

Command successful				
<Code>	HEX	1	=0	Wake up successfully
Command failed				
<Code>	HEX	1	see ERROR list	
Note				

7.3.28. Upload Parameter When Initiate

Command

at+storeenable=<mode>\r\n

Description

This command is used to choose whether store parameter or not when initiate.

Parameter Description

If at+storeenable=0, after reboot module, enter into normal working mode

If at+storeenable=1, module stores parameter after reboot, and automatically create or set up connection with stored password, IP and etc.

This command is following at+storeconfig.

Parameter	Description
< mode >	= 0 do not store parameter after reboot
	= 1 store parameter after reboot

Return Value Description

Parameter	Format	Length(byte)	Description	
<Length[7:0]>	HEX	1	Length of 8-bit LSBs	
<Length[15:8]>	HEX	1	Length of 8-bit MSBs	
Command successful				
<Code>	HEX	1	=0	Set successfully
Command failed				
<Code>	HEX	1	see ERROR list	
Note				

7.3.29. Store Configuration Parameter

Command

at+storeconfig\r\n

Description

This command is used to store user data, including password, SSID, IP address, power mode

and scanned information, etc. It must be used after getting IP address,otherwise, connection cannot be automatically set up after reboot.

Parameter Description

N/A

Return Value Description

Parameter	Format	Length(byte)	Description	
<Length[7:0]>	HEX	1	Length of 8-bit LSBs	
<Length[15:8]>	HEX	1	Length of 8-bit MSBs	
Command successful				
<Code>	HEX	1	=0	Set successfully
Command failed				
<CODE>	HEX	1	0XFE=-2the store parameter is already 1.	
Note				

7.3.30. Boot Mode

Command

at+boot_mode=<mode>\r\n

Description

Configure module to enter into boot mode, and performs upgrade.
Configure module enter into WEB SERVER, and configures parameters.

Parameter Description

Parameter	Description
< mode >	= 0 enter into boot loader
	= 1 enter into web server

Return Value Description

N/A

7.3.31. Delete Data

Command

at+del_data\r\n

Description

This command is used to delete all the stored parameters.

Parameter Description

N/A

Return Value Description

Parameter	Format	Length(byte)	Description
<Length[7:0]>	HEX	1	Length of 8-bit LSBs
<Length[15:8]>	HEX	1	Length of 8-bit MSBs
Command successful			
<Code>	HEX	1	=0 Set successfully
Command failed			
<CODE>	HEX	1	see ERROR list
Note			

7.3.32. Reset

Command

at+reset =<mode>\r\n

Description

This command is used to reset the entire module or reset wireless module only.

Parameter Description

Parameter	Description
< mode >	= 0 reset the entire module
	= 1 just reset the wireless part, the control part remains working

Return Value Description

Parameter	Format	Length(byte)	Description
<Length[7:0]>	HEX	1	Length of 8-bit LSBs
<Length[15:8]>	HEX	1	Length of 8-bit MSBs
Command successful			
<Code>	HEX	1	=0 Reset successfully (< mode >=1 valid)
Command failed			
<CODE>	HEX	1	see ERROR list
Note			

7.3.33. Query Version Information

Command

at+version\r\n

Description

This command is used to query module version, including host version and WLAN version.

Parameter Description

Parameter	Format	Length(byte)	Description
<Length[7:0]>	HEX	1	Length of 8-bit LSBs
<Length[15:8]>	HEX	1	Length of 8-bit MSBs
Command successful			
OK	ASCII	2	OK
<Code>	HEX	1	=0 Query successfully
HOST VERSION	ASCII	1	host version
	ASCII	1	0X2E= .
	ASCII	1	host version
	ASCII	1	0X2E= .
	ASCII	1	host version
	HEX	1	0X00
WLAN VERSION	ASCII	1	wlan version
	ASCII	1	0X2E= .
	ASCII	1	wlan version
	ASCII	1	0X2E= .
	ASCII	1	wlan version
	HEX	1	0X00
Command failed			
<CODE>	HEX	1	see ERROR list
Note			

8. Revision History

Version	Date	Description
V1.0	2012/9/1	Initial Draft
V1.1	2012/11/3	RevisedAT Command Flow Chart
V2.0	2012/11/26	✓ Added commands:at+rssi, at+dns, at+httpget, at+httppost, at+ap, at+apconfig, at+wps, at+del_data ✓ Deleted commands:at+get_ltcp ， at+upgrade ✓ Refined commands: at+ltcp, at+ipdhcp, at+reset, at+storeenable, at+storeconfig
		✓ Revised AT Command Flow Chart
V2.1	2013/3/6	✓ Deleted commands:at+httpget、at+httppost ✓ Added description of SPI communicate ✓ Modify flow chart of AT commands
V2.2	2014/1/14	✓ Modify the logo of RAK ✓ Modify flow chart of AT commands ✓ Added description of port_flag