

# RAK473 UART WiFi Module

## Specification V1.4

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## 1. General Description

RAK473 module is a Wi-Fi module that fully compliant with IEEE 802.11b/g/n wireless standards, It combines an ARM-CM3 MCU, WLAN MAC, a 1T1R capable WLAN baseband, and RF in the module. It have onboard antenna, and external antenna interface, RF output PIN also exist in the board. RAK473 internally integrated TCP / IP protocol stack, supporting numerous protocols such as ARP, IP, ICMP, TCP, UDP, DHCP CLIENT, DHCP SERVER, DNS and other etc. It supports AP mode, Station mode. It also support rich AT command for all kinds of application. Users can easily and quickly use it to wifi networking and data transmission. The baud rate of module serial port is up to 921600bps, which can fully meet the low-rate applications.

In network part, RAK473 supports storing network parameters in the module, and reduce time connect to network. The module has built-in WEB server, supporting wireless network parameters configuration, supporting wireless firmware upgrade. It also supports WPS and EasyConfig. In application part, HTTP, MQTT, MDNS and SSL also be supported.

It also provides a bunch of configurable GPIOs which are configured as SPI ,UART, I2C, I2S, PWM, for different applications and control usage. RAK473 integrates internal 2M SRAM ,and 512KB DRAM and 2MB flash for complete WIFI protocol functions.

## 2. Features

### Application

- UART serial AT command set operation
- Support for multiple baud rate
- Support wireless configuration and OTA upgrade firmware
- Support the UART interface, OTW(over the wire) upgrade function
- Support for fast networking, easyconfig, WPS function
- Support MDNS, MQTT, HTTP, TLS applications
- Support TLS1.2
- Support 160KByte NVM Flash

### Standards Supported

- 802.11b/g/n compatible WLAN
- 802.11e QoS Enhancement (WMM)
- 802.11i (WPA, WPA2). Open, shared key, and pair-wise key authentication services
- WIFI WPS support
- Light Weight TCP/IP protocol

### WLAN MAC Features

- CMOS MAC, Baseband PHY, and RF in a single chip for 802.11b/g/n compatible WLAN
- Complete 802.11n solution for 2.4GHz band
- 72.2Mbps receive PHY rate and 72.2Mbps transmit PHY rate using 20MHz bandwidth
- 150Mbps receive PHY rate and 150Mbps transmit PHY rate using 40MHz bandwidth
- Backward compatible with 802.11b/g devices while operating in 802.11n mode
- Compatible with 802.11n specification
- Frame aggregation for increased MAC efficiency (A-MSDU, A-MPDU)
- Low latency immediate High-Throughput Block Acknowledgement (HT-BA)
- Long NAV for media reservation with CF-End for NAV release
- PHY-level spoofing to enhance legacy compatibility
- Power saving mechanism

## WLAN PHY Feature

- 802.11n OFDM
- One Transmit and one Receive path (1T1R)
- 20MHz and 40MHz bandwidth transmission
  
- Short Guard Interval (400ns)
- DSSS with DBPSK and DQPSK, CCK modulation with long and short preamble
- OFDM with BPSK, QPSK, 16QAM, and 64QAM modulation. Convolutional Coding Rate: 1/2, 2/3, 3/4, and 5/6
- Maximum data rate 54Mbps in 802.11g and 150Mbps in 802.11n
- Fast receiver Automatic Gain Control (AGC)

## Peripheral Interfaces

- Maximum 2 PCM with 8/16KHz sample rate
- Maximum 2 SPI supported with baud rate up to 41.5MHz.
- Support 4 PWM with configurable duration and duty cycle from 0 ~ 100%
- Support 4 External Timer Trigger Event (ETE function) with configurable period in low power mode
- Maximum 20 GPIO pins
- A high speed UART interface with baud rate up to 4MHz

### 3. System Block Diagram

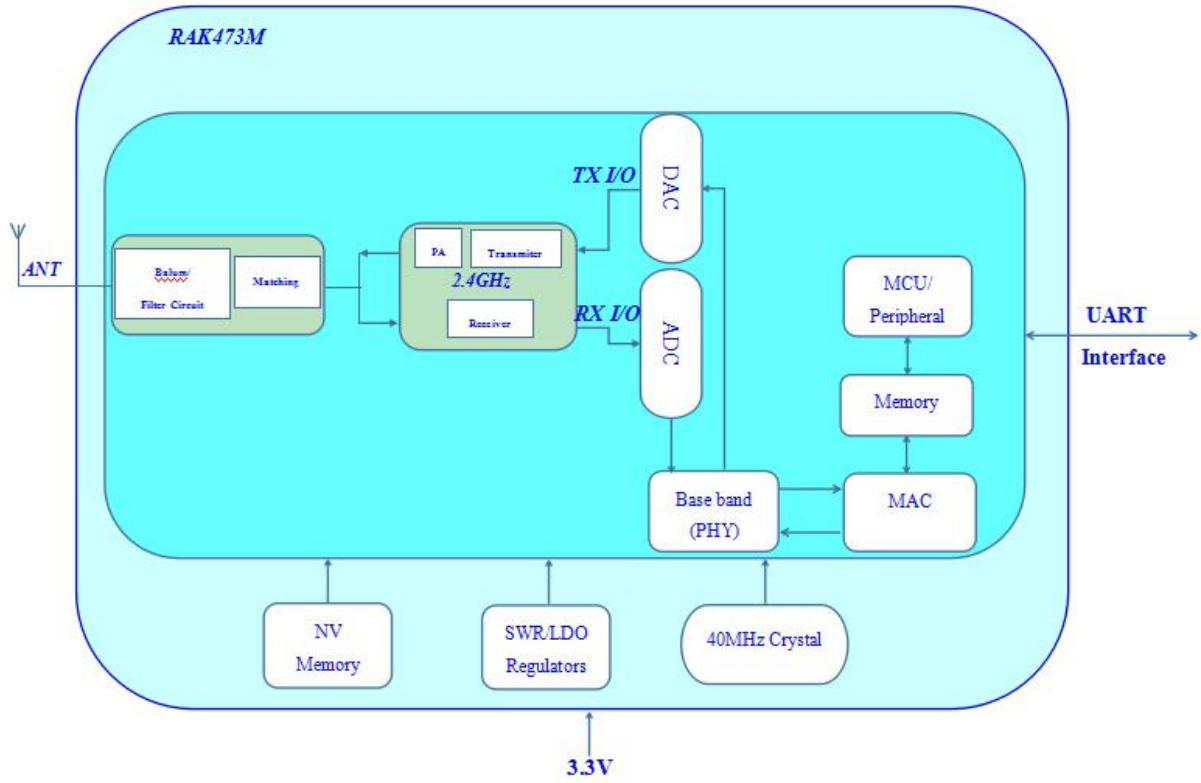


Figure 3-1 RAK473 System Diagram

RAK473M

## 4. Module Hardware Description

### 4.1 Module photo



Figure 4-1 RAK473 Top View

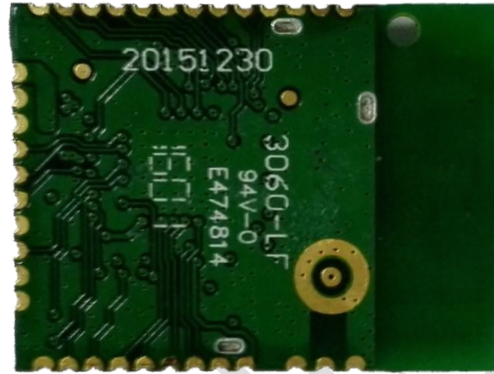


Figure 4-2 RAK473 Bottom View

### 4.2 Package information

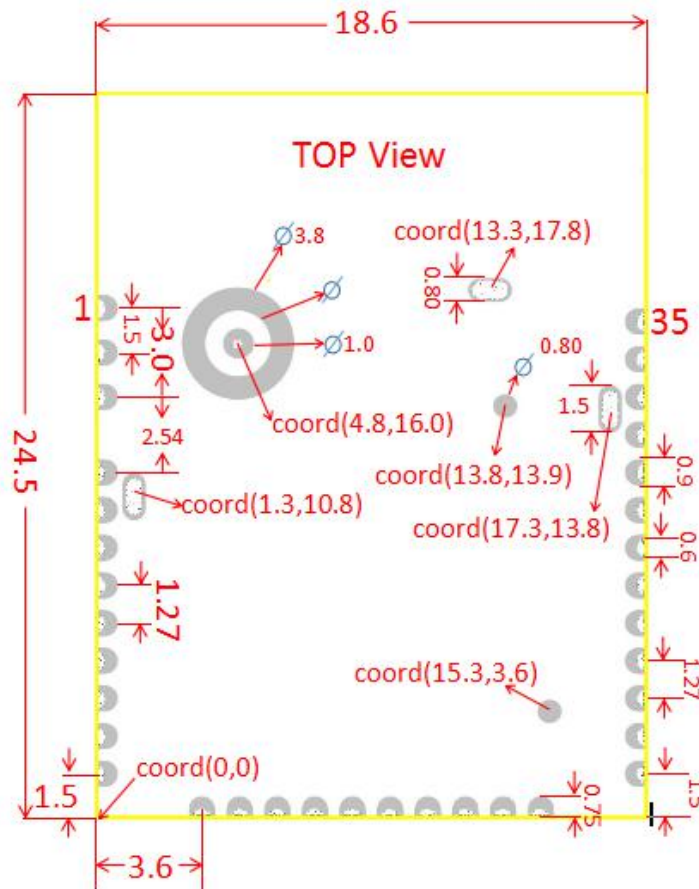


Figure 4-3 Module Pin Size (mm)

### 4.3 Pin definition

Table 4-1: Pin Definition

Pin	Name	Type	Description
1,3,21,33	GND	Ground	All ground pins are connected to ground pad or the copper.
22	VCC3.3V	Power	3.3V power supply.
2	RF_OUT	O	2.4GHz RF output
4	VDDIO	Power	3.3V for Digital IO or digital blocks
11	RESET	I	Module reset pin, Active low.
17	LINK	O , PU	Work status indicator pin of module, output low effective.
23	TXD	O	Serial data communication interface send
26	RXD	I	Serial flow control pin, ready to receive, Active low.
24	RTS	O	Serial flow control pin, The default output low. Active low, ready to receive data / request the other party to send data.
25	CTS	I	Serial flow control pin, Input pull. Active low, ready to send data/request each other to send data. High level cannot send data, low level can send data.
20	NC/VCC	I	Use 473/475 module,this pin can Suspended;If use the 476/477 module,this pin must connect VCC3.3V
Others	NC	NC	Remain disconnected when no use

#### Note:

1. I - input O - output PU – pulling up PD - pulling down
2. NC - not connected

#### Link indicator:

OTA upgrade —50 ms high-speed flashing

EasyConfig, WPS configuration —200ms fast flash

After the network connection —On (Output Low)



Idle — 1S slow flash

### 4.4 Reference design

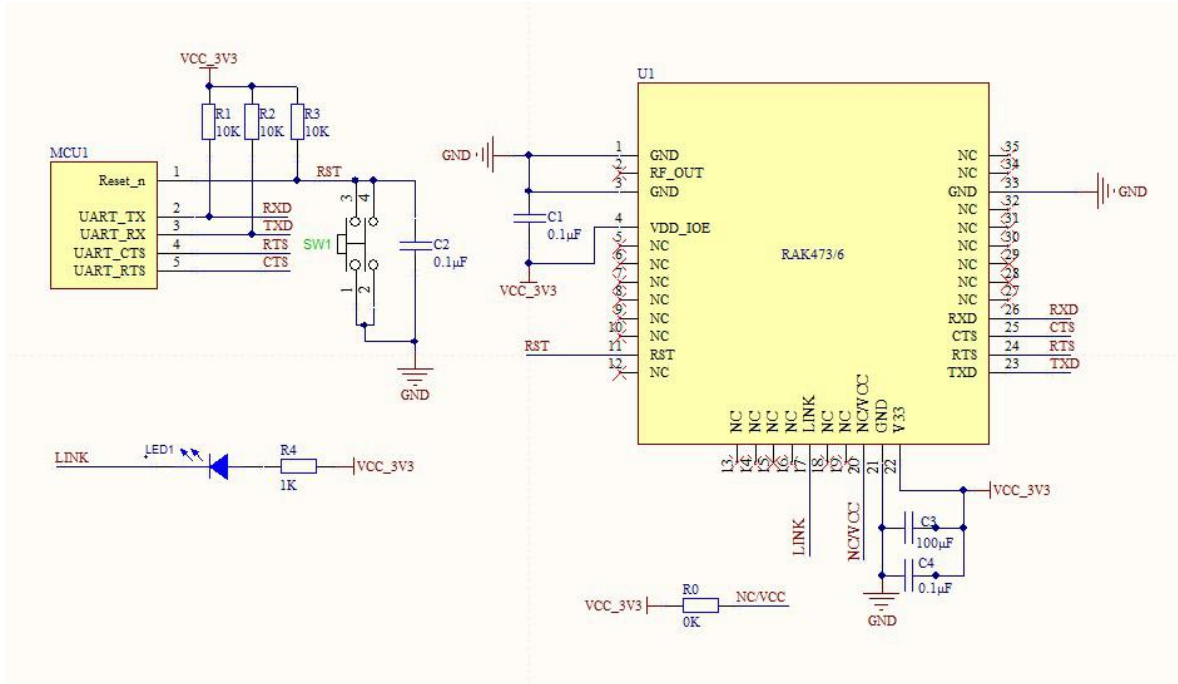


Figure 4-4 Module Typical Design Reference

RAKWIRELESS

## 5. Electrical Specification

### 5.1 General specification

ITEMS	CONTENTS
Operating Frequency	2.400-2.4835GHz
WiFi Standard	802.11b/g/n
Modulation	11b: DBPSK,DQPSK and CCK and DSSS 11g: BPSK,QPSK16QAM,64QAM and OFDM 11n: MCSO-15 OFD
Data rates	11b:1,2,5.5 and 11Mbps 11g:6,9,12,18,24,36,48 and 54 Mbps 11n:MCSO-15,up to 150Mbps
Host Interface	UART
Dimension	Typical (L x W):21mm x 18mm
Operation Temperature	-20°C to +85°C
Storage Temperature	-55°C to +125°C
Operation Voltage	3.3V±0.2V

### 5.2 802.11b Mode

ITEMS	CONTENTS				
Specification	IEEE802.11b				
Mode	DSSS/CCK				
Channel	CH 1to CH13				
Data rate	1,2,5.5,11Mbps				
1.Power Levels (calibrated)	Min.	Typ.	Max.	Unit	Note
1)16dBm Target (For each antenna Port)	15	17	19	dBm	
2.Frequency error	-25	0	+25	kHz	
3. Minimum input level sensitivity	Min.	Typ.	Max.	Unit	Note
1)11Mbps(FER≤8%)	---	-87	---	dBm	
2)Maximum input level (FER≤8%)	---	-10	---	dBm	

### 5.3 802. 11g Mode

ITEMS	CONTENTS				
Specification	IEEE802.11g				
Mode	OFDM				
Channel	CH 1to CH13				
Data rate	6,9,12,18,24,36,48,54Mbps				
<b>1.Power Levels (calibrated)</b>					
	Min.	Typ.	Max.	Unit	Note
1)16dBm Target (For each antenna Port)	12	14	16	dBm	
<b>2.Constellation error(EVM)@target power</b>					
	Min.	Typ.	Max.	Unit	Note
1)54Mbps	---	-30	-28	dB	
<b>3.Frequency error</b>					
	Min.	Typ.	Max.	Unit	Note
1)54Mbps(PER≤10%)	---	-75	---	dBm	
<b>5.Maximum input level (PER≤10%)</b>					
	Min.	Typ.	Max.	Unit	Note
1)54Mbps(PER≤10%)	---	-10	---	dBm	

### 5.4 802. 11n HT20 Mode

ITEMS	CONTENTS				
Specification	IEEE802.11n HT20@2.4GHz				
Mode	OFDM				
Channel	CH 1to CH13				
Data rate	MCS0/1/2/3/4/5/6/7/8/9/10/11/12/13/14/15				
<b>1.Power Levels</b>					
	Min.	Typ.	Max.	Unit	Note
1)16dBm Target (For each antenna Port)	12	14	16	dBm	
<b>2.Constellation error(EVM)@target power</b>					
	Min.	Typ.	Max.	Unit	Note
1)MCS7	---	-30	-28	dB	
<b>3.Frequency error</b>					
	Min.	Typ.	Max.	Unit	Note
1)MCS7	---	-30	-28	dB	
<b>3.Frequency error</b>					
	Min.	Typ.	Max.	Unit	Note
1)MCS7	---	-30	-28	dB	

4.Minimum input level sensitivity	Min.	Typ.	Max.	Unit	
1)MCS7(PER≤10%)	---	-73	---	dBm	
5.Maximum input level (PER≤10%)	---	-10	---	dBm	

## 5.5 802. 11n HT40 Mode

ITEMS	CONTENTS				
Specification	IEEE802.11n HT40@2.4GHz				
Mode	OFDM				
Channel	CH 1to CH13				
Data rate (MCS index)	MCS0/1/2/3/4/5/6/7/8/9/10/11/12/13/14/15				
<b>1.Power Levels (calibrated)</b>					
	Min.	Typ.	Max.	Unit	Note
1)16dBm Target (For each antenna Port)	12	14	16	dBm	
<b>2.Constellation error(EVM)@target power</b>					
	Min.	Typ.	Max.	Unit	Note
1)MCS7		-30	-28	dB	
<b>3.Frequency error</b>					
	-25	0	+25	kHz	
<b>4.Minimum input level sensitivity</b>					
	Min.	Typ.	Max.	Unit	
1)MCS7(PER≤10%)	---	-70	---	dBm	
5.Maximum input level (PER≤10%)	---	-10	---	dBm	

## 5.6 NVM specification

ITEMS	CONTENTS
Specification	NVM Flash
Space	160KByte
Operate write times	Total 10000 times

Note: NVM flash is used to store user configuration or firmware, do not use to store these often changed configuration or user data.

## 6. Power Consumption

State	Current (3.3V)	Description
Deep Sleep	5.5uA	Low Power Timer and GPIO Event Wake up
Deep Standby	25uA	Low Power Timer and GPIO Event Wake up
Associated Idle(DTIM=1)	3.3mA	Associated with AP but no traffic
Associated Idle(DTIM=2)	2.41mA	Associated with AP but no traffic
Associated Idle(DTIM=3)	1.98mA	Associated with AP but no traffic
Sleep	0.5mA	Associated with AP but no traffic
Run in active clock	25mA	CPU full run, UART available,WiFi is disable
11n RX mode	62mA	CPU full run, UART available,WiFi is in 11n RX
11n TX mode@13dBm	162mA	CPU full run, UART available,WiFi is in 11n TX
Peak current	240mA	CPU full run, UART available,WiFi is in 11n TX

## 7. Order information

### 7.1 Order part number

Table 7-1 : Order model

Product	Describe	Antenna	MOQ(PCS)	Evaluation Board
RAK473AS-XXXX	UART interface module, with on-board antenna	On-board	400	RAK473-EVB
RAK473BS-XXXX	UART interface module, with external antenna	External , U.fl/i.PEX	400	
RAK473CS-XXXX	UART interface module, with RF output interface	RF output	400	

### 7.2 Module size

Packaging: Hard plastic pallets

Weight: <= 3 g/pcs

Table 7-2: Thickness (Height)

RAK473	Thickness (Height)
With Shield	3.15±0.15mm

Note: In considering height design of the product, please consider your motherboard thickness error and product fit gap (recommended 0.10-0.15mm).

## 8. Contact information

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## 9. Modification records

Version	Date	Change
V1.0	2015/12/4	Creating document
V1.1	2016/5/13	1. Add module pin size description about right pin interval size 1.27mm 2. Modify typical design , compatible with RAK473 and RAK476 3. Add NVM flash description 4. Add Power Consumption chapter
V1.2	2016/6/20	Change order model information
V1.3	2016/12/1	Change Reference design
V1.4	2017/1/09	Updata the sensitivity