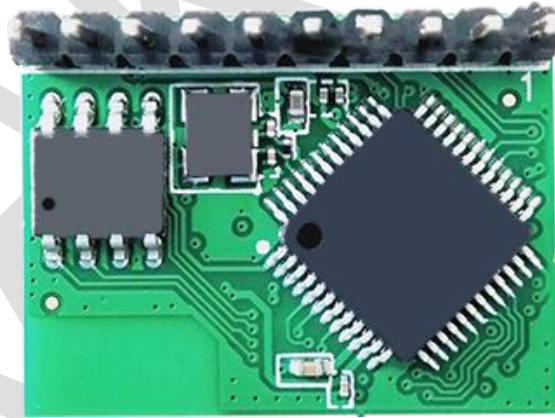
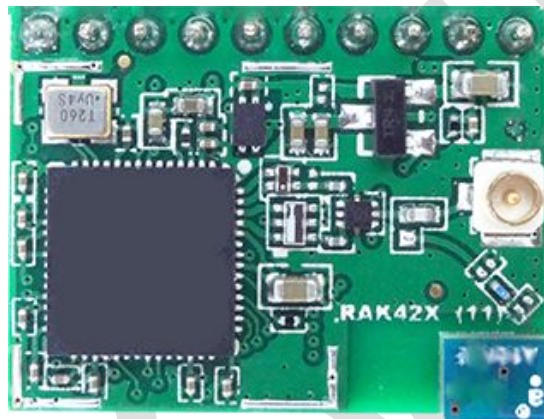


RAK421 SPI-WIFI Module

Specification V1.2



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RAK421 SPECIFICATION

1 Overview

1.1 Module Overview

RAK421 module is a Wi-Fi module that fully compliant with 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, DNS and other etc. It supports AP mode, Station mode and Ad-hoc and mode. Users can easily and quickly use it to networking and data transmission. Through SPI interface, the module's maximum transmission rate is up to 2Mbps.

RAK421 supports storing parameters, and by the customer commands it determines whether to enable automatic networking to realize easy networking and reduce time for system to networking. The module has built-in WEB server, supporting wireless network parameters configuration, supporting wireless firmware upgrade. It also supports WPS and EasyConfig one-key networking, significantly reducing software development effort.

RAK421 has four power management modes, among which the minimum standby power consumption is 2uA, fully meet customer's requirement for low power design.

1.2 Key Applications

- Portable products
- Home appliances and electrical appliances
- Industrial sensors
- Sales terminals
- Buildings automation
- Logistics and freight management
- Home security and automation
- Medical applications, such as patient monitoring, medical diagnostics
- Metering (stop timing, measuring instruments, meters, etc.)

1.3 Device Features

- Support IEEE 802.11b/g/n wireless standards
- Support four-wire SPI interface
- Support SPI Clock up to Maximum 16Mhz
- Minimalist hardware peripheral circuit design
- Support Station, Ad-hoc and AP modes
- Support DHCP SERVER / DHCPCLIENT
- Support OPEN, WEP, WPA-PSK, WPA2-PSK and WPS encryptions
- Support TCP, UDP protocols, with maximum 8 UDP/TCP connections
- Support webpage-based parameter configuration
- Support WPS and EasyConfig one-key to network connection
- Support parameter storage, customer orders loading after boot
- Support parameters store in Deep Sleep State, with connection time as fastest as 300ms
- Support wireless upgrade firmware
- On-board ceramic antenna or U.FL antenna connector
- Operating voltage: 3.3V
- 4 kinds power working modes, with minimum power consumption as 1-2uA
- Small package size: 20.5mm×15.5mm
(curved needle: height 6.4mm; vertical needle: height 8.7mm)
- FCC, RoHS and CE compliant

1.4 RAK421 System Diagram

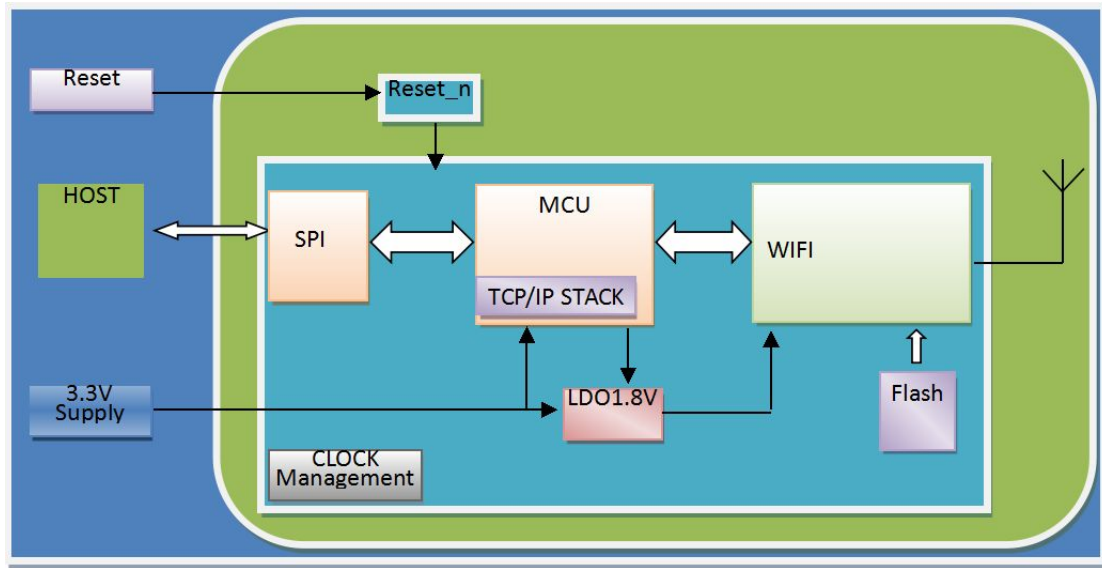


Figure 1-1 RAK421 System Diagram

2 Functional Description

2.1 HW Interface

- Support clock 16MHz Maximum
- Interface actual throughput up to 2Mbps
- Four-wire SPI interface, support SPI data interrupt pin

2.2 Wireless Driver

- Compliant with IEEE 802.11b/g/n standards
- Support AP and STA Mode
- Support WEP, WPA/WPA2-PSK encryptions
- Fast networking, allowing module to be added to network within 1 sec after power up
- Support WPS and EasyConfig one-key to network connection
- Support wireless configuration and firmware upgrade

2.3 TCP/IP

- DHCP Client and Server features
- DNS Client and Server functions
- TCP Client, TCP Server, UDP Client, UDP Server and Multicast functions
- 8-way socket applications

2.4 Power Consumption

The module supports four power consumption modes:

- Fullspeed working mode, with approx 80mA average power consumption, peak current less than 200mA
- Power-saving mode, with approx 10mA average power consumption, peak current <200mA, DTIM = 100ms
- Deep sleep mode, with approx 5mA average power consumption, peak current <200mA, DTIM = 100ms
- Standby mode, with power consumption <2uA

3 Hardware Introduction

3.1 Module type

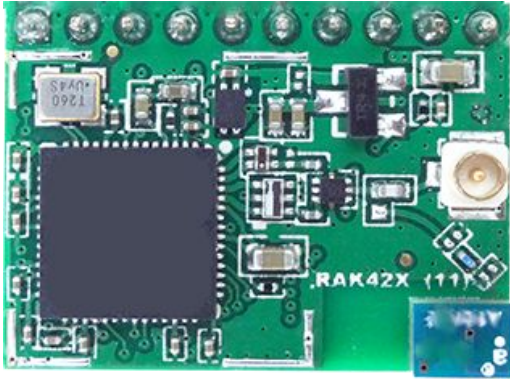


Figure 3-1 RAK421BI Top View

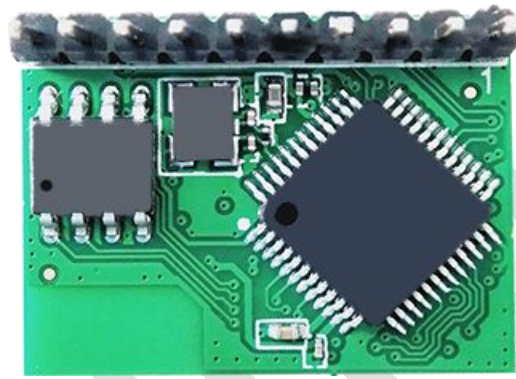


Figure 3-2 RAK421BI Bottom View

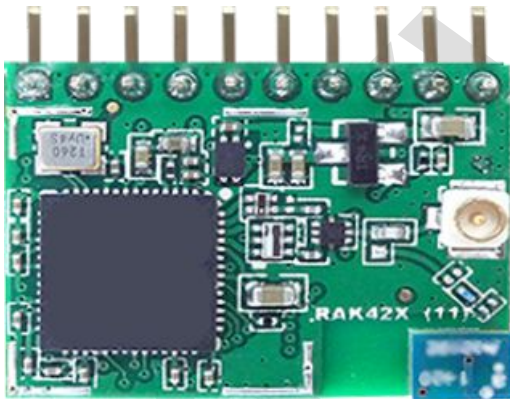


Figure 3-3 RAK421BL Top View

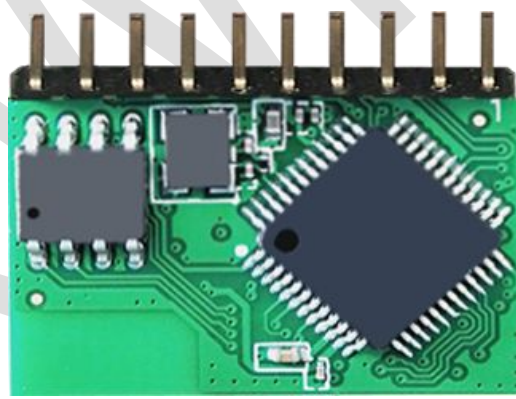


Figure 3-4 RAK421BL Bottom View

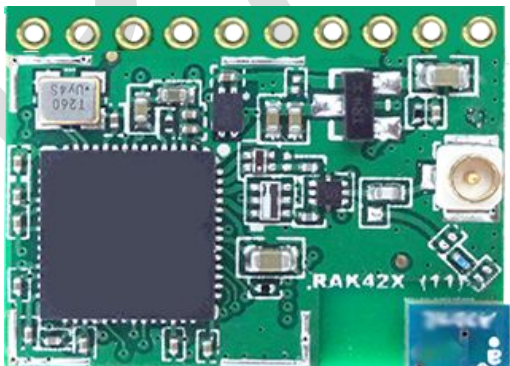


Figure 3-5 RAK421BX Top View

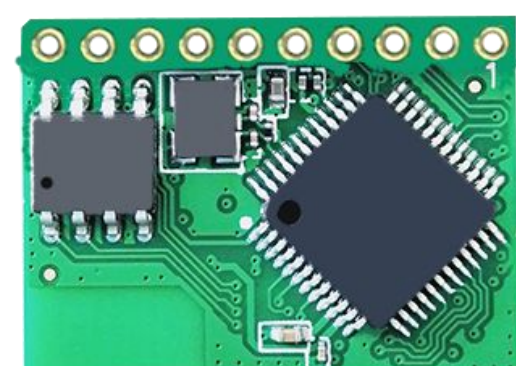


Figure 3-6 RAK421BX Bottom View

3.2 Module height

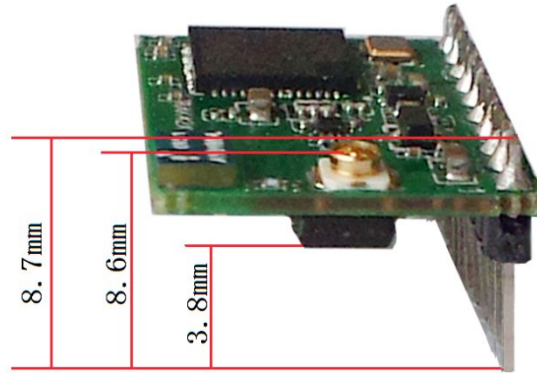


Figure 3-7 RAK4211 Height

3.3 Pin Definition

Table 3-1: Pin Definition

Pin Serial No.	Name	Type	Description
1	GND	Ground	connected to ground pad or the copper
2	VCC3V3	Power	3.3V power supply
3	NC	NC	Remain disconnected when no use
4	RESET	I, PU	Module reset pin, low effective
5	SPI_INT	O	SPI mode interrupt pin "0"——idle level "1"——has data sent to host
6	SPI_MOSI	I	SPI slave: data of SPI Master Output, Slave Input
7	SPI_MISO	O	SPI slave: data of SPI Master Input, Slave Output
8	SPI_CLK	I	SPI slave: SPI clock input
9	SPI_CSS	I	SPI slave: SPI chip select input
10	LINK	O, PU	Module networking indicator "0" - STA connected in AP mode, Connected to router in STA mode "1" - disconnected Remain disconnected when no use

Note:

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

3.4 Design Reference

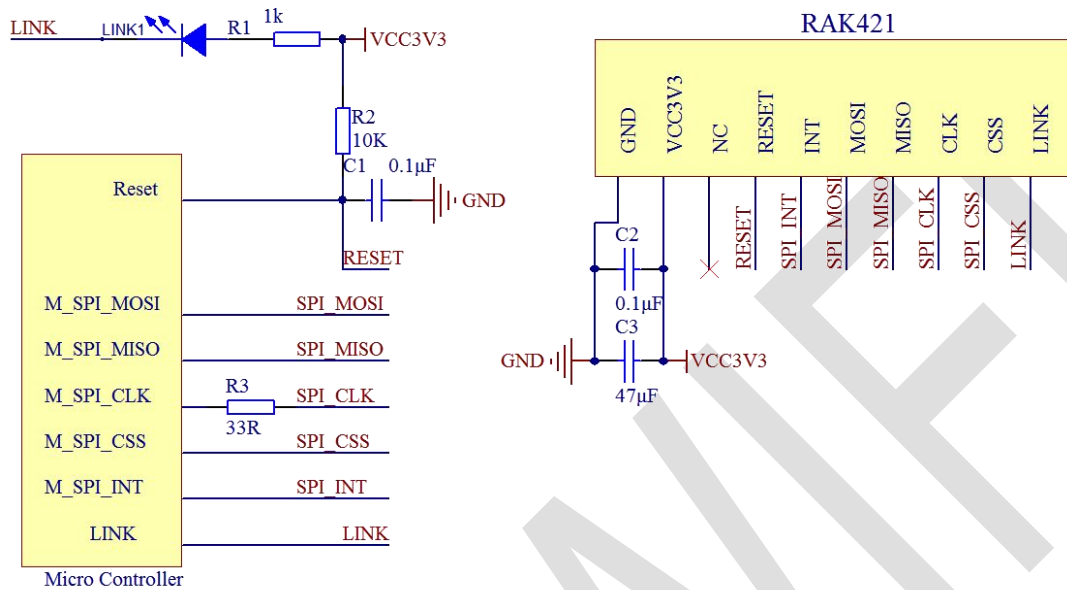


Figure 3-8 Module Typical Design Reference

Note: Upon SPI interface, the value of R3 depends on output resistance of host and PCB trace resistance, the default value is 33 Euro.

3.5 RAK421 PCB Mechanical Size

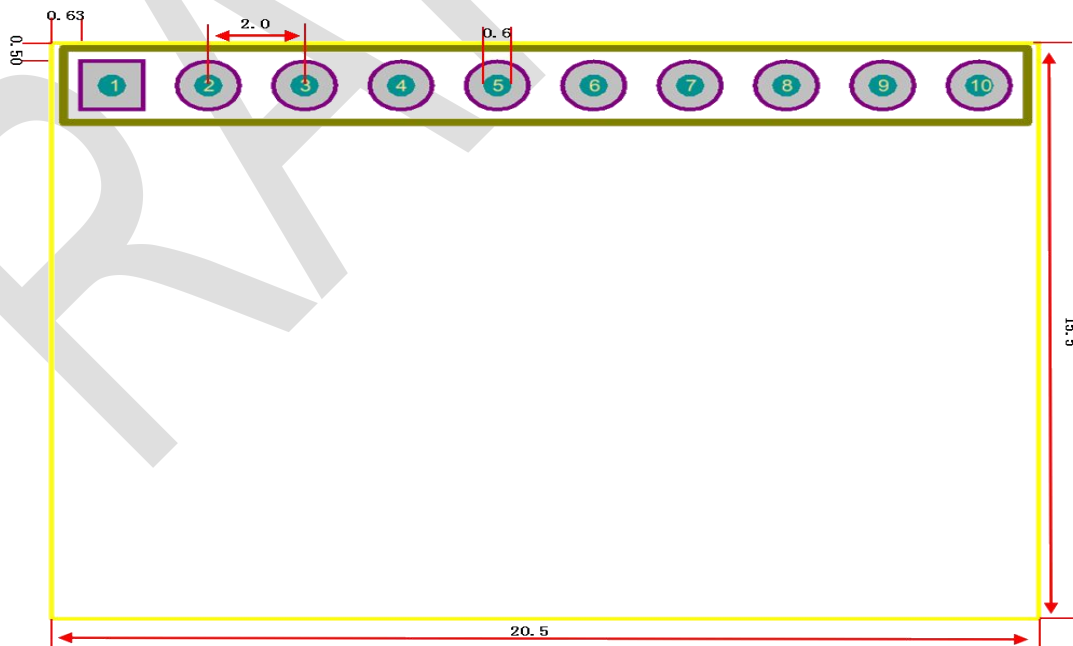


Figure 3-9 PCB Mechanical Size (mm)

3.6 Reflow Soldering Temperature Graph

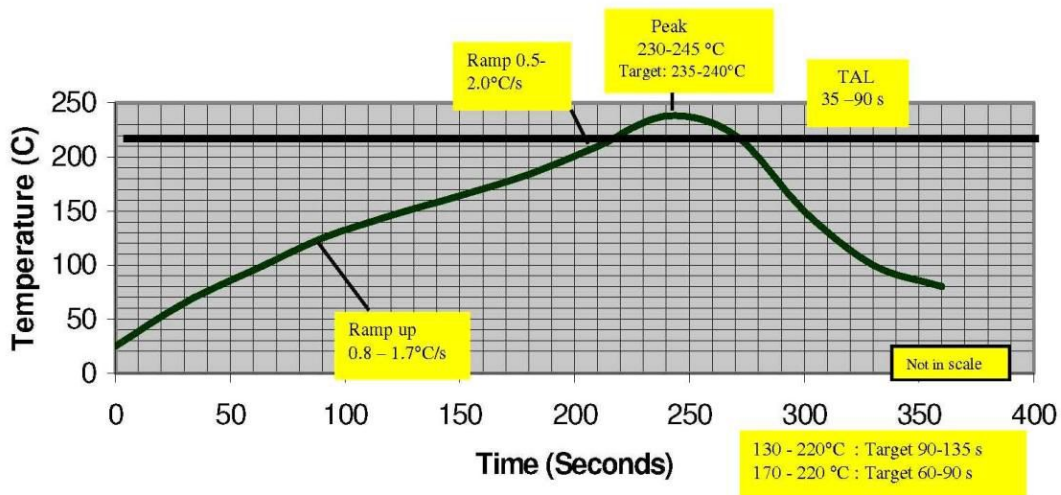


Figure 3-10 Temperature Graph

Note:

As shown in Figure 3-8, it is based on the SAC305 lead-free tin paste (3% silver, 0.5% copper). Alpha OM-338 lead-free cleaning-free flux is recommended. The Figure 6 is mainly used for guidance. The entire process time is subject to thermal pad number of assembly board and device Intensity.

3.7 Baking Instructions

The RAK421 module is very sensitive to water. Be cautious to baking the device. At ambient conditions, it is required that within 168 hours removed from the vacuum packaging, the module should be processed with the circuit board assembly by reflow soldering; Or stored in the environment with a relative humidity below 10%. If the condition is not satisfied, the RAK421 must be processed with a 9-hour baking in the environment of 125 °C before the reflow soldering.

4 Electrical Characteristics

4.1 Absolute Maximum

The following table shows the absolute maximum. Note that the module device may be damaged when exceeds the maximum. To avoid damages to the module and the device, please operate under specified conditions.

Table 4-1: Parameters and Value Range

Parameters	Symbols	Value	Unit
External supply voltage	VCC3V3	-0.3~4.0	V
Maximum RF Input (Reference: 50Ω)	RF _{in}	+10	dBm
When voltage is 3.3V, IO Max voltage	3V3V _{in} IO _{Max}	VCC+0.3	V
When voltage is 3.3V, IO Min voltage	3V3V _{in} IO _{Min}	-0.3	V
Storage ambient temperature	T _{store}	-65~+135	°C
ESD resistance	ESD _{HBM}	2000	V

4.2 Recommended Operating Parameters

Table 4-2: Recommended Operating Parameter Range

Parameters	Symbols	Min Value	Typical Value	Max Value	Unit
External voltage	V _{cc}	3.14	3.3	3.46	V
Ambient temperature	T _{ambient}	-40	--	+85	°C

4.3 RF Electrical Characteristics

- RF Transmit Specifications**

Table 4-3: Partial RF Transmit Specifications

Symbol	Parameter	Conditions	Typical Value	Unit
Ftx	Frequency range	--	2.4	GHz
Pout	Output power	--	--	--
	802.11b	1Mbps	17	dBm
	802.11g	6Mbps	17	dBm
	802.11n,HT20	MCS0	17	dBm
	802.11g,EVM	54Mbps	14	dBm
	802.11n,HT20EVM	MCS7	10	dBm

- RF Receiver Specifications**

Table 4-4: Partial Receiver Specifications

Parameter		conditions	Typical Value	Unit
Receiver sensitivity	11b,1Mbps		-97	dBm
	11b,2Mbps		-92	dBm
	11b,5.5Mbps		-90	dBm
	11b,11Mbps		-88	dBm
	11g,9Mbps		-91	dBm
	11g,18Mbps		-87	dBm
	11g,36Mbps		-81	dBm
	11g,54Mbps		-75	dBm
	11n,MCS1,13Mbps		-89	dBm
	11n,MCS3,26Mbps		-82	dBm
	11n,MCS5,52Mbps		-75	dBm
11n,MCS7,65Mbps		-72	dBm	
Maximum input signal	CH7	11g,54Mbps	10	dBm
Adjacent channel	6Mbps		37	dBc
	54Mbps		21	dBc
	MCS0		38	dBc
	MCS7		20	dBc

4.4 MCU Reset

Figure 4-1 shows the MCU reset timing diagram and reset pulse length. When power on the module or an exception occurs, the module needs to be reset. RESET pin is internally pulled up, low input is effective.

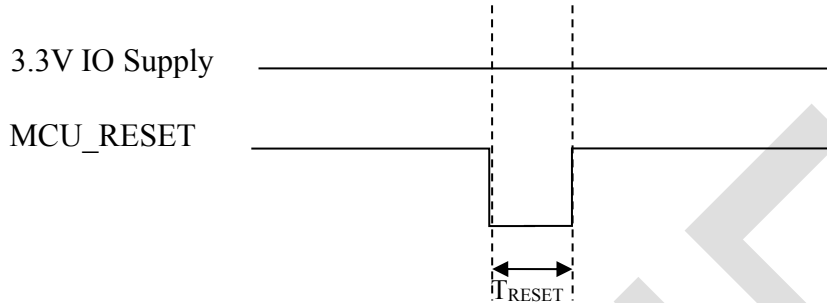


Figure 4-1: MCU Reset Timing

Table 4-5 shows the description of MCU reset parameters.

Table 4-5: MCU Reset Parameter

Symbol	Description	typical (mS)
T_{RESET}	MCU reset pulse length	>10

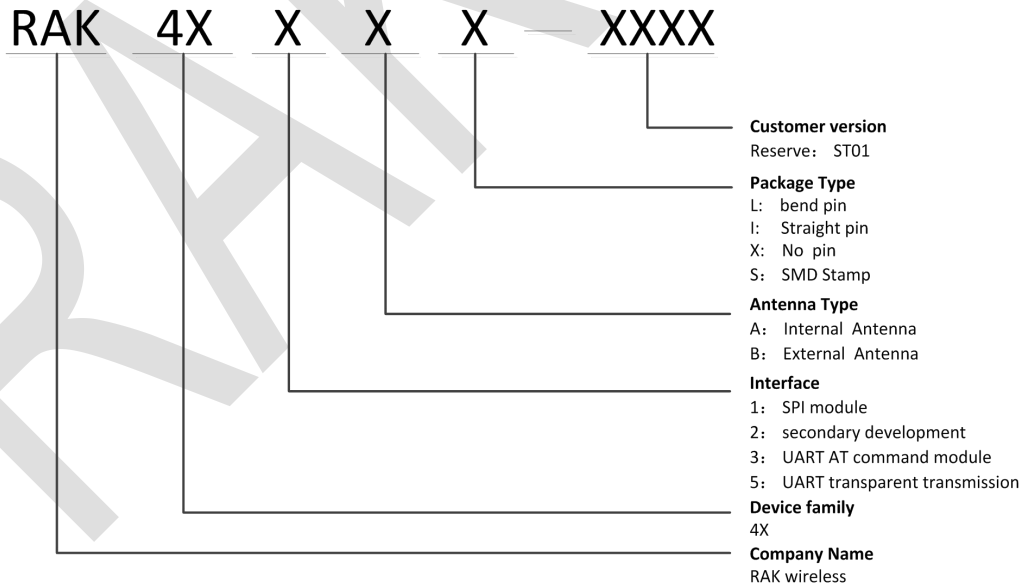
5 Order Information

5.1 Products

Table 5-1: Product Models

Product	Description	Packaging	Development board corresponding model
RAK421AI-XXXX	SPI interface module, with on-board antenna , use of the straight pin	50pcs/tray	RAK421AI_EVB
RAK421AL-XXXX	SPI interface module, with on-board antenna , use of the bend pin	50pcs/tray	RAK421AL_EVB
RAK421AX-XXXX	SPI interface module, with on-board antenna ,no pin	50pcs/tray	RAK421AX_EVB
RAK421BI-XXXX	SPI interface module, with external antenna , use of the straight pin	50pcs/tray	RAK421BI_EVB
RAK421BL-XXXX	SPI interface module, with external antenna, use of the bend pin	50pcs/tray	RAK421BL_EVB
RAK421BX-XXXX	SPI interface module, with external antenna,no pin	50pcs/tray	RAK421BX_EVB

5.2 Description



5.2 Size

Packaging: Hard plastic pallets

Weight: <=3.00g/pcs

Table 5-2: Thickness (Height)

RAK421	Thickness (Height)
Length * width	20.5mm×15.5mm
Height	See the 3.2 module height

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



6 Sales and Service

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7 Revision History

Version	Modifications	Date
V1.0	Initial Draft	2014-02-08
V1.1	Update the contact way, Update the document format	2014-08-22
V1.2	Update the Physical picture, Update the Order Information	2014-09-05