RAK49X WIFI Module
Specification V1.5

Shenzhen Rakwireless Technology Co.,Ltd www.rakwireless.com

Mail：info@rakwireless.com

Content

1 Overview

1.1 Module Overview

RAK49X 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.

RAK49X 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.

RAK49X 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 encryption
- 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 as1~2uA
- Small package size: 28.75mmX23.14mmX3.40mm
- FCC, RoHS and CE compliant

1.4 RAK49X System Diagram

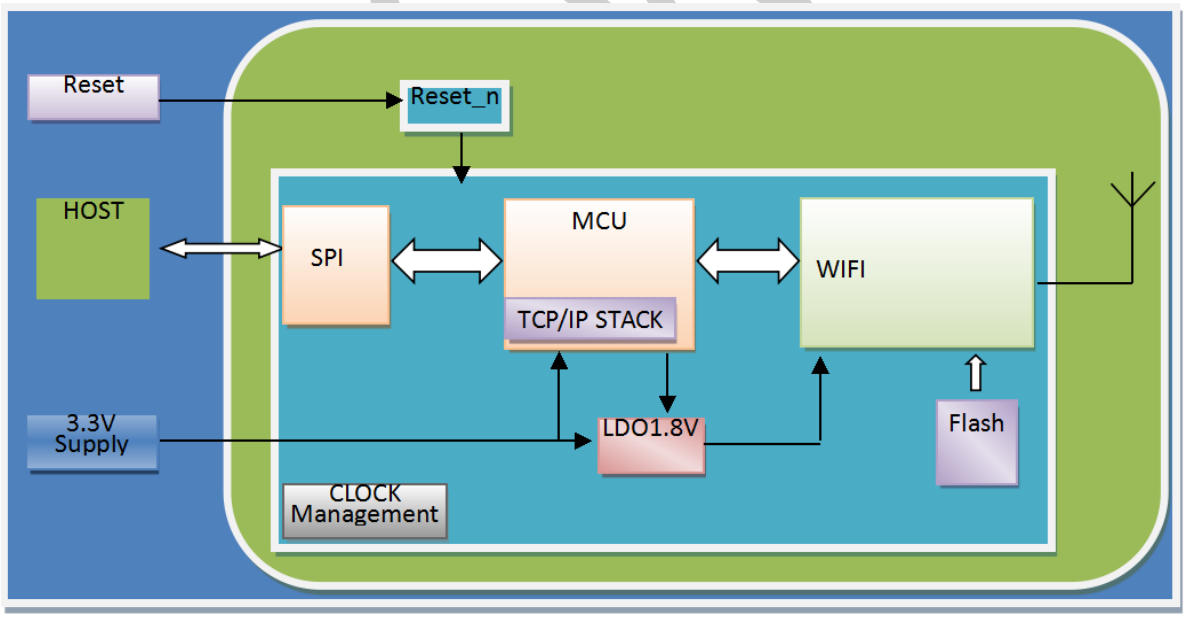


Figure 1-1 RAK49X System Diagram

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、STA 、AD-HOC Mode
- Support WEP, WPA/WPA2-PSK encryption
- 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:

- Full speed 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 Top and Bottom View

Figure 3-1 RAK49X Top View

Figure 3-2 RAK49X Bottom View

3.2 Pin Definition

Table 3-1: Pin Definition

Pin Serial No.	Name	Type	Description
1,2,5,12,13,14,36	GND	Ground	connected to ground pad or the copper
35	VCC3V3	Power	3.3V power supply
18	LINK	O，PU	"0" - STA connected in AP mode, Connected to router in STA mode "1" - disconnected Remain disconnected when no use
19	RESET	I，PU	Module reset pin, low effective
27	SPI_INT	O	SPI mode interrupt pin “0”——idle level “1”——has data sent to host
31	SPI_MISO	O	SPI slave: data of SPI Master Input, Slave Output
32	SPI_MOSI	I	SPI slave: data of SPI Master Output, Slave

			Input
33	SPI_CLK	O	SPI slave: SPI clock input
34	SPI_CS	I	SPI slave: SPI chip select input
Others	NC	NC	Remain disconnected when no use

Note:

1. I – input O - output PU – pulling up PD - pulling down NC - not connected
2. Pin in NC, remain disconnected

3.3 Design Reference

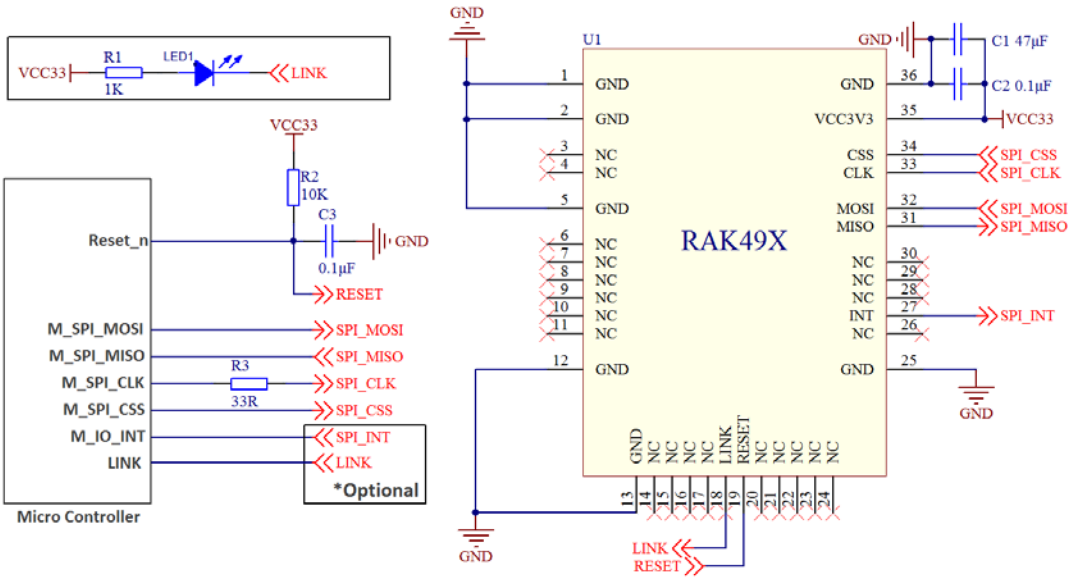


Figure 3-3 Module Typical Design Reference

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

3.4 RAK49X PCB Mechanical Size

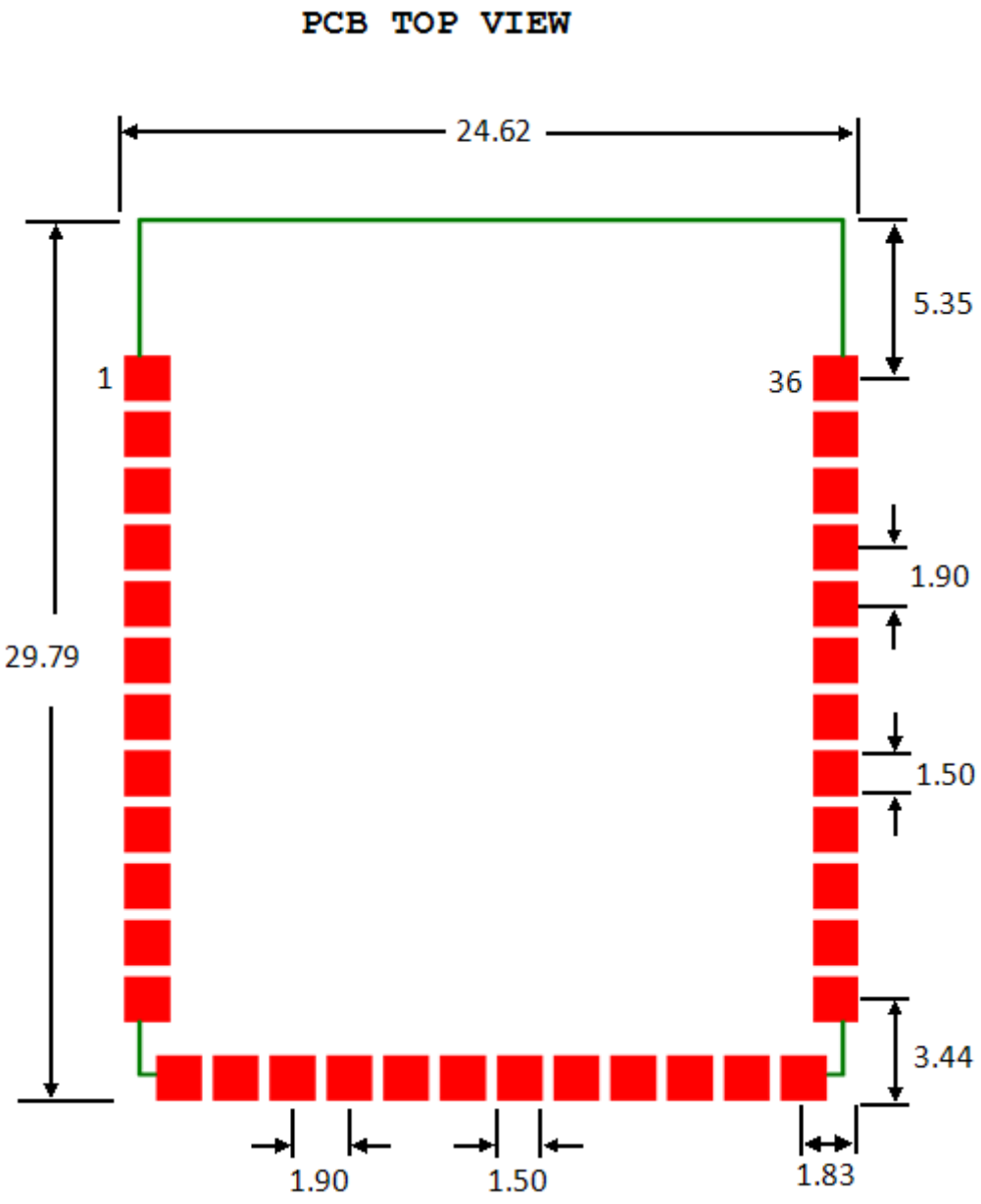


Figure 3-4: PCB Mechanical Size (mm)

3.5 Reflow Soldering Temperature Graph

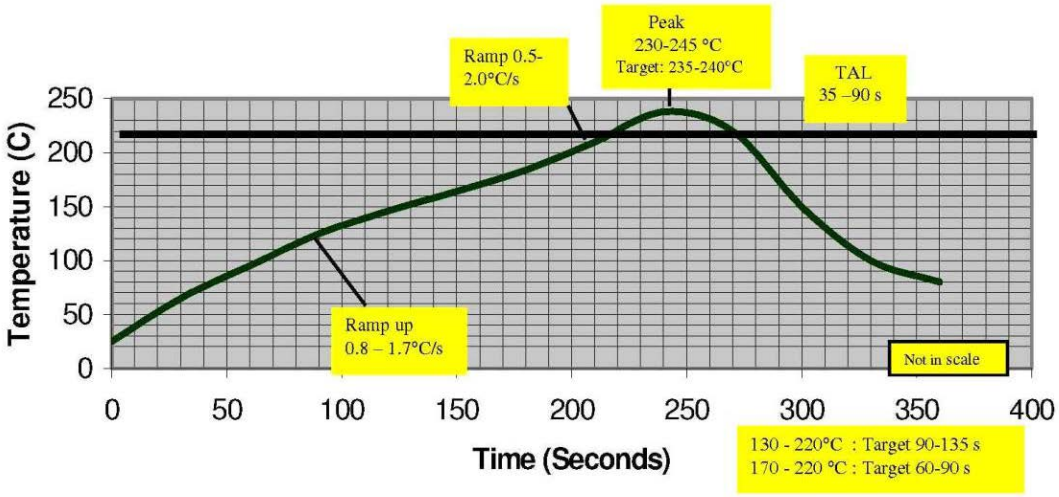


Figure 3-5: Temperature Graph

Note:

As shown in Figure 3-5, 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.

3.6 Baking Instructions

The RAK49X 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 RAK49X must be processed with a 9-hour baking in the environment of 125 ℃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	$3V3V_{in}IOMax$	VCC+0.3	V
When voltage is 3.3V, IO Min voltage	$3V3V_{in}IOMin$	-0.3	V
Storage ambient temperature	T_{store}	-65~+135	℃
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	℃

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	Parameter	Test 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.

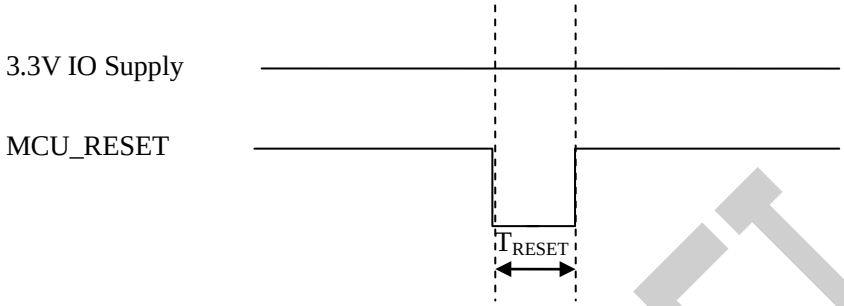


Figure 4-1: MCU Reset Timing

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

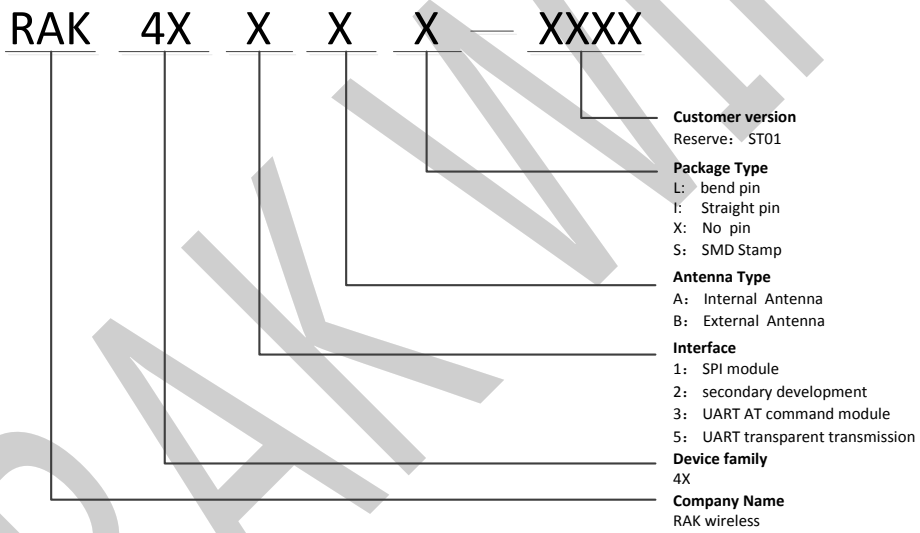
5 Order Information

5.1 Products

Table 5-1: Product Models

Product	Description	Single Tray Packing	Minimum Package	Development board corresponding model
RAK49XAS-XXXX	SPI interface module, with on-board antenna	27pcs/tray	270pcs	RAK49XAS_EVB
RAK49XBS-XXXX	SPI interface module, with external antenna	27pcs/tray	270pcs	RAK49XBS_EVB

5.2 Description



5.3 Size

Packaging: Hard plastic pallets

Weight: <=3.00g/pcs

Table 5-2: Thickness (Height)

RAK49X	Thickness (Height)
Without shield holder	2.85±0.05mm
With shield holder	2.95±0.05mm
With shield	3.30±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).

6 Sales and Service

Beijing

FAE mailbox: allan.jin@rakwireless.com

Tel : 010-62716015

Fax: 010-62716015

Address: Room 1108, Jin Yanlong Building, Xisanqi Desheng Gate, Haidian District, Beijing

Shanghai

FAE mailbox: steven.tang@rakwireless.com

Tel : 021-54721182

Fax: 021-54721038

Address: Room 306, Ran East Business Center 1 Building, No.150, 2161 Lane, Wanyuan road, Minhang District, Shanghai

Shenzhen

FAE mailbox: vincent.wu@rakwireless.com

Tel：0755-26506594

Fax：0755-86152201

Address: Room 406, Tsinghua information comprehensive building, Nanshan Science Park North District , Shengzhen

7 Revision History

Version	Modifications	Date
V1.0	Initial Draft	2013-12-08
V1.1	Modified Sales and Service section	2014-01-12
V1.2	Modified partial text editing	2014-04-16
V1.3	Added WPS function	2014-08-20
V1.4	Add module packet Reference design to add a reset circuit and pull up for serial port	2015-02-27

FCC STATEMENT :

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) This device may not cause harmful interference, and

(2) This device must accept any interference received, including interference that may cause undesired operation.

Warning: Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

☐ Reorient or relocate the receiving antenna.

☐ Increase the separation between the equipment and receiver.

☐ Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

☐ Consult the dealer or an experienced radio/TV technician for help.

FCC Radiation Exposure Statement:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

FCC INFORMATION (additional)

OEM INTEGRATION INSTRUCTIONS:
This device is intended only for OEM integrators under the following conditions: The module must be installed in the host equipment such that 20 cm is maintained between the antenna and users, and the transmitter module may not be co-located with any other transmitter or antenna. The module shall be only used with the internal antenna(s) that has been originally tested and certified with this module. As long as 3 conditions above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed (for example, digital device emissions, PC peripheral requirements, etc.).

Validity of using the module certification:
In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization for this module in combination with the host equipment is no longer considered valid and the FCC ID of the module cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

End product labeling:
This transmitter module is authorized only for use in device where the antenna may be installed such that 20 cm may be maintained between the antenna and users. The final end product must be labeled in a visible area with the following: “Contains FCC ID: 2AF6B-RAK41X”.

Information that must be placed in the end user manual:
The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module. The end user manual shall include all required regulatory information/warning as show in this manual.

This device must be kept away from all persons by 20cm or more and installations using less distance, or installations using antennas with gain greater than that with which this was Certified will require additional approvals.

Antenna Specification:
External Antenna: 2.0 dBi
Onboard Antenna: 0.5 dBi