

PRODUCT SPECIFICATION

Product Name	AI7688H2 MT7688 WIFI Module
Version	A
Doc No	901-09003
Date	May 16, 2022



RAK[®]
IoT Made Easy

RAKwireless
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Document History

Date	Revised Contents	Revised by	Version
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INDEX

1. Description	3
1.1. Platform Features	3
2. Block Diagram	4
2.1. Typical application	5
2.2. Specification	6
3. Electrical Characteristics	7
3.1. Absolute Maximum Ratings	7
3.2. RF Characteristics	7
3.2.1. RF Characteristics for 802.11b 11M	7
3.2.2. RF Characteristics for 802.11g 54M	8
3.2.3. RF Characteristics for 802.11n MCS7(HT20)	8
3.2.4. RF Characteristics for 802.11n MCS7(HT40)	8
4. Pin Definition	9
4.1. Detailed Pin Description	9
4.2. AI7688H2 Dimension	12
4.3. AI7688H2 Footprint Dimension	13
4.4. Antenna Connector Dimension	14
5. Regulator	14
6. Recommended Reflow Profile	15
7. SiP Module Preparation	16
7.1. Handling	16
7.2. SMT Preparation	16
8. Package Information	17
8.1. Product Making	17
8.2. Tray Dimension	18
8.3. Packing Information	19
8.4. Humidity Indicator Card	19
9. Warning	20

1. Description

RAK Technology Corp. introduces a low-cost and low-power consumption IoT module. The module is an operating system designed for Wearables and Internet of Things (IoT) devices that can connect to other smart devices or directly to cloud applications and services.

AI7688H2 is one of the most highly integrated SIP module for IoT prototyping

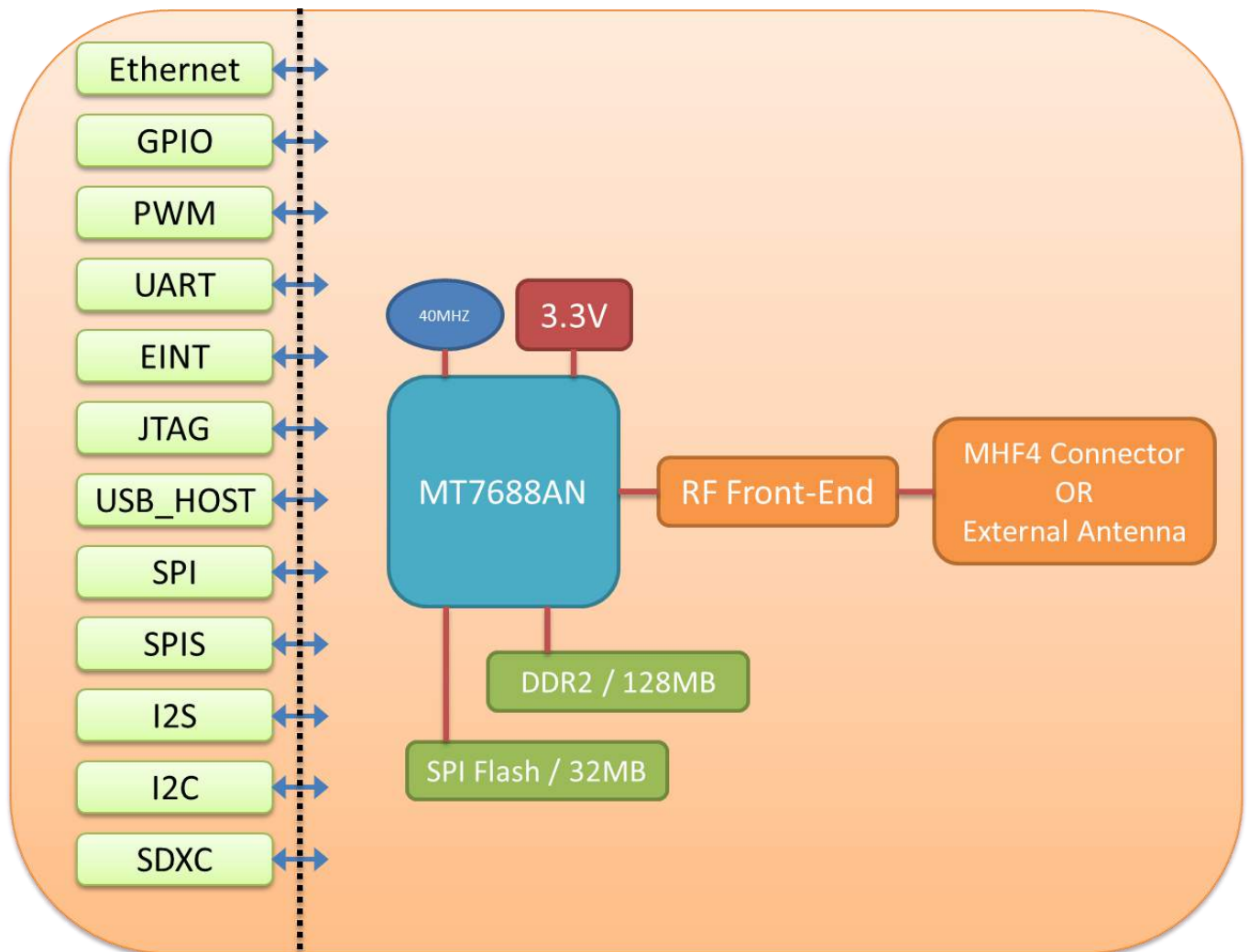
1.1. Platform Features

General

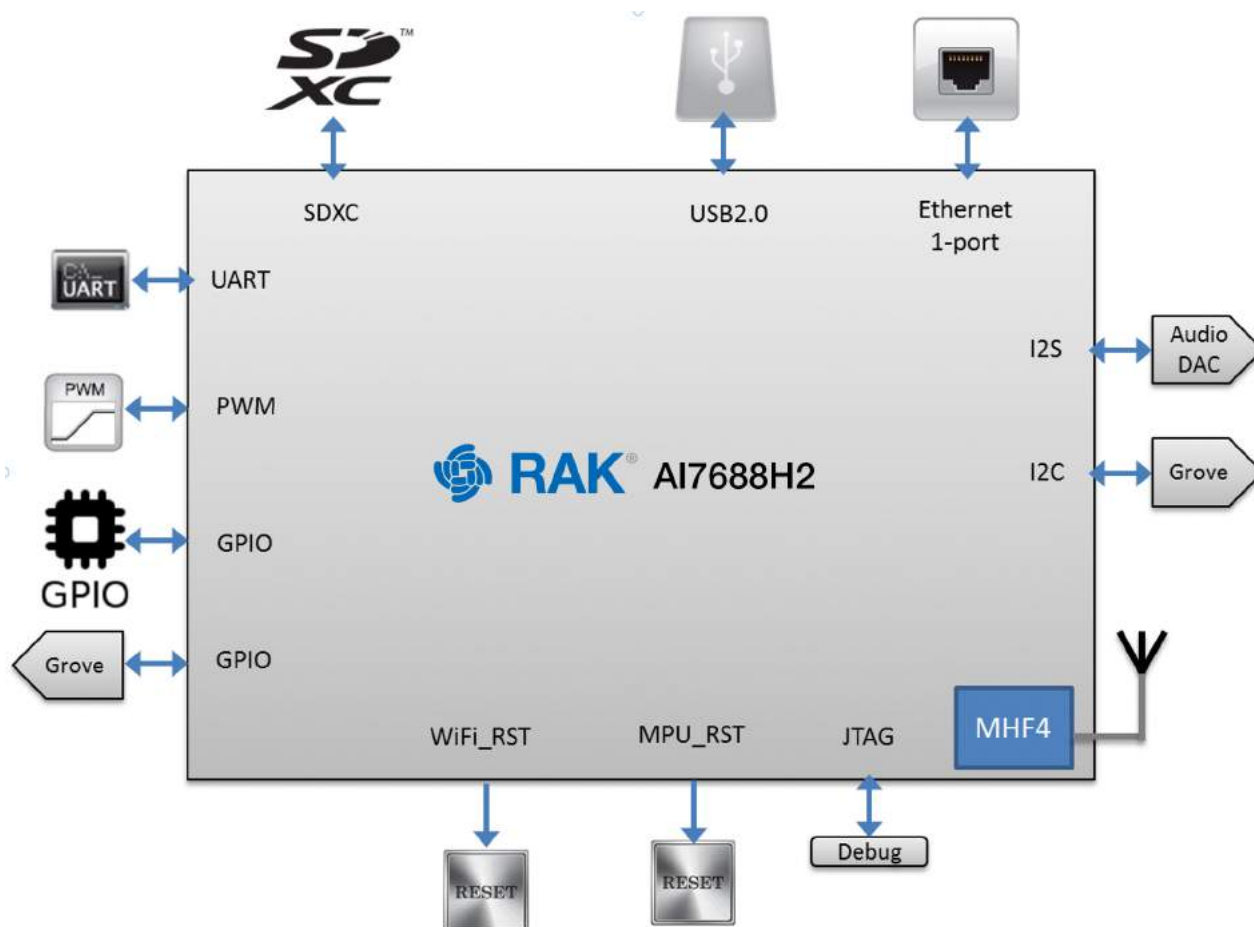
- Embedded MIPS24KEc (575/580 MHz) with 64 KB I-Cache and 32 KB D-Cache
- 1T1R 2.4 GHz with 150 Mbps PHY data rate
- Legacy 802.11b/g and HT 802.11n modes
- 20/40 MHz channel bandwidth
- 802.11v
- Green AP/STA – Intelligent Clock Scaling (exclusive) – DDRII: ODT off, Self-refresh mode
- 1-port 10/100 FE PHY
- x1 USB 2.0 Host,
- SPI/SD-XC/eMMC
- SPI,I2C, I2S,PCM, UART, JTAG, GPIO
- Internet Of Thing
- An optimized PMU
- 16 Multiple BSSID
- WEP64/128, TKIP, AES, WPA, WPA2, WAPI
- QoS: WMM, WMM-PS
- AP/STA Firmware: Linux 2.6.36 SDK, OpenWrt



2. Block Diagram



2.1. Typical application



2.2. Specification

Model Name	AI7688H2
Chipset	MT7688AN
Core	MIPS24KEc
Clock Speed	580MHz
Memory	DDR2 128MB
Flash	32MB
Operation Conditions	
Temperature	Operating : -40°C ~ +85°C Storage : -40°C ~ +85°C
Humidity	Operating : 10 ~ 95% (Non-Condensing) Storage : 5 ~ 95% (Non-Condensing)
Dimension	24mm X 32mm X1.8mm (Typ.)
Package	LGA 65Pin

3. Electrical Characteristics

3.1. Absolute Maximum Ratings

Symbol	Parameter	Min.	Typ.	Max.	Unit
V _{BAT}	Supply Voltage	3	3.3	3.6	V
I/O Voltage	I/O supply voltage	3	3.3	3.6	V

3.2. RF Characteristics

Test Condition :	Temperature	26.8° C
	Humidity	30%

3.2.1. RF Characteristics for 802.11b 11M

802.11b Transmit (Conductive)					
Item	Condition	Min.	Typ.	Max.	Unit
Frequency Range		Channel 1		Channel 13	
Tx Power Level	DQPSK	18.0	20.0	22.0	dBm
Frequency Tolerance		-15	0	15	ppm
Spectral Mask	11MHz→22MHz		40		dBr
	> 22MHz		53		dBr
Modulation Accuracy	All Data Rate		15		%
802.11b Receiver (Conductive)					
Item	Condition	Min.	Typ.	Max.	Unit
Frequency Range		Channel 1		Channel 13	
Min. Input	11Mbps PER<8%	-91.5	-89.5	-87.5	dBm

3.2.2. RF Characteristics for 802.11g 54M

802.11g Transmit (Conductive)					
Item	Condition	Min.	Typ.	Max.	Unit
Frequency Range		Channel 1		Channel 13	
Tx Power Level	OFDM	15.0	17.0	19.0	dBm
Frequency Tolerance		-15	0	15	ppm
Modulation Accuracy	All data rate		-31	-28	
802.11g Receiver (Conductive)					
Item	Condition	Min.	Typ.	Max.	Unit
Frequency Range		Channel 1		Channel 13	
Min. Input	54Mbps PER<10%	-78.0	-76.0	-74.0	

3.2.3. RF Characteristics for 802.11n MCS7(HT20)

802.11n_HT20 Transmit (Conductive)					
Item	Condition	Min.	Typ.	Max.	Unit
Frequency range		Channel 1		Channel 13	
Tx Power Level	OFDM	15.0	17.0	19.0	dBm
Frequency Tolerance		-15	0	15	ppm
Modulation Accuracy	All Data Rate		-31	-28	dB
802.11n_HT20 Receiver (Conductive)					
Item	Condition	Min.	Typ.	Max.	Unit
Frequency Range		Channel 1		Channel 13	
Min. Input	MCS7 PER<10%	-76.5	-74.5	-72.5	dBm

3.2.4. RF Characteristics for 802.11n MCS7(HT40)

802.11n_HT40 Transmit (Conductive)					
Item	Condition	Min.	Typ.	Max.	Unit
Frequency range		Channel 1		Channel 13	
Tx Power Level	OFDM	15.0	17.0	19.0	dBm
Frequency Tolerance		-15	0	15	ppm
Modulation Accuracy	All Data Rate		-31	-28	dB
802.11n_HT40 Receiver (Conductive)					
Item	Condition	Min.	Typ.	Max.	Unit
Frequency Range		Channel 1		Channel 13	
Min. Input	MCS7 PER<10%	-76.5	-74.5	-72.5	dBm

4. Pin Definition

4.1. Detailed Pin Description

[illegible]

Module_pinout	Pin NAME	DIGITAL Pin	SERIAL Pin	Other
1	GND			
2	JTAG_TMS			
3	JTAG_TDO	GPIO 43	EPHY LED	
4	JTAG_RST_N			
5	UART_TXD1	GPIO 45	UART_TXD1	
6	UART_RXD1	GPIO 46	UART_RXD1	
7	I2S_SDI	GPIO 0	I2S_SDI	
8	I2S_SDO	GPIO 1	I2S_SDO	
9	I2S_WS	GPIO 2	I2S_WS	
10	I2S_CLK	GPIO 3	I2S_CLK	
11	I2C_SCLK	GPIO 4	I2C_SCL	
12	I2C_SD	GPIO 5	I2C_SDA	
13	GND			
14	MDI_RP_P0		ETHY RD+	
15	MDI_RN_P0		ETHY RD-	
16	MDI_TP_P0		ETHY TD+	
17	MDI_TN_P0		ETHY TD-	
18	GPIO0			
19	UART_TXD0	GPIO 12	UART_TXD0	
20	UART_RXD0	GPIO 13	UART_RXD0	
21	USB_DP		USB D+	
22	USB_DM		USB D-	
23	SD_WP			
24	SD_CD			
25	SD_D1			
26	SD_D0			
27	SD_CLK			
28	SD_CMD			
29	SD_D3			
30	SD_D2			

Module_pinout	Pin NAME	DIGITAL Pin	SERIAL Pin	Other
31	GND			
32	UART_RXD2	GPIO 21	UART_RXD2	PWM2
33	UART_TXD2	GPIO 20	UART_TXD2	PWM3
34	MDI_RN_P2	GPIO 19		
35	MDI_RP_P2	GPIO 18		PWM0
36	MDI_RN_P1	GPIO 17		PWM1
37	MDI_RP_P1	GPIO 16		
38	MDI_TN_P1	GPIO 15		
39	MDI_TP_P1	GIPO 14		
40	GND			
41	GND			
42	GND			
43	GND			
44	GND			
45	WLED_N			Wi-Fi LED
46	REF_CLKO	GPIO 37		REF_CLK
47	PERST_N			
48	WDT_RST_N			WiFi RESET
49	PORST_N			MPU RESET
50	PCIE_TXP0			
51	PCIE_TXN0			
52	PCIE_RXP0			
53	PCIE_RXN0			
54	3v3			
55	PCIE_CKN0			
56	PCIE_CKP0			
57	JCLK			
58	JTDI			
59	GND			
60	2.4G_RF			
P1 *	SPI_CLK	GPIO7	SPI_CLK	
P2 *	SPI_MOSI	GPIO8	SPI_MOSI	
P3 *	SPI_MISO	GPIO9	SPI_MISO	

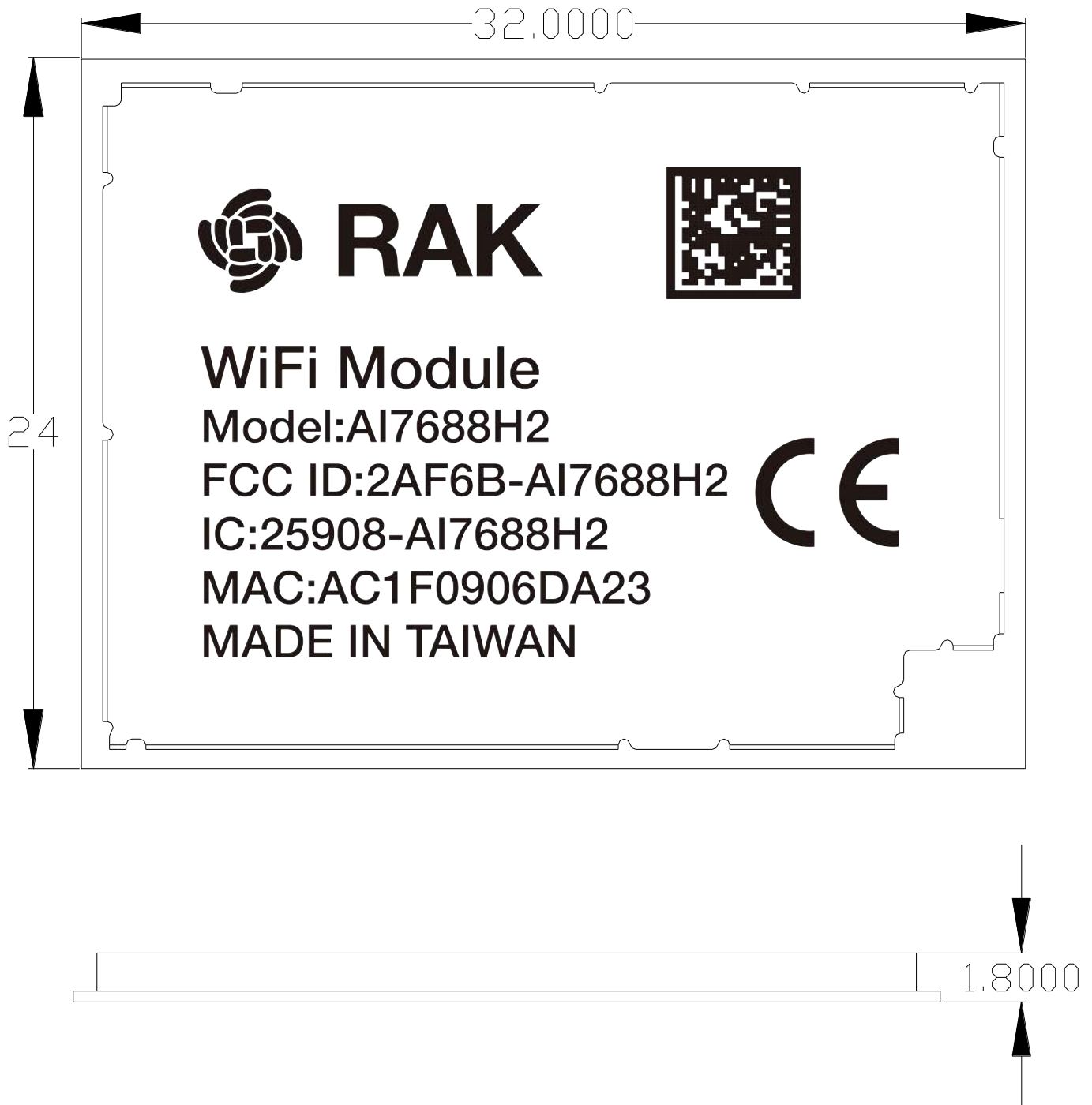
P4	*	SPI_CS1	GPIO6	SPI_CS1	
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*IF P1 、 P2 、 P3 、 P4 are not used, please do not connect them (DNC)

4.2. AI7688H2 Dimension

UNIT : mm

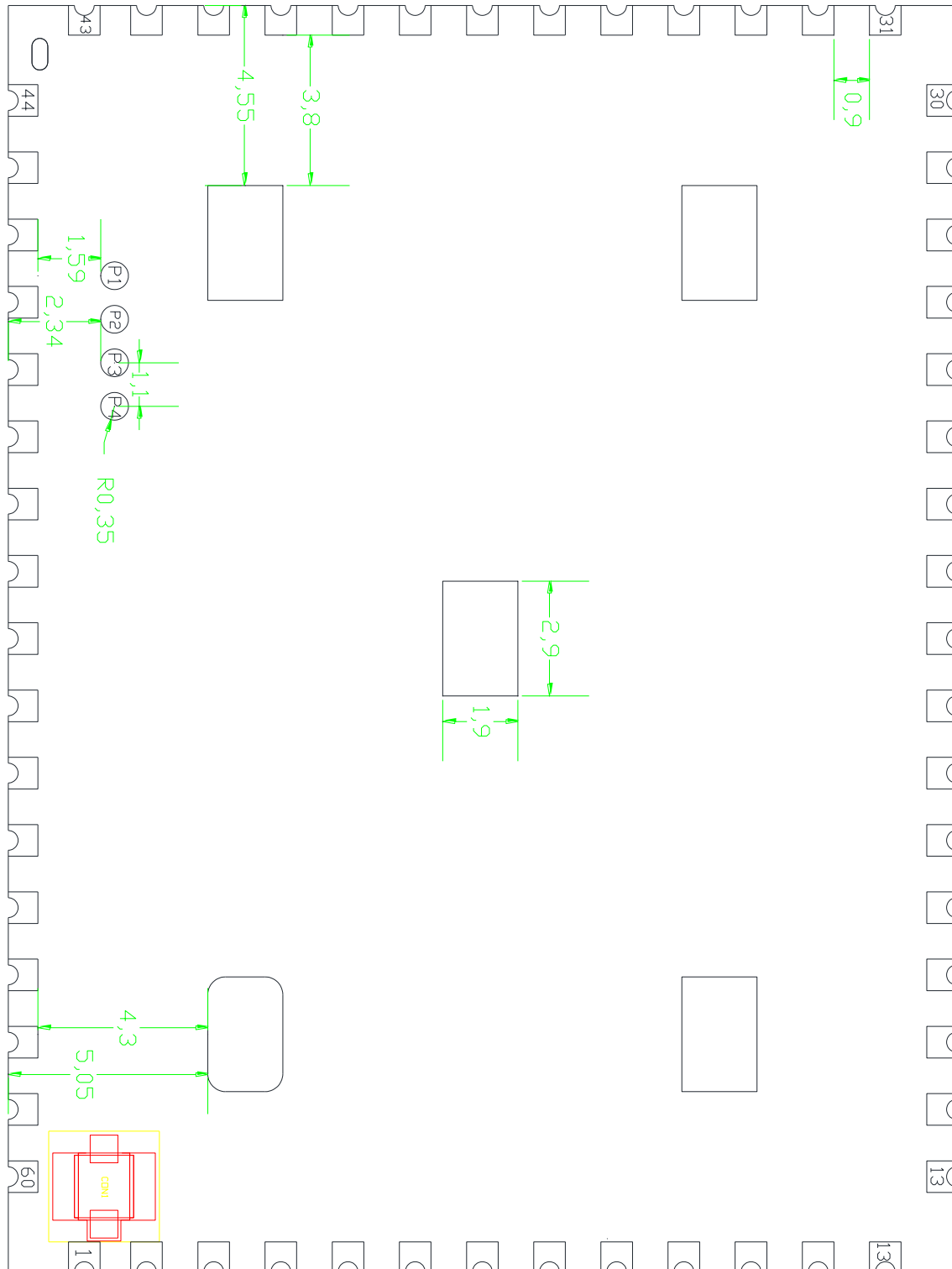
TOP VIEW



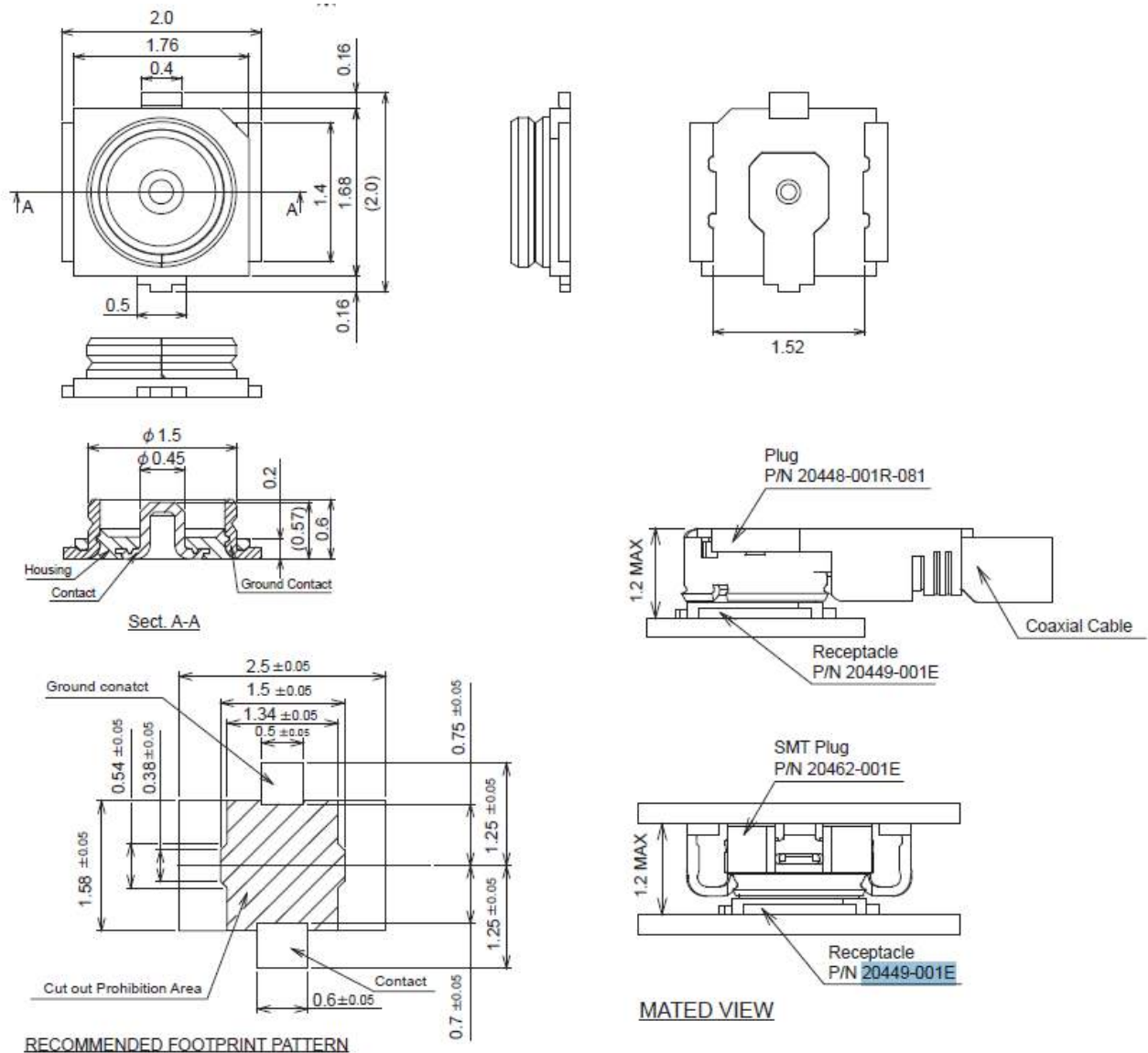
4.3. AI7688H2 Footprint Dimension

UNIT : :mm

TOPVIEW



4.4. Antenna Connector Dimension

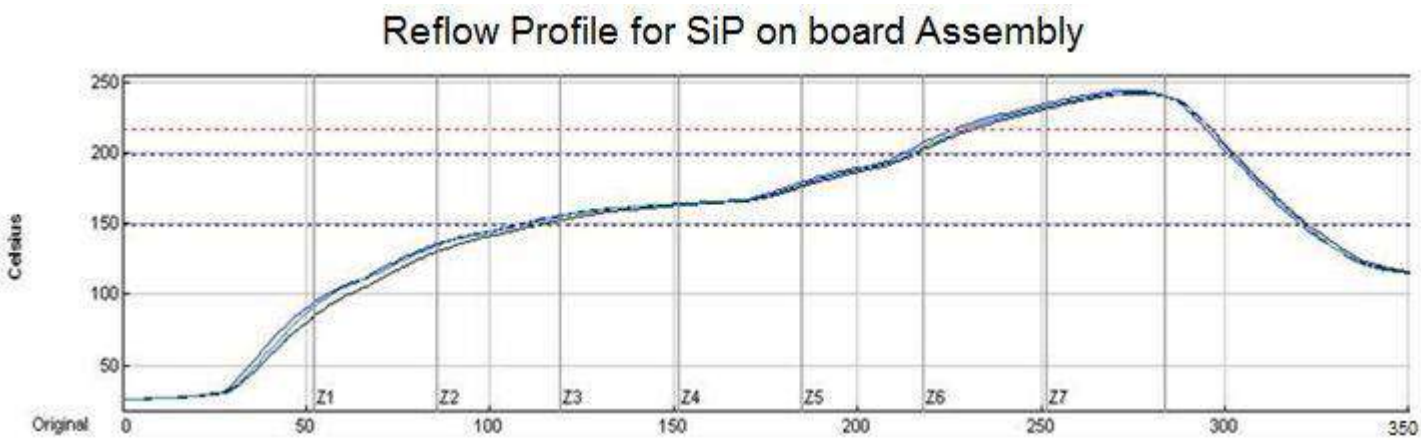


5. Regulator

This SiP module is pre-scanned on module level to comply with following standards:

- FCC IDENTIFIER : 2AF6B-AI7688H2
- CE Test Report No. : LD160513C24

6. Recommended Reflow Profile



Preheat time	150℃—200℃ : 105+/-15sec
Dwell time	Over 220℃ : 70+5/-10 sec
Peak Temp	240 +10/-5℃
Ramp Up/Down Rate	Up: 3 +0/-2 °C / sec Down: 2 +0/-1℃ / sec

7. SiP Module Preparation

7.1. Handling

Handling the module must wear the anti-static wrist strap to avoid ESD damage. After each module is aligned and tested, it should be transport and storage with anti -static tray and packing. This protective package must be remained in suitable environment until the module is assembled and soldered onto the main board.

7.2. SMT Preparation

1. Calculated shelf life in sealed bag: 6 months at $<40^{\circ}\text{C}$ and $<90\%$ relative humidity (RH).
2. Peak package body temperature: 250°C .
3. After bag was opened, devices that will be subjected to reflow solder or other high temperature process must.
 - A. Mounted within: 168 hours of factory conditions $<30^{\circ}\text{C}/60\%\text{RH}$.
 - B. Stored at $\leq 10\%\text{RH}$ with N2 flow box.
4. Devices require baking, before mounting, if:
 - A. Package bag does not keep in vacuumed while first time open.
 - B. Humidity Indicator Card is $>10\%$ when read at $23\pm 5^{\circ}\text{C}$.
 - C. Expose at 3A condition over 8 hours or Expose at 3B condition over 24 hours.
5. If baking is required, devices may be baked for 12 hours at $125\pm 5^{\circ}\text{C}$.

8. Package Information

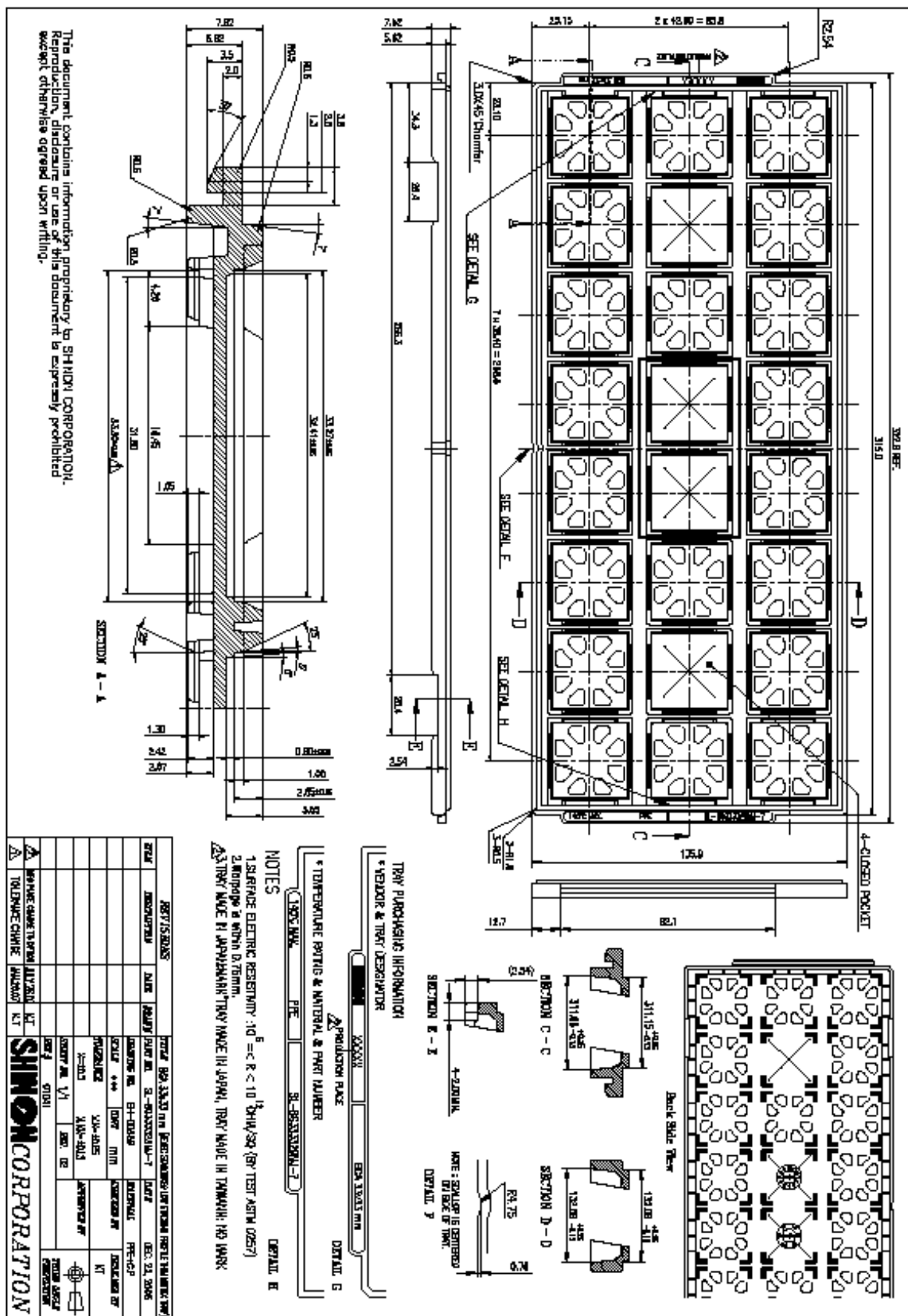
8.1. Product Making

Figure 1 below details the standard product marking for all RAK Corp. products. Cross reference to the applicable line number and table for a full detail of all the variables.

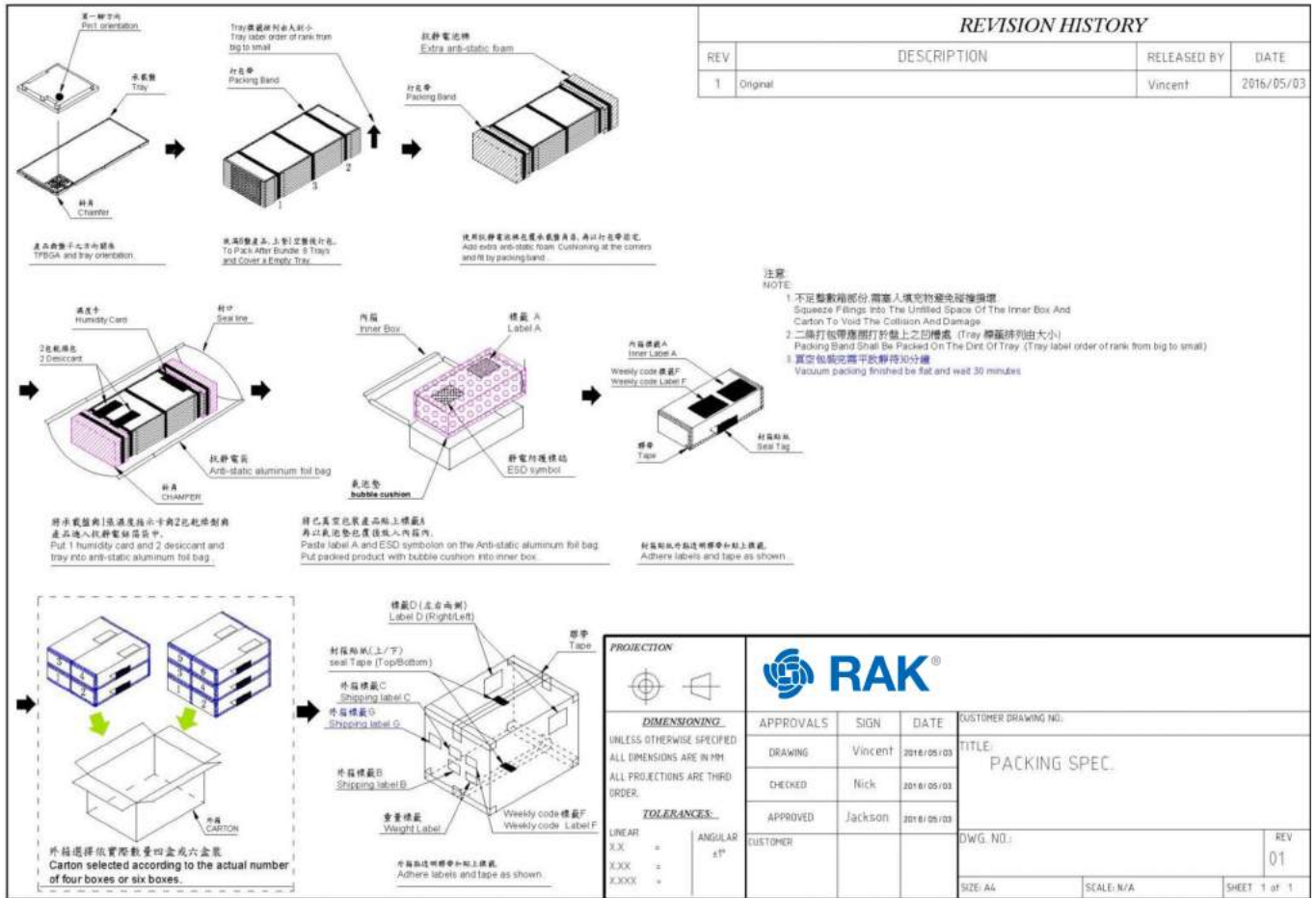


Figure 1 Standard Product Marking Diagram- TOP VIEW

8.2. Tray Dimension



8.3. Packing Information



8.4. Humidity Indicator Card



Dry

Indicates 指示點:
10%,20%,30,40%,50%,60% relative humidity
10%,20%,30,40%,50%,60% 相對濕度

Color Change 顏色變化:
Brown (Dry) ---> Blue (Wet)
棕色 (乾燥) ---> 藍色 (潮溼)

9 Warning

FCC Warning:

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

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

FCC Statement:

"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."

INTEGRATION INSTRUCTIONS

1. This Modular Approval is limited to OEM installation for mobile and fixed applications only. The antenna installation and operating configurations of this transmitter, including any applicable source-based time- averaging duty factor, antenna gain and cable loss must satisfy MPE categorical Exclusion Requirements of 2.1091. This equipment complies with FCC & Industry Canada exposure limits set forth for an uncontrolled environment.
2. When the module is installed in the host device, the FCC ID label must be visible through a window on the final device or it must be visible when an access panel, door or cover is easily removed. If not, a second label must be placed on the outside of the final device that contains the following text: —Contains FCC ID: 2AF6B-AI7688H2.

3. The Shenzhen Rakwireless Technology Co., Ltd. modular transmitter is only FCC authorized for the FCC Part15.247 listed on the grant, and that the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. If the grantee markets their product as being Part 15 Subpart B compliant (when it also contains unintentional-radiator digital circuitry), then the grantee shall provide a notice stating that the final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

ISED Warning:

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:

1. This device may not cause interference.
2. This device must accept any interference, including interference that may cause undesired operation of the device.

L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

1. L'appareil ne doit pas produire de brouillage;
2. L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

This equipment complies with FCC & Industry Canada exposure limits set forth for an uncontrolled environment, this Transmitter must be installed to provide a separation distance of at least 20 cm from all persons.

L'équipement est conforme aux limites d'exposition établies par l'IC et Industrie Canada pour les environnements non contrôlés, Cet émetteur doit être installé pour fournir une distance de séparation d'au moins 20 cm de toute personne.

The host product shall be properly labelled to identify the modules within the host product. The ISED certification label of a module shall be clearly visible at all times when installed in the host product; otherwise, the host product must be labelled to display the ISED certification number for the module, preceded by the word "contains" or similar wording expressing the same meaning, as follows:

Contains IC: 25908-AI7688H2

Le numéro d'homologation d'ISDE, le NIVM, le NMP et le NIVL ne doivent pas nécessairement être adjacents.

Le numéro d'homologation se compose d'un numéro de compagnie (NC), attribué par le Bureau d'homologation et de services techniques d'ISDE, suivi du numéro de produit

unique (NPU) attribué par le requérant. Le numéro d'homologation doit apparaître comme suit : IC: 25908- AI7688H2

Labelling

The proposed FCC IC label format is to be placed on the module. If it is not visible when the module is installed into the system,
“Contains FCC ID: 2AF6B-AI7688H2, Contains IC: 25908-AI7688H2” shall be placed on the outside of final host system.

Labelling

— This radio transmitter [25908-AI7688H2] has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

— Le présent émetteur radio [25908-AI7688H2] a été approuvé par Innovation, Sciences et Développement économique Canada pour fonctionner avec les types d'antenne énumérés cidessous et ayant un gain admissible maximal. Les types d'antenne non inclus dans cette liste, et dont le gain est supérieur au gain maximal indiqué pour tout type figurant sur la liste, sont trictement interdits pour l'exploitation de l'émetteur.

Antenna info

Antenna #	Model	Antenna Gain	Manufacturer	Antenna Type
1#	6147F00027	3dBi	Signal Plus Technology Co., Ltd	PCB layout Antenna