a module solution provider

MM5D91-0B

60GHz mmWave Radar

Entrance Counter Sensor Module

Datasheet

Draft 0.2

http://www.jorjin.com.tw

Index

1. INTRODUCTION

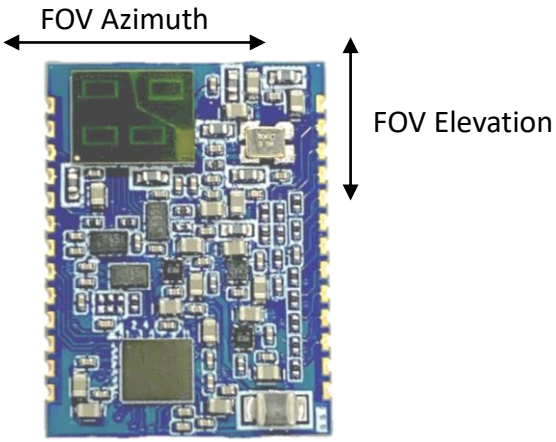
The MM5D91-0B is the Smart Entrance Counter sensor solution which integrates 60GHz mmWave technology counts number of people entering and/or exiting an entrance. The module simplifies the implementation of mmWave sensors in the band of 61.0 to 61.5GHz, and it includes the ARM Cortex-M4F based processor system, 1Tx 3Rx antenna and onboard regulator.

1.1. General Features

- ARM Cortex-M4F 150MHz, 1024KB Flash, 288KB RAM
- Built-in Antenna (1Tx, 3Rx)
- Built-in Regulator
- UART interface and GPIOs
- 3.6~5.5V Power input
- 26pin pitch 1.27mm Castellated Holes
- Dimensions: 20 x 15 x 2.3 mm

1.2. Entrance Counter Features

- Real time count of people entering or exiting the premises.
- High accuracy counting without delay.
- Adjustable detect range and sensitivity
- Both Ceiling and Side installable
- Field of View of Radar: Azimuth: ± 45° / Elevation: ± 40°



2. HARDWARE INFORMATION

2.1. Block Diagram

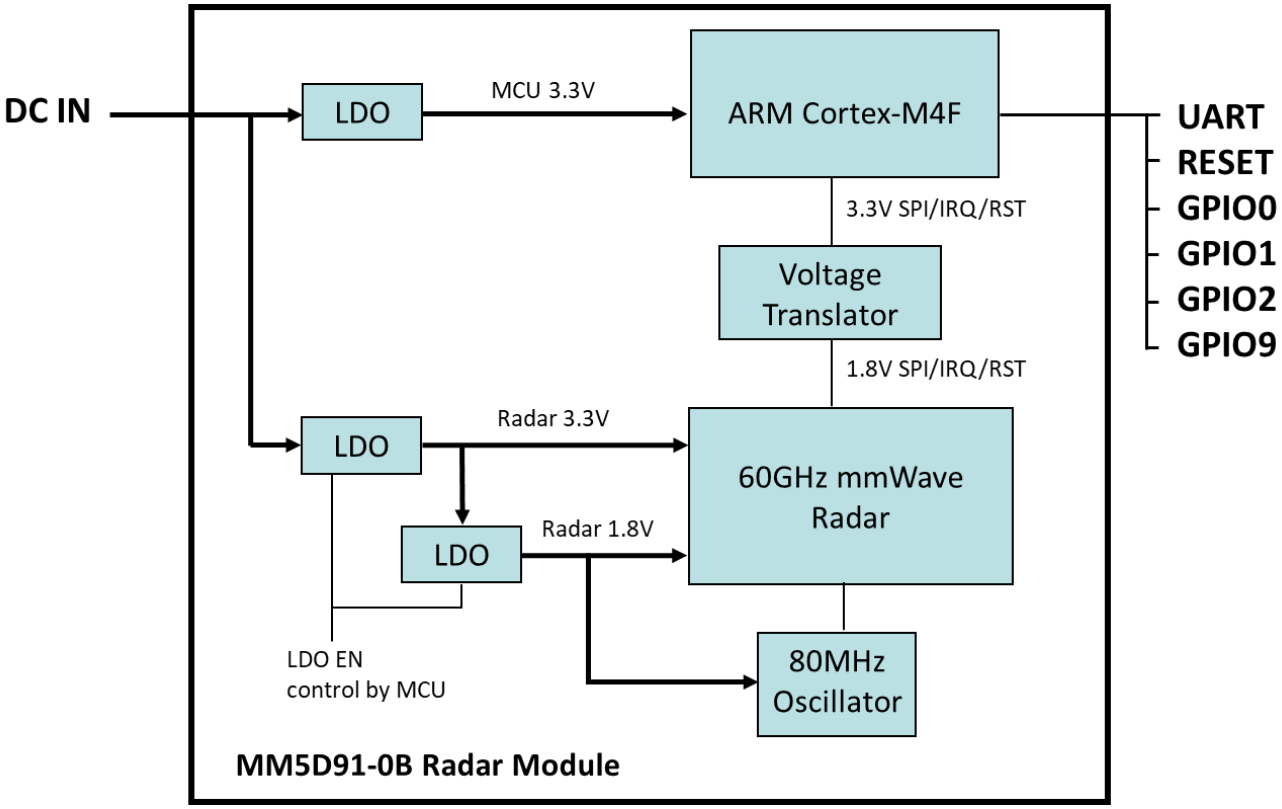


Figure 2-1. MM5D91-0B Block Diagram

2.2. Module Pin Define

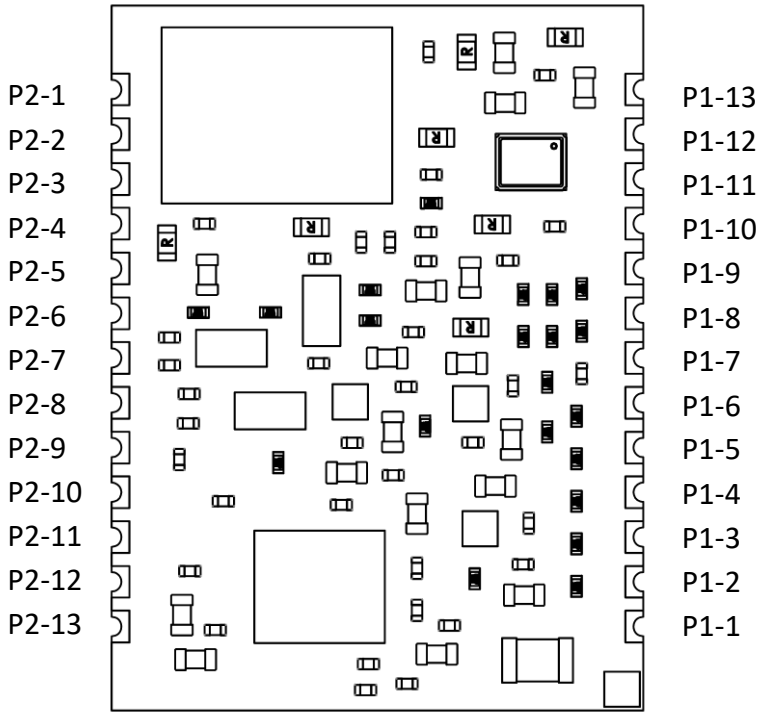


Figure 2-2. MM5D91-0B Module View

P1 Pin define:

Pin No.	Signal Name	Description
P1-1	NC	No Used.
P1-2	NC	No Used.
P1-3	NC	No Used.
P1-4	NC	No Used.
P1-5	NC	No Used.
P1-6	NC	No Used.
P1-7	NC	No Used.
P1-8	nRESET	Reset for radar module. Internal pull high default.
P1-9	UART_TX	UART Transmit. Reserve test point for firmware upgrade.
P1-10	UART_RX	UART Receive. Reserve test point for firmware upgrade.
P1-11	NC	No Used.
P1-12	NC	No Used.
P1-13	GND	Ground.

P2 Pin define:

Pin No.	Signal Name	Description
P2-1	NC	No Used.
P2-2	NC	No Used.
P2-3	GPIO0	GPIO0. Default low, green color for no people detected.
P2-4	GPIO1	GPIO1. Default low, red color for people detected.
P2-5	GPIO2	GPIO2. Default low, blue color for bootloader mode indication.
P2-6	NC	No Used.
P2-7	NC	No Used.
P2-8	NC	No Used.
P2-9	NC	No Used.
P2-10	NC	No Used.
P2-11	NC	No Used.
P2-12	GPIO9	GPIO9. Please Pull high 1K ohm to VIO.
P2-13	DC_IN	Power supply input. Range from 3.6V to 5.5V.

2.3. Recommended Operating

Parameter		Min	Typ	Max	Units
DC_IN	DC supply input	3.6		5.5	V
VIH	IO high-level input voltage	2.3	-	-	
VIL	IO low-level input voltage	-	-	1	
Current Consumption @ DC_IN=5V (1)	Counter detect mode on		24.0		mA
	Counter detect mode off		3.7		
	Deep sleep mode		0.04		
Phase noise	At 100KHz offset		-80		dBc/Hz
Operating Temperature (2)		-20		70	°C
Storage Temperature		-40		85	°C

(1) Based on Entrance Counter firmware e6fba1c version.

(2) Means ambient temperature when working.

2.4. Built-in Antenna Specifications

Parameter		Min	Typ	Max	Units
RX_BW, TX_BW	Antenna bandwidth	61.0		61.5	GHz
Output Power	EIRP		+7.5		dBm
Antenna gain of single TX		2.0	3.5	5.0	dBi
Antenna gain of single RX		2.0	3.5	5.0	dBi
Field of View of Azimuth		70	90	110	Deg
Field of View of Elevation		60	80	100	Deg

3. RADAR RADIATION PATTERN

3.1. Test Setup

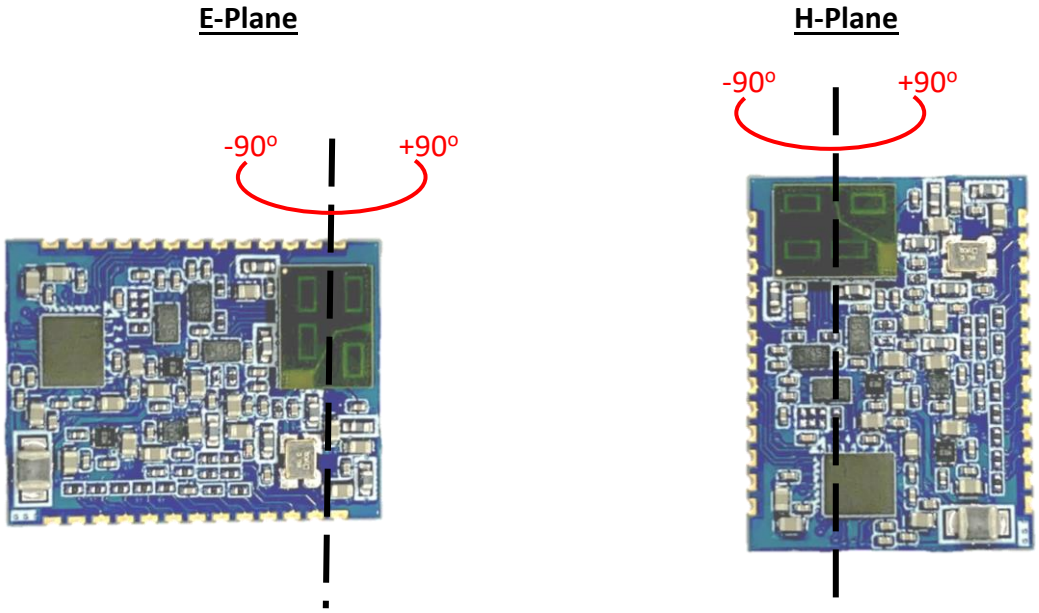


Figure 3-1. Antenna Setup

3.2. Radio Pattern

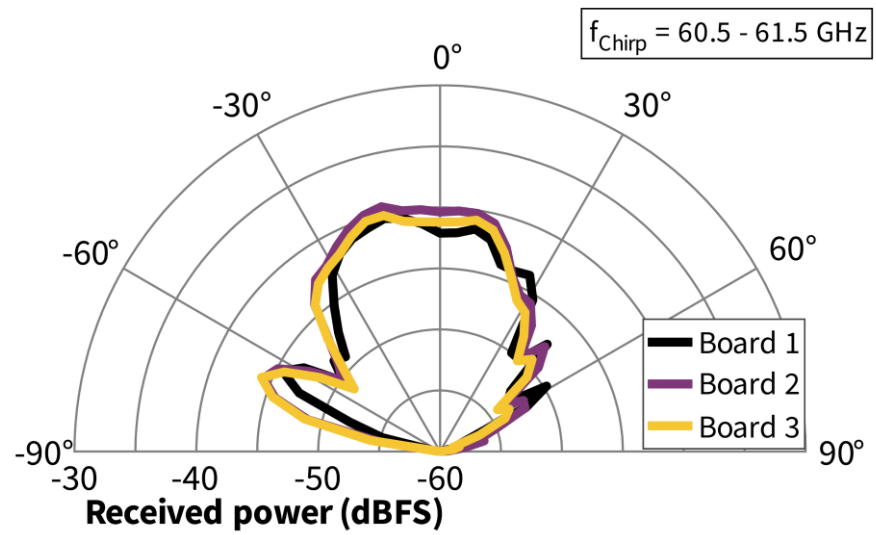


Figure 3-2. Radiation Pattern of the E-Plane

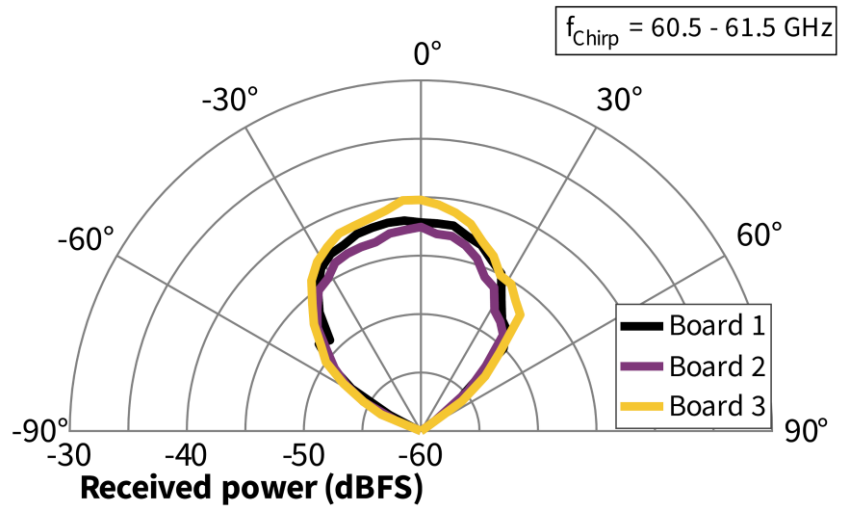
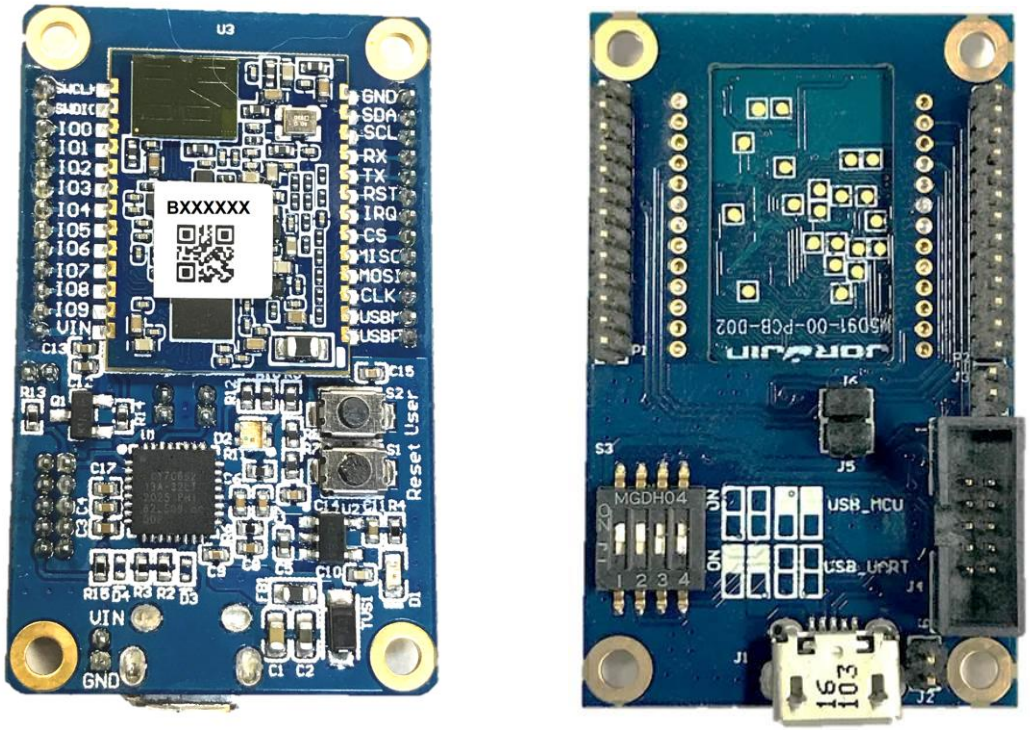


Figure 3-3. Radiation Pattern of the H-Plane

4. EVALUATION KIT

The Jorjin mmWave Radar sensor evaluation kit show as below. Based on the MM5D91-0B Radar sensor module, evaluation board is built to demonstrate the function of Smart Entrance Counter of the 60 GHz radar sensor with its sophisticated radar algorithms. This evaluation kit easy to demo and development for customer.



TOP side **Bottom side**

Figure 4-1. mmWave Radar Evaluation Kit

4.1. Evaluation Hardware Description

The following figure and table describe physical sections of the board.

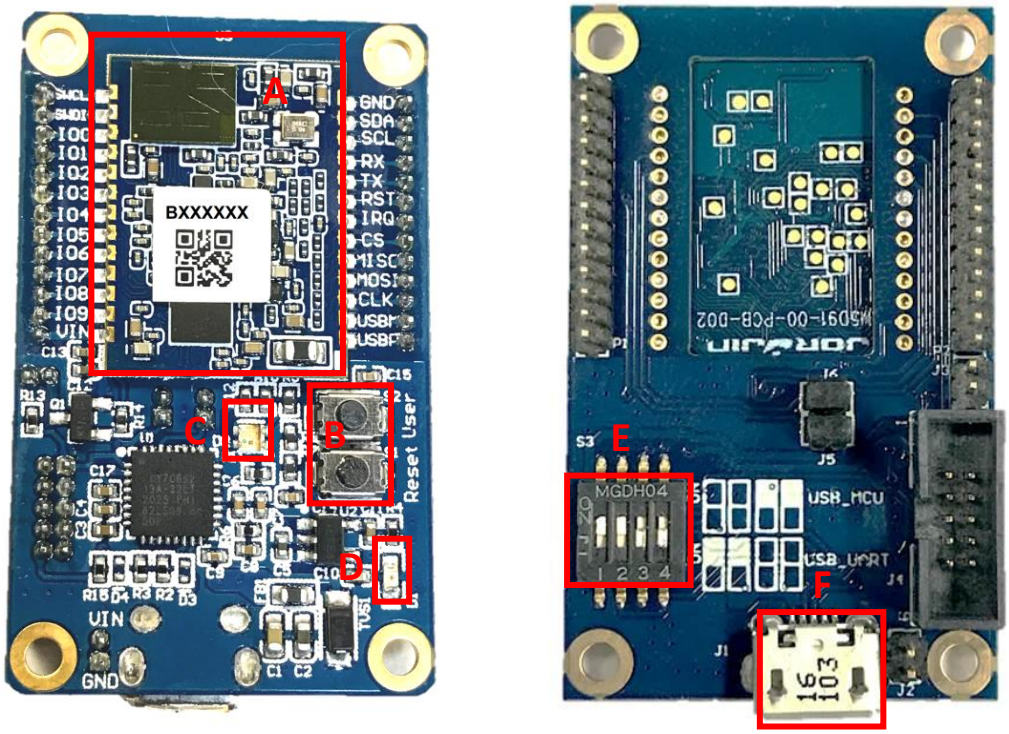


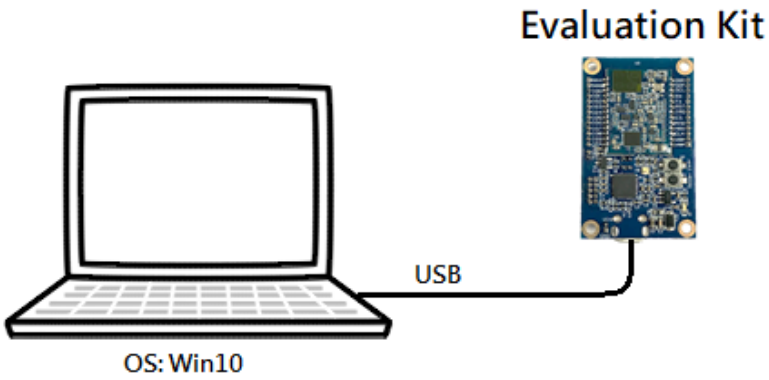
Figure 4-2. Hardware description of Evaluation Kit

Table 4-1. Evaluation Kit component descriptions list

Region	Description
A	Jorjin mmWave Radar sensor module.
B	Radar sensor module reset switch.
C	Red LED light when the evaluation kit is power on.
D	LED of radar detect status: - Green color : No people detected. - Red color : people are detected in setting area.
E	Interface setting: Turn up of left two / Turn down of right two. Please keep the setting always.
F	Micro USB connector. Connected to PC (config tool) or power bank to demo.

5. CONFIGURABILITY

5.1. Config Software Setup



If the OS is win7 or lower , please find the USB driver as the link.

Figure 5-1. Radar module connect to PC

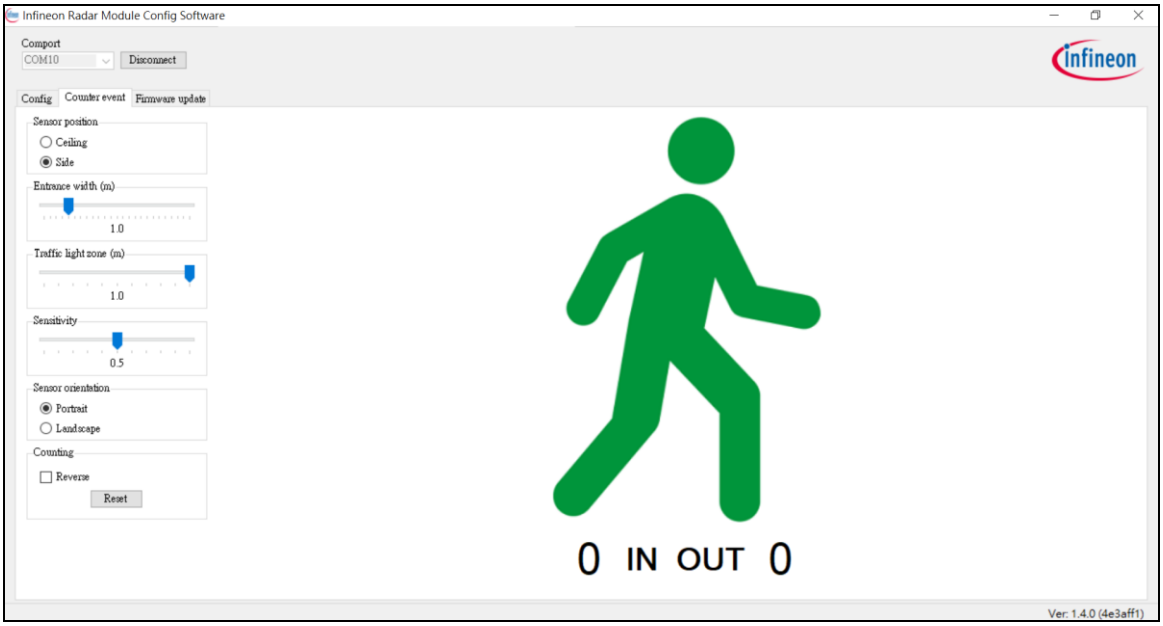


Figure 5-2. Configuration options for Smart Entrance Counter Solution

Configure the Smart Entrance Counter Solution according to your placement / installation using following settings:

- **Sensor Position:** Depending on the location of installation, select either ceiling or side.
- **Ceiling Height:** The height at which the module is mounted. The maximum height is 3m.
- **Entrance Width:** The width of the passage or the entrance. The maximum width is 3m.
- **Traffic Light Zone:** The detection zone of the smart entrance counter solution.
- **Sensitivity:** Changing the sensitivity changes the threshold for triggering the count. At higher senility, the threshold is closer to the noise floor.
- **Sensor Orientation**: The sensor can be mounted either in the portrait mode or in landscape orientation. The figure below describes the definition of longer and shorter edge.

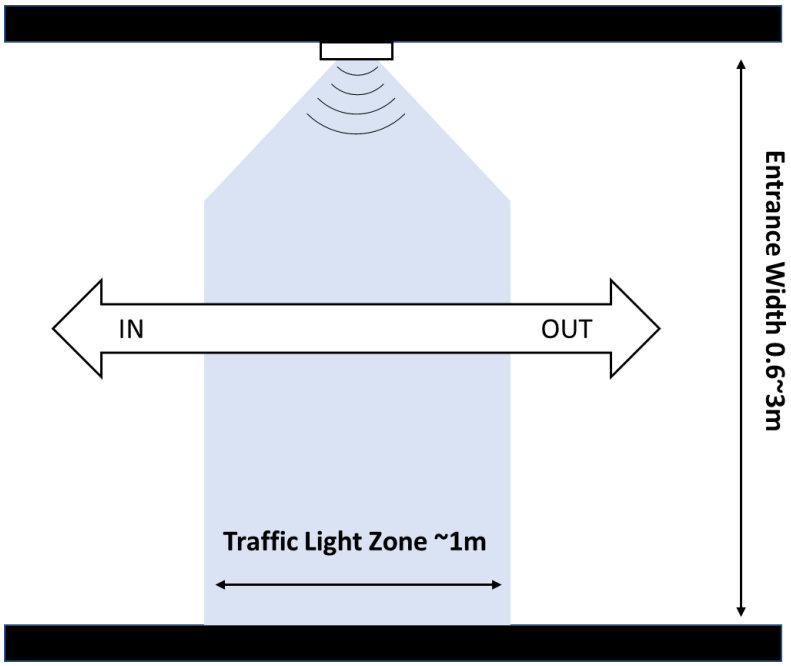


Figure 5-3. FOV of the smart entrance counter solution (Side mount)

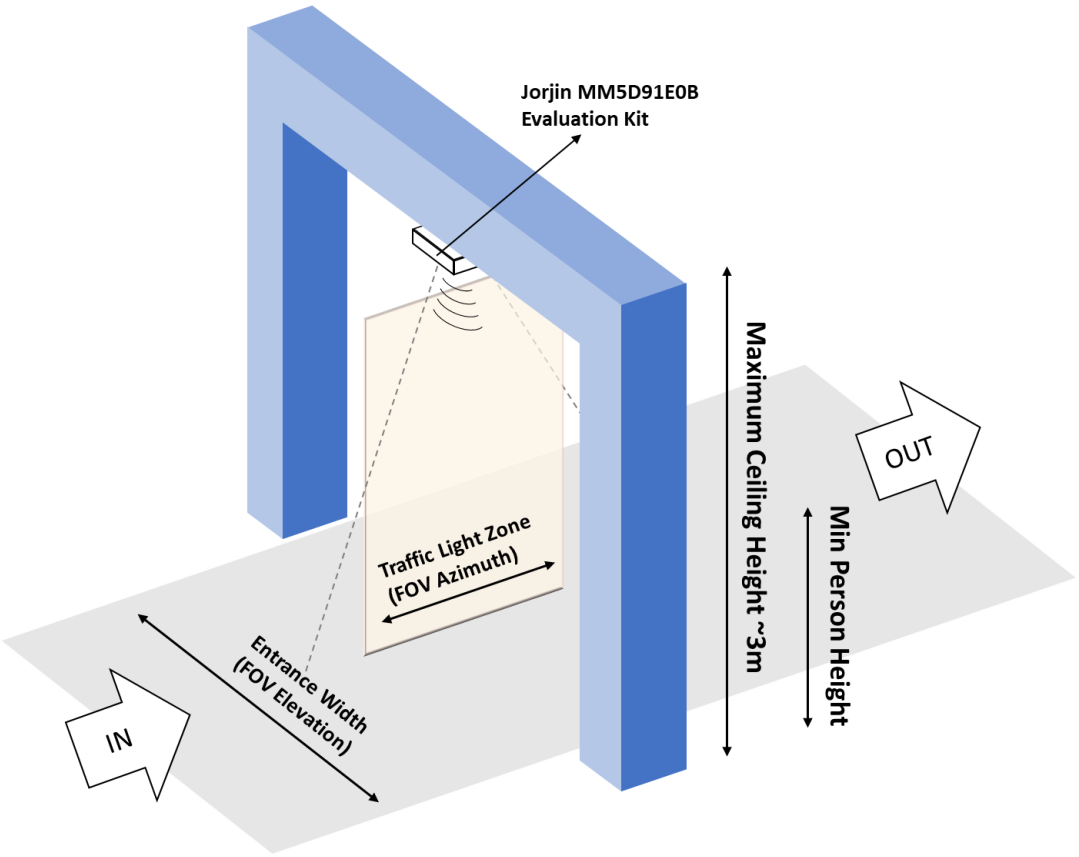


Figure 5-4. FOV of the smart entrance counter solution (Ceiling mount)

6. REFERENCE OF DESIGN

6.1. Reference Schematic

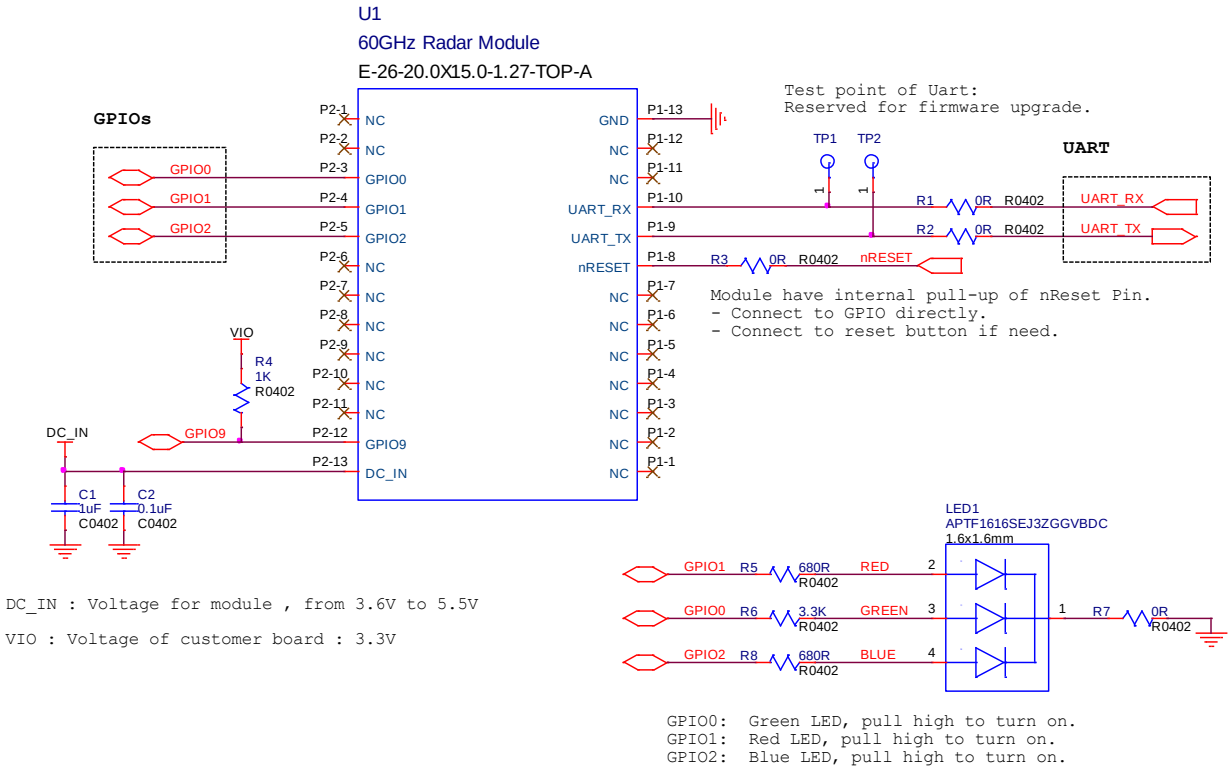


Figure 6-1. MM5D91-0B Radar Module Reference Circuit

6.2. Design Recommendation

1. Please reserve the test points of UART for firmware upgrade in the future.
2. Please keep the module solder layer that no ground plane and trace rout in the keep-out area. Show in Figure 6-2.
3. The power trace for DC_IN must be at least 20-mil wide.

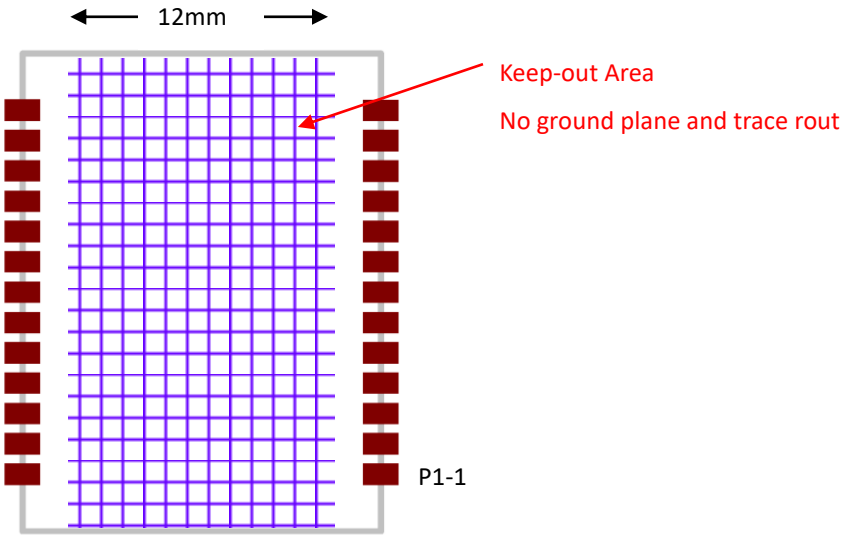
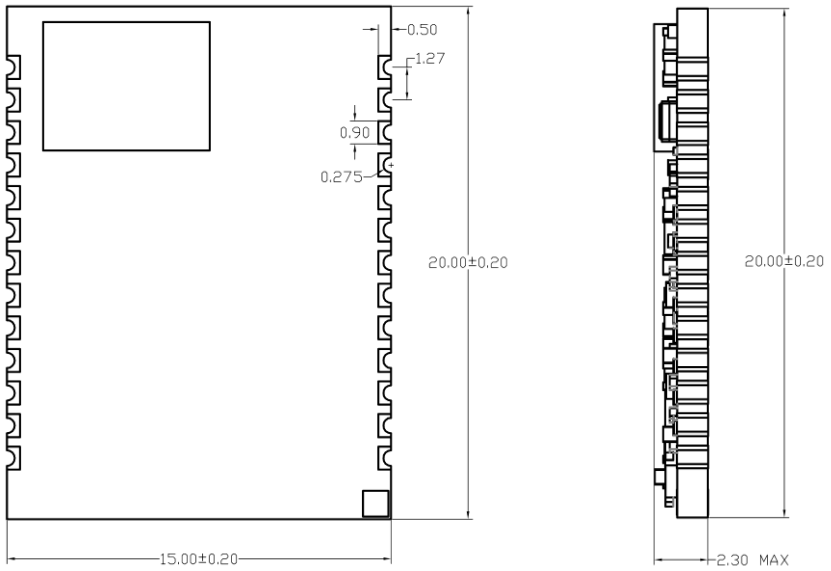


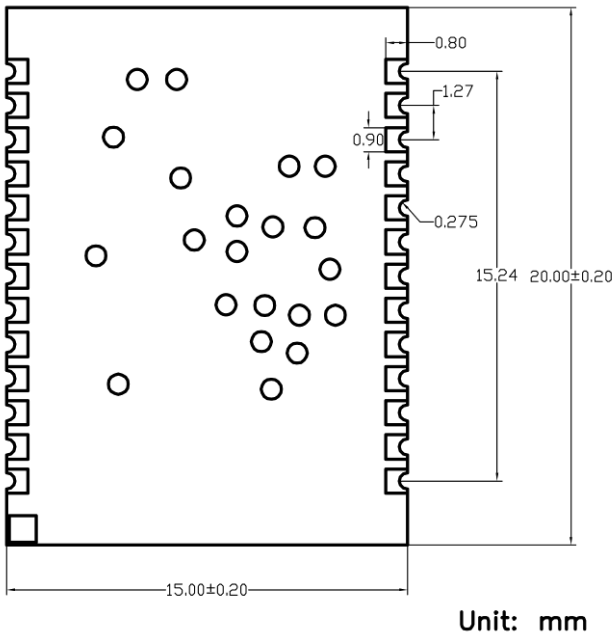
Figure 6-2. Recommend Layout of Radar module

7. PACKAGE INFORMATIION

7.1. Module Dimension



Top View Side View



Bottom View

Figure 7-1. MM5D91-0B Module Dimension

7.2. Recommended Land Pattern

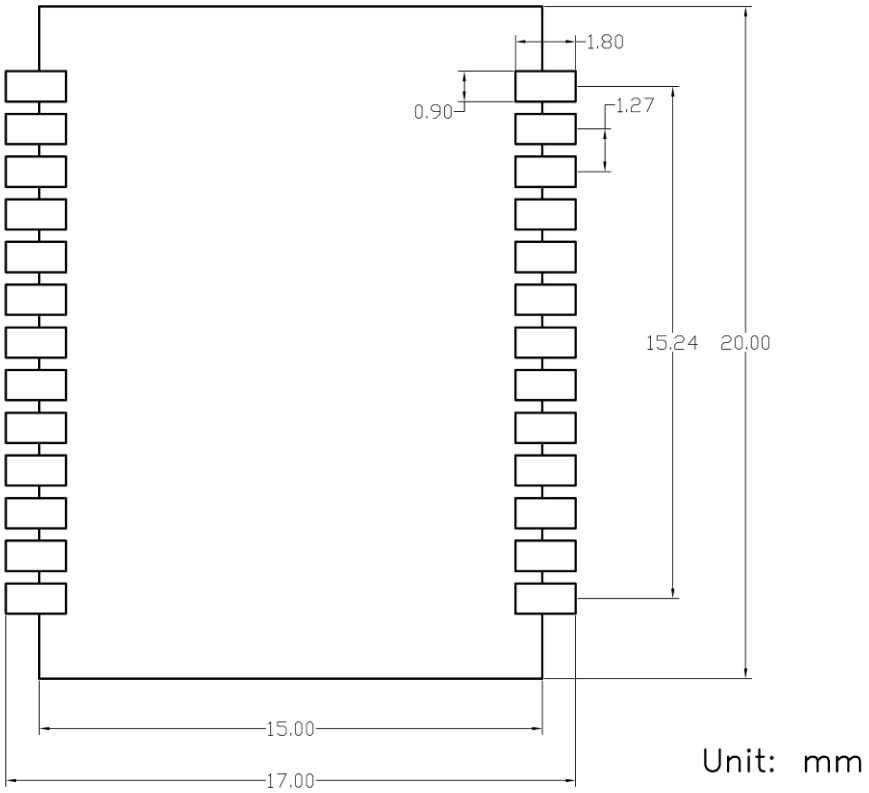
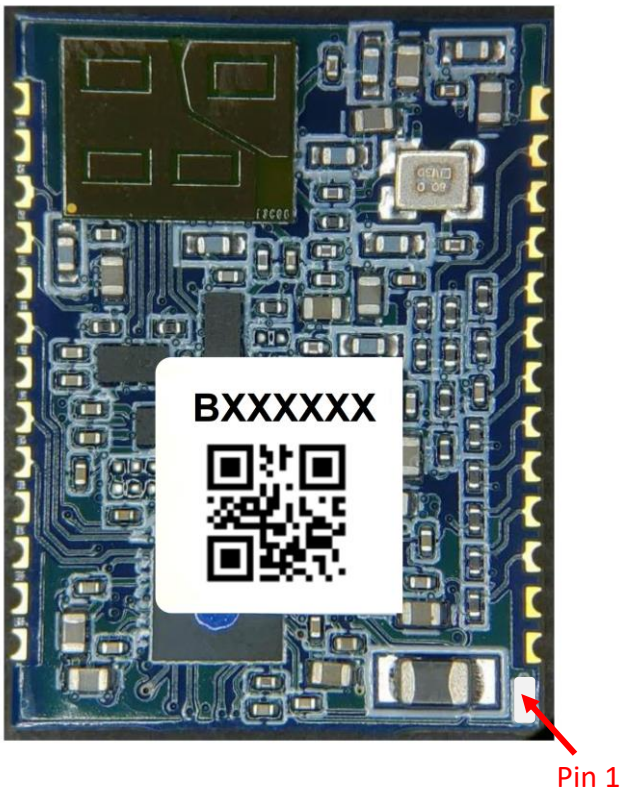


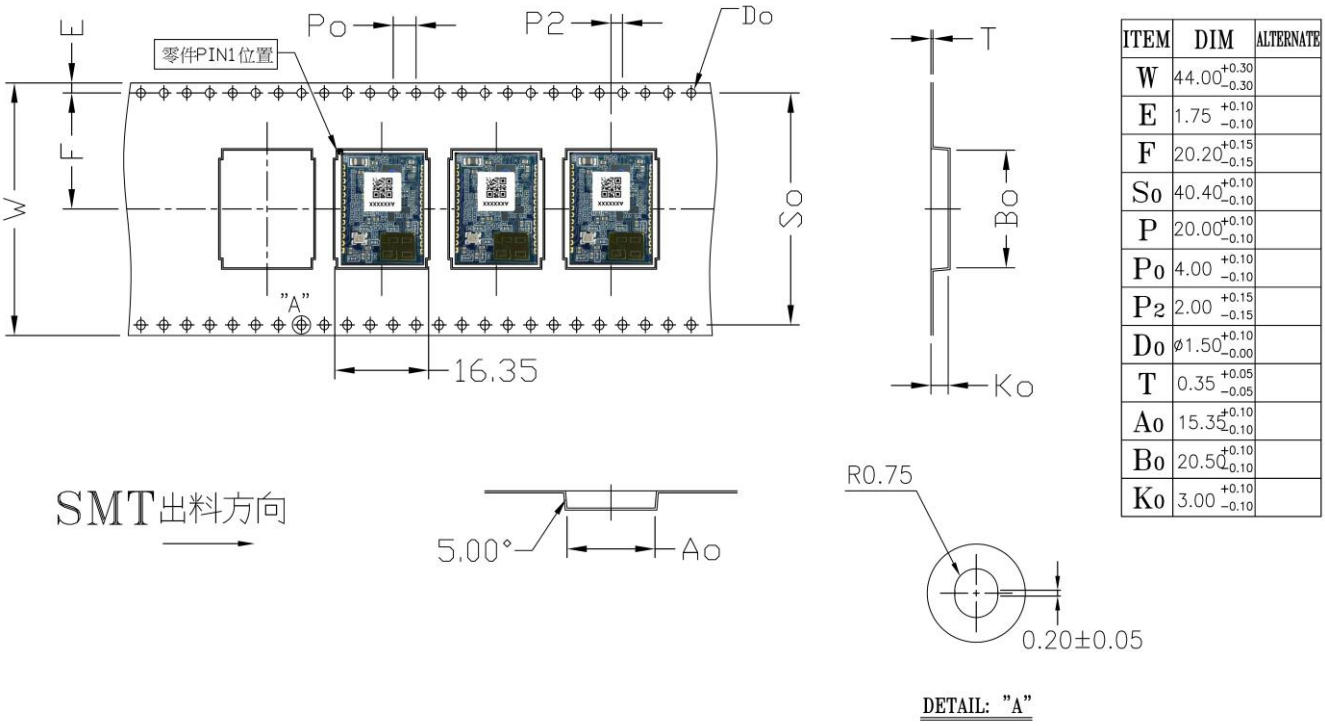
Figure 7-2. Recommended Land Pattern Dimension

7.3. Device Label

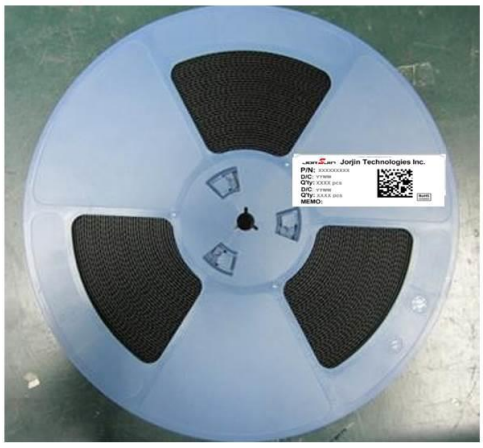


Marking	Description
QR Code : YYWW,BXXXXXX	YY : Digit of the year, ex: 2019=19 WW : Week (01~52) B : Product Number, ex: B=MM5D91-0B XXXXXX : Series number.

7.4. Tape Reel information



ITEM	DIM	ALTERNATE
W	$44.00^{+0.30}_{-0.30}$	
E	$1.75^{+0.10}_{-0.10}$	
F	$20.20^{+0.15}_{-0.15}$	
So	$40.40^{+0.10}_{-0.10}$	
P	$20.00^{+0.10}_{-0.10}$	
Po	$4.00^{+0.10}_{-0.10}$	
P2	$2.00^{+0.15}_{-0.15}$	
Do	$\phi 1.50^{+0.10}_{-0.00}$	
T	$0.35^{+0.05}_{-0.05}$	
Ao	$15.35^{+0.10}_{-0.10}$	
Bo	$20.50^{+0.10}_{-0.10}$	
Ko	$3.00^{+0.10}_{-0.10}$	



Reel : 1000 pcs per reel

Pizza Box : 1 reel per pizza box

8. SMT / BAKING INFORMATION

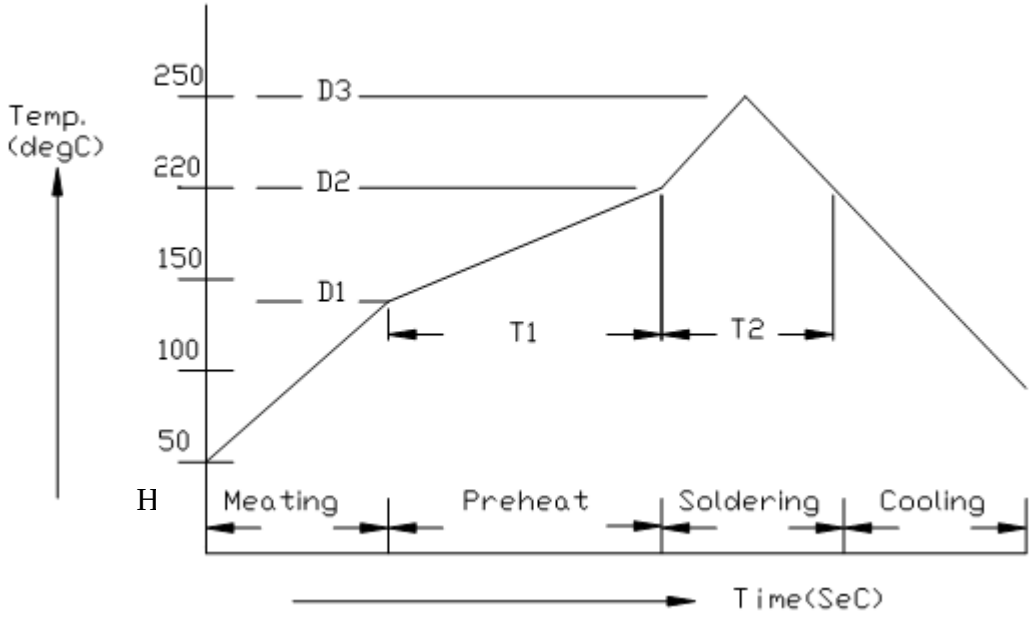
8.1. Baking Recommendation

Baking condition:

- Follow MSL Level 4 to do baking process.
- After bag is opened, devices that will be subjected to reflow solder or other high temperature process must be
  a. Mounted within 72 hours of factory conditions <30°C / 60% RH
  b. Stored at <10% RH.
- Devices require bake, before mounting, if Humidity Indicator Card reads >10%
- If baking is required, Devices may be baked for 8 hrs at 125 °C.

8.2. SMT Recommendation

Recommended Reflow profile:



No.	Item	Temperature (°C)	Time (sec)
1	Pre-heat	D1: 140 ~ D2: 200	T1: 80 ~ 120
2	Soldering	D2: = 220	T2: 60 +/- 10
3	Peak-Temp.	D3: 250 °C max	

Note-1: Reflow soldering is recommended two times maximum.

Note-2: Add Nitrogen while Reflow process: SMT solder ability will be better.

- **Stencil thickness:** 0.1~ 0.13 mm (Recommended)
- **Soldering paste (without Pb):**
  Recommended SENJU N705-GRN3360-K2-V can get better soldering effects.

9. ORDERING INFORMATION

Order number	Description
MM5D91-0BA	Entrance Counter Sensor module
MM5D91E0B	Evaluation kit of MM5D91-0B

10. HISTORY CHANGE

Revision	Date	Description
Draft 0.1	2021-03-18	Official version release.
Draft 0.2	2022-01-03	Correct the photo and description of evaluation kit.