MINEWSEMI

24G Millimeter Wave Radar

ME73MS01

DateSheet

V 1.0.0

Applicable Product Model
ME73MS01

Version Note

Version	Details	Contributor(s)	Date	Notes
1.0.0	First edit	Vincle	2024.5.31	First
1.0.1	Operating Temperature	Vincle	2024.9.25	revise

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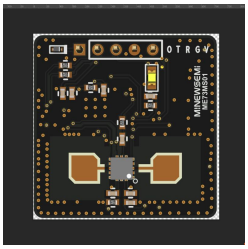
ME73MS01

High-performance,high-reliability,detectable micro-motion targets, user motion area detection



ME73MS1 is a high-sensitivity 24GHz millimeter-wave FMCW human presence detection radar module. Different from traditional radar, ME73MS01 detects the presence of human body by detecting large or small movements of human body. the main feature of this module is that it can detect small movements such as human breathing to determine the presence of human body based on the functions of traditional human body sensing radar. the module uses FMCW modulation and can simultaneously output the distance of the target. This product has the advantages of low cost, realizes the detection of whether the room is occupied or not., high reliability, high performance and so on.

■ Features

- High sensitivity
- High-reliability
- High-performance
- Detectable micro-motion targets
- User motion area detection

■ Application

Smart home people detection

Courtyard and indoor security people detection

Street lighting radar system

Industrial control radar sensor

■ Key parameter

Working frequency	24~24.25GHz	**Antenna**	PCB
Module size	20×20mm	**Processing Period**	Realize
Installation method (Application):	Ceiling/Wall Mount	**Detection Distance**	0.5 ~ 6m
Azimuth Coverage	±60°	**Pitch angle coverage**	±60°
Max Consumption	0.40w	**Avg Current**	22mA
Firmware	Ceiling/Wall Mount firmware		

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1 Module Description

1.1 Module Function Description

No.	Function	Detailes
1	Static Maintenance	Detectable micro-motion targets
2	Motion Sensing	User motion area detection

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1.2 Module Features

No.	Feature	Detailes
1	Installation scene	The product detection distance: 0.5~6m. （Note: The detection distance is related to factors such as installation environment, human body volume, relative angle, and movementrange. The above parameters are the test results of our company. Under different test conditions, the actual test results shall prevail）
2	Unaffected by the environment	Unaffected by temperature, humidity, dust, light, noise, etc.
3	Ceiling mount	Ceiling mounting 3M: stationary human body detection radius: Maximum 3m(configurable); Mobile human detection radius: Maximum 3m(configurable).
4	Wall mount	Supports 6m motion detection in straight line, 3m presence detection.

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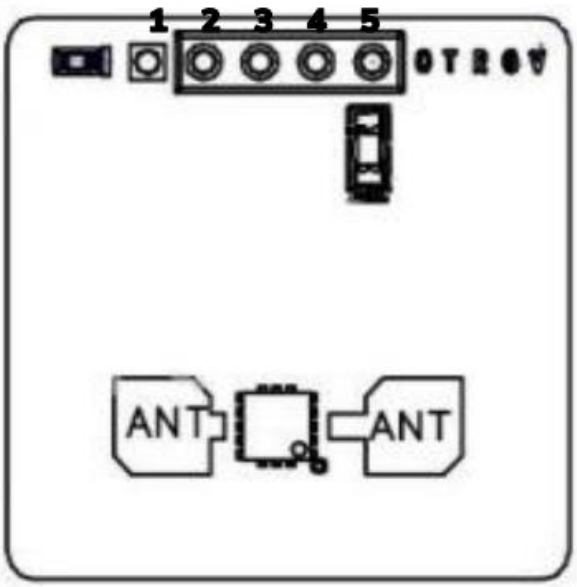
2 Electrical Specification

Parameter	Values	Notes
Operating Voltage	3.6 ~ 5.5V	Standard supply voltage 5V
Operating Temperature	-40℃~+85℃	
Avg Current	22mA	
Max Consumption	0.40w	
Module Dimension	20*20mm	
Quantity of IO Port	3	TX、RX、OUT

3 Pin Description



(TOP View)

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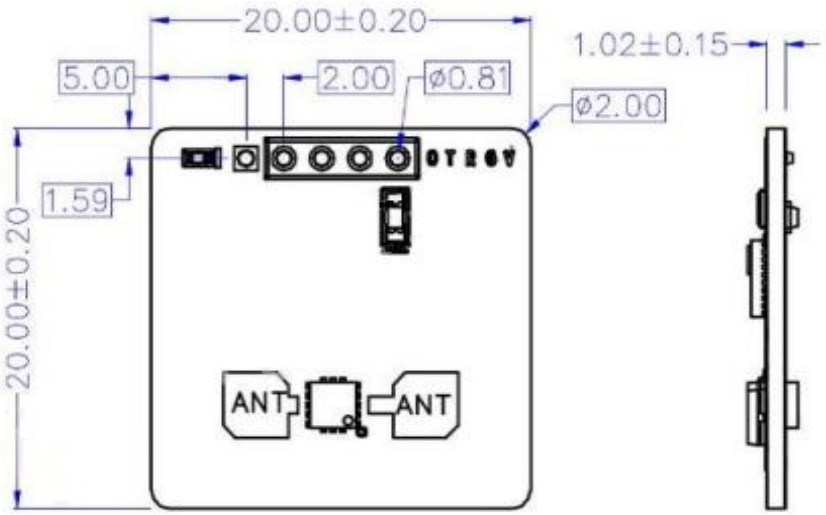
4 Pin Definition

Symbol	Type	Definition
1-O	Output	Output 3V with target, 0V without target (Optional 5V output, please specify in advance when ordering)
2-T	UART TX	Used for UART serial transmitter (UART TX)
3-R	UART RX	Used for UART serial Receiver (UART RX)
4-G	Ground	Power Ground
5-V	Power Supply	Power supply, input voltage 4V~5.5V

5 Mechanical Drawing



*（Default unit：mm　　Default tolerance：±0.15）

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6 Debug Configurable

6.1 Debug connect device

The module can be connected to terminals VCC, GND, Vo (output), RX, TX, and can display configuration parameters and target status information through the serial port. According to the module pin definition diagram, the module's power supply VCC, ground GND, serial port TX, serial port RX can be connected to the corresponding pins of the serial port board.

6.2 Debug instructions

Hexadecimal sending and receiving, support online modification and saving of parameters

- **Communication supports uart protocol**

  Baud Rate: 115200

  Data bits: 8

  Stop bits: 1

  Parity: none

- **Frame structure definition**

1. Frame header, 2 bytes

   Upper computer sends, radar receives: 0x55 0x5A

   Radar sends, upper computer receive: 0x55 0xA5

2. Data length, 2 bytes, high byte first, low byte last

   Length = function code + command + data + checksum

3. Function code, 1 bytes

   Read: 0x0

   Write: 0x1

   Passive reporter: 0x2

   Active reporter: 0x3

The read and write commands are for the upper computer to send instructions to the radar, and the report command is for the radar to send information to the upper computer.

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4. Command code

Command code 1 is the function classification, command code 2 is the specific function

5. Data

N Bytes

6. Checksum, 1 Bytes

The lower 8 bits of the sum of all data before the checksum in uint8_t format.

Notice: Data format description:

All multi-byte parameters are transmitted in big-endian format.

- **Radar output data format**

	Head		Packet Len		Func code	CMD		Data	Sum
Receiver	55	A5	00	0E	03	81	00	Data[0]~Data[9]:Target detected information	SUM
Data Format Description									
Setting/ Receiver	Data[0]				Target ID Number: 8-bit unsigned integer				
	Data[1]				Target status：8-bit unsigned integer; 0: NoBody, 1: Indicates movement body, 2: Indicates existence body				
	Data[2]		Data[3]		distance：16-bit unsigned integer, unit: cm				
	Data[4]		Data[5]		speed：16-bit signed integer， unit: cm/s				
	Data[6]				direction cosine：8-bit signed integer, unit: degrees				
	Data[7]				Pitch：8-bit signed integer, unit: degrees				
	Data[8]		Data[9]		Signal strength: 16-bit unsigned integer				

The radar detection results are reported actively. In the next page, we will give an example to illustrate the radar output information.

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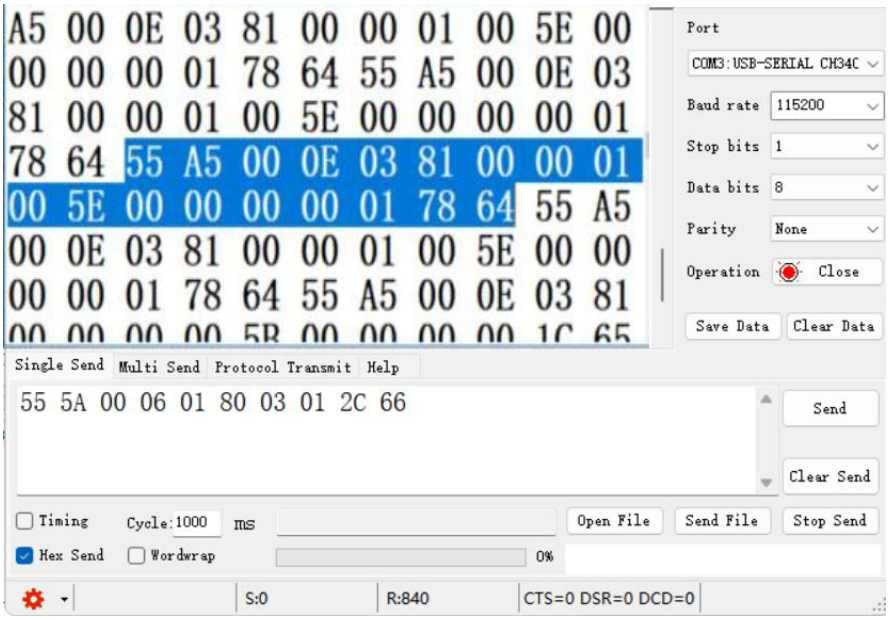
Example 1: Read Target information



The one marked on the figure is a complete received message: 55 A5 00 0E 03 81 00 00 01 00 5E 00 00 00 00 01 78 64

Target ID: 8th byte 0x00

Movement status: 9th byte 0x01, detected movement body

Target distance: 10th ~11th bytes 0x00 0x5E, converted to decimal is 94

Target Signal strength: 16th ~17th bytes 0x01 0x78, converted to decimal is 376

Checksum: 18th byte

In conclusion, detected movement target, target distance is 0.94 meter, signal strength is 376.

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Radar parameter configuration and read commands

OTA online upgrade	Send Receiver	55 5A 00 04 01 20 01 D5 55 A5 00 04 02 20 01 21	
Restore to default parameters	Send Receiver	55 5A 00 04 01 20 02 D6 55 A5 00 04 02 20 02 22	
Save all parameters to flash	Send Receiver	55 5A 00 04 01 20 04 D8 55 A5 00 04 02 20 04 24	
Get the software version	Send Receiver	55 5A 00 04 00 00 01 B4 55 A5 00 11 02 00 01 DATA1~DATA13 SUM	
Motion detection threshold within 1 meter	Read Setting Receiver	55 5A 00 04 00 80 03 36 55 5A 00 06 01 80 03 DATA1 DATA2 SUM 55 A5 00 06 02 80 03 DATA1 DATA2 SUM	Default value 200
1 meter motion detection threshold	Read Setting Receiver	55 5A 00 04 00 80 04 37 55 5A 00 06 01 80 04 DATA1 DATA2 SUM 55 A5 00 06 02 80 04 DATA1 DATA2 SUM	Default value 120
Detection threshold within 1 meter	Read Setting Receiver	55 5A 00 04 00 80 09 3C 55 5A 00 06 01 80 09 DATA1 DATA2 SUM 55 A5 00 06 02 80 09 DATA1 DATA2 SUM	Default value 300
1 meter presence detection threshold	Read Setting Receiver	55 5A 00 04 00 80 0A 3D 55 5A 00 06 01 80 0A DATA1 DATA2 SUM 55 A5 00 06 02 80 0A DATA1 DATA2 SUM	Default value 300
Minimum detection distance（cm）	Read Setting Receiver	55 5A 00 04 00 80 0C 3F 55 5A 00 06 01 80 0C DATA1 DATA2 SUM 55 A5 00 06 02 80 0C DATA1 DATA2 SUM	Default value 10
Maximum motion detection distance(cm)	Read Setting Receiver	55 5A 00 04 00 80 0D 40 55 5A 00 06 01 80 0D DATA1 DATA2 SUM 55 A5 00 06 02 80 0D DATA1 DATA2 SUM	Default value 600
Maximum detection distance(cm)	Read Setting Receiver	55 5A 00 04 00 80 0E 41 55 5A 00 06 01 80 0E DATA1 DATA2 SUM 55 A5 00 06 02 80 0E DATA1 DATA2 SUM	Default value 450
VO Output level Holding time(ms)	Read Setting Receiver	55 5A 00 04 00 80 14 47 55 5A 00 06 01 80 14 DATA1 DATA2 SUM 55 A5 00 06 02 80 14 DATA1 DATA2 SUM	Default value 20000

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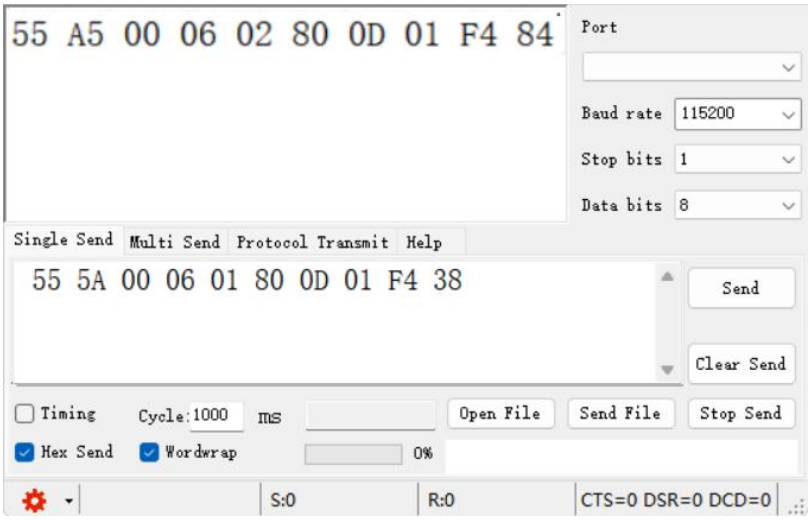
VO Indication mode	Read	55 5A 00 04 00 80 15 48	0x00 High level indication indicate body ; 0x01 Low level indication
	Setting	55 5A 00 05 01 80 15 DATA1 SUM	
	Receiver	55 A5 00 05 02 80 15 DATA1 SUM	

Example 2: Setting Radar parameter

If we want to set the radar's motion sensing distance to 5 meters, the distance is 4 meters, and the high level output delay time after sensing is 5 seconds: Then the serial port sends information: 55 5A 00 06 01 80 0D 01 F4 38.(For the specific meaning of each bit, please refer to the previous frame structure definition.)

Serial port return data information: 55 A5 00 06 02 80 0D 01 F4 84, Indicates that the motion detection distance has been set to 5 meters.



The serial port sends information: 55 5A 00 06 01 80 0E 01 90 D5.

then serial port return data information: 55 A5 00 06 02 80 0E 01 90 21, Indicates that the presence detection distance has been set to 4 meters.

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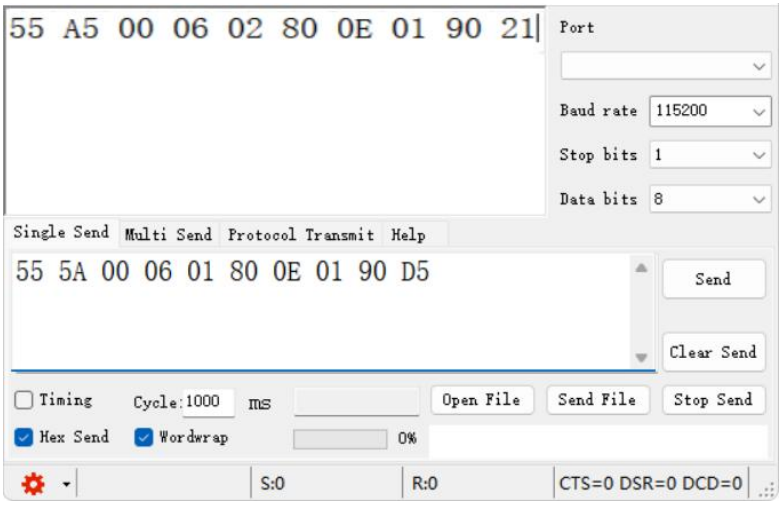
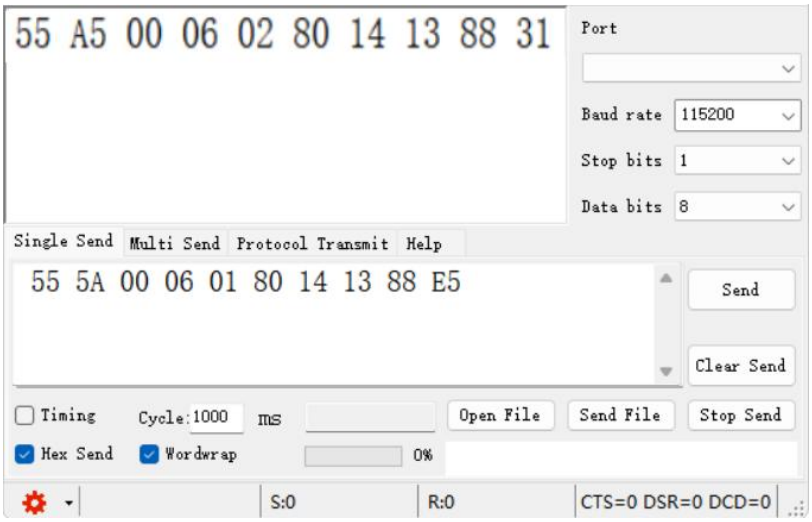


The serial port sends information:55 5A 00 06 01 80 14 13 88 E5,
then serial port return data information:55 A5 00 06 02 80 14 13 88 31, Indicates that the high level holding time of the sensing output is set to 5 seconds.



After the setup is complete, sends command: 55 5A 00 04 01 20 04 D8 to save, Otherwise, the power will fail.

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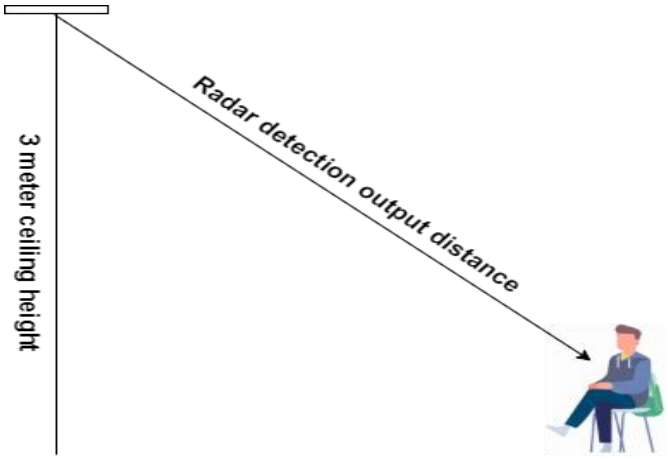
7 Radar installation and testing

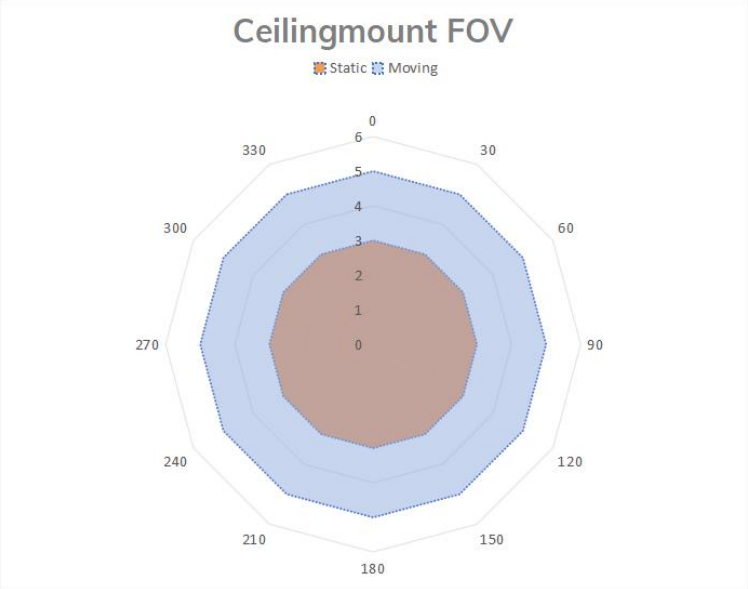
7.1 Test application scenarios: Ceiling mount

The installation height is 3 meters, and the coverage range is tested in both sitting and walking states. (The module is used at Ceiling mount, so the output detection distance will have some errors compared to the straight line test. The sensing distance threshold is corrected according to the measured sensing radius).



7.1.1 Reference coverage

The following figure shows the coverage of the radar in the static state (orange area) and the moving state (blue area) under the default configuration for reference. Users can directly use the default mode for testing.



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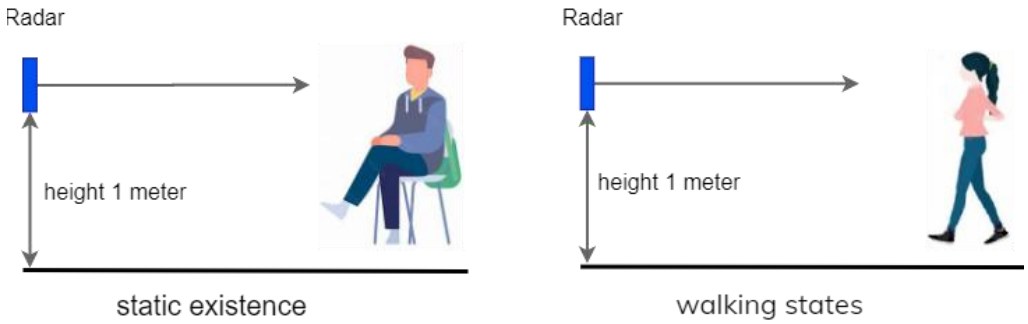
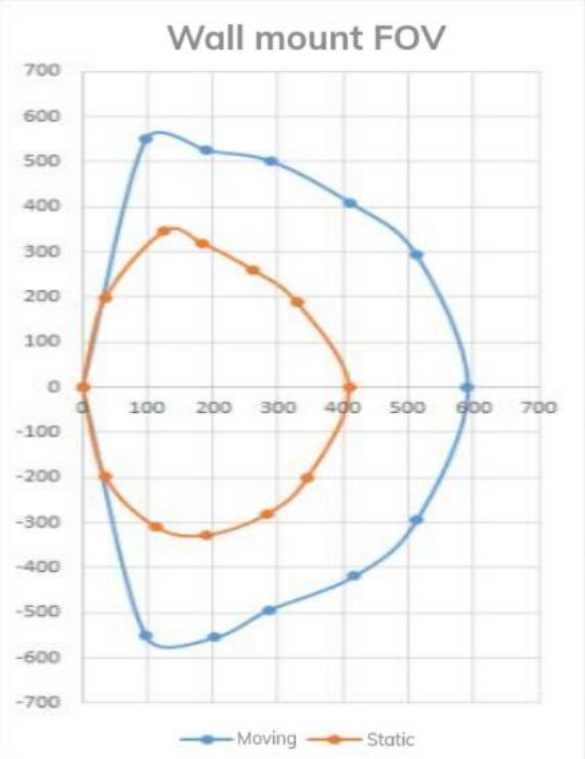
7.2 Test application scenarios: Wall mount

When testing wall mount installation, the installation height is about 1 meter, and the coverage range is tested in both sitting and walking states.



7.2.1 7.1.1Reference coverage

The following figure shows the wall mount coverage of the radar in the static state (orange area) and the moving state (blue area) under the default configuration for reference. Users can directly use the default mode for testing.



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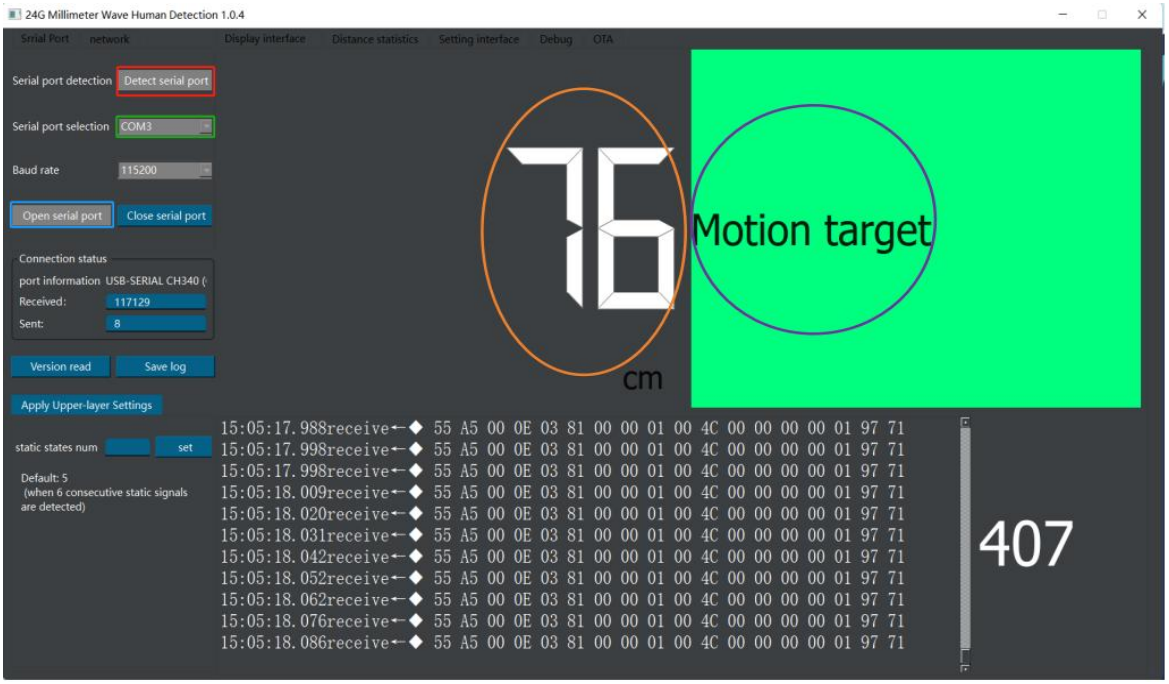
8 Use of the upper computer

MinewSemi also provides the upper computer of ME73MS01, which allows users to quickly configure and test the module performance. The following is the instructions for using the upper computer.

1) Use USB to TTL to power the radar with 5V voltage, then open "24G Millimeter Wave Human Detection" ;

2) Click **Serial Port Detection** - **Serial Port Selection** - **Open Serial Port** - Display interface. **The display interface will show the distance value** and **status**.

See to follow picture:



3) Application layer settings: mainly used to set the switching between people moving, people stationary, and people not in motion. Enter an integer greater than 2 in **the window for the number of people stationary state**s, and click Set. When the upper computer receives OCCs for a number greater than or equal to the set value, the upper computer displays People Stationary. For example, if you set it to 10, it means that the host computer needs to receive 10 OCCs in a row to display People Stationary. (See picture below)

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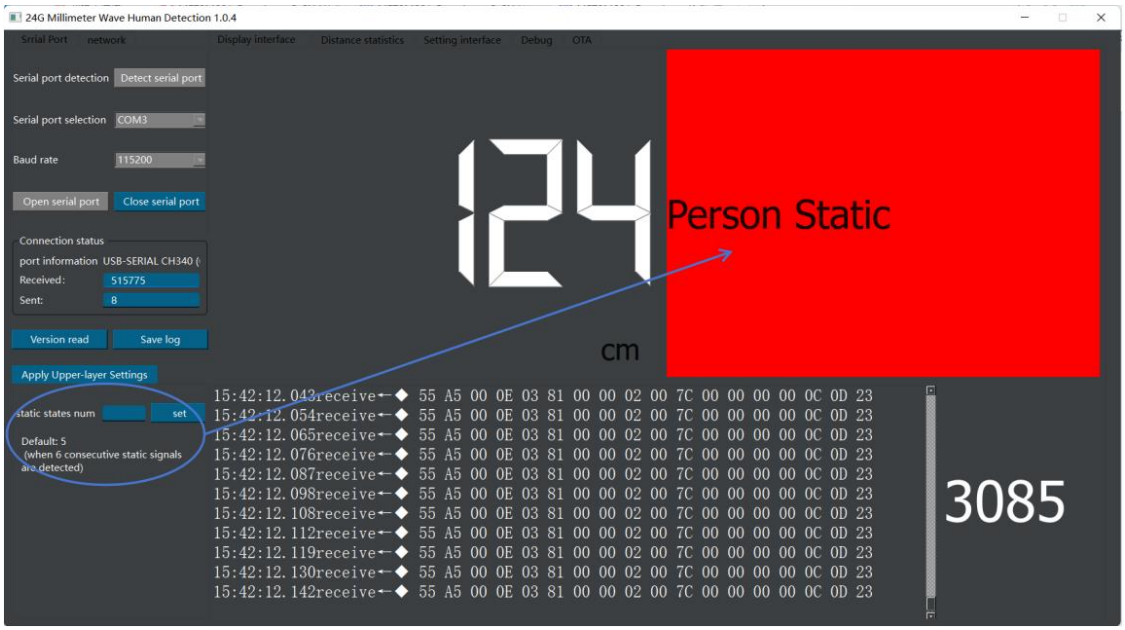
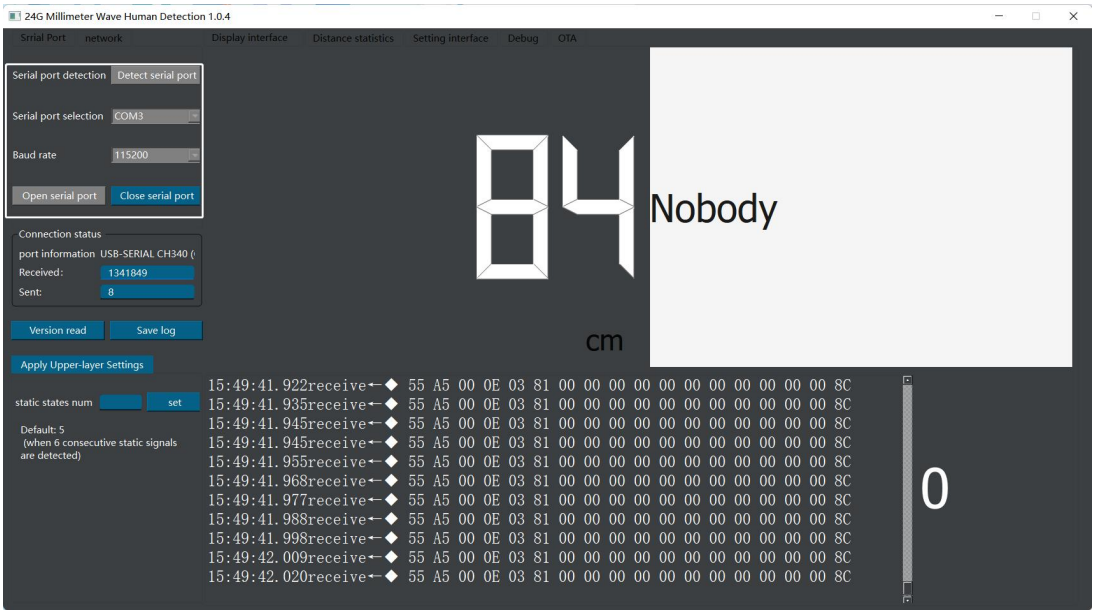


4) When the radar cannot detect the body, the upper computer outputs the Nobody state.



5) Click the **setting interface window** to enter the parameter setting interface. You can configure the module's **sensitivity**, **detection distance**, **light sensitivity threshold**, **delay**, etc. You can directly enter the value in the command box and click Write to modify the module parameters. In the sensitivity setting column, the close-range motion/presence sensitivity corresponds to the setting within 1 meter, the medium-range motion/presence sensitivity corresponds to the setting outside 1 meter, and the long-distance column is not open yet. For detailed parameter descriptions, see the command description in the previous text.

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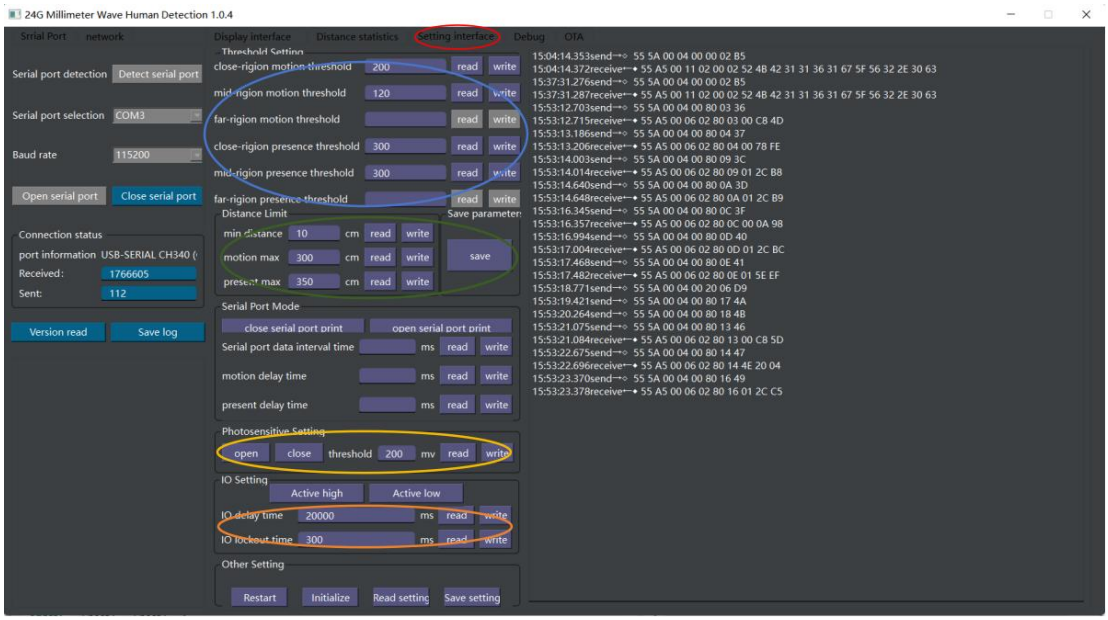
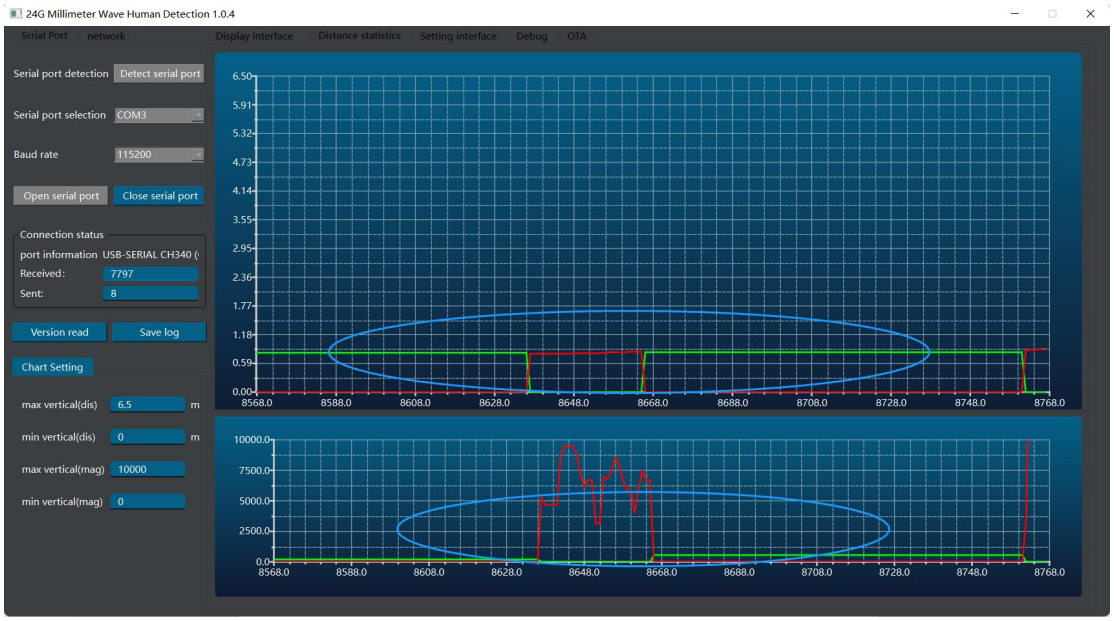
After modifying the parameters, click the Save button to save. (See picture below)



6) Click **the distance statistics window** to display the distance and signal strength curve in real time. The curve above the distance statistics window is the real-time distance curve. The red curve represents the distance of a stationary target, and the green curve represents the distance of a moving target. The lower window displays the real-time signal strength curve. The red curve represents the energy value of a stationary target, and the green curve represents the energy value of a moving target. (See picture below)



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9 Precautions

1. When installing, the front of the module shall avoid metal and other objects that hinder the transmission of electromagnetic waves.

2. Different housing materials, and the distance between the module and the inner surface of the shell, the returned spectrum energy and parameter setting will be different, which need to be fine-tuned according to the actual conditions. It is generally recommended that the module is 5-6mm away from the housing, which can be adjusted according to the measured situation.

3. We recommend that users first test according to the default Settings of the module. If the effect is not as expected, they can send the housing structure to the original factory, and the original factory will test and adjust a reference setting.

4. It is recommended to use ABS and other materials as the housing, because the human body radar is a very sensitive module. If the large attenuation material is used as the housing, it may affect the detection.

5. If the person is sitting back to radar or side to radar, the induction effect will decrease. Because the fluctuation of the chest or abdomen cannot be detected from back to side to radar.

6. Install to avoid air conditioning vents, fans and other objects. Ditered equipment and objects may be detected by radar and judged to be present.

7. Avoid large areas of metal and other strong reflective objects when installing. Metals strongly reflect electromagnetic waves and may cause distortion in the receiving signal.

8. When the multiple modules are installed at the same time, the module spacing is greater than 0.5 meters, and the antennas of different modules should be avoided face to face.

9. The module is used in ceiling mount, so the output detection distance has some errors compared with the straight line test. The FOV given in the manual is also only for our test environment, and the actual FOV may be biased due to the different actual scene environment or the factors such as the housing.

10. If you need more technical support, please contact the sales force.

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10 Housing Layout and Welding Requirements

- The module recommends a clearance of 2.5mm from the antenna surface to the inner surface of the housing, the housing material can not be used metal or metal-plated paint material, the housing is recommended PC, ABS housing material can not use metal or metal-plated paint materials, etc., the thickness of the material is 2 ~ 3mm is better.
- PCBA: It is necessary to keep the radar's patch height ⩾ 1mm higher than the other devices.and PCBA in SMT, do not contaminate the chip, the chip must be pasted flat, not warped.
- Housing detection surface: non-metallic, need to be flat to avoid bending surface, affecting the performance of the entire swept area.

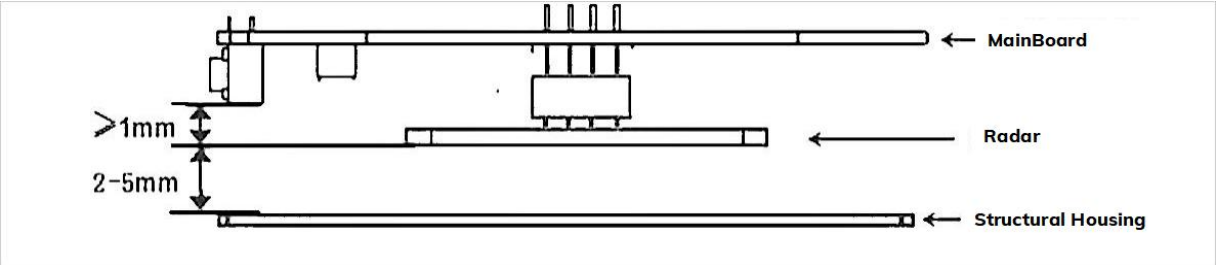

Figure2 Layout diagram of antenna and housing

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FCC regulatory compliance statement
§15.19 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.

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

List of applicable FCC rules:
47 CFR Part 15.249

Summarize the specific operational use conditions
This module can be used in IOT devices, the input voltage to the module is nominally 5V.

Limited module procedures
This module is a limited module.

Trace antenna designs
The device has an integrated PCB antenna.so host manufacturer can not change antenna.

RF exposure considerations
This Module complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 20cm between the radiator and your body. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Antennas
If you desire to increase antenna gain and either change antenna type or use same antenna type certified, a NEW application is required to be filed .

Label and compliance information
Please notice that if the FCC identification number is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. This exterior label can use wording such as the following: "Contains FCC ID: 2BDJ6-ME73MS01" any similar wording that expresses the same meaning may be used.

§ 15.19 Labelling requirements shall be complied on end user device.

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Labelling rules for special device, please refer to §2.925, § 15.19 (a)(5) and relevant KDB publications. For E-label, please refer to §2.935.

Information on test modes and additional testing requirements
The OEM integrator is responsible for ensuring that the end-user has no manual instruction to remove or install module.
The module is limited to installation in mobile application, a separate approval is required for all other operating configurations, including portable configurations with respect to §2.1093 and difference antenna configurations.

FCC other Parts, Part 15B Compliance Requirements for Host product manufacturer
This modular transmitter is only FCC authorized for the specific rule parts listed on our grant, 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.
Host manufacturer in any case shall ensure host product which is installed and operating with the module is in compliant with Part 15B requirements.
Please note that For a Class B or Class A digital device or peripheral, the instructions furnished the user manual of the end-user product shall include statement set out in §15.105 Information to the user or such similar statement and place it in a prominent location in the text of host product manual. Original texts as following:

For Class B

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.

For Class A

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Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

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Quality

Cognizant of our commitment to quality, we operate our own factory equipped with state-of-the-art production facilities and a meticulous quality management system. We hold certifications for ISO9001, ISO14001, ISO27001, OHSA18001, BSCI.

Every product undergoes stringent testing, including transmit power, sensitivity, power consumption, stability, and aging tests. Our fully automated module production line is now in full operation, boasting a production capacity in the millions, capable of meeting high-volume production demands.

Contact Us

Shenzhen Minewsemi Co., Ltd. is committed to swiftly delivering top-quality connectivity modules to our customers. For assistance and support, please feel free to contact our relevant personnel, or contact us as follows:

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Click the icon to view and download the latest product documents electronically.

Copyright Statement

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Test Plan for host Product:

This module does not contain a shield and therefore is limited. The host integrator will be required to file a Class II Permissive Change for each host specific installation. The following testing should be performed to demonstrate continued compliance.

1. Part 15 Subpart B disclaimer

Host manufacturer is responsible for compliance of the host system with module installed with all other applicable requirements for the system such as Part 15B. These tests should be based on ANSI C63.4 as guidance.

Item	Standard	Method	Remark
Conducted Emissions at Mains Terminals (150kHz-30MHz)	47 CFR Part 15, Subpart B	ANSI C63.4:2014	AC Power Line Conducted Emissions Voltage need to evaluate according to FCC Part 15.207(a) requirement when the host product is designed to be connected to the public utility (AC) power line.
Radiated Emissions (9KHz-30MHz)	47 CFR Part 15, Subpart B	ANSI C63.4:2014	According to FCC Part15.33
Radiated Emissions (30MHz-1GHz)	47 CFR Part 15, Subpart B	ANSI C63.4:2014	According to FCC Part15.33
Radiated Emissions (Above 1GHz)	47 CFR Part 15, Subpart B	ANSI C63.4:2014	According to FCC Part15.33 Test :1GHz to 5th harmonic of the highest frequency or 40 GHz, whichever is lower.
Test mode: Host normal operation with Radar.			

2.The host product will need to evaluate according to FCC Part 15 Subpart C 15.249 for Radar:

(1). Maximum radiated power of channel 24GHz-24.25GHz from the original grant is 94.8dBuV/m at 24.15GH, followed by an in-host measurement to be made showing that the radiated power must < 94.8dBuV/m. Based on the original report, the test mode of radiated power for host product should be setting as 24.15GHz.

(2). AC Power Line Conducted Emissions Voltage need to evaluate according to FCC Part 15.207(a) requirement when the host product is designed to be connected to the public utility (AC) power line. Test channel and data rate list as below：

Test Channels for Conducted Emissions	Operation mode
24.15GHz	Radar Tx continue mode

(3). Radiated spurious emissions and band edge on 24GHz-24.25GHz with the other co-located transmitters. The test modes for these tests need to be setting as below, These tests can be based on C63.10 as guidance and radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a).

Test Channels for RSE	Operation mode
24.15GHz	Radar Tx continue mode

Test Channels for Band-edge	Operation mode
24.15GHz	Radar Tx continue mode

3. RF Exposure evaluation: The host product operating conditions must be such that there is a minimum separation distance of 20 cm (or possibly greater than 20 cm) between the antenna radiating structures and nearby persons. The host manufacturer is obligated to confirm the use conditions of the host product to ensure that the distance specified in the instructions is met. In this

case the host product is classified as either a mobile device or a fixed device for RF exposure purposes.
If the modular transmitter is authorized to be used in a specific type of host platform and installed such that it can be operated at closer than 20 cm to users or nearby persons, please follow below guidance.
If the portable host product has only stand-alone mode, the maximum radiated power from the original grant is 94.8dBuV/m, so it can meet SAR exemption requirements.
If the portable host product has multiple transmitters, it requires routine evaluation or SAR testing for the simultaneous transmission of the co-located transmitters according to KDB 447498. The potable host product shall be evaluated for ensuring to continue compliance FCC rule part 2.1093 & part 1.1310 by C2PC. The additional guidance for the portable host products is provided in KDB Publication 996369 D02 and D04. For the host product is not installed according to this guide, the module certification will be invalid, and a new grant certification will be required for the host product.