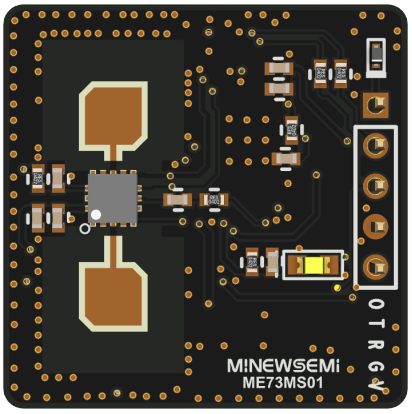
MINEWSEMI

24GHz mmWave Radar Module

ME73MS01



Datasheet

V 1.0.0

Version Note

Version	Details	Contributor(s)	Date	Notes
1.0.0	First edit	Vincle, Leo	2024.07.01	

Part Number

Model	Hardware Code
ME73MS01	-

Click the icon to view and download the latest product documents electronically.
https://en.minewsemi.com/file/ME73MS01_Datasheet_C_EN.pdf

ME73MS01

High-performance, High-reliability, Can detect micro-moving targets and user motion areas

ME73MS01 is a high-sensitivity 24GHz millimeter wave FMCW human presence detection radar module. Different from traditional radars that detect large movements of human movement or small body movements to determine the presence of human body, the main feature of this module is that it has the function of detecting small movements such as human breathing on the basis of the functions of traditional human body sensing radar to determine the presence of human body. The module adopts FMCW modulation and can output the distance of the target at the same time. This product can detect whether there is someone in the room, and is highly reliable and high-performance.

FEATURES

- High Sensitivity
- High-reliability
- High-performance
- User motion track detection
- Micro-moving targets detection

KEY PARAMETER

ME73MS01			
Working Frequency	24~24.25GHz	**Antenna**	PCB
Module Size	20×20mm	**Processing Period**	Realize
Installation Method:	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		

APPLICATION

Smart home people detection

Street lighting radar system

Courtyard and indoor security-people detection

Industrial control radar sensor

INDEX

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

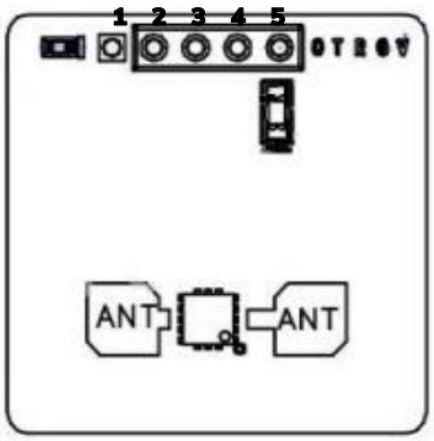
1.2 Module Features

No.	Function	Detailes
1	Installation scene	The detection distance of this product is: 0.5~6m. （Note: The detection distance is related to factors such as installation environment, human body volume, relative angle, and movementrange amplitude. 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.

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

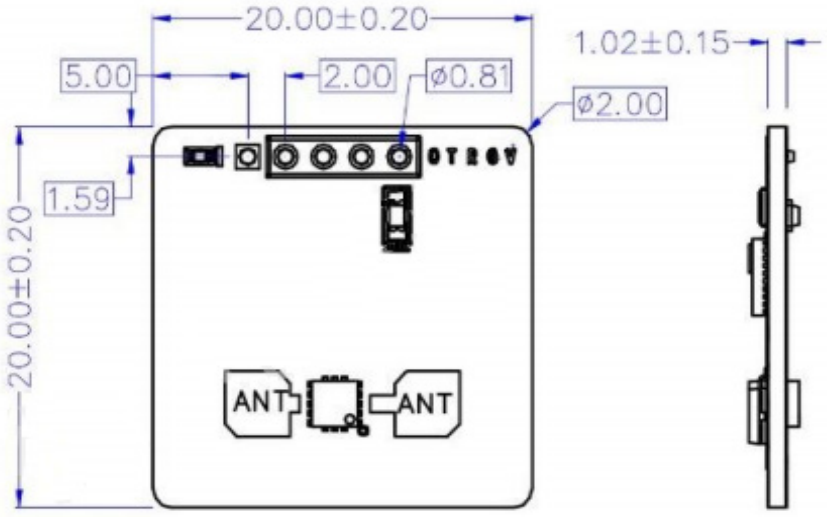


(TOP View)

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)

6 DEBUG CONFIGURATION

6.1 Debug Wiring

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 receives: 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 command is the host computer sending instructions to the radar, and the report command is the radar sending information to the host computer.

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**

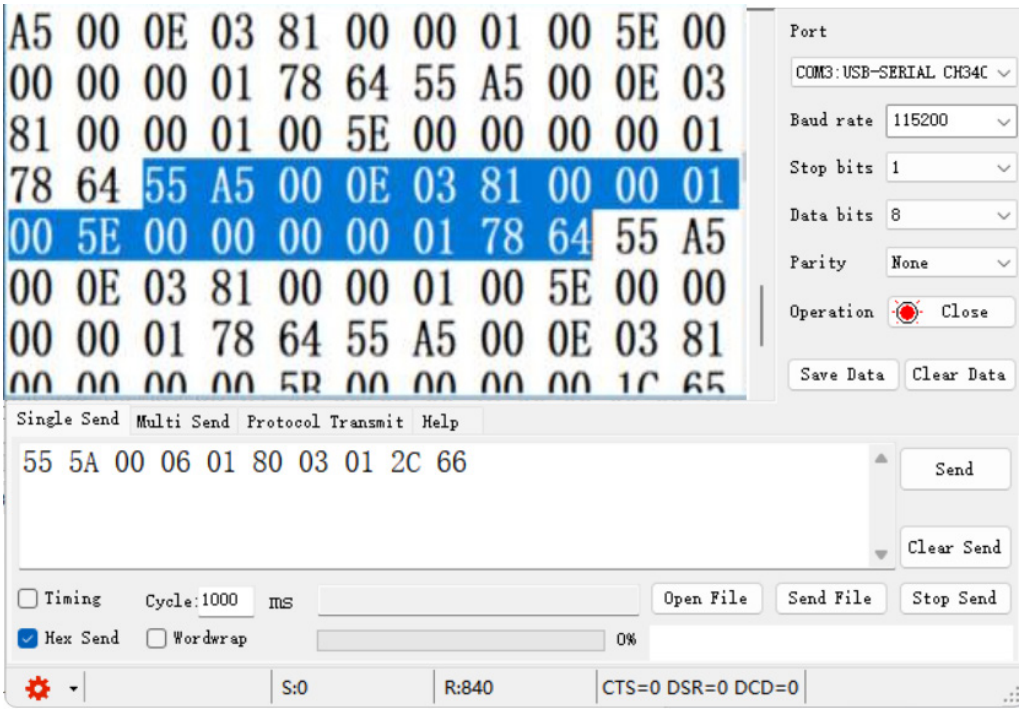
	Head	Packet Len	Func code	CMD	Data	Sum
Receiving	55 A5	00 0E	03	81 00	Data[0]~Data[9]:Information of detected targets	SUM

Data Format Description

Setting/ Receiving	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.

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.

Radar parameter configuration and read commands

OTA online upgrade	Send	55 5A 00 04 01 20 01 D5
	Receiver	55 A5 00 04 02 20 01 21
Restore to default parameters	Send	55 5A 00 04 01 20 02 D6
	Receiver	55 A5 00 04 02 20 02 22
Save all parameters to flash	Send	55 5A 00 04 01 20 04 D8
	Receiver	55 A5 00 04 02 20 04 24
Get the software version	Send	55 5A 00 04 00 00 01 B4
	Receiver	55 A5 00 11 02 00 01 DATA1~DATA13 SUM

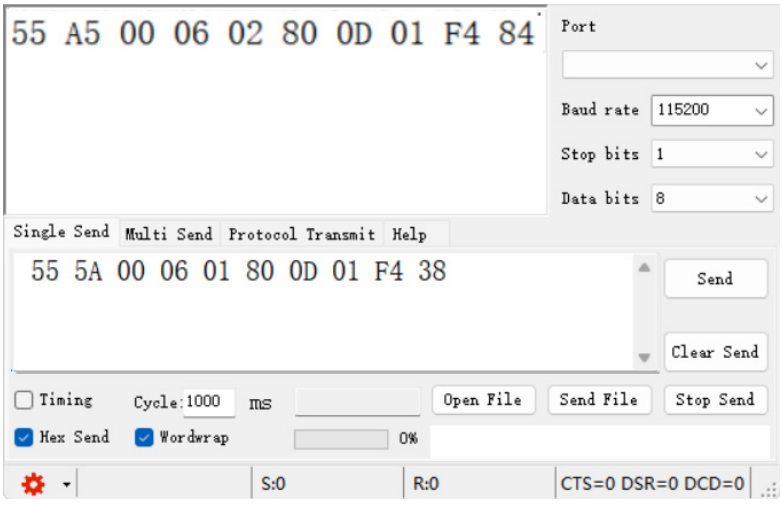
Motion detection threshold within 1 meter	Read	55 5A 00 04 00 80 03 36	
	Setting	55 5A 00 06 01 80 03 DATA1 DATA2 SUM	Default value 200
	Receiver	55 A5 00 06 02 80 03 DATA1 DATA2 SUM	
1 meter motion detection threshold	Read	55 5A 00 04 00 80 04 37	
	Setting	55 5A 00 06 01 80 04 DATA1 DATA2 SUM 55	Default value 120
	Receiver	A5 00 06 02 80 04 DATA1 DATA2 SUM	
Detection threshold within 1 meter	Read	55 5A 00 04 00 80 09 3C	
	Setting	55 5A 00 06 01 80 09 DATA1 DATA2 SUM 55	Default value 300
	Receiver	A5 00 06 02 80 09 DATA1 DATA2 SUM	
1 meter presence detection threshold	Read	55 5A 00 04 00 80 0A 3D	
	Setting	55 5A 00 06 01 80 0A DATA1 DATA2 SUM 55	Default value 300
	Receiver	A5 00 06 02 80 0A DATA1 DATA2 SUM	
Minimum detection distance (cm)	Read	55 5A 00 04 00 80 0C 3F	
	Setting	55 5A 00 06 01 80 0C DATA1 DATA2 SUM	Default value 10
	Receiver	55 A5 00 06 02 80 0C DATA1 DATA2 SUM	
Maximum motion detection distance(cm)	Read	55 5A 00 04 00 80 0D 40	
	Setting	55 5A 00 06 01 80 0D DATA1 DATA2 SUM	Default value 600
	Receiver	55 A5 00 06 02 80 0D DATA1 DATA2 SUM	
Maximum detection distance(cm)	Read	55 5A 00 04 00 80 0E 41	
	Setting	55 5A 00 06 01 80 0E DATA1 DATA2 SUM	Default value 450
	Receiver	55 A5 00 06 02 80 0E DATA1 DATA2 SUM	

VO Output level Holding time(ms)	Read	55 5A 00 04 00 80 14 47	Default value 20000
	Setting	55 5A 00 06 01 80 14 DATA1 DATA2 SUM 55	
	Receiver	A5 00 06 02 80 14 DATA1 DATA2 SUM	
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	

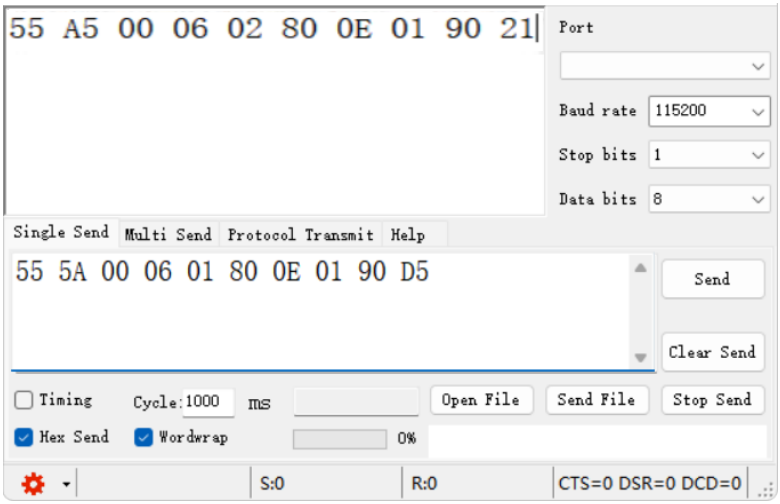
Example 2: Setting radar parameter

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.)

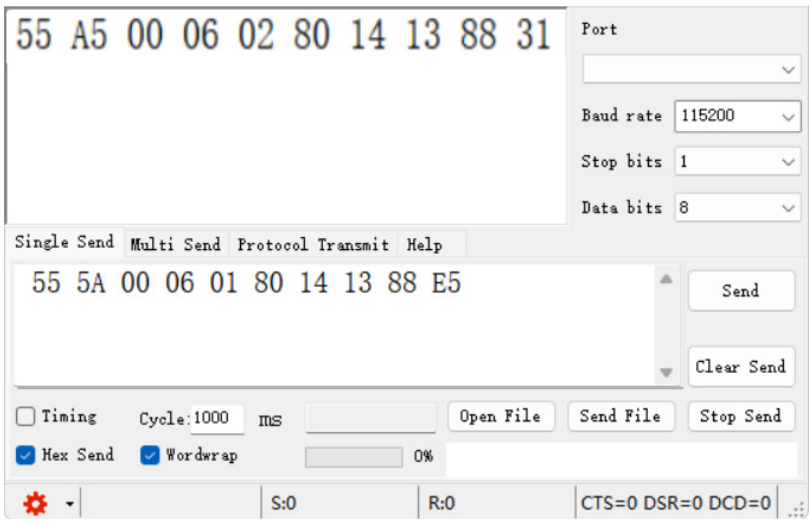
Serial port return data information: 55 A5 00 06 02 80 0D 01 F4 84, Indicates that the motion detection distance has been set to 5 meters.



The serial port sends information: 55 5A 00 06 01 80 0E 01 90 D5.
then serial port returns information: 55 A5 00 06 02 80 0E 01 90 21, Indicates that the presence detection distance has been set to 4 meters.



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.

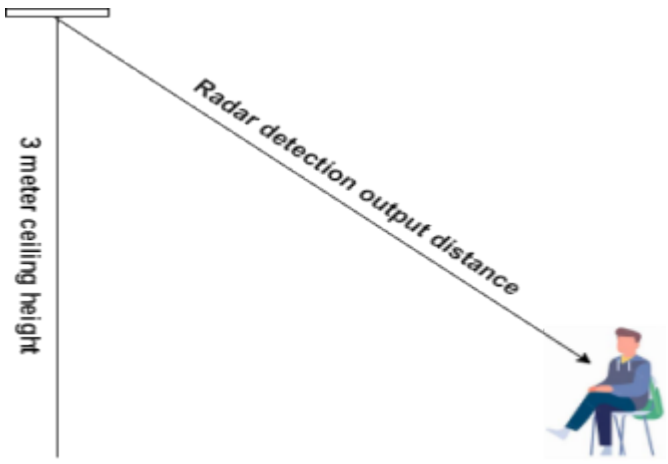


After the setup is complete, sends command: 55 5A 00 04 01 20 04 D8 to save, Otherwise, the power will fail.

7 RADAR INSTALLATION AND TESTING

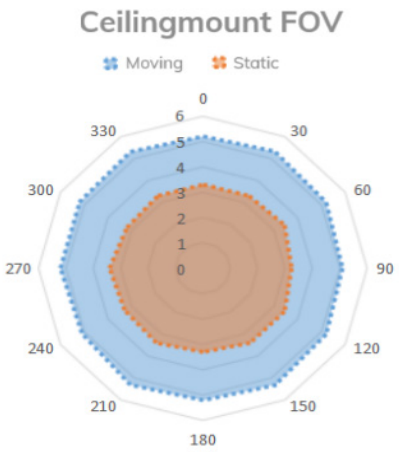
7.1 Test Application Scenarios: Ceiling Mount

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).



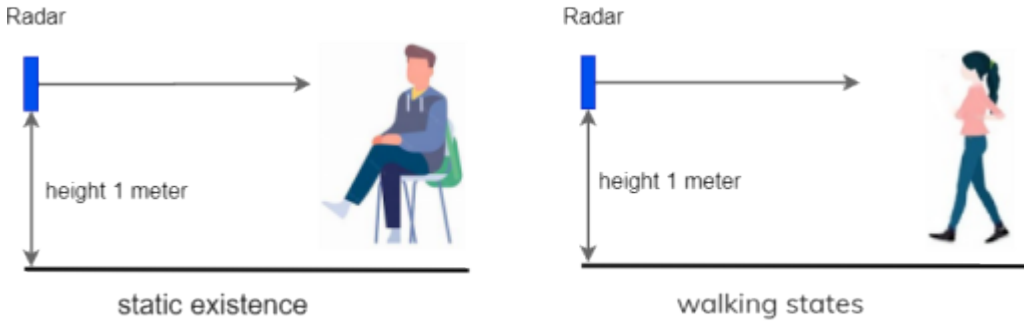
7.1.1 Reference Coverage

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.



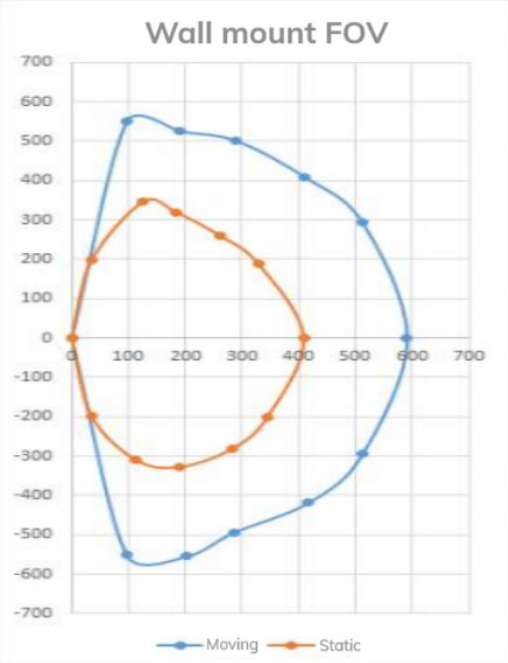
7.2 Test Application Scenarios: Wall Mount

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 Reference 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.



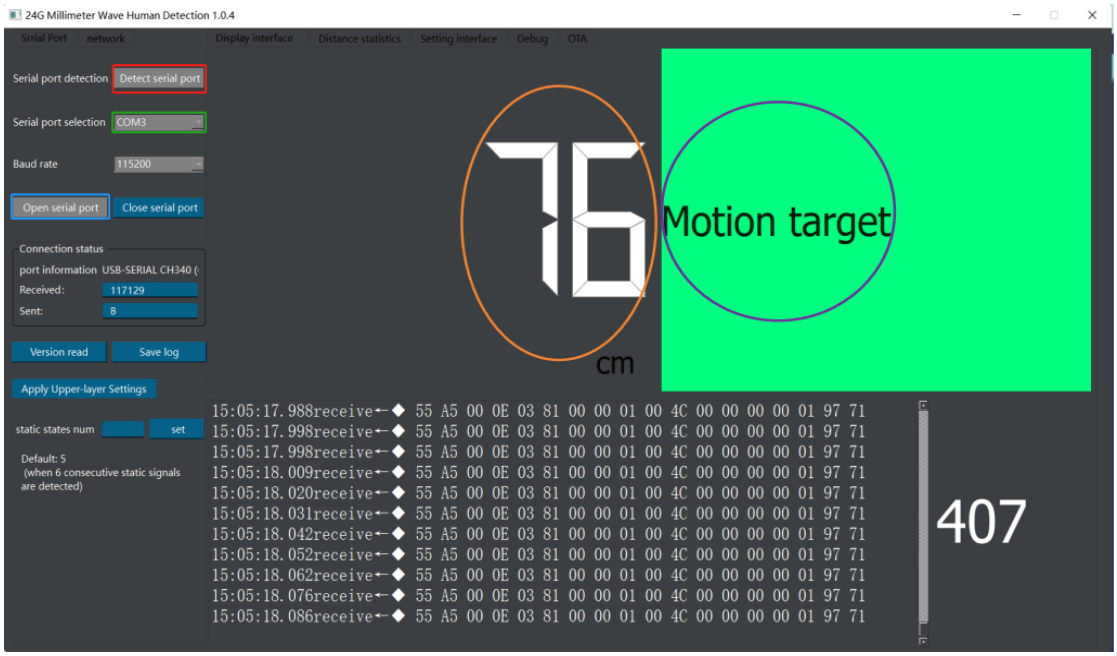
8 USE OF UPPER COMPUTER

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.

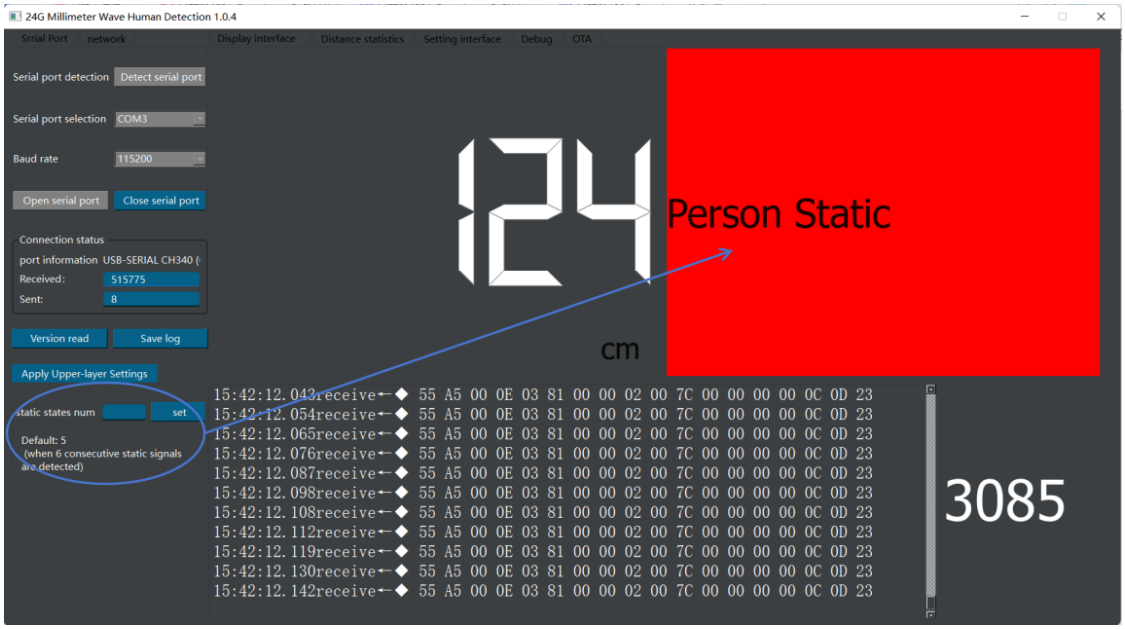
1)Use USB to TTL to power the radar with 5V voltage, then open "24G Millimeter Wave Human Detection" ;

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

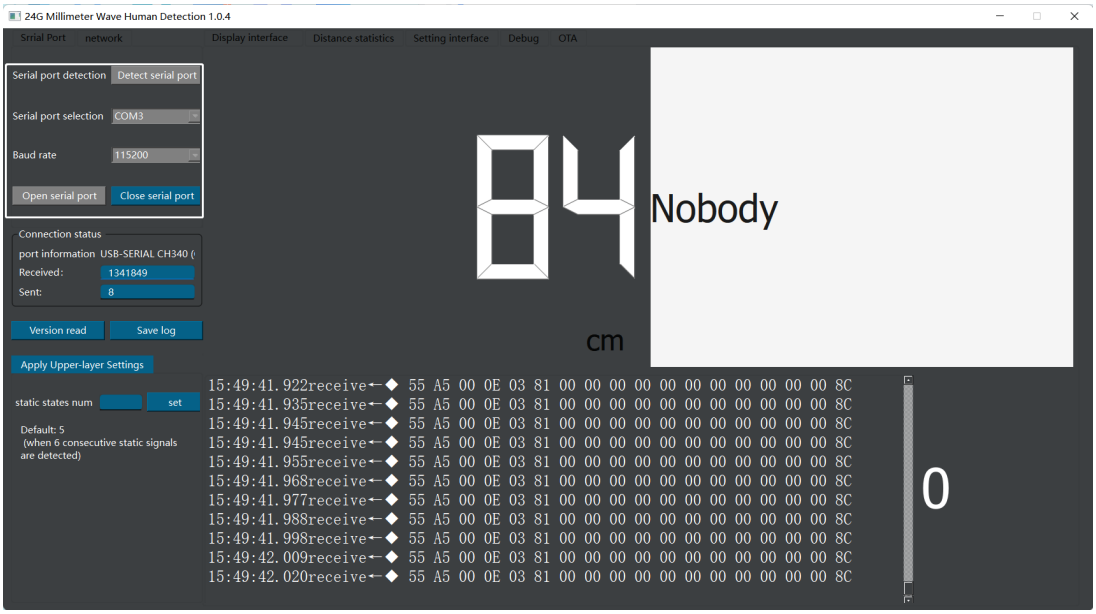
See follow picture:



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 states, 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)

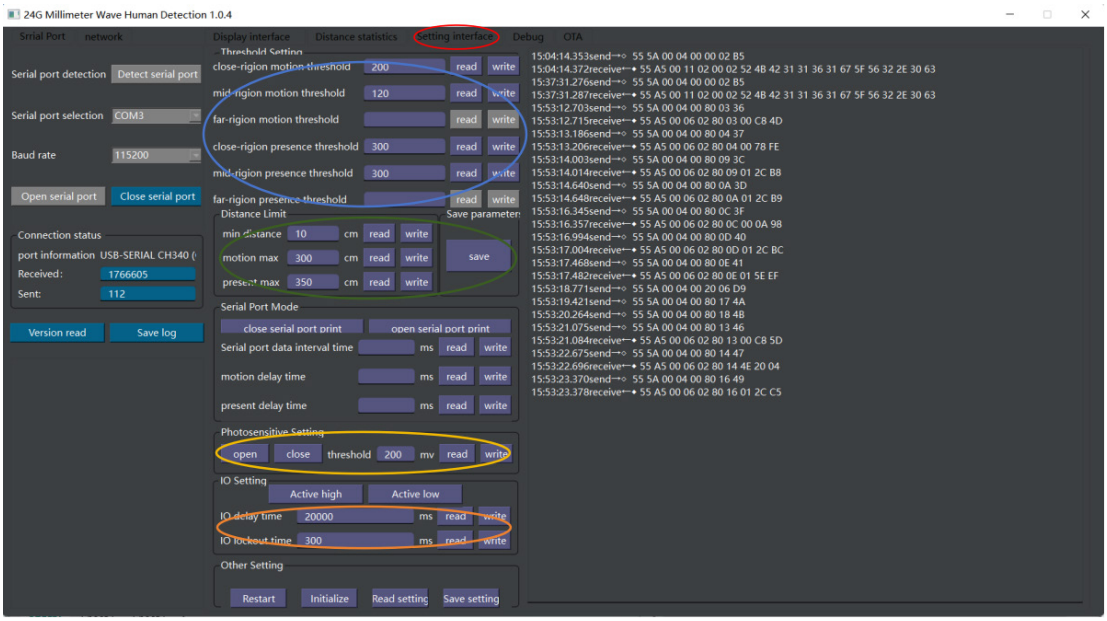


4)When the radar cannot detect the body, the upper computer outputs the Nobody state.

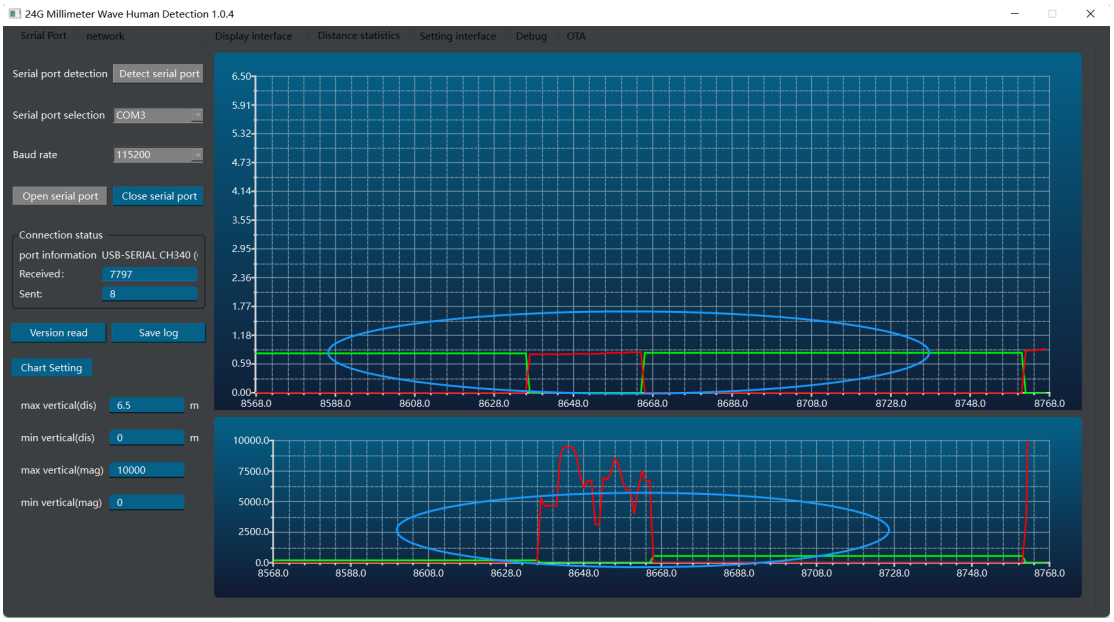


5)Click the setting interface window to enter the parameter setting interface. You can configure the module's sensitivity, detection distance, light sensitivity threshold, delay, etc. You can directly enter the value in the command box and click Write to modify the module parameters. In the sensitivity 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.

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)



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.

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.

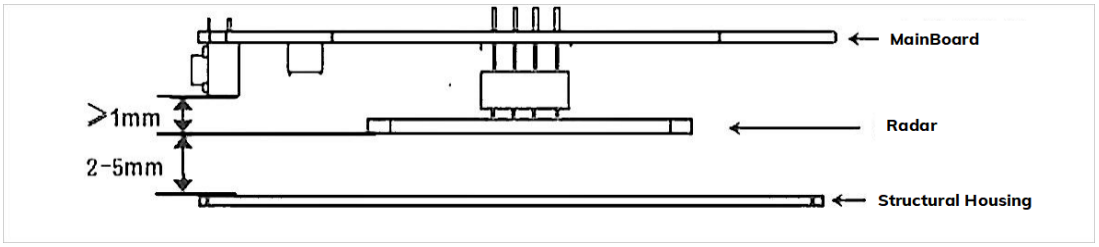


Figure3 Layout diagram of antenna and housing

HOUSING 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.

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

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.

11 STORAGE CONDITIONS

- **Please use this product within 6 months after signing the receipt.**
  - This product should be stored without opening the package at an ambient temperature of 5~35°C and a humidity of 20~70%RH.
  - This product should be left for more than 6 months after receipt and should be confirmed before use.
  - The product must be stored in a non-corrosive gas (CI2, NH3, SO2, NOx, etc.).
  - To avoid damaging the packaging material, do not apply any excessive mechanical shocks, including but not limited to sharp objects adhering to the packaging material and product dropping.

- **This product is suitable for MSL2 (based on JEDEC standard J-STD-020).**
  - After opening the package, the product must be stored at ≤30°C/<60%RH. It is recommended to use the product within 3-6 months after opening the package.
  - When the color of the indicator in the package changes, the product should be baked before welding.

- **Baking is not required for one year if exposure is limited to <30°C and 60%RH. Refer to MSL2 for exposure criteria for moisture sensitivity level. If exposed to (≥168h@85°C/60%RH) conditions or stored for more than one year, recommended baking conditions.**
  1. 120 +5/-5°C, 8 hours, 1 time
  Products must be baked individually on heat-resistant trays because the materials (base tape, reel tape, and cover tape) are not heat-resistant, and the packaging material may be deformed at temperatures of 120℃;
  2、90℃ +8/-0℃, 24hours, 1times
  The base tape can be baked together with the product at this temperature. Please pay attention to the uniformity of heat.

12 HANDLING CONDITIONS

• Be careful in handling or transporting products because excessive stress or mechanical shock may break products.
• Handle with care if products may have cracks or damages on their terminals. If there is any such damage, the characteristics of products may change. Do not touch products with bare hands that may result in poor solder ability and destroy by static electrical charge.

13 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.

14 COPYRIGHT STATEMENT

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15 RELATED DOCUMENTS

- MinewSemi_Product_Naming_Reference_Manual_V1.0
  https://en.minewsemi.com/file/MinewSemi_Product_Naming_Reference_Manual_EN.pdf
- MinewSemi_Connectivity_Module_Catalogue_V2.0
  https://en.minewsemi.com/file/MinewSemi_Connectivity_Module_Catalogue_EN.pdf

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