MINEWSEMI

Millimeter Wave Radar|

MS72SF1

Datasheet

V 1.1.0

Applicable Product Model
MS72SF1

Version Note

Version	Details	Contributor(s)	Date	Notes
1.0.0	First edit	Coral	2023.05.30	
1.0.1	Addition housing layout and welding requirements	Vincle	2023.07.10	
1.1.0	Added instruction description and modified data analysis	Neo	2024.01.09	

MS72SF1

Low-cost,high-reliability,high-performance,accurate tracking and positioning of multiple people indoors,user motion track detection
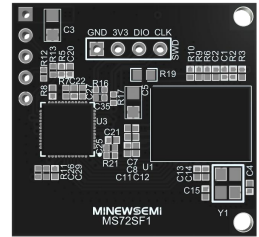
MS72SF1 is a 60G millimetre wave radar module, relative to the traditional visual, infrared, laser and other means of perception, millimetre wave radar is not affected by light, can be achieved around the clock without sensing active indoor personnel perception and monitoring, and has a personal privacy protection function, it is the best sensor for the current application of home scenes. This product adopts the national production chip, independent and controllable, to achieve accurate tracking, and can inhibit curtains, green plants and other interference. This product has the advantages of low cost, high reliability and high performance and so on.

■ Features

- ➤ Low-cost
- ➤ High-reliability
- ➤ High-performance
- ➤ User motion track detection
- ➤ accurate tracking and positioning of multiple people indoors

■ Application

Smart home people detection

User motion track detection

Indoor personnel track detection

Industrial control radar sensor

■ Key parameter

Working frequency	60~64GHz	Antenna	PCB
Module size	29.36×28mm	Processing Period	≤30ms
Installation method:	top/side installation	Detection Distance	0.5 ~ 8m
Azimuth Coverage	±60°	Pitch angle coverage	±60°
Max Consumption	1.7W	Avg Current	110mA(Processing Period 100ms)
Firmware	top/side firmware		

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1 Module Description

1.1 Module Function Description

| No.	Function	Detailes
1	Multi-target tracking	1) It can realize the target tracking function of up to 10 people, including the target movement trajectory and the real-time position of the target; 2) Strong ability to suppress false targets (curtains, green plants, multipath, etc.); High sensitivity to detect micro-moving targets (stationary, shaking, waving, etc.).
2	Area division	The user can flexibly configure the detection area.

1.2 Module Features

No.	Function	Detailes
1	Installation scene	 Detection distance: 0.5~8m, (the effective projection ground is a circle with a radius of 4meters, and the installation height is 2.7meters) （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	Flexible parameter configuration	The detection threshold, function mode, etc. can be configured through the serial port.

2 Electrical Specification

Parameter	Values	Notes
Working Voltage	2.5 ~ 3.3	Standard supply voltage 3.3V
Working Temperature	-40℃~+85℃	Storage temperature is -40℃~+125℃
Transmission Power	-20 ~ +8dBm	
Avg Current	110mA	Processing Period 100ms
Max Consumption	1.7W	
Module Dimension	29.36*28mm	
Quantity of IO Port	5	

3 Pin Description
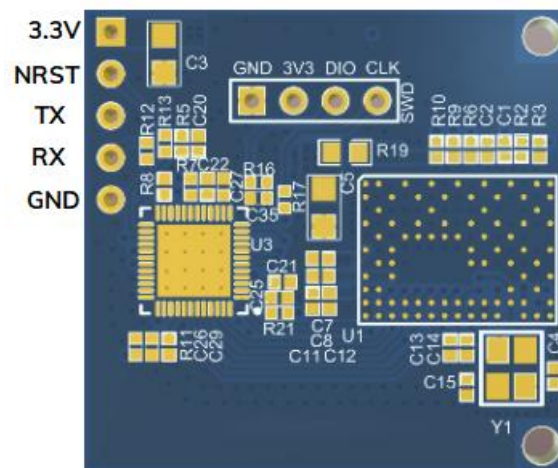
4 Pin Definition

Symbol	Type	Definition
3.3V	Power Supply	Power supply, input voltage 3.3V
NRST	Reset	Module reset pin
TX	UART TX	Used for UART serial transmitter (UART TX)
RX	UART RX	Used for UART serial reception (UART RX)
GND	Power supply ground	Ground

4.1 Mechanical Drawing
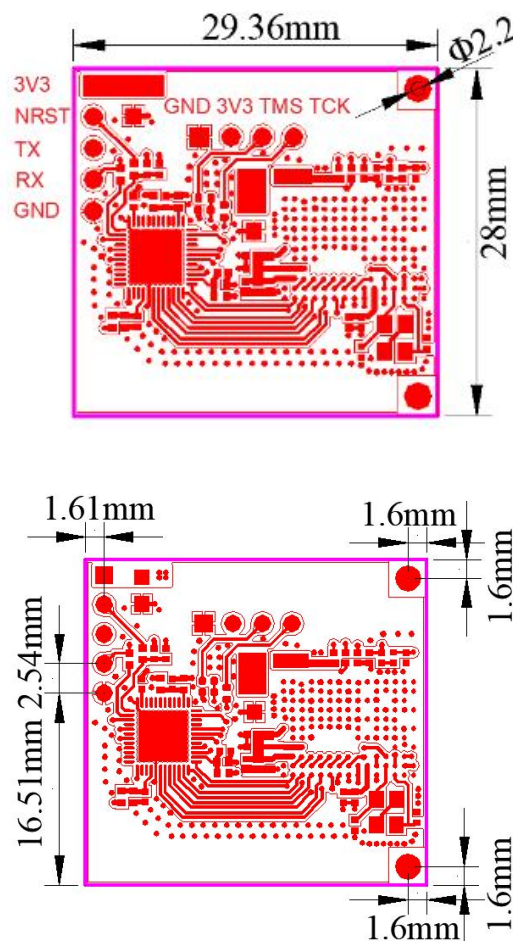
* （Default unit：mm　　Default tolerance：±0.1）

5 Electrical Characteristics

5.1 Limit Rated Parameters

Pin	Min	Max	unit
3.3V	-0.5	3.6	v
I/O (TX/RX/VO)	-0.5	3.6	v

5.2 Typical working parameters

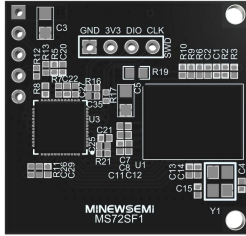| Pin	Typical value	unit
3.3V	3.0 ~ 3.3	v
I/O (TX/RX/VO)	-0.5 ~ VDD+0.3	v
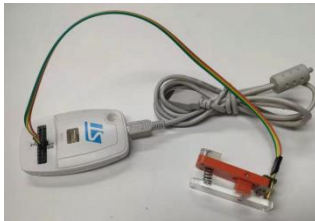
Notice: .VDD in the above table refers to the power supply input.

5.3 Module Consumption

The radar module contains RF devices, the current is about 530mA during the working time of starting RF transceiver, and about 80mA during the working time of shutting down RF transceiver. the average power consumption of the module is related to the frame period of the radar detection and processing, and if the radar works with a frame period of 100ms, then the average current is about 110mA. for the power supply input of the module, the power supply needs to be of high driving capacity, and the output current needs to be not less than 1A.

6 Environmental Build

6.1 Hardware components

NO.	Name	Figure	Description
1	Radar Module		Model NO.： MS72SF1
2	USB to TTL Module		USB to TTL module for serial port command configuration, antenna calibration and other functions.
3	USB Extension Cable		USB extension cable for connecting PC to USB TTL module
4	ST-LINK Down-loader		ST-LINK down-loader for radar module firmware upgrade and secondary development simulation debugging.

6.2 Installation position

The module is installed on the ceiling with the antenna facing down, and the installation height is 2.3-2.8m. When installing the module, try to keep it as fixed as possible to avoid shaking of the module. The surrounding environment should be as open as possible, and the USB extension cable should be fixed as much as possible to avoid interference caused by the cable. See e.g. Figure 1.
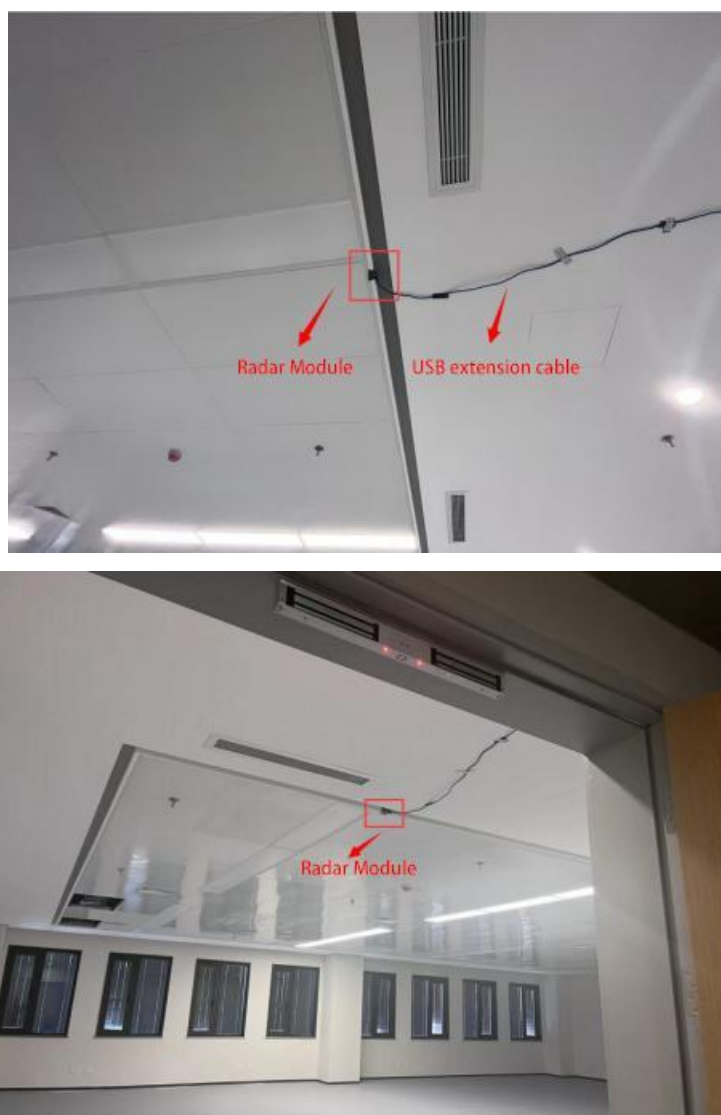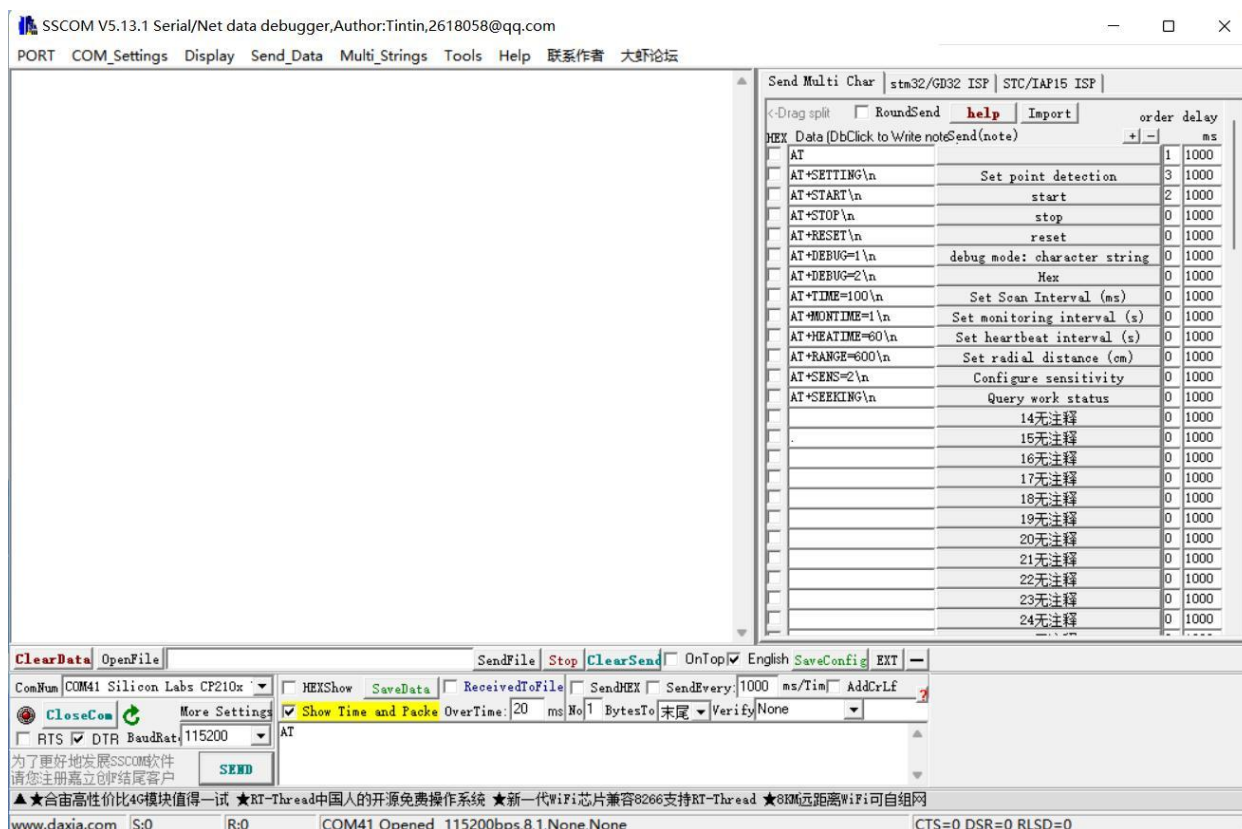
Figure 1 Top Mounting Legend

7 Parameter Configuration

Adjust the corresponding parameters as needed. Note: After modifying the parameters, click the button behind the parameters to complete the parameter modification.

Common parameters are as follows:

Command	interpretations
AT+RESTORE\n	Restore default Settings (flash will not be restored)
AT+STUDY\n	Learning mode (relearning every time you deploy to a new location)
AT+ISCEIL=X\n	Switch between top and side mounting, top mounting is 1, side mounting is 0 (default is top mounting mode)
AT+HEIGHTD=XXX\n	Configuration module scan height (unit cm, range <= Installation height, default 270)
AT+HEIGHT=XXX\n	Configure radar mounting height (unit cm, range 250-320, default 270)
AT+READ\n	Read the version number and parameters
AT+START\n	Start Operation
AT+STOP\n	Stop Operation
AT+DEBUG=X\n	Switching protocol (default 0 ,simple protocol) (1: string output, 2: test mode, 3: working mode)

AT+RESET\n	Module reset
AT+TIME=XX\n	Configure scan interval (unit:ms, range:100-10000, default value 100）
AT+MONTIME=XX\n	Configure monitoring interval(units:s, range 1-99, default value 1)
AT+HEATIME=XX\n	Configure heartbeat interval (unit s, range 10-999, default value 60)
AT+RANGE=XX\n	Configure radial distance (in cm, range 10-1000, default 600)
AT+WRANGE=XXX\n	Set Y axis maximum distance (unit cm, range 100-1200, default value 800, valid only for side mounting)
AT+SENS=XX\n	Configure sensitivity (range 1-19, default is 2)
AT+SETTING\n	Fixed-point detection mode
AT+SEEKING\n	Check operation status
AT+WINARANGE=XXXXXXXXXXX\n	Gate 1 configuration
AT+WINBRANGE=XXXXXXXXXXX\n	Gate 2 configuration
AT+WINCRANGE=XXXXXXXXXXX\n	Gate 3 configuration
AT+WINDRANGE=XXXXXXXXXXX\n	Curtain 1 configuration
AT+WINERANGE=XXXXXXXXXXX\n	Curtain 2 configuration
AT+WINFRANGE=XXXXXXXXXXX\n	Curtain 3 configuration

Typical example：

If the configuration is successful, it will return AT+OK, if the configuration fails, it will return Save Para Fail, and you need to resend the command.

AT+SETTING\n

Before performing fixed-point detection, please first ensure that the detection environment has no other interference and let people stand still at the place where the fixed point is required, and then send AT+SETTING\n to configure. At this time, the module will upload the location information of the person as follows.

In this way, the coordinates of each point are recorded

AT+WINARANGE=XXXXXXXXXXXX\n

AT+WINARANGE followed by 12 digits, e.g.AT+WINARANGE=123211128217\n

It means that the doors and windows are on the straight line between point x1=-2.3, y1=1.1 and point x2=-2.8, y2=1.7, and the radar module will discard detection targets outside the straight line.

AT+WINARANGE=999999999999\n means to delete the restriction（the 1st, 4th, 7th,

and 10th digits indicate that the sign bit can only be 1 or 2, and 1 means negative, 2 means positive,AT+WINBRANGE=, AT+WINCRANGE=, AT+WINDRANGE=,

AT+WINERANGE=, AT+WINFRANGE= the same reason）

As shown in Figure 2, the radar detection area is diagrammed.
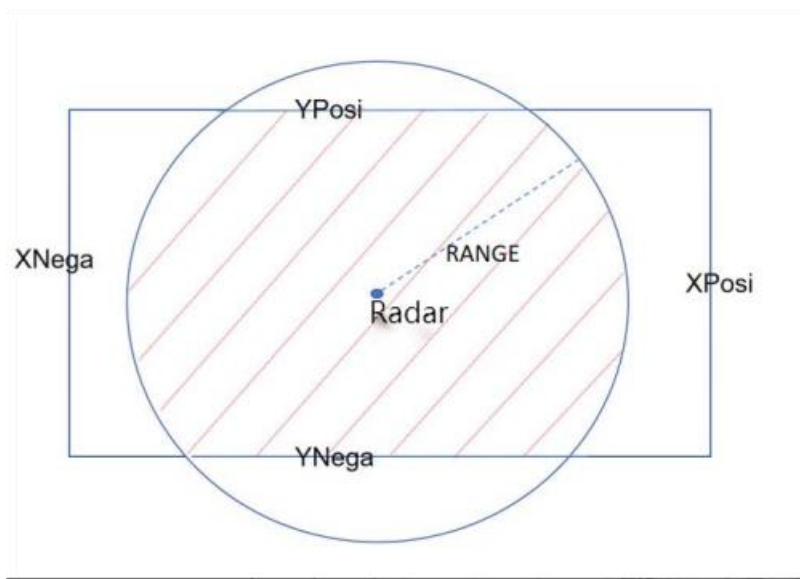

Figure 2   Radar detection area diagrammed.

8 Radar Module Serial Data Communication Protocol Description

8.1 Communication parameters

Baud Rate	115200
Data bits	8
Stop bits	1
Parity	NONE
Flow control	None

Notice: .Existing firmware module can update the firmware by serial port burning

8.2 Message Output Protocol Format

The protocol in protocol mode 3 (AT+DEBUG=3\n) can be displayed on the host computer

Field		Number of bytes	Description
HEAD		8	Frame header, fixed\x01\x02\x03\x04\x05\x06\x07\x08
LENGTH		4	Whole frame data length (uint32)
FRAME		4	Frame number (uint32)
TLVs		4	TLVs=1 followed by point cloud information (uint32)
POINTLENTH		4	Point cloud length is always 0 (uint32)
TLVs		4	TLVs=2 followed by person information (uint32)
TRACKLENTH		4	Length of person data (number of persons = TRACKLENTH/32) (uint32)
Personnel 1	ID	4	Personnel markers (uint32)
	Q	4	reserve(uint32)
	X	4	X/Y/Z coordinates of the person and the speed (float)
	Y	4	
	Z	4	
	Vx	4	
	Vy	4	
	Vz	4	
......			
Personnel n	ID	4	Personnel markers (uint32)
	Q	4	reserve(uint32)
	X	4	X/Y/Z coordinates of the person and the velocity (float), in units: coordinates in m and velocity in m/s, to two decimal places. Single precision floating point type according to the standard for binary floating point arithmetic (IEEE 754),with the small endunwrappedbefore. https://www.binaryconvert.com/convert_float.html https://www.cnblogs.com/guanshan/articles/guan022.html
	Y	4	
	Z	4	
	Vx	4	
	Vy	4	
	Vz	4	

Provide example

01 02 03 04 05 06 07 08 40 00 00 00 A3 01 00 00 01 00 00 00 00 00 00 00 02 00 00 00 20 00 00 00 00 00 00 00 00 00 00 00 21 28 96 BF CB 85 20 40 9A AB A3 3E 8A BD C1 3D 50 98 99 BD 40 52 C3 3A

01 02 03 04 05 06 07 08:Frame header

40 00 00 00:The total length of the frame is 64 bytes

A3 01 00 00:The current frame count is 419

01 00 00 00:TLV=1

00 00 00 00:Always zero

02 00 00 00:TLV=2

20 00 00 00:The length of personnel data is 32, that is, the number of personnel =32/32=1 person

00 00 00 00:Personnel zero

00 00 00 00:reserve

21 28 96 BF 72 6F 81 BF CB 85 20 40:The XYZ coordinates of person 0 are -1.17, 2.50, and 0.31

8A BD C1 3D 50 98 99 BD 40 52 C3 3A:The XYZ speed of person 0 is 0.094, -0.074, 0.001

9 Use of the upper computer

1) Use USB to TTL to power the radar with 3.3V voltage, then open "Radar_DemoSideMount.exe" (Check that it has been adjusted to HEX data mode (AT+DEBUG=3););

2) Select the serial port number as shown in Figure 3, the default baud rate is 115200, click "Open Serial Port";

3) Select "Top or Side Fit";

4) Click on "Start" and the radar starts to operate;

5) Selecting "R&D Mode" displays the point cloud, while selecting "Demo Mode" does not display the point cloud data;

6) As in Figure 3, the left side is 2D coordinates display, the right side is 3D display；

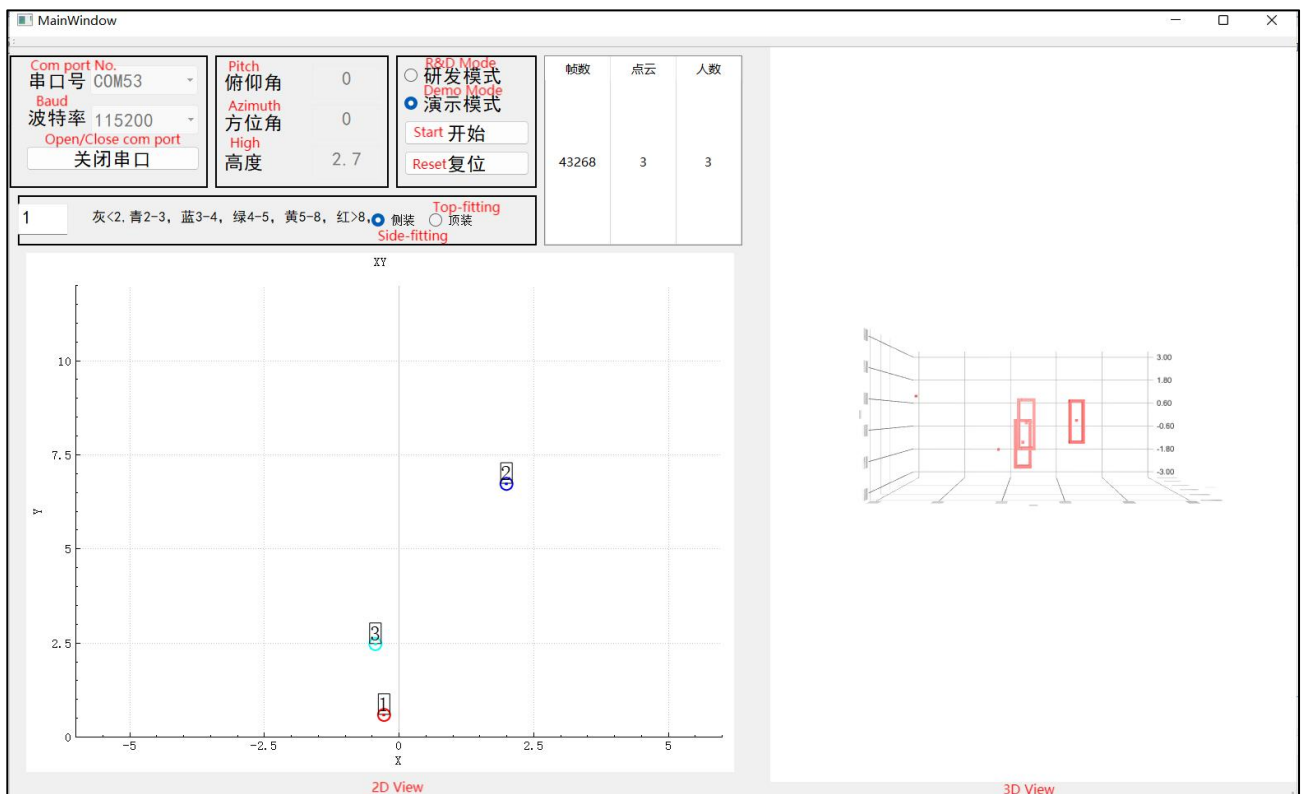7) Click on the " Stop " button and the radar stops working.

Figure3 Upper computer diagram

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, and a housing (PC/ABS material) thickness of 1.44mm or an integral multiple of 1.44mm.
● The 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.
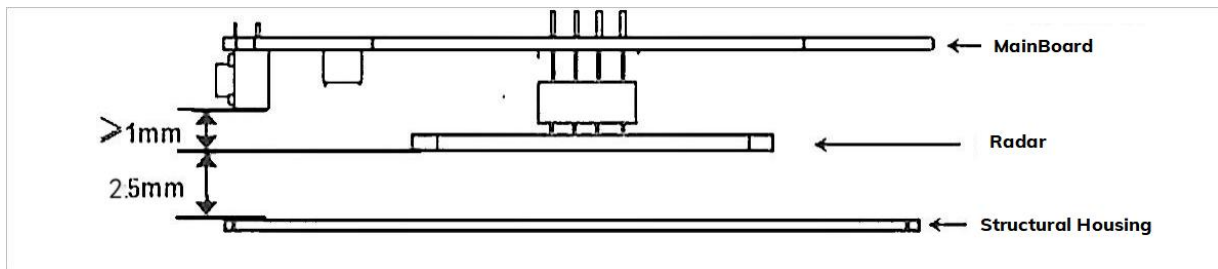

Figure2 Layout diagram of antenna and housing

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● 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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