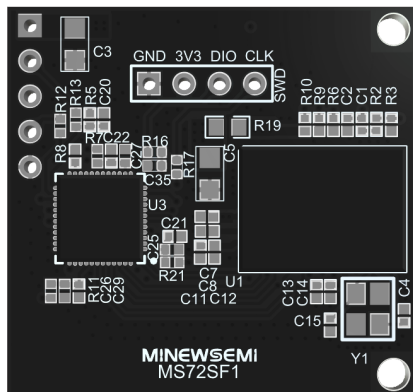


mmWave Radar Module

MS72SF1



Datasheet

V 1.0.0



Version Note

Version	Details	Contributor(s)	Date	Notes
1.0.0	First edit	Vincle, Leo	2024.06.06	

Part Number

Model	Hardware Code
MS72SF11	-

Click the icon to view and download the latest product documents electronically.
https://en.minewsemi.com/file/MS72SF1_Datasheet_C_EN.pdf



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

KEY PARAMETER

MS72SF1			
Working frequency	60~64GHz	Antenna Type	Aip antenna
Module size	29.36×28mm	Upload interval	≤30ms
Installation method:	top/side installation	Detection Distance	0.5 ~ 8m
Azimuth Coverage	±60°	Pitch angle coverage	±60°
Max Consumption	1.7W	Tracking number of people	≤10
Firmware	AT firmware		

APPLICATION



Smart home
people detection



User motion
track detection



Indoor personnel
track detection



Industrial control
radar sensor



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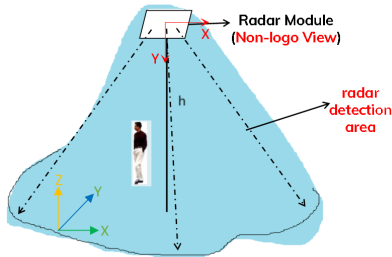


1 MODULE DESCRIPTION

1.1 Module Function Description

No.	Function	Details
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.

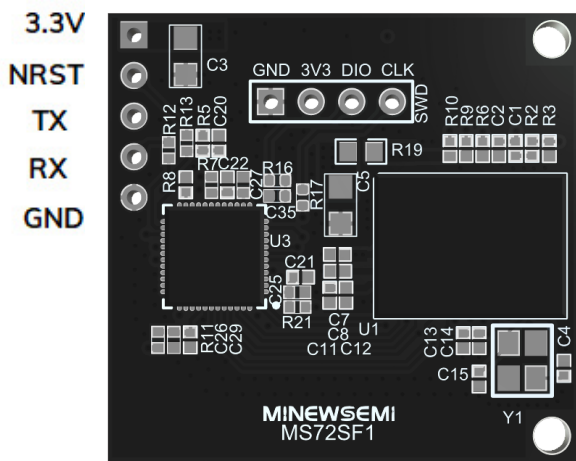
1.2 Module Features

No.	Function	Details
1	Installation scene	 <p>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 movement-trange. The above parameters are the test results of our company. Under different test conditions, the actual test results shall prevail)</p>
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	

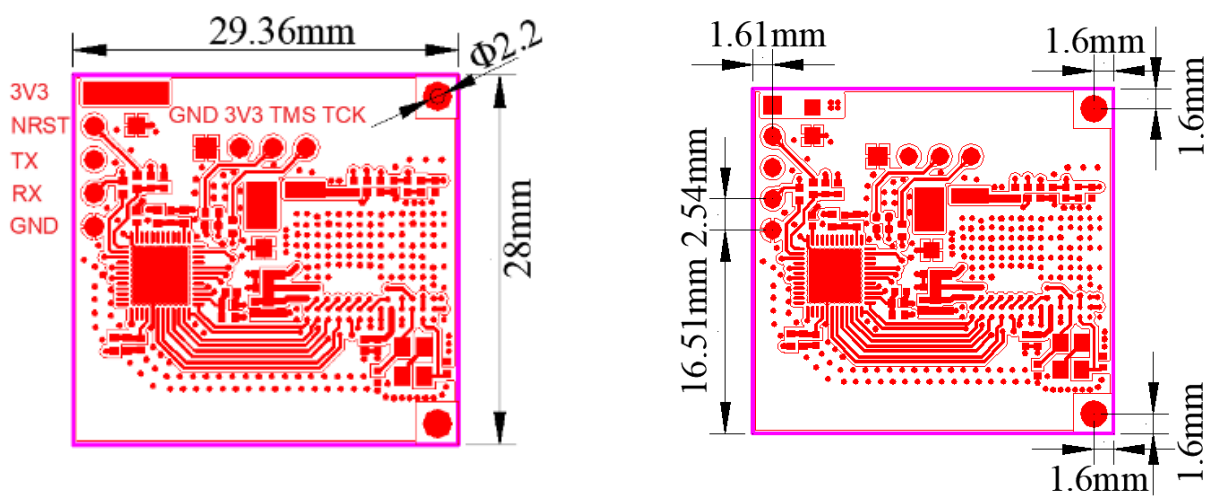
3PIN DESCRIPTION



4PIN DEFINITION

Pin Number	Pin Symbol	Pin Type
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 supply pin

4.1 Mechanical Drawing



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.

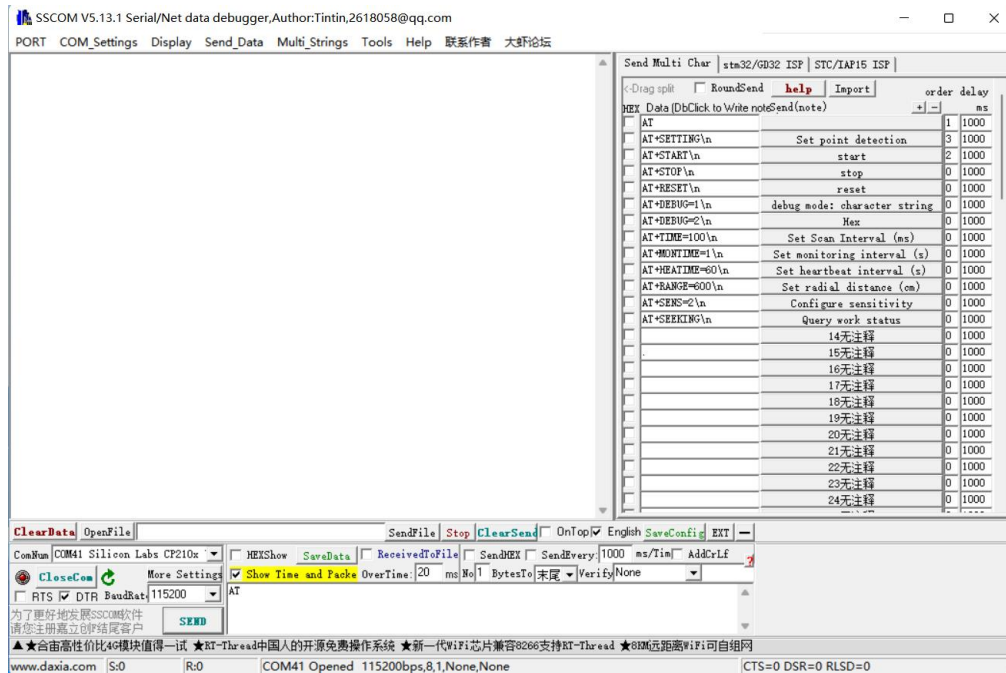
6.2 Installation position

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+START\n	Start Operation
AT+STOP\n	Stop Operation
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+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=XXXXXXXXXXXX\n	Gate 1 configuration
AT+WINBRANGE=XXXXXXXXXXXX\n	Gate 2 configuration
AT+WINCRange=XXXXXXXXXXXX\n	Gate 3 configuration
AT+WINDRANGE=XXXXXXXXXXXX\n	Curtain 1 configuration
AT+WINERANGE=XXXXXXXXXXXX\n	Curtain 2 configuration
AT+WINFRANGE=XXXXXXXXXXXX\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=XXXXXXXXXX\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.

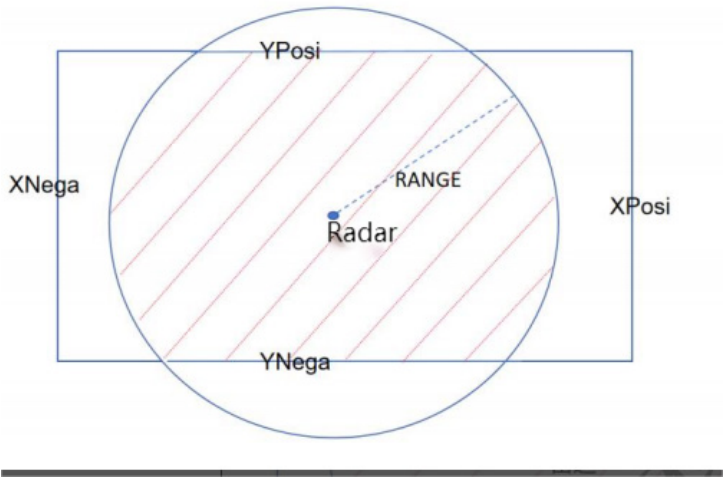


Figure 2 Radar detection area diagrammed.

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



Existing firmware module can update the firmware by serial port burning



8.2 Message Output Protocol Format

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 data length (points = POINTLENTH/25) (uint32)
Point 1	x	4	Coordinates x/y/z and energy signal-to-noise ratio information (v is int8, all others are float)
	y	4	
	z	4	
	v	1	
	SNR	4	
	POW	4	
	DPK	4	
.....			
Point n	x	4	Coordinates x/y/z and energy signal-to-noise ratio information (v is int8, all others are float)
	y	4	
	z	4	
	v	1	
	SNR	4	
	POW	4	
	DPK	4	
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	
	X	4	(uint32)
	Z	4	X/Y/Z coordinates of the person and the speed (float)
	Y	4	
	Vx	4	
	Vz	4	
	Vy	4	
.....			
Personnel n	ID	4	Personnel markers (uint32)
	Q	4	
	X	4	(uint32)
	Z	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 endunwrapped- before. https://www.binaryconvert.com/convert_float.html https://www.cnblogs.com/guanshan/articles/guan022.html
	Y	4	
	Vx	4	
	Vz	4	
	Vy	4	



8.3 Provide example

```

01 02 03 04 05 06 07 08 BE 01 00 00 6E 6F 09 00 01 00 00 00 00 5E 01 00 00 01 CC 34 BF 01 A0 CE 3D 08 5A
B9 3F 00 BE B3 07 40 00 06 8B 3F EA 86 87 41 01 B6 41 BF 01 08 3B 3E 6E 1B BD 3F FF B4 93 79 41 00 E4 8F 3F
63 32 50 41 01 B6 41 BF 01 50 20 3E 7C 7D BD 3F 00 36 A9 01 40 00 C2 11 40 03 A3 78 41 01 08 3B BF 01 98 05
3E 2D 7B BF 3F 01 68 19 99 41 00 E5 92 3F 33 6E 77 41 01 2B 48 BF 01 A8 25 3E 77 CE C3 3F FF DD 6C 72 41 00
7F 8F 3F 54 F6 4C 41 01 2B 48 BF 01 0C 0A 3E 0A 24 C4 3F 00 59 D0 02 40 00 D4 0D 40 DF C7 5F 41 01 2B 48 BF
01 E0 5C 3E FB F3 C2 3F 01 0D 4B C8 41 00 C7 8A 3F E4 19 68 41 01 C0 55 BF 01 80 0E 3E 37 9C C8 3F 00 15 00
0A 40 00 1D 9A 3F 7B 9B 22 41 01 5B 36 BF 01 F0 0A 3E 23 F5 02 40 00 97 6C 09 40 00 DF B7 3F 56 B1 06 41 01
F0 43 BF 01 20 32 3E 33 5A 05 40 00 D0 1C 0F 40 00 1D D0 3F 7B B2 DF 40 01 E9 35 BF 01 C3 22 3F 0C 82 0C 40
00 C0 A6 09 40 00 42 BE 3F 5B 9B C6 40 01 58 30 BF 01 8C 26 3F A1 8B 10 40 FF 22 FD 2E 43 00 9C D5 3F 15 5C
01 41 01 8C 26 BF 01 8C 26 3F 16 45 11 40 00 B6 B3 05 40 00 20 5F 40 7D 2C 00 41 01 8C 26 BF 01 8C 26 3F 16
45 11 40 01 45 00 78 41 00 AF E7 3F 5E B5 08 41 02 00 00 00 00 40 00 00 00 00 01 00 00 00 08 00 00 00 26 C2
2C BF 98 C1 B1 3E 6D 86 E7 3F 00 00 00 00 00 00 00 00 00 00 00 00 00 03 09 00 00 00 3E 4F 81 BF B1 3D
38 BF 45 06 2B 40 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
  
```

01 02 03 04 05 06 07 08 : Frame header

BE 01 00 00 : frame length 446 bytes

6E 6F 09 00 : frame number 618350

01 00 00 00 : TLVs=1 followed by point cloud information

5E 01 00 00 : Length of point cloud 350, number of points = $350/25 = 14$

01 CC 34 BF 01 A0 CE 3D 08 5A B9 3F 00 BE B3 07 40 00 06 8B 3F EA 86 87 41:

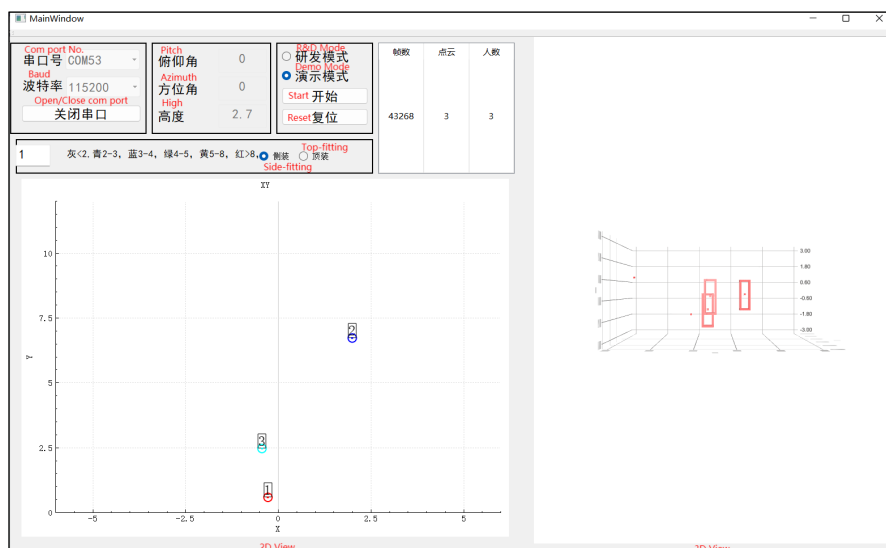
Point information, X=-0.7,Y=0.1,Z=1.44,V=0,SNR=2.12,POW=1.08,DPK=16.94

02 00 00 00 : TLVs=2 followed by person information

40 00 00 00 : Length of person 64, number of points = $64/32 = 2$

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 "Reset" button and the radar stops working.





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.
- When mounting the PCBA, do not contaminate the chip. Ensure the chip is mounted flat and not warped.

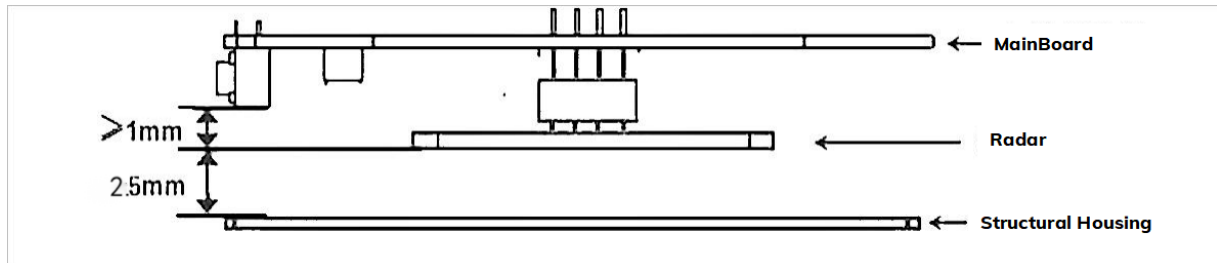


Figure4 Layout diagram of antenna and housing

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 (Cl₂, NH₃, SO₂, NO_x, 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 timeProducts 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°C;
 2. 90°C ±8/-0°C, 24hours, 1timesThe 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, OHSAS18001, 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.

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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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