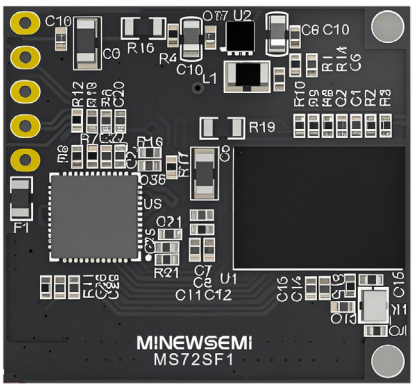
MINEWSEMI

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 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

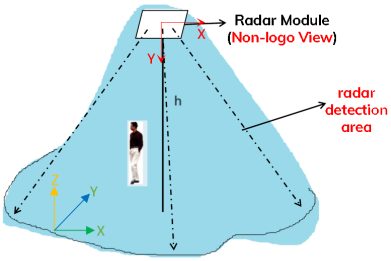
INDEX

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.

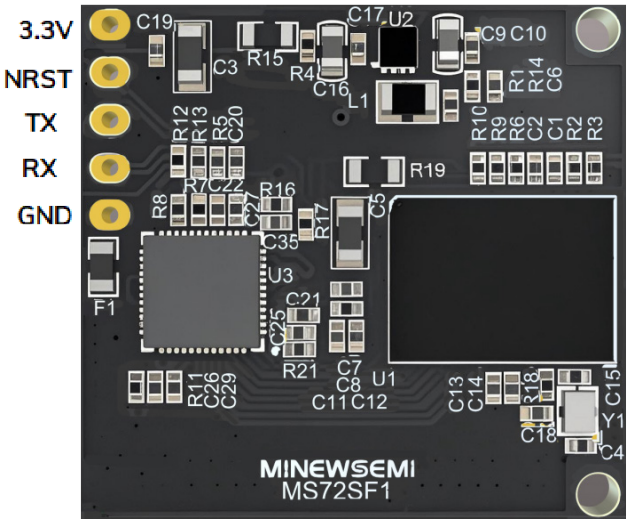
1.2 Module Features

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 movemen-trange. 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	

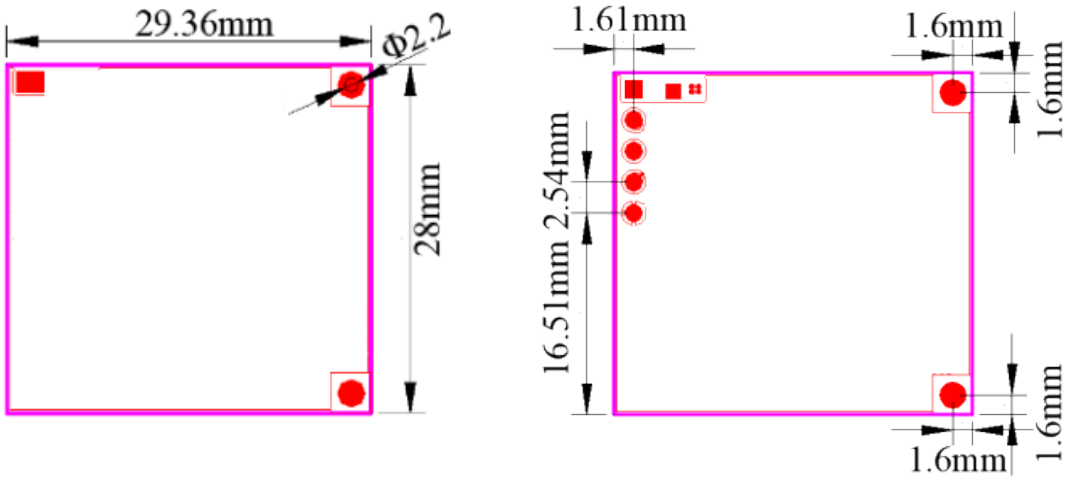
3 PIN DESCRIPTION



4 PIN DEFINITION

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

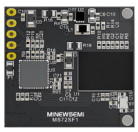
Notice: VDD in the above table refers to the power supply input.

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

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.

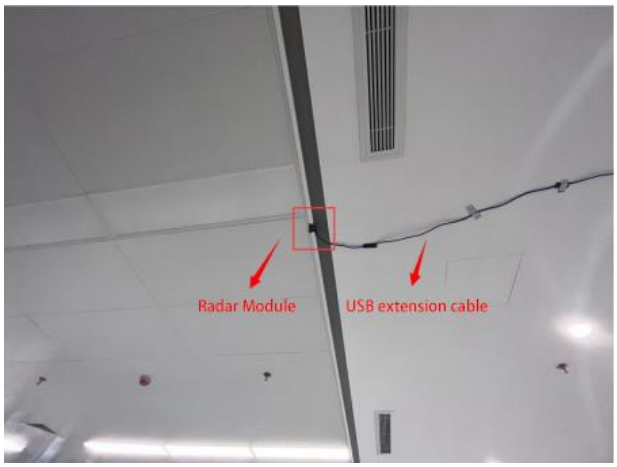
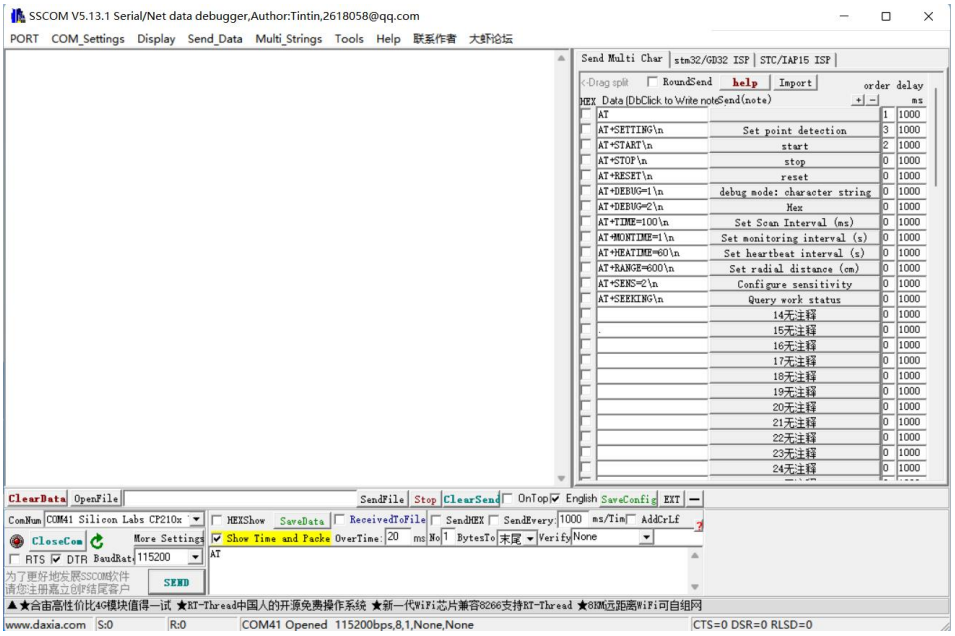


Figure 1 Top Mounting Legend

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.

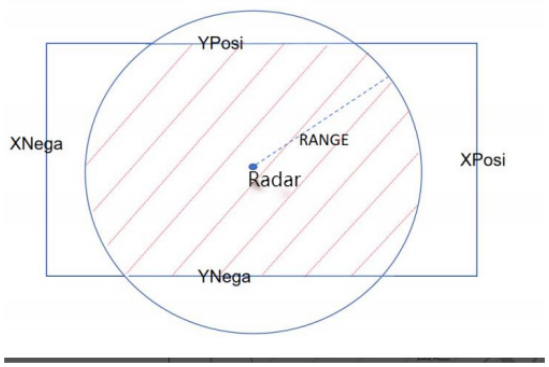
Common parameters are as follows:

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=XXX\n	Configure radar-to-boundary distance (in cm, range 100 - 2000, default 300)
AT+SENS=XX\n	Configure sensitivity (range 1-19, default is 2)
AT+SETTING\n	Fixed-point detection mode
AT+RESTORE\n	Restore Default Settings
AT+STUDY\n	Start Learning
AT+HEIGHT=270\n	Configure radar mounting height (in cm, range 250 - 320, default 270)
AT+HEIGHTD=270\n	Configure the module scanning height (in cm, range less than or equal to the mounting height, default 270)
AT+READ\n	Read version number and parameters
AT+DEBUG=X\n	Switching protocols (default 0, 1 string mode, 2 test mode, 3 operating mode)
AT+XNegaD=-300\n	Configuring X Negative Boundaries
AT+XPosiD=300\n	Configuring X Positive Boundaries
AT+YNegaD=-300\n	Configuration Y Negative Boundary
AT+YPosiD=300\n	Configuring the Y Positive Boundary

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.

As shown in Figure 2, Radar detection area diagrammed.



DEFAULT THRESHOLD:

AT+XNEGAD=-300\N	CONFIGURING X NEGATIVE BOUNDARIES
AT+XPOSID=300\N	CONFIGURING X POSITIVE BOUNDARIES
AT+YNEGAD=-300\N	CONFIGURATION Y NEGATIVE BOUNDARY
AT+YPOSID=300\N	CONFIGURING THE Y POSITIVE BOUNDARY

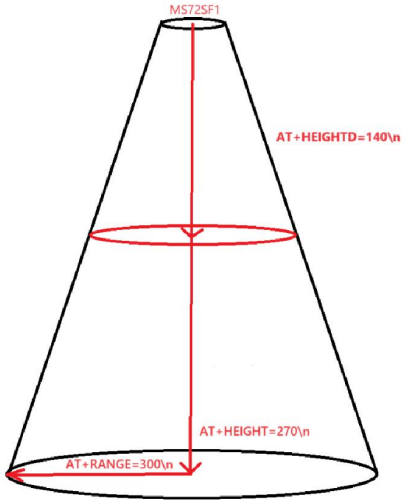
Figure 2 Radar detection area diagrammed.

HEIGHT SETTING

After sending AT+RESTORE\n the module restores the default configuration, the previously

learned information has been saved into the flash and the flash will not be restored.

Default radial distance: AT+RANGE=300\n 3M
Default mounting height: AT+HEIGHT=270\n 2.7M
Default probe height: AT+HEIGHTD=270\n 2.7M



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	The length of the point cloud 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	Q 4	Reserve(uint32)
	ID 4	Personnel markers (uint32)
	X 4 Z 4 Y 4 Vx 4 Vz 4 Vy 4	X/Y/Z coordinates of the person and the speed (float)
.....		
Personnel n	Q 4	Reserve(uint32)
	ID 4	Personnel markers (uint32)
	X 4 Z 4 Y 4 Vx 4 Vz 4 Vy 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 end unwrapped before. https://www.binaryconvert.com/convert_float.html https://www.cnblogs.com/guanshan/articles/guan022.html

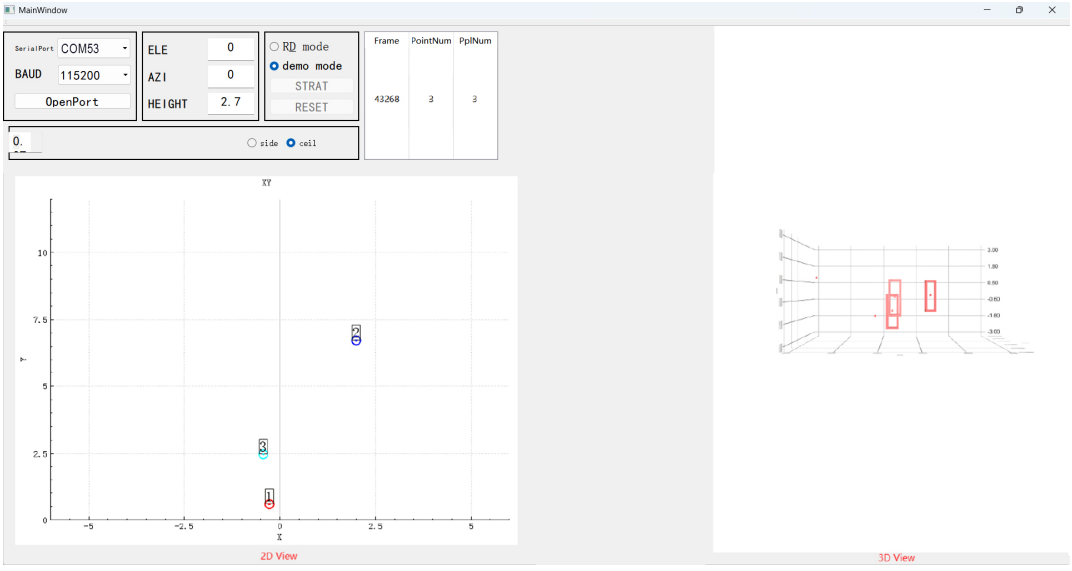
8.3 Provide example

01 02 03 04 05 06 07 08 A0 00 00 00 CD 01 00 00 01 00 00 00 00 00 00 00 02 00 00 00 80 00 00 00 00 00 00 00 00 00 00 00 BE 36 D8 BE CD B6 DC 3E 26 C0 87 3F 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 01 00 00 00 C6 36 2E BF D3 BF F2 BF B6 75 9F 3F 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 02 00 00 00 F4 D1 12 3E E1 E9 99 3F 3F 33 8E 3F 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 03 00 00 00 8E F1 38 BB FB B9 52 BF EE BE 02 40 00 00 00 00 00 00 00 00 00 00 00 00

01 02 03 04 05 06 07 08: Frame header
A0 00 00 00: total length of the frame is 160 bytes
CD 01 00 00: current frame count is 525 frames
01 00 00 00: TLV=1
00 00 00 00: constant 0
02 00 00 00: TLV=2
80 00 00 00: length of personnel data 128, i.e. number of personnel = 128/32 = 4 person
00 00 00 00: Reserved
00 00 00 00: Personnel 0
BE 36 D8 BE CD B6 DC 3E 26 C0 87 3F: The XYZ coordinates of Person 0 are -1.79, -3.83, and 1.34 respectively
00 00 00 00 00 00 00 00 00 00 00 00: XYZ speeds of 0, 0, 0 for person 0
00 00 00 00: Reserved
01 00 00 00: Personnel 1

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 "ceiling mount";
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.

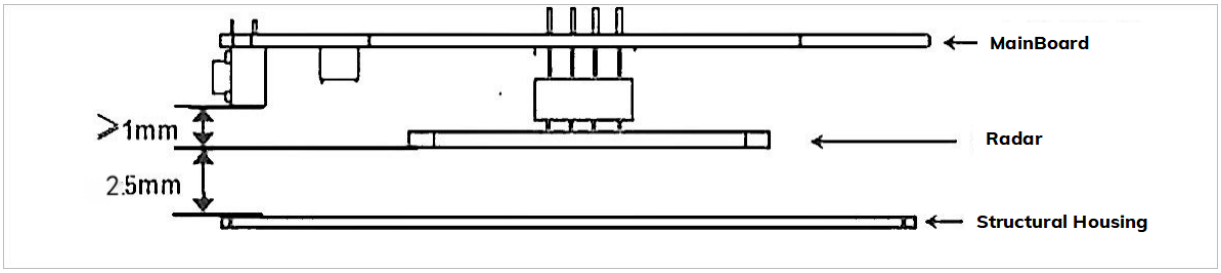


Figure4 Layout diagram of antenna and housing

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 22, 24, 27, 90

Summarize the specific operational use conditions

This module can be used in IOT devices, the input voltage to the module is nominally 4V.

Limited module procedures

This module is a single module.

Trace antenna designs

The antenna is not a trace 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 Class II permissive change application is required to be filed by us, or you (host manufacturer) can take responsibility through the change in FCC ID (new application) procedure followed by a Class II permissive change application.

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 binstalled must also display a label referring to the enclosed module. This exterior label can use wording such as the following: “Contains FCC ID:2BDJ6-MS72SF11” 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 (Cl2, 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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