

MR62

60GHz Millimeter Wave Radar

User Manual

Xiamen Milesight IoT Co., Ltd.

Disclaimer

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This manual contains important information, please keep it for later use.

Version History

Date	Version	Version Description
2020-12-21	1.0	MR62 60GHz Millimeter Wave Radar User Manual 1st Edition

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1. Overview

1.1 Important Tips

This user manual is written for MR62 60GHz millimeter wave radar developed by Hunan Nanoradar Science and Technology Co., Ltd.

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Hunan Nanoradar Science and Technology Co., Ltd. will not assume any responsibility for personal injury or property loss caused by failure to comply with the description in this manual or improper use of equipment, and all warranty claim clauses will also become invalid. No matter for any reason, it is not allowed to make arbitrary changes and modifications to radar sensors. If any danger occurs due to the above conditions, all warranty claims are invalid.

We reserve the right to make technical modifications or modify delivery specifications. If customers need to test radar function or repair radar, please contact us. Please keep the original packaging of the product to avoid violent damage to MR62 during transportation.

The manual will be updated synchronously according to MR62 60GHz millimeter wave radar, and revised, corrected and enhanced according to radar conditions to meet customer development requirements and accuracy. This manual cannot list all possible applications or usage scenarios of MR62. After the release of the new version, the previous version of the manual will be invalid. Please get the latest version of the user manual in time.

1.2 Overview of Features

MR62 60GHz millimeter wave radar can measure obstacles as far as 90 meters. The radar supports the following functions:

- 1) It can simultaneously detect moving objects with a relative velocity of ± 200 km/h.
 - The distance, velocity and angle information of the object can be obtained.
 - Moving objects such as vehicles and pedestrians can be distinguished.
 - Obstacles with different motion states can be identified, such as Tathagata moving in the direction and moving in the direction.
- 2) The short distance can reach 30m @ $\pm 30^\circ$, and the long distance can reach 90m @ 0° .
- 3) Up to 32 tracking targets can be output through TTL interface.
- 4) If radar is to be integrated with other equipment (such as cameras), customers need to develop it themselves.

1.3 Application Scenario

MR62 60GHz millimeter wave radar is suitable for traffic flow monitoring, intersection detection, perimeter safety protection and other applications. Other atypical applications are as follows:

- Monitoring target distance and alarm: If the distance of the target ahead is found to be too close, a distance monitoring alarm will be issued.
- Industrial and on-board applications: detect and track collisions with people, vehicles, animals and equipment in industry, construction, agriculture and mining.
- Traffic monitoring: traffic management and the application of safety aspects such as distinguishing lane objects.
- Early warning at fork in the road: Early warning of vehicles coming at fork in the road.

Even when the line of sight is covered, the high sensitivity and high resolution of the radar can ensure the detection of the front object.

1.4 Brief Introduction of Principle

The MR62 uses FMCW (Frequency Modulated Continuous Wave) modulation. Its basic principle is that the transmitted wave is a high-frequency continuous wave, and its frequency changes with time according to the law of triangular wave. The echo frequency received by FMCW has the same change rule as the transmitted frequency, which is a triangular wave rule, but there is only a time difference, and the target distance can be calculated by using this tiny time difference.

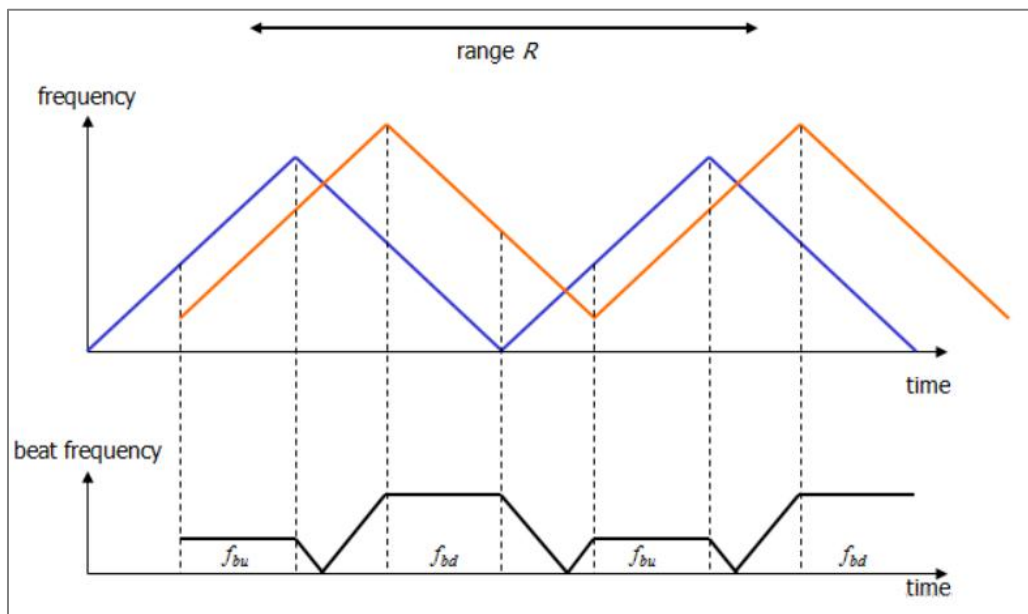


Fig. 1 Principle Diagram of Continuous Wave Radar

Taking triangular wave FM continuous wave as an example, the ranging principle of radar is briefly introduced. As shown in Fig. 1, blue is the frequency of the transmitted signal, yellow is the frequency of the received signal, the frequency sweep period is T , and the frequency sweep bandwidth is B . When the transmitted signal is transmitted by the target, the echo signal will be delayed. In the frequency change of triangular wave, distance measurement can be carried out on both the rising edge and the falling edge.

1.5 Radar Field of View

MR62 60GHz millimeter wave radar is a medium range radar. It can detect target distance, velocity and angle information by receiving radar reflected waves.

1.6 Technical Parameters

Classification	Specification No.	Description	Indicators
Overall	A1	Dimensions	48*52mm
	A2	Weight (radar module)	Weight of veneer $\leq 10g$
	A3	Power consumption of the whole machine (scanning status)	$\leq 2.5W$
	A4	Modulation waveform	FMCW
Detection performance	B1	Capture rate	The capture rate is over 99%, and the traffic jam is over 95%
	B2	Detection range-moving target	Moving target
	B3	Overspeed capture rate	$\geq 95\%$
	B4	Position accuracy	$< \pm 2.5\%$ or $< \pm 0.5 m$
	B5	Speed measurement accuracy	0.36 km/h
	B6	Multi-target detection	32
	B7	Speed measuring range	$\pm 200 km/h$
	B8	Support lane	1-4 lane vehicle detection can distinguish lanes, and the lane recognition rate is $\geq 95\%$
	B9	Detection range	2-90 meters
	B10	Installation height	1.5 ~ 6M (adjustable)
	B11	Capture distance	15 ~ 60M (adjustable)
Power supply	C1	Power supply	5V DC
External Interface	D1 D1	Data interface	TTL serial communication, customized communication protocol, support radar parameter configuration, support configuration of detection area, configuration of data push distance range
Environmental adaptability	E1	Level of protection	/
	E2	Operating temperature	-40 ~ 60 °C
	E3	Storage temperature	-40 °C ~ 85 °C
	E4	Working humidity	0~90%RH
Packaging	F1	Packing outer box	Yes
	F2 F2	Whether to allocate outsourcing	Yes

2. Radar Setting

2.1 Interface Connection

The MR62 external interface only supports TTL (3.3 V) connections.

2.2 Configuration, Startup, Shutdown, and Failure

When MR62 connects to PC through TTL protocol, please refer to MR62 60GHz Millimeter Wave Radar Protocol Manual for relevant protocols.

The MR62 radar does not support hot swap. If an error is found in the internal detection of the system, it may lead to abnormal radar function or even radar damage.

3. Installation Specification

3.1 Radar Installation

In traffic flow detection and related applications, MR62 is recommended to be installed at a height of 1.5 ~ 6M from the ground. The radar antenna faces straight ahead and can be tilted down by 0 ~ 5 according to the requirements of customer application for detection distance and blind area. The installation specifications are shown in Fig. 2 and 3:

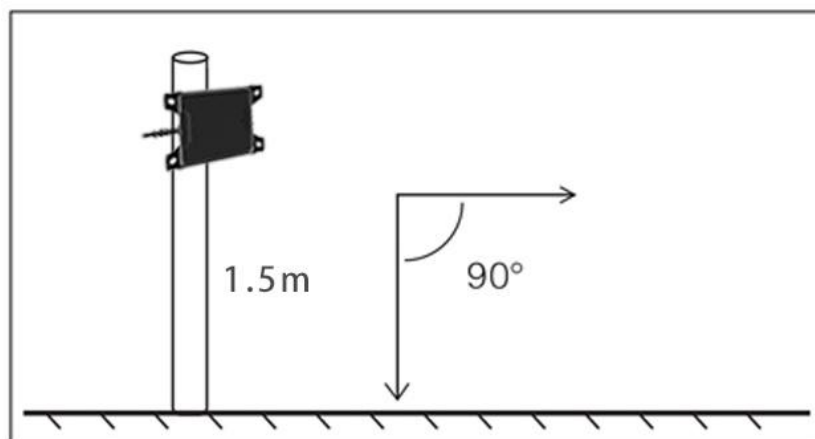


Fig. 2 Vertical Installation Schematic Diagram of MR62 Radar

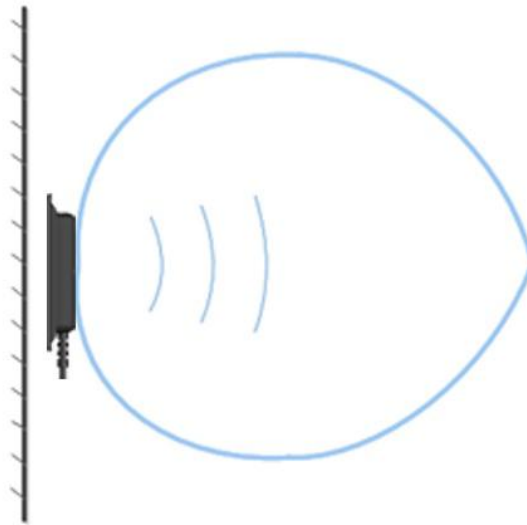


Fig. 3 Horizontal Installation Schematic Diagram of MR62 Radar

3.2 Radar Direction Description

The beam width of MR62 antenna is 56° (-6dB) on azimuth plane and 17° (-6dB) on pitch plane. The direction description in Cartesian coordinate system is shown in Fig. 4:

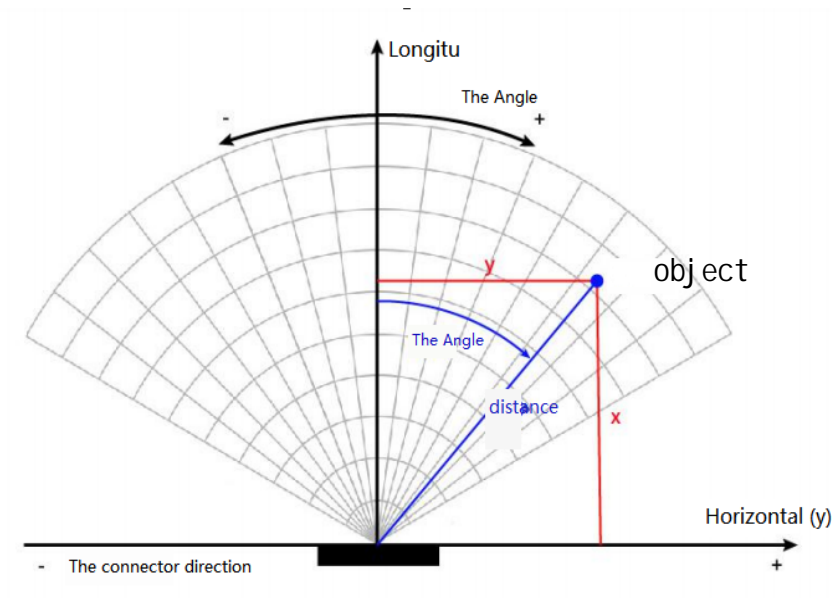


Fig. 4 Schematic Diagram of Radar Direction Description

3.3 Installation Considerations

Radar sensor installation principle:

- Try to stay away from other signal sources during installation;
- Stay away from the position where high-power equipment is frequently started during installation.

In addition, when installing MR62 60GHz millimeter wave radar, the following matters should also be paid attention to:

- When installing the sensor, make sure that the radome surface is clean and unobstructed.
- Welding activities cannot be carried out near the radar sensor position.
- Radar sensors can only wipe surface dust with wet and lint-free cotton cloth, and cannot scratch or damage the sensor surface.
- The equipment needs to be inspected routinely before it is put into use.

Customers can design radomes and other structures according to application requirements; Radomes material will have a greater impact on radar performance; In essence, radomes affect radar performance in three aspects; First, radar waves cannot completely transmit through radomes, resulting in a reduction in radar effective radiation power, including reflection loss and dielectric loss; The second is that the radar antenna beam distortion changes the radar action area, which may cause the radar to be interfered by backward targets; The third is that the radome makes the radar standing wave worse. For detailed design of radome, please refer to the Design Guide for 60GHz Radome of Nanoradar Science and Technology.

In order to prevent the radar beam from distorting, the radome should be kept flat and uniform in thickness as much as possible. Any slight bending will have a great impact on the radar beam.

(1) Spraying

Theoretically, radomes can be sprayed, but careful analysis and detection should be carried out to avoid significant degradation of radar sensor performance.

(2) Heat dissipation and electromagnetic shielding

If the customer designs the radome and other structures himself, he also needs to consider the influence of radar heat dissipation and electromagnetic shielding. Please refer to the design drawings provided by Nanoradar Science and Technology.

4. Electrical Characteristics

4.1 Harness Connection

MR62 connecting wire harness is a 0.8 m long cable, including four power supply positive electrode, power supply negative electrode, data transmission and data reception.

MR62 radar needs to be powered by battery or other equipment. In order to protect radar from electromagnetic interference, the grounding wire must be as short as possible.

MR62 does not support reverse connection of power supply polarity. Any consequences arising from reverse connection shall be borne by the customer. The design of MR62 conforms to the test requirements of ISO 16750-2.

Table 1 Pin Interface Definition Table

Pin	Harness Color	UART Definition
1	Red	POWER_IN
2	Black	GND
3	White	UART_RX
4	Yellow	UART_TX

4.2 Test Usage

The "NSM Tools Management System" test software provided by Nanoradar can acquire and analyze MR62 sensor data and visually display observation results. Using this tool is helpful to use MR62 sensors.

First of all, obtain NSM Tools management system (upper computer test software)

and user manual of NSM Technology from NSM customer service. According to the user manual, install and configure the upper computer test software. The tools or software used for testing are as follows:

Table 2 Tools used for Product Testing

No.	Device Name	Quantity
1	MR62 millimeter wave radar	1
2	PC/notebook computer	1
3	USB-TTL	1
4	12V power adapter	1
5	Upper computer test software	1

Connect the PC to the MR62 radar sensor through the USB-TTL module. Connection diagram 5 is as follows:

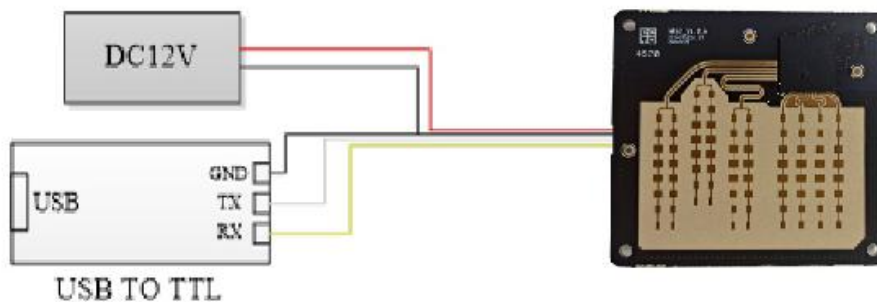


Fig. 5 Schematic Diagram of Wiring Harness Connection

1) USB-TTL connects to the PC and opens the upper computer software. First, the configuration parameters are shown in Fig. 6. At the top left is MR62 test configuration parameters. Then click the Start button on the upper left side.

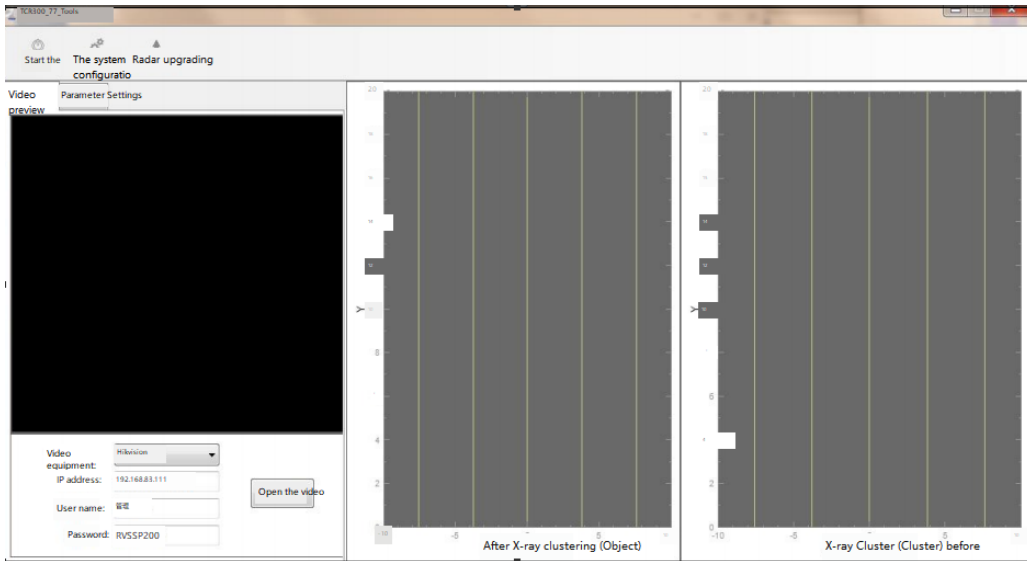


Fig. 6 Radar Upper Computer Interface

2) Start testing. If the antenna surface of MR62 radar is facing the moving target, or there is slight relative movement between the sensor and the target, the triangle indicated by the target can appear in the UI interface and the target distance R can be displayed. As shown in Fig. 7, if there is no triangle indication, it means that no target is present within the detectable distance and field of view.



Fig. 7 Test Interface of Radar Upper Computer

5. Health and Protection

5.1 Electrostatic Protection Measures

It is necessary to do a good job of electrostatic protection in the process of radar transportation, storage, use, fetching and placing. Users must pay attention when dealing with independent modules that are not integrated; When the module is taken out of the sealed anti-static package, it is necessary to start to do a good job of electrostatic protection; Never touch or grab the radar antenna surface and connector pins, only touch their edges.

Recommendation: Wear anti-static gloves when working with all radar sensors.

◆ **Incorrect usage:**

- Wrap the antenna with metal foil or some metal parts;
- Direct measurement of pins with multimeter, causing damage;
- Any kind of paint or varnish spraying antenna structure;
- Wrap the antenna with CFK sheet (conductive);
- The plastic material is in direct contact with the corroded antenna structure (it has a high dielectric constant influence on the resonance frequency of the patch).

5.2 Identification of Static Damage

In general, the following two situations indicate that the radar sensor has suffered electrostatic damage:

- When there is no target object in the radar detection range, the radar continuously outputs irregular targets;
- When the parameters such as power supply voltage and power supply current are in the normal range, the output signal cannot be obtained.

5.3 Power Protection

The radar input voltage range is 5 V DC, and the ripple is less than 20mV.

The power supply with large ripple will cause the radar to continuously output wrong target information, which will affect the normal use of the radar.

5.4 Space Electromagnetic Interference Protection

The products have adopted shielding measures to avoid the adverse effects caused by electromagnetic interference as much as possible. However, when installing, the radar should be far away from strong electromagnetic interference sources such as motors and isolated metal shells.

6. Interface

6.1 UART Interface

The MR62 millimeter wave radar UART interface supports TTL.

TTL is the abbreviation of Transistor-Transistor Logic, which is mainly composed of BJT (Bipolar Junction Transistor), transistor and resistor, and has the characteristic of high speed.

TTL level signals are used most because the data representation is usually binary, +5V is equivalent to logic "1" and 0V is equivalent to logic "0". This is called TTL (Transistor-Transistor Logic Level) signal system, which is a standard technology for communication between various parts of equipment controlled by computer processors.

TTL level signals are ideal for data transmission within devices controlled by computer processors. First of all, the data transmission inside the equipment controlled by the computer processor has low requirements for power supply and low heat loss; In addition, TTL level signals are directly connected with integrated circuits without expensive line drivers and receiver circuits; Furthermore, the data transmission within the equipment controlled by the computer processor is carried out at high speed, and the operation of TTL interface can just meet this requirement. In most cases, TTL communication adopts parallel data transmission, which is not suitable for distances

exceeding 10 feet. This is due to both reliability and cost. Because there are problems of phase deviation and asymmetry in parallel interface, these problems have an impact on reliability.

TTL output high > 2.4 V, output low < 0.4 V. At room temperature, the output high level is generally 3.5 V and the output low level is 0.2 V. Minimum input high level and maximum input low level: input high level ≥ 2.0 V, input low level ≤ 0.8 V, noise margin is 0.4 V.

6.2 Equipment Dimensions

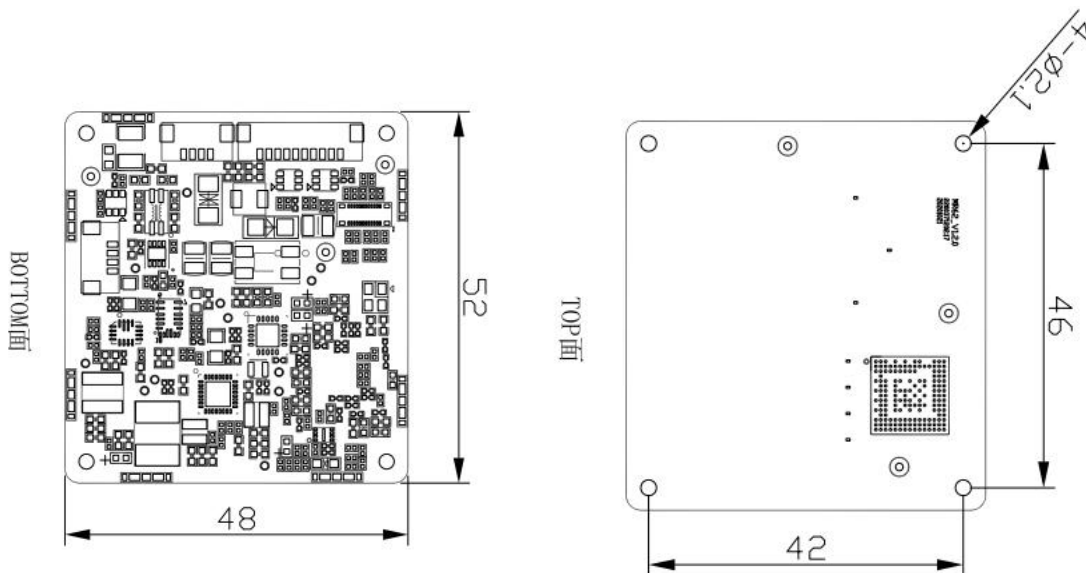


Fig. 8 Dimensional Drawing of MR62

7. Safety and Risks

The purpose of this chapter is to enable MR62 customers and users to identify all possible risks in a timely and accurate manner.

MR62 is developed for traffic flow statistics, perimeter security and other applications. Customers must master basic technical knowledge. Radar should be used by trained professionals. The person or owner responsible for the equipment must ensure that all operators understand and observe these safety precautions. If MR62 is part of the overall system, the system manufacturer is responsible for ensuring

safety-related aspects, such as operation manuals, labels and instructions. Responsibilities are divided as follows:

(1) Scope of responsibility of manufacturer for equipment

Hunan Nanoradar Science and Technology Co., Ltd. is responsible for providing the equipment under technically safe and reliable conditions, including white paper, agreement manual and user manual.

(2) Scope of liability of third-party parts manufacturers

The manufacturer of third-party accessories is responsible for developing, implementing and ensuring the safety and effect of its products together with MR62 60GHz millimeter wave radar of Hunan Nanoradar Science and Technology Co., Ltd.

(3) Scope of responsibilities of customers, end customers and end users

It is the responsibility of customers, end customers and end users to ensure that the equipment is used for their intended purposes, for the actions of their employees, for giving instructions to employees, and for the safe operation of the equipment.

(5) Customer, end customer and end user have the following obligations:

- The safety information on the radar and the instructions in the operation manual must be understood.
- Must be familiar with the applicable local accident prevention regulations.
- In case of any safety defects in the equipment or equipment, Hunan Nanoradar Science and Technology Co., Ltd. must be notified.

The customer must confirm that the end customer and end user have added responsible copies of disclaimers and information, including the conformity statement of their product document responsibility manual.

The MR62 60GHz millimeter wave radar sensor can be used for research and development testing purposes.

8. Reference

- [1] MR62 Millimeter Wave Radar White Paper
- [2] MR62 Millimeter Wave Radar Color Page
- [3] MR62 Millimeter Wave Radar Communication Protocol
- [4] Nanoradar 60GHz Radome Design Guide

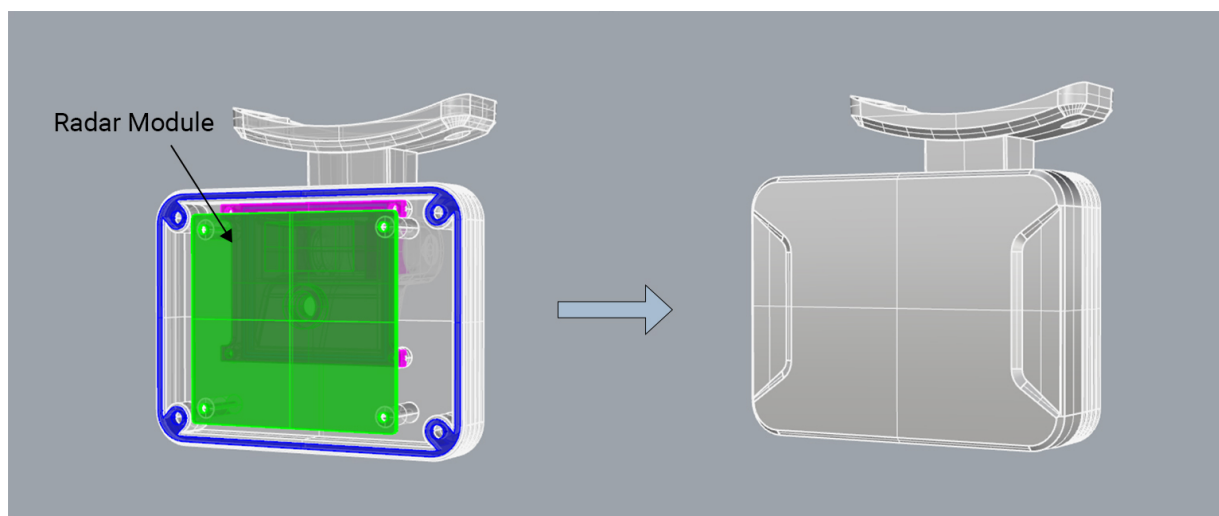
The Manufacturer declared that the EUT will not be advertised or sold for use on aircraft or satellites. The user manual includes a statement that cautions users that it is not permitted to use the product on aircraft or satellites.

9. Installation Guide

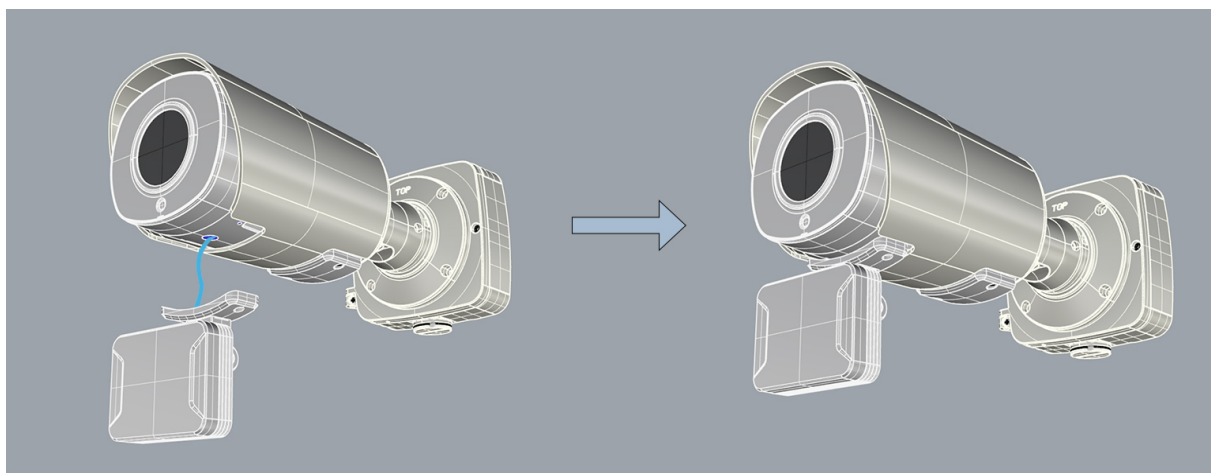
To comply with FCC regulations for fixed operation, final device must consider the following:

For long-term stable operation, the module must be mounted in a plastic enclosure made of PC(polycarbonate).

Install the IP camera in the desired location, and then attach the housing to the IP camera
Use a tiltable bracket if you need to adjust the angle the radar faces.



< Example of the module mounted in an enclosure >



< Example of fixed installation >

FCC Statement:

Any Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

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.

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.

FCC Radiation Exposure Statement:

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